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14. ABSTRACT

Year 4 included a fourth targeted request for proposals (RFP). One project was recommended for funding. Additional funds were released and funding for two additional projects from the fourth RFP are pending. The MSRC supports a total of 25 funded projects, including 5 long-term follow-up studies of MSRC 1.0 projects; 4 secondary data analyses of the MSRC Common Data Elements; 11 intervention studies; 3 assessment studies; 1 postvention study; and 1 implementation study. The MSRC continued to provide training opportunities to future leaders in the field of military suicide research through a joint MSRC-Army STARRS postdoctoral fellowship program. The Denver staff continues to collaborate with the Florida State University site and seek guidance from the Military External Advisory Board.

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Funding research projects; pre-doctoral and post-doctoral training; leveraging funds; collaboration with MSRC Cores; quarterly and annual reports; progress meetings

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INTRODUCTION:

The Military Suicide Research Consortium's (MSRC) continued goal is suicide prevention in the military, through research, including on primary, secondary, and tertiary interventions, as well as through information management/scientific communications (disseminating knowledge on military suicide). Specifically, suicidal personnel compromise force readiness, place a strain on the healthcare resources of the military, impact unit morale, and take a large emotional toll on the involved friends, family, and commanders. The stigma associated with being suicidal, which limits the extent to which at-risk individuals are willing to seek help, continues to be present and can be heightened by media focus. MSRC intends to progress in the development of its tools and funding new studies, it is now an established go-to resource for decision-makers to obtain accurate and efficient answers regarding suicidal behavior, with the continued emphasis on the military perspective. MSRC plans to facilitate information management/scientific communications for the Department of Defense (DoD) and to maximize research efforts at understanding and improving suicide risk screening and assessment, interventions, and population-level prevention programs. MSRC and its associates plan to increase their level of involvement and dissemination of information. MSRC continues to receive acknowledgement for its work and its contributions. MSRC has a main goal: expanding knowledge, understanding, and capacity to prevent, treat, and enhance the quality of life of persons in military communities who are affected by suicide-related problems.

KEYWORDS:

Military, suicide, research, dissemination, prevention, intervention, assessment, training

ACCOMPLISHMENTS:

What are the major goals of the project?

(1) Maintain situational readiness, research infrastructure, intellectual capacity, and institutional memory to ensure that the resources exist to meet future military suicide research needs as they change and develop.
(2) Continuing to produce new scientific knowledge about suicidal behavior in the military.
(3) Use high quality research methods and analyses to extend significant findings from studies completed in the first five years of MSRC.
(4) Conduct after-action analyses of null findings from initial MSRC studies to determine whether interventions significantly affected other outcomes (e.g., mechanism variables covered by the Common Data Elements [CDE]).
(5) Capitalize on the CDE (variables collected by all currently funded studies) to encourage rigorous secondary analyses, exploring rival mediators and mechanisms, and moving toward making the data available to the broader research community.
(6) Build on the first five years of research conducted by the MSRC, by continuing to disseminate Consortium knowledge, information, and findings through a variety of methods appropriate for decision makers, practitioners, and others who are accountable for ensuring the mental health of military personnel.
(7) Train future leaders in military suicide research.

What was accomplished under these goals?

Consortium Specific Aim 1: Maintain situational readiness, research infrastructure, intellectual capacity, and institutional memory to ensure that the resources exist to meet future military suicide research needs as they change and develop.

Major Task 1: Implement plan for revised infrastructure

Subtask 2: Consortium Start-up

- The MSRC continues to respond to queries from decision makers and others with speed and efficiency.
- Core B research staff in Denver continue to monitor listservs for military suicide research. Cores A and B continue to respond to media inquiries, data requests, membership requests, general information requests, and funding requests made through the MSRC website portal.

Subtask 3: Attend meetings (annual MSRC, MSRC IPR, MEAB, and DoD IPR) and submit reports (annual and quarterly)

- The MEAB meeting was held on 23 May 2019 at Ft. Detrick. Drs. Joiner, Gutierrez, and Comtois updated the MEAB on the status of currently funded studies, Core D, and post-doctoral activities.
- The MOMRP Suicide IPR meeting was held on 21-22 May 2019 at Ft. Detrick. Drs. Joiner and Gutierrez presented the status of the MSRC and currently funded studies.
- The MSRC IPR meeting was held on 11 July 2019 in Denver, CO. PIs presented updates on funded studies.
- The MSRC Annual meeting was held on 02 October 2019 in Seattle, WA. Representatives from Core A, Core C, Core D, MOMRP, and the Senior Advisors were in attendance.
- The MEAB meeting to review proposals from the 4th RFP was held on 23 October 2019 at Ft. Detrick, MD. The following proposals were presented:
    - Thomas Joiner, PhD, Florida State University: Replication of the taxometric study
    - Jim McNulty, PhD, Florida State University: Enhancing marital feelings using evaluative conditioning
    - Tom Nassif, PhD, Walter Reed Army Institute of Research: Military transition and suicide-related risk
    - Kate Comtois, PhD, University of Washington: Precision Medicine/Caring Contacts
    - Mike Anestis, PhD, University of Southern Mississippi: Plus-up of Project Safe Guard to include Marines
- Quarterly reports for Year 4 were submitted to MOMRP on schedule.

Subtask 4: Prepare MEAB and scientific review functions

- During the 23 May 2019 MEAB meeting, the panel requested we solicit targeted proposals in five specific areas to fully obligate all remaining research program funds.
- Requests for proposals were sent to the following investigators:
    - Thomas Joiner, PhD, Florida State University: Replication of the taxometric study
    - Jim McNulty, PhD, Florida State University: Enhancing marital feelings using evaluative conditioning

    - Tom Nassif, PhD, Walter Reed Army Institute of Research: Military transition and suicide-related risk
    - Kate Comtois, PhD, University of Washington: Precision Medicine/Caring Contacts
    - Mike Anestis, PhD, University of Southern Mississippi: Plus-up of Project Safe Guard to include Marines
- Core A worked with the American Association of Suicidology (AAS) to facilitate scientific peer reviews of the proposals, with the exception of the Anestis proposal which was previously reviewed.
- Core A provided MOMRP full proposals and independent scientific peer reviews.
- Investigators presented proposals to the panel at the 23 October 2019 MEAB Meeting.
- The MEAB recommended funding the Anestis project following the 23 October 2019 meeting. The Chief of Staff for the recruitment site opted out, and Dr. Anestis is working on identifying a replacement site.
- The MEAB also recommended a revise and revote for the Nassif and Comtois projects, if additional funds became available. On 19 March 2020 FSU was notified that option period funds in the amount of $822,666 had been released. Drs. Nassif and Comtois are currently revising their proposals, which will be sent to the MEAB for review on 20 April 2020.
- The MEAB also reviewed the Core D action briefs. No major changes were recommended to the documents or the format. However, the MEAB would like notes added to the Caring Contacts, CRP, and future relevant briefs indicating there are conflicting opinions about how to interpret the results.

The following milestones were achieved in Year 4:

- Meetings attended
- Reports submitted
- Review functions defined and in place

Consortium Specific Aim 2: Continuing to produce new scientific knowledge about suicidal behavior in the military.

<u>Major Task 2: Refine & Develop research priorities</u>
Subtask 1: Plan research projects

- Drs. Gutierrez and Joiner participated in monthly Study to Assess Risk & Resilience in Servicemembers – Longitudinal Study (STARRS-LS) PI conference calls.
- Drs. Gutierrez and Joiner continue to refine and develop research priorities with the MSRC MEAB.
- A 12 month no-cost extension was approved on 08 July 2019. This extension was necessary in order to move forward with the Air Force Zero Suicide project (PI Aronson), as well as fund the new proposals requested by the MEAB.

Subtask 2: Identify research teams

- The following studies were approved by the MEAB and are currently funded or complete:
    - Dr. Mike Anestis: Project Safe Guard and Plus-Up to include Marines (Plus-Up subaward in progress)

- Dr. Jessica Ribeiro: Examining the nature of suicide risk over time using machine learning (COMPLETE)
- Dr. Brad Schmidt: Long Term Follow-up for MSRC DARTS Clinical Trial (COMPLETE)
- Dr. Joe Franklin: Using Machine Learning to Distinguish among Active Duty, Veteran, and Civilian Suicidality (COMPLETE)
- Dr. Jessica Ribeiro: Optimized suicide risk detection and management in military primary care
- Dr. Brad Schmidt: Building Stronger Allies: Development and Evaluation of a Web Application Targeting Interpersonal Risk Factors for Suicide in Active Duty Service Members
- Dr. Sarra Nazem: Efficacy of a Computerized Cognitive Behavioral Treatment for Insomnia: Increasing Access to Insomnia Treatment to Decrease Suicide Risk
- Dr. Alexis May: Couples Crisis Response Planning to Reduce Post-Discharge Suicide Risk
- Dr. Courtney Bagge: Profiles of Behavioral Warning Signs for Suicide Attempts in the Prediction of Future Suicidality
- Dr. Lora Johnson: Three Year Follow-up of Study on Suicide Risk Assessments within Suicide-Specific Group Therapy Treatment for Veterans (COMPLETE)
- Dr. Andrew Littlefield: Enhancing Identification of Suicide Risk among Military Service Members and Veterans: A Machine Learning Approach to Suicidality (COMPLETE)
- Dr. April Smith: Interoceptive Deficits and Suicidality (COMPLETE)
- Dr. David Vogel: Establishing Measurement Equivalence of MRSC Database Assessments (COMPLETE)
- Dr. Kate Comtois: Reviewing the Effects of Caring Contacts (RECON): A Long-Term Follow-Up Study from the Military Continuity Project
- Dr. Lily Brown: Suicide Risk and Sleep in Treatment: An Intensive Daily Sampling Study
- Dr. Dan Capron: Behavioral Economics Intervention to Increase Treatment Seeking in the National Guard
- Dr. Marjan Holloway: A Brief Peer-Support Cognitive Behavioral Intervention for Military Life Transitions (Mil-iTransition) Following Medical and Physical Evaluation Boards
- Dr. Lisa Brenner: Facilitating Assessment of At-Risk Sailors with Technology (FAAST)
- Dr. April Smith: Characterizing the Dynamics of Acute Suicidal Affective Disturbance: A Between-Subjects and Intra-Individual Network Approach
- Dr. April Smith: Reconnecting: Improving Interoception to Reduce Suicidal Ideation and Behavior
- Dr. Thomas Joiner: Increasing Connection to Care Among Military Service Members at Elevated Suicide Risk: A Randomized Controlled Trial of a Web-Based Intervention
- Dr. Brian Marx: Decreasing Suicide Risk among Service Members with Posttraumatic Stress
- Dr. Dan Capron: Mobile Interpretation Bias Modification Clinical Trial

- Dr. Julie Cerel: Personal and Professional Exposure to Suicide in Military Populations
    - Dr. Keith Aronson: Bolstering the Implementation Quality and Impact of Zero Suicide Efforts in the Air Force.
- The following studies are currently being revised and funding is pending a re-vote by the MEAB:
    - Tom Nassif, PhD, Walter Reed Army Institute of Research: Military Transition and Suicide-Related Risk
    - Kate Comtois, PhD, University of Washington: Precision Medicine/Caring Contacts
- Revised proposals from Drs. Nassif and Comtois will be sent to the MEAB on 20 April 2020.
- Core A is working with funded investigators to establish subawards and to facilitate IRB and HRPO approvals.

Subtask 3: Consult with funded MSRC applicants to develop D&I plans for their research proposals that are feasible and relevant to military settings and populations

- Core D presented at the MSRC introduction meetings for all newly funded investigators and continued to provide ongoing consultation to PIs as their studies reached appropriate stages for implementation or dissemination. PIs include: Aronson, Bagge, Holm-Denoma/Witte, and Schmidt.
- The Core D Annual Meeting was held on 26 April 2019 to strategize goals and tasks for the coming year including:
  Dissemination Science Institute
  D&I Bibliographic Pilot Study
  MSRC Action Brief process
- In coordination with Core A, Core D organized a Dissemination Science Institute (DSI), which was held 14-15 May 2019 at the Catholic University of America, Washington, D.C. Contributing sponsors included the American Foundation of Suicide Prevention and Catholic University. Invitations to attend the DSI were extended to researchers currently or previously funded by MSRC or involved in military suicide research. Training objectives oriented to acquiring knowledge and skills for applying dissemination science principles to research design and dissemination actions at study completion. Faculty included dissemination science experts combined with panels of senior uniformed and civilian DoD behavioral health and suicide prevention officials. Training Day 1 provided didactic instruction while Training Day 2 utilized a workshop-based venue for selected attendees to present current projects or research. In addition, DoD panel members and MSRC leaders and staff conducted a coordinating luncheon to facilitate communication. Core D provided D&I consultation to 17 MSRC funded PIs through the expert DSI faculty presentations, panel discussion with DoD leadership, and hands-on workshops.

Subtask 4: Determine gaps in implementation science research and methods relevant to military populations

- Knowledge gained from the DSI continues to be put into action to determine novel and efficient methods to disseminate MSRC recommendations.
- Discussions with Core A regarding conducting pilot D&I projects with MSRC EBPs in military settings to evaluate novel, efficient methods, led to the determination that, given the limitations to providing subject reimbursement within the DoD context (the primary

focus of this funding) this task would not be replaced with a D&I pilot study. Following lessons learned at the Dissemination Science Institute, Core D began collaborating with science experts at the University of Washington Information School to conduct a bibliometric pilot study to assess and map the reach of MSRC publications, products, and dissemination efforts over the past decade, and to identify new pathways and mechanisms of dissemination. This pilot study began in January 2020 and initial data from bibliometric evaluation was sent to Core D and has been shared with Cores A and C.

- Core D drafted a manuscript about the activities and perspective of Core D, including important considerations for D&I of new scientific findings by research funding organizations. Manuscript to be submitted for publication in the *Military Behavioral Health* journal.

Subtask 6: Call for proposals for fourth round of new studies

- Per the MEAB's recommendation, the 4th RFP consisted of targeted proposals sent to the following investigators:
  - Thomas Joiner, PhD, Florida State University: Replication of the taxometric study
  - Jim McNulty, PhD, Florida State University: Enhancing marital feelings using evaluative conditioning
  - Tom Nassif, PhD, Walter Reed Army Institute of Research: Military transition and suicide-related risk
  - Kate Comtois, PhD, University of Washington: Precision Medicine/Caring Contacts
  - Mike Anestis, PhD, University of Southern Mississippi: Plus-up of Project Safe Guard to include Marines
- Proposals were received 29 July 2019 and underwent independent scientific peer review, with the exception of the Anestis project, which was previously reviewed. Scientific reviews and proposals were sent to the MEAB in advance of the 23 October 2019 proposal review meeting.

The following milestones were achieved in Year 4:

- Research priorities updated
- Research studies funded

<u>Major Task 3: Fund and Oversee Clinical Trials and Research Studies</u>

Subtask 1: Facilitate Success

- Twenty-four funded studies have received local IRB approval and twenty-one have received HRPO approval.
- Four secondary data analysis studies using the MSRC CDEs are complete.
- Three long-term follow-up studies are complete.
- Dr. Bagge requested and received a no-cost extension until 14 September 2019. The study team requested additional time to finish data collection, code lethality and medical attention, prepare final data, conduct analyses, interpret, write-up, and disseminate results.
- Dr. Bagge requested and received a second no-cost extension until 14 May 2020 due to her transferring to the University of Michigan and needing additional time for IRB and HRPO approvals, as well as transferring study data.
- Dr. Johnson requested and received a no-cost extension until 30 September 2019. The team requested additional time to complete data analysis and manuscript preparation.

- Dr. Littlefield requested and received a no-cost extension until 31 December 2019. Two co-investigators (Bagge and Kleiman) transferred to new institutions. The team requested additional time in order to obtain IRB and HRPO approval from the new institutions and complete analyses.
- Dr. Nazem requested and received a no-cost extension until 31 March 2021. The team requested additional time to collect remaining 12-month follow-up data, complete data analysis and manuscript preparation.
- Dr. Ribeiro requested and received a no-cost extension until March 2022. The team requested additional time due to unanticipated project delays due to regulatory issues.
- Dr. Smith requested and was denied a no-cost extension. The team was unable to complete Aim 3, which was to test whether Service members have a higher interoceptive deficits latent mean than civilians as the MSRC civilian data were lacking some key variables. They proposed collecting the missing data from civilians via an on-line platform in order to complete the third aim. Drs. Joiner and Gutierrez did not approve this no-cost extension because it would have changed the approved statement of work.
- Dr. Vogel requested and was denied a no-cost extension. The project will be complete by the approved end date, however, Dr. Vogel requested additional time to disseminate findings.
- Funded investigators have submitted quarterly reports on time.
- Core C continues to manage the upload and maintenance of the common data elements, the common demographics form, and additional data submitted by the PIs.
- Core A held an in-person review meeting for funded investigators on 11 July 2019 in Denver, CO. Core A is pleased with the progress being made and problem solving that occurred during the meeting.

The following milestones were achieved in Year 4:

- Maintain defined schedule of data uploads and meetings.

Consortium Specific Aim 3: Use high quality research methods and analyses to extend significant findings from studies completed in the first five years of MSRC.

<u>Major Task 4: Perform analyses on findings from years 1-5</u>

Subtask 1: Perform analyses on years 1-5 findings to extend first five years of MSRC research activities

- Two long-term follow-up studies of the MSRC 1.0 projects are in progress and three are complete.
    - o Dr. Jessica Ribeiro: Examining the nature of suicide risk over time using machine learning (COMPLETE)
    - o Dr. Brad Schmidt: Long Term Follow-up for MSRC DARTS Clinical Trial (COMPLETE)
    - o Dr. Courtney Bagge: Profiles of Behavioral Warning Signs for Suicide Attempts in the Prediction of Future Suicidality
    - o Dr. Lora Johnson: Three Year Follow-up of Study on Suicide Risk Assessments within Suicide-Specific Group Therapy Treatment for Veterans (COMPLETE)
    - o Dr. Kate Comtois: Reviewing the Effects of Caring Contacts (RECON): A Long-Term Follow-Up Study from the Military Continuity Project

The following milestone was achieved in Year 4:

- Analyses completed.

Consortium Specific Aim 5: Capitalize on the CDE (variables collected by all currently funded studies) to encourage rigorous secondary analyses.

<u>Major Task 6: Capitalize on CDE Secondary Analyses</u>
Subtask 1: Call for proposals for secondary data analyses of Common Data Elements

- Four secondary data analysis projects are complete.
  - Dr. Joe Franklin: Using Machine Learning to Distinguish among Active Duty, Veteran, and Civilian Suicidality
  - Dr. Andrew Littlefield: Enhancing Identification of Suicide Risk among Military Service Members and Veterans: A Machine Learning Approach to Suicidality
  - Dr. April Smith: Interoceptive Deficits and Suicidality
  - Dr. David Vogel: Establishing Measurement Equivalence of MRSC Database Assessments

Consortium Specific Aim 6: Disseminate Consortium knowledge, information, and findings.

<u>Major Task 7: Development of D&I Plans</u>
Subtask 2: Evaluate MSRC study interventions for readiness for D&I

- Core D continues to hold weekly meetings to organize Core D tasks, review the MSRC study research findings, and hold MSRC D&I Readiness Working Group reviews.
- To date, 10 Action Briefs and one 1 Publication Report have been finalized and reported to MOMRP. Six Action Briefs are under review by Core D.
- Core D and Core Directors decided that a Publication Report will be created in lieu of an Action Brief if the recommendation indicates any of the following:
  - Do not disseminate – insufficient evidence and no research methodology implications
  - Disseminate to researchers only – insufficient evidence to support but research implications or some evidence, needs further study

Subtask 3: Core D will establish and maintain ongoing relationships and partnerships with agencies and organizations that can support D&I in military and veteran settings with military communities.

- Core D remains in communication with colleagues at the Harborview Medical Center Injury Prevention and Control Center in collaboration with Dr. Jevin West, Associate Professor with the Information School at the University of Washington, co-founder of the DataLab, and director of the Center for an Informed Public regarding the D&I Bibliographic Pilot Study.
- Core D continues to collaborate with the Society for Implementation Research Collaboration (SIRC) – bringing a military perspective to the organization and conference as well as engaging with and linking military partners to the SIRC Policy Network. Core D has started a collaboration with the SIRC Intermediary Network (i.e., trainers, consultants, facilitators of EBPs in large health care and state systems) as well.

The following milestones were achieved in Year 4:

- Establish D&I relationships
- Create clear D&I plans for MSRC funded studies

Major Task 8: Organized Dissemination

Subtask 2: Cores B and D will support the MSRC in communication of deliverables

- Cores B and D continue to support the overall communication of deliverables.
- The MSRC Research in Action blog (https://msrc.fsu.edu/research-in-action) remained a Core D pathway for disseminating informational findings from MSRC-funded research, and vehicle for increasing awareness of MSRC by encouraging traffic toward the MSRC website. The MSRC-funded studies below were highlighted:

  April 2019
  The Improved Virtual Hope Box (VHB)
  PI: Nigel Bush, PhD

  May 2019
  Crisis Response Plan (CRP)
  PI: Craig Bryan, PsyD, ABPP

  June 2019
  A Window to Hope (WToH)
  PI: Lisa A. Brenner, Ph.D., ABPP, Rp

  July 2019
  TEC-TEC: An app for evaluative conditioning
  PI: Joseph Franklin, PhD

  September 2019
  Strengthening Marital Attitudes to Decrease Suicidal Ideation
  PI: James McNulty, PhD

  October 2019
  Toward a Gold Standard for Suicide Risk Assessment for Military Personnel
  PI: Pete Gutierrez, PhD and Thomas Joiner, PhD

  February 2020
  The HOME Program: Engaging Veterans in Care Post-Hospitalization
  PI: Bridget Matarazzo, PsyD

- On 28 June 2019 Core D facilitated the third MSRC Advances in Suicide Prevention Methodology Webinar. Core C Director, Dr. Ashby Plant, presented the MSRC Common Data Elements (CDE). The objective of this webinar was to provide an overview of the CDE and how it can be used to address novel research questions. The following topics were discussed:
  - the development and validation of CDE including the selection of the variables included in the CDE;
  - the data that are currently available and the data that will be available in the future;

    - some examples of research questions that have been addressed with the CDE.

  At the end of the presentation Dr. Plant provided a detailed description of how the data from the CDE and the more expansive MSRC database can be requested for use in research activities.
- MSRC PIs Drs. Jill Holm-Denoma and Tracy Witte, along with their colleague Dr. Nicholas Allen, Assistant Professor at Ohio University presented "Using Person-Centered Statistical Approaches to Understand the Latent Structure of Suicidal Thoughts and Behaviors" on 18 October 2019 as part of the Advances in Suicide Prevention Methodology Webinar Series. The video recording is available on the MSRC website.

The following milestone was achieved in Year 4:
- Communication of MSRC deliverables

Consortium Specific Aim 7: Train future leaders in military suicide research.

<u>Major Task 9: Continue pre-doctoral and postdoctoral training experiences at FSU and Rocky Mountain MIRECC</u>
Subtask 1: Establish career development network
- Under the leadership and guidance of Drs. Gutierrez and Joiner, the MSRC continues to provide training and research opportunities to pre-doctoral students and post-doctoral fellows.

Subtask 2: Establish joint pre-doctoral and postdoctoral training experiences through the MSRC
- The 2019 MSRC Training Day held in conjunction with the 2019 AAS Conference was held on 24 April 2019 in Denver, CO. A total of 35 students attended with 10 faculty.
- The 2020 MSRC Training Day in conjunction with the AAS conference on 24 April 2020 was cancelled due to COVID-19. Core A decided that a virtual training would not offer the same benefits as a live one, especially with the mentorship components. The training day will be postponed until next year and accepted participants will not be required to reapply.
- The joint MSRC/STARRS fellows, Drs. Samantha Bernecker and Kelly Zuromski completed their post-doc fellowships. Dr. Zuromski is continuing her work at Harvard and Dr. Bernecker accepted a private industry consulting position.
- Drs. Carol Chu and Chelsey Wilks continue to conduct research bridging MSRC and Army STARRS, focusing on the interface of risk identification and treatment interventions for suicidal behavior.
- Dr. Wilks and Dr. Gutierrez attended a meeting on 24 and 25 October 2019 with researchers at WRAIR regarding use of mobile technology applications to enhance suicide prevention effectiveness for service members.
- MSRC awarded dissertation awards to three graduate students. The awards of $2,000/each are intended to provide support for completion of a doctoral dissertation topic of relevance to the MSRC.
    - Julia Harris, University of Utah: *A Mechanistic Examination of the Maintenance of Suicidal Thoughts and Attempts from a Process Model of Emotion Regulation Perspective*
    - Rachel Martin, University of Southern Mississippi: *Mitigating Suicidal Thought Suppression: Exploring the Maladaptive Cognitions of Moral Injury*

    - Caitlin Titus, Mississippi State University: *Suicide Acceptability in a Veteran and Non-Veteran Sample*
- Dissertation award final reports were received from Brian Bauer, Joseph Boffa, Hannah Martinez, and Lauren Forrest.

Subtask 3: Establish military/veteran oriented D&I postdoctoral training experiences within Core D

- Dr. Bruce Crow departed MSRC D&I Fellowship on 11 OCT 2019, one month earlier than expected, after accepting a position with the Veterans Health Administration suicide prevention program at the VA Central Office in Washington, DC.

What opportunities for training and professional development has the project provided?

Please refer to Consortium Specific Aim 7: Train future leaders in military suicide research (above).

How were the results disseminated to communities of interest?

Nothing to Report.

What do you plan to do during the next reporting period to accomplish the goals and objectives?

- Core A will submit quarterly reports on time.
- Core A will work with Dr. Anestis to establish a subaward for the recently funded Plus-Up to include Marines in the Project Safe Guard project.
- Core A will submit revised proposal from Drs. Nassif and Comtois to the MEAB for review and re-vote. If funding is recommended, Core A will work with PIs to establish subawards.
- Core A staff will work with the currently funded PIs to obtain IRB and HRPO approvals.
- Core A will plan an in-person review meeting for funded investigators in 2020. Due to COVID-19, these meetings may be virtual.
- The MSRC Annual Meeting will be held in Fall 2020, location and date to be determined.
- Drs. Gutierrez and Joiner will continue to maintain relationships and partnerships with STARRS-LS, DSPO, DCoE, and military and veteran communities and organizations.
- Provide ongoing training opportunities for MSRC staff, MSRC trainees, and MSRC investigators.
- During the next reporting period Core D will:
    - Publish the Dissemination and Implementation of Suicide Research in the Department of Defense: Perspective from the Military Suicide Research Consortium manuscript in the *Military Behavioral Health* journal
    - Complete the D&I Bibliographic Pilot Study
    - Complete an Action Brief or Publication Report for every MSRC 1.0 study publication
    - Complete an Action Brief or Publication Report for every MSRC 2.0 study publication

- Create a priorities list for unfunded D&I based on feedback from the MSRC Readiness Working Group and what has been discussed during the creation of Action Briefs
- Present recommendations on D&I proposals designed to promote suicide prevention in military populations
- Continue Advances in Suicide Prevention Methodology Webinar Series
- Continue MSRC Research in Action blog

IMPACT:

What was the impact on the development of the principal discipline(s) of the project?

The Consortium has funded twenty-five projects to date. Twenty-four funded studies have received local IRB approval and twenty-one have received HRPO approval and are recruiting subjects or conducting data analyses. Four secondary data analysis projects and three long-term follow-up studies are complete.

What was the impact on other disciplines?

Nothing to report.

What was the impact on technology transfer?

Nothing to report.

What was the impact on society beyond science and technology?

Nothing to report.

CHANGES/PROBLEMS:

Changes in approach and reasons for change

A no-cost extension was approved on 8 July 2019. This extension is necessary in order to move forward with the Air Force Zero Suicide project, as well as fund the new proposals requested by the MEAB.

Due to the larger role of the MEAB in directing research priorities, which at times contradicted recommendations from the senior advisors, it was determined the senior advisors were no longer essential. The MSRC directors discussed the change with the senior advisors and they were in agreement with the termination effective January 2020. This change will allow funds that would have gone to their stipends and travel to be preserved for other uses during the NCE.

Actual or anticipated problems or delays and actions or plans to resolve them

The COVID-19 pandemic has impacted recruitment and regulatory reviews for several funded projects. PIs reporting impacts related to COVID-19 include:

- Brenner/FAAST - Recruitment paused. Data collection of enrolled participants continues.

- Smith/RISE & Network - Recruitment paused. No subjects enrolled to date.
- May/Couples Crisis Response - Recruitment paused. Data collection of enrolled participants continues.
- Schmidt/Building Strong Allies – Recruitment paused. Data collection of enrolled participants continues.
- Marx/WET – Recruitment paused. Data collection of enrolled participants continues.

Local IRBs and HRPO have been notified of COVID-19 study implications.

Changes that had a significant impact on expenditures

On 19 March 2020 the FSU site received a contract modification with a fourth increase in funding in the amount of $822,666. The additional funds were added to the research program budget.

Significant changes in use or care of human subjects.

Nothing to report.

Significant changes in use or care of vertebrate animals.

N/A

Significant changes in use of biohazards and/or select agents

N/A

<u>PRODUCTS:</u>

Publications, conference papers, and presentations

<u>Publications</u>

Stanley, I. H., Day, T. N., Gallyer, A. J., Shelef, L., Kalla, C., Gutierrez, P. M., & Joiner, T. E. (in press). Autism-related traits and suicide risk among active duty U.S. military service members. *Psychological Services*. DOI: 10.1037/ser0000418

Buchman-Schmitt, J. M., Stanley, I. H., Gallyer, A. J., Chu, C., Gutierrez, P. M., Hanson, J. E., & Joiner, T. E. (2020). Military Suicide Research Consortium common data elements: Bifactor analysis and longitudinal predictive ability of suicidal ideation and suicide attempts within a clinical sample. *Psychological Assessment*. DOI: 10.1037/pas0000817

Janakiraman, R., Stanley, I. H., Duffy, M. E., Gai, A. R., Hanson, J. E., Gutierrez, P. M., & Joiner, T. E. (2020). Suicidal ideation severity in transgender and cisgender elevated-risk military service members at baseline and three-month follow-up. *Military Behavioral Health*. DOI: 10.1080/21635781.2020.1742821

Caulfield, N. M., Gutierrez, P. M., Comtois, K. A., Johnson, L. L., O'Connor, S. S., & Jobes, D. A., (2020). Exploring the content of suicidality in military personnel and veterans using CAMS. *Military Behavioral Health*, 8(1), 1-10. DOI: 10.1080/21635781.2019.1611509

Zuromski, K. L., Bernecker, S. L., Chu, C., Wilks, C. R., Gutierrez, P. M., Joiner, T. E., Liu, H., Naifeh, J. A., Nock, M. K., Sampson, N. A., Zaslavsky, A. M., Stein, M. B., Ursano, R. J., & Kessler, R. C. (2020). Pre-deployment predictors of suicide attempt during and after combat deployment: Results from the Army Study to Assess Risk and Resilience in Servicemembers. *Journal of Psychiatric Research, 121,* 214-221. DOI: 10.1016/j.jpsychires.2019.12.003

Bernecker, S. L., Zuromski, K. L., Curry, J. C., Kim, J. J., Gutierrez, P. M., Joiner, T. E., Kessler, R. C., Nock, M. K., Rudd, M. D., & Bryan, C. J. (2019). Economic evaluation of brief cognitive-behavioral therapy vs treatment as usual for suicidal U.S. Army soldiers. *JAMA Psychiatry.* DOI:10.1001/jamapsychiatry.2019.3639

Soberay, K. A., Plant, E. A., Hanson, J. E., Dwyer, M., & Gutierrez, P. M. (2019). Improving military readiness and reducing suicide risk: The role between positive TBI screens, severe insomnia and suicidal outcomes. *Military Behavioral Health*, 7(4), 448-458. DOI: 10.1080/21635781.2019.1608877

Smith A.R., Dodd D.R., Ortiz S., Forrest L.N., Witte T.K. (2019). Interoceptive deficits differentiate suicide groups and associate with self-injurious thoughts and behaviors in a military sample. *Suicide and Life Threatening Behavior*. doi: 10.1111/sltb.12603

Zuromski, K. L., Ustun, B., Hwang, I., Keane, T. M., Marx, B. P., Stein, M. B., Ursano, R. J., & Kessler, R. C. (2019). Developing an optimal short-form of the PTSD Checklist for DSM-5 (PCL-5). *Depression and Anxiety*, 36, 790-800. doi: 10.1002/da.22942

White Paper

Joiner, T., & Gutierrez, P. Suicidal Ideation and Ability to Serve. https://msrc.fsu.edu/white-paper/suicidal-ideation-and-ability-serve

Presentations

Witte, T., Stanley, I. H., Gutierrez, P. M., Anestis, M. D., & Ribeiro, J. (2019, April). Advancements in means safety for suicide prevention: Novel populations and approaches to messaging. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Gutierrez, P. M., O'Connor, S., Johnson, L. L., Jobes, D. A. (2019, April). Mental health services research to inform suicide prevention strategies in Veterans Affairs. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Buchman-Schmitt, J., Stanley, I. H., Chu, C., Gutierrez, P. M., Joiner, T., Hanson, J. E., & Gallyer, A. J. (2019, April). Military Suicide Research Consortium common data elements: Bifactor analysis and longitudinal predictive ability of suicide-related outcomes within a clinical sample. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Hom, M. A., Stanley, I. H., Duffy, M. E., Rogers, M. L., Hanson, J. E., Gutierrez, P. M., & Joiner T. E. (2019, April). Investigating patterns in the reporting of suicide attempt history across measures: A study of high-risk U.S. military service members. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Soberay, K.A., Ringer, F., Stanley, I., Gutierrez, P.M., & Joiner, T.J. (2019, April). Initial Validation of the Military Suicide Research Consortium Common Data Elements. In M. Anestis (Chair), Beyond Validity and Reliability: Nuanced Examinations of the Performance of Scales Designed to Assess Suicide Risk. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Soberay, K.A., Hanson, J., & Gutierrez, P.M. (2019, April). Health Service Utilization among Service Members At-Risk for Suicide. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Crow, B.E., Pierson, A.K. (2019, April) Translating Knowledge into Action for the Military Suicide Research Consortium. Poster presentation at the 52nd Annual American Association for Suicidology Conference, Denver, CO.

Gutierrez, P. M., Joiner, T. E., & Hanson, J. E. (2019, April). Evidence-based suicide assessment in the U.S. Military. Presented at the Shoresh Meeting on Military Medicine, Tel Aviv, Israel.

Gutierrez, P. M., & Shelef, L. (2019, April). Evidence-based suicide assessment in the IDF. Presented at the Shoresh Meeting on Military Medicine, Tel Aviv, Israel.

Gutierrez, P. M. (2019, May). How narrative informs risk assessment and treatment planning. Presented at Aeschi 10, Vail, CO.

Stanley, I. H., Day, T. N., Gallyer, A. J., Shelef, L., Kalla, C., Gutierrez, P. M., & Joiner, T. E. (2019, August). Examining the influence of autism symptoms and unit cohesion on suicide risk among military personnel. Presented at the meeting of the Military Health System Research Symposium, Kissimmee, FL.

Gutierrez, P. M., O'Connor, S. S., Johnson, L. L., Hagman, S. H., Podlogar, M. C., & Jobes, D. A. (2019, August). Suicide-Specific Group Therapy for Veterans: Development and testing of CAMS-G. Paper presented at the VA/DOD Suicide Prevention Conference, Nashville, TN.

Gutierrez, P. M. (2019, August). Measurement of Suicide Outcomes in Clinical Research: Psychometric Properties of the Columbia Suicide Severity Rating Scale. Paper presented at the VA/DOD Suicide Prevention Conference, Nashville, TN.

Gutierrez, P. M., Joiner, T. E. (2019, August). MSRC High-Impact Findings: An overview of 6 studies. Paper presented at the meeting of the Military Health System Research Symposium, Kissimmee, FL.

Gai, A. R., Gutierrez, P. M., & Joiner, T. E. (2019, August). Separation from Active Duty Service and Suicidality: Inaccurate Affective Forecasting? Paper presented at the meeting of the Military Health System Research Symposium, Kissimmee, FL.

Crow, B. E., & Gai, A. R. (2019, August). Does suicide risk migrate from DoD to the VA? Poster presented at the American Psychological Association annual conference, Chicago, IL.

McInerney, S., Crow, B. E., & Comtois, K. A. (2019, August). Can we schedule that next crisis? Relating unscheduled acute care to Soldier suicidality. Poster presented at the American Psychological Association annual conference, Chicago, IL.

Gutierrez, P. M., O'Connor, S. S., Johnson, L. L., Hagman, S. H., Podlogar, M. C., & Jobes, D. A. (2019, August). Suicide-Specific Group Therapy for Veterans: Development and testing of CAMS-G. Presented at the VA/DOD Suicide Prevention Conference, Nashville, TN.

Gutierrez, P. M. & Joiner, T. E. (2019, September). Psychometric Properties of Suicide-Specific Measures and Their Clinical Utility. Implications for U.S. Military Treatment Facilities. Presented at the 30th World Congress of the International Association for Suicide Prevention, Derry-Londonderry, UK.

Joiner, T. E. & Gutierrez, P. M. (2019, September). Prediction of Suicide Ideation and Attempts in High Risk U.S. Military Service Members. Presented at the 30th World Congress of the International Association for Suicide Prevention, Derry-Londonderry, UK.

Gutierrez, P. M., Hindman, J., Brummett, S., Reed, J., & Gallanos, J. (2019, October). Public-Private Partnerships to Combat Suicide: The Colorado National Collaborative and Governor's Challenge to Prevent Suicide Among Service Members, Veterans, and their Families. Presented at the IASR/AFSP International Summit on Suicide Research, Miami Beach, FL.

Other Products

Advances in Suicide Prevention Methodology Webinar Series - https://msrc.fsu.edu/webinars

MSRC Blog: Research in Action - https://msrc.fsu.edu/research-in-action

Publication Report

- Problem-Solving Therapy for Suicide Prevention (PST-SP) is Acceptable and Feasible for Veterans with TBI (PI: Brenner)

Action Briefs:

- Veterans contact the healthcare system within one month of attempted suicide (PI: Bagge)
- 'Window to Hope' Reduces Hopelessness for Veterans with Moderate-to-Severe TBI (PI: Brenner)
- Crisis Response Planning to Prevent Suicidal Thoughts and Behavior (PI: Bryan)
- The Virtual Hope Box is Accessible and Effective for Increasing Coping Self-Efficacy among Suicidal Veterans (PI: Bush)
- Exposure to Suicide Death is Associated with Symptoms of Psychopathology (PI: Cerel)
- Half of American Adults are Exposed to Death by Suicide (PI: Cerel)

- Caring Contacts via Text Messages for Suicide Prevention among Soldiers & Marines (PI: Comtois)
- Home-based Mental Health Evaluation (HOME) Program for Veterans after Psychiatric Inpatient Care (PI Matarazzo)
- Suicidality is More Accurately Predicted via Machine Learning using Many Variables (PI Ribeiro)
- Valid and Reliable Suicide Risk Assessment for Active Duty Personnel (PIs: Gutierrez and Joiner)

Technologies or techniques

Nothing to report.

Inventions, patent applications, and or licenses

Nothing to report.

Leveraging

Dr. Gutierrez participated in the collaborative Shoresh meeting with US and Israeli military medicine researchers, presenting on the MSRC and Toward a Gold Standard research.

Dr. Gutierrez continues to serve as a member of the steering committee for the Colorado National Collaborative (CNC). He ensures that MSRC findings and expertise regarding military and veteran suicide prevention inform this state-wide public health approach to suicide prevention. If CNC efforts to reduce Colorado suicide rates 20% by 2024 prove effective, the model will be disseminated nationally.

Dr. Gutierrez serves as a member of the Colorado Team for SAMHSA's Service Members, Veterans, and their Families (SMVF) Technical Assistance Center's Governor's Challenge to facilitate implementation of the 2018-2028 National Strategy for the Prevention of Veteran Suicide. His participation is to ensure that relevant MSRC research findings and expertise inform this effort.

Dr. Gutierrez serves as a member of the Prevention Intervention Section on the Research Strategies Line of Effort responding to Executive Order (EO) 13861 to develop the President's Roadmap to Empower Veterans and End a National Tragedy of Suicide (PREVENTS). This section is tasked with helping develop the portion of the National Research Strategy based upon the EO element related to prevention interventions tasked to "develop and improve individual interventions that increase overall veteran quality of life and decrease the veteran suicide rate". Dr. Gutierrez's participation in part ensures that MSRC research efforts inform the Strategy.

Dr. Joiner has been selected as a recipient of the 2020 James McKeen Cattell Fellow Award from the Association of Psychological Science. The award recognizes APS members for a lifetime of outstanding contributions to the area of applied psychological research.

Several MSRC 1.0 funded studies are referenced in the VA/DoD Clinical Practice Guidelines for "The Assessment and Management of Patients at Risk for Suicide" (https://www.healthquality.va.gov/guidelines/MH/srb/). Window to Hope (Brenner), Crisis

Response Planning (Bryan), and the Virtual Hope Box (Bush) are included. Also, Dr. Cerel's work finding that 135 individuals are exposed to suicide is noted.

Matt Podlogar, a MIRECC Fellow mentored by Dr. Gutierrez, is conducting a secondary data analysis of the Gold Standard data looking at the performance of an abbreviated version of the BSS compared to the full measure. He is now awaiting regulatory approval to replicate it using the CDEs. An abstract will be submitted to the MHSRS conference.

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS:

What individuals have worked on the project?

Denver VA Medical Center, Denver Research Institute

Peter Gutierrez, PhD
Principal Investigator
75% effort
Contribution to Project: Dr. Gutierrez is responsible for the oversight and management of project staff based at Denver. He works closely with Dr. Joiner on overall Consortium executive management (Core A co-direction) and provides oversight of all Consortium Cores (B, C, D) in collaboration with Dr. Joiner.

Kelly Soberay, MA
Project Coordinator
50% effort
Contribution to Project: Ms. Soberay is the Project Coordinator for the Denver site and serves to facilitate the daily management of administrative tasks to include financial management, technical reporting, and management of reports from the research projects.

Karen Gronau, BS
Project Coordinator/IRB Coordinator
100% effort
Contribution to Project: Ms. Gronau is the Project Coordinator/IRB Coordinator for the Denver site and serves to facilitate the daily management of administrative tasks to include financial management, technical reporting, and management of reports from the research projects. She also manages local regulatory issues and assists funded PIs with regulatory approvals.

Jettta Hanson, MA
Research Coordinator
90% effort
Contribution to Project: Ms. Hanson supports the Principal Investigator in day to day operations and managing research studies at the Denver site. She also monitors military and civilian research relevant to the MSRC and fields research requests.

Core D – Dissemination and Implementation (D&I) Core – University of Washington

Kate Comtois, PhD
Director
30% Effort
Contribution to Project: Dr. Comtois directs Core D and is responsible for the team's completion of tasks in the Statement of Work (SOW).

Chris DeCou
Core D Faculty
15% Effort
Contribution to Project: Dr. DeCou writes the Action Briefs based on the literature needed to evaluate the finding using the CDC research standards and collaborates with Core D and the Core Directors on revisions. Dr. DeCou will also coordinate with the UW DataLab on the bibliometric analysis of MSRC publications and products.

Christopher Penn, BA
Research Assistant
60% Effort
Contribution to Project: Mr. Penn supports Dr. Comtois, Ms. Pierson, Dr. DeCou in completing all Core D tasks on time and on budget.

Andria Pierson, MEd
Program Manager
90% Effort
Contribution to Project: Ms. Pierson coordinates operations for Core D, including management of time line, budget, scheduling, and training events.

Justin Um, BA
Research Coordinator
61% Effort
Contribution to Project: Mr. Um supports Dr. Comtois and Ms. Pierson in completing all Core D tasks on time and on budget as well as ongoing management and maintenance of the Access database used to track all MSRC products.

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Lisa Brenner is no longer a Senior Advisor/Co-Investigator receiving 3% salary support.

What other organizations were involved as partners?

Florida State University

SPECIAL REPORTING REQUIREMENTS:

Quad charts are attached in Appendix A18.

APPENDICIES:

A1 VITA

DATE: 2-17-19

NAME: Peter M. Gutierrez

ADDRESS: Rocky Mountain MIRECC
1700 N. Wheeling Street
Aurora, Colorado 80045

PHONE: 303-378-5562

E-MAIL: peter.gutierrez@va.gov

EDUCATION:

Degree	Date	Institution	Location
Ph.D., Clinical Psychology	1997	University of Michigan	Ann Arbor, MI
M.A., Clinical Psychology	1994	University of Michigan	Ann Arbor, MI
B.A., Psychology *Summa Cum Laude*	1991	Winona State University	Winona, MN

AREAS OF SPECIALIZATION AND RESEARCH INTERESTS:

Suicide risk factors, assessment, and interventions. Scale development and psychometric evaluation.

PROFESSIONAL EXPERIENCE:

2008- Clinical/ Research Psychologist, Department of Veterans Affairs, Rocky Mountain Mental Illness Research and Education Clinical Center.

6/9/08- Licensed Clinical Psychologist, Colorado #3203.

7/1/14- Professor, University of Colorado School of Medicine, Department of Psychiatry.

2009-2014 Associate Professor, University of Colorado School of Medicine, Department of Psychiatry.

2008-2009 Visiting Associate Professor, University of Colorado Denver School of Medicine, Department of Psychiatry.

2007-2008 Research Psychologist, Denver VA Medical Center, Mental Illness Research and Education Clinical Center.

2006-2008 Adjoint Associate Professor, University of Colorado Denver School of Medicine, Department of Psychiatry.

2006-2007 Research Consultant, Denver VA Medical Center, Mental Illness Research and Education Clinical Center.

2002-2007 Associate Professor, Northern Illinois University, Department of Psychology.

2002-2006 Assistant Chair, Northern Illinois University, Department of Psychology.

1996-2002 Assistant Professor, Northern Illinois University, Department of Psychology.

PUBLICATIONS (129): http://www.ncbi.nlm.nih.gov/sites/myncbi/1NSkUvt-678QZ/bibliography/48519024/public/?sort=date&direction=ascending

Buchman-Schmitt, J. M., Stanley, I. H., Gallyer, A. J., Chu, C., Gutierrez, P. M., Hanson, J. E., & Joiner, T. E. (in press). Military Suicide Research Consortium common data elements: Bifactor analysis and longitudinal predictive ability of suicidal ideation and suicide attempts within a clinical sample. Psychological Assessment.

Stanley, I. H., Day, T. N., Gallyer, A. J., Shelef, L., Kalla, C., Gutierrez, P. M., & Joiner, T. E. (in press). Autism-related traits and suicide risk among active duty U.S. military service members. Psychological Services. DOI: 10.1037/ser0000418

Janakiraman, R., Stanley, I. H., Duffy, M. E., Gai, A. R., Hanson, J. E., Gutierrez, P. M., & Joiner, T. E. (2020). Suicidal ideation severity in transgender and cisgender elevated-risk military service members at baseline and three-month follow-up. Military Behavioral Health. DOI: 10.1080/21635781.2020.1742821

Caulfield, N. M., Gutierrez, P. M., Comtois, K. A., Johnson, L. L., O'Connor, S. S., & Jobes, D. A., (2020). Exploring the content of suicidality in military personnel and veterans using CAMS. Military Behavioral Health, 8(1), 1-10. DOI: 10.1080/21635781.2019.1611509

Gutierrez, P. M., O'Connor, S. S., Johnson, L. L., Dwyer, M., Mund, N. E., & Jobes, D. A. (2020). Training clinicians to provide Collaborative Assessment and Management of Suicidality - Group (CAMS-G) for Veterans. Military Behavioral Health, 8(1), 21-32. DOI: 10.1080/21635781.2019.1705214

Zuromski, K. L., Bernecker, S. L., Chu, C., Wilks, C. R., Gutierrez, P. M., Joiner, T. E., Liu, H., Naifeh, J. A., Nock, M. K., Sampson, N. A., Zaslavsky, A. M., Stein, M. B., Ursano, R. J., & Kessler, R. C. (2020). Pre-deployment predictors of suicide attempt during and after combat deployment: Results from the Army Study to Assess Risk and Resilience in Servicemembers. Journal of Psychiatric Research, 121, 214-221. DOI: 10.1016/j.jpsychires.2019.12.003

Bernecker, S. L., Zuromski, K. L., Curry, J. C., Kim, J. J., Gutierrez, P. M., Joiner, T. E., Kessler, R. C., Nock, M. K., Rudd, M. D., & Bryan, C. J. (2019). Economic evaluation of brief cognitive-behavioral therapy vs treatment as usual for suicidal U.S. Army soldiers. JAMA Psychiatry. DOI:10.1001/jamapsychiatry.2019.3639

Lavigne, J., Falbo, & Gutierrez, P. M. (2019). Cost-utility analysis of blister packaging all outpatient medications for veterans with bipolar disorder, major affective disorder, posttraumatic stress disorder or schizophrenia. Journal of Pharmaceutical Health Services Research, 10, 401-406. DOI: 10.1111/jphs.12324

Soberay, K. A., Plant, E. A., Hanson, J. E., Dwyer, M., & Gutierrez, P. M. (2019). Improving military readiness and reducing suicide risk: The role between positive TBI screens, severe insomnia and suicidal outcomes. Military Behavioral Health, 7(4), 448-458. DOI: 10.1080/21635781.2019.1608877

Hom, M. A., Duffy, M. E., Rogers, M. L., Hanson, J. E., Gutierrez, P. M., & Joiner, T. E. (2019). Examining the link between prior suicidality and subsequent suicidal ideation among high-risk U.S. military service members. Psychological Medicine, 49(13), 2237-2246. DOI: 10.1017/S0033291718003124

Stanley, I. H., Rogers, M. L., Hanson, J. E., Gutierrez, P. M., & Joiner, T. E. (2019). PTSD symptom clusters and suicidal behaviors among high-risk military service members: A three-month prospective investigation. Journal of Consulting and Clinical Psychology, 87(1), 67-78. doi:10.1037/ccp0000350

Podlogar, M. C., Gutierrez, P. M., and Joiner, T. E. (2019). Improving our understanding of the Death/Life Implicit Association Test. Journal of Personality Assessment. doi: 10.1080/00223891.2019.1663357

Bernecker, S. L., Zuromski, K. L., Gutierrez, P. M., Joiner, T. E., King, A. J., Liu, H., Nock, M. K., Sampson, N. A., Zaslavsky, A. M., Stein, M. B., Ursano, R. J., & Kessler, R. C. (2019). Predicting suicide attempts among soldiers who deny suicidal ideation in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). Behaviour Research and Therapy, 120. DOI: 10.1016/j.brat.2018.11.018

Soberay, K. A., Hanson, J. E., Dwyer, M., Plant, E. A., & Gutierrez, P. M. (2019). The relationship between suicidal responses and traumatic brain injury and severe insomnia in active duty, veteran, and civilian populations. Archives of Suicide Research, 23(3), 391-410. DOI: 10.1080/13811118.2018.1479322

Hom, M. A., Stanley, I. H., Duffy, M. E., Rogers, M. L., Hanson, J. E., Gutierrez, P. M., & Joiner, T. E. (2019). Investigating the reliability of suicide attempt history reporting across five measures: A study of U.S. military service members at risk of suicide. Journal of Clinical Psychology, 75(7), 1332-1349. DOI: 10.1002/jclp.22776

Gutierrez, P. M., Joiner, T., Hanson, J., Stanley, I. H., Silva, C., & Rogers, M. L. (2019). Psychometric properties of four commonly used suicide risk assessment measures: Applicability to military treatment settings. Military Behavioral Health, 7(2), 177-184. DOI: 10.1080/21635781.2018.1562390

Chen, J. I., Osman, A., Freedenthal, S. L., & Gutierrez, P. M. (2019). An examination of the psychometric properties of the Reasons for Living Inventory within a male veteran clinical sample. Archives of Suicide Research, 0:1–27. DOI: 10.1080/13811118.2018.1563576

Zuromski, K. L., Bernecker, S. L., Gutierrez, P. M., Joiner, T. E., King, A. J., Liu, H., Naifeh, J. A., Nock, M. K., Sampson, N. A., Zaslavsky, A. M., Stein, M. B., Ursano, R. J., & Kessler, R. C. (2019) Assessment of a risk index for suicide attempts among US Army Soldiers with suicidal ideation: Analysis of data from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). JAMA Network Open, 2(3), e190766. doi:10.1001/jamanetworkopen.2019.0766.

Corona, C. D., Gutierrez, P. M., Wagner, B. M., & Jobes, D. A. (2019). The psychometric properties of the Collaborative Assessment and Management of Suicidality rating scale. Journal of Clinical Psychology, 75, 190-201. https://doi.org/10.1002/jclp.22699

Johnson, L. L., O'Connor, S. S., Kaminer, B., Gutierrez, P. M., Carney, E., Groh, B., & Jobes. (2019). Evaluation of structured assessment and mediating factors of suicide focused group therapy for veterans recently discharged from inpatient psychiatry. Archives of Suicide Research, 23(1), 15-33. DOI: 10.1080/13811118.2017.1402722

Nock, M. K., Han, G., Millner, A. J., Gutierrez, P. M., Joiner, T. E., Hwang, I., King, A., Naifeh, J. A., Sampson, N. A., Zaslavsky, A. M., Stein, M. B., Ursano, R. J., & Kessler, R. C. (2018). Patterns and predictors of persistence of suicide ideation: Results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). Journal of Abnormal Psychology, 127(7), 650. doi:10.1037/abn0000379

Stanley, I. H., Buchman-Schmitt, J. M., Chu, C., Rogers, M. L., Gai, A. R., Wagner, R. K., Gutierrez, P. M., & Joiner, T. E. (2018). The Military Suicide Research Consortium common data elements: An examination of measurement invariance across current service members and veterans. Assessment, 26(6), 963-975. doi:10.1177/1073191118777635

Brown, T. M., Gutierrez, P. M., Grunwald, G. K., DiGuiseppi, C., Valuck, R. J., & Anderson, H. D. (2018). Access to psychotropic medication via prescription is associated with choice of suicide method: A retrospective study of 27,876 suicide attempts. The Journal of Clinical Psychiatry, 79(6). doi:10.4088/JCP.17m11982

Bernecker, S. L., Rosellini, A. J., Nock, M. K., Chiu, W. T., Gutierrez, P. M., Hwang, I., Joiner, T. E., Naifeh, J. A., Sampson, N. A., Zaslavsky, A. M., Stein, M. B., Ursano, R. J., & Kessler, R. C. (2018). Improving risk prediction accuracy for new soldiers in the U.S. Army by adding self-report survey data to administrative data. BMC Psychiatry, 18(1), 87.

Stanley, I. H., Hom, M. A., Chu, C., Dougherty, S. P., Gallyer, A. J., Spencer-Thomas, S., Shelef, L., Fruchter, E., Comtois, K. A., Gutierrez, P. M., Sachs-Ericsson, N. J., & Joiner, T. E. (2018). Perceptions of belongingness and social support attenuate PTSD symptom severity among firefighters: A multi-study investigation. Psychological Services. Advanced online publication. DOI: 10.1037/ser0000240

Chu, C., Hom, M. A., Stanley, I. H., Gai, A., Nock, M. K., Gutierrez, P. M., & Joiner, T. E. (2018). Non-suicidal self-injury and suicidal thoughts and behaviors: A study of the explanatory roles of the interpersonal theory variables among military service members and veterans. Journal of Clinical and Consulting Psychology, 86(1), 56. doi:10.1037/ccp0000262

Nock, M. K., Millner, A. J., Joiner, T. E., Gutierrez, P. M., Han, G., Hwang, I., King, A., Naifeh, J. A., Sampson, N. A., Zaslavsky, A. M., Stein, M. B., Ursano, R. J., Kessler, R. C. (2018). Risk Factors for the Transition from Suicide Ideation to Suicide Attempt: Results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). Journal of Abnormal Psychology, 127(2), 139. doi:10.1037/abn0000317

Ringer, F., Soberay, K., Rogers, M., Hagan, C., Chu, C., Schneider, M., Podlogar, M., Witte, T., Holm-Denoma, J., Plant, A., Gutierrez, P. M., & Joiner, T., (2018). Initial validation of brief measures of suicide risk factors: Common Data Elements used by the Military Suicide Research Consortium. Psychological Assessment, 36(6), 767-778. doi:10.1037/pas0000519

Corona, C. D., Gutierrez, P. M., Wagner, B. M., & Jobes, D. A. (2018). Assessing the reliability of the CAMS rating scale using a generalizability study. Crisis. DOI: 10.1027/0227-5910/a000565

Huh, D., Jobes, D. A., Comtois, K. A., Kerbrat, A. H., Chalker, S. A., Gutierrez, P. M., & Jennings, K. W. (2018). The Collaborative Assessment and Management of Suicidality (CAMS) versus Enhanced Care as Usual (E-CAU) with suicidal soldiers: Moderator analyses from a randomized controlled trial. Military Psychology, 30(6), 495-506. DOI: 10.1080/08995605.2018.1503001

Chiurliza, B., Gutierrez, P. M., Joiner, T., Hanson, J., Ben Yehuda, A., Tatsa-Laur, L., Schneider, M., Stanley, I., & Shelef, L. (2018). Evaluation of suicide risk assessment measures in an Israel Defense Forces military sample. Military Behavioral Health, 6(4), 317-325. DOI: 10.1080/21635781.2018.1470585

Jobes, D. A., Comtois, K. A., Gutierrez, P. M., Brenner, L.A., Huh, D., Chalker, S. A….& Crow, B. (2017). A Randomized Controlled Trial of the Collaborative Assessment and Management of Suicidality versus Enhanced Care as Usual with Suicidal Soldiers. Psychiatry: Interpersonal and Biological Processes, 80, 339–356. DOI: https://doi.org/10.1080/00332747.2017.1354607

Gutierrez, P. M., Wortzel, H. S., Forster, J. E., Leitner, R. A., Hostetter, T. A., & Brenner, L. A. (2017). Blister packaging medication increases treatment adherence for psychiatric patients. Journal of Psychiatric Practice, 23(5), 320-327. doi: 10.1097/PRA.0000000000000252

Ribeiro, J. D., Gutierrez, P. M., Joiner, T. E., Kessler, R. C., Petukhova, M. V., Sampson, N. A., Stein, M. B., Ursano, R. J., & Nock (2017). Healthcare Contact and Suicide Risk Documentation prior to Suicide Death: Results from the Army Study to Assess Risk. Journal of Consulting and Clinical Psychology, 85(4), 403-408. doi: 10.1037/ccp0000178

Hom, M. A., Stanley, I. H., Gutierrez, P. M., & Joiner, T. E. (2017). Exploring the association between exposure to suicide and suicide risk among military service members and veterans. Journal of Affective Disorders, 207, 327-335. doi:10.1016/j.jad.2016.09.043

Davidson, C. L., Anestis, M., & Gutierrez, P. M. (2017). Ecological momentary assessment is a neglected methodology in suicidology. Archives of Suicide Research, 21(1), 1-11. doi: 10.1080/13811118.2015.1004482

Hom, M. A., Chu, C., Schneider, M. E., Lim, I. C., Hirsch, J. K., Gutierrez, P. M., & Joiner, T. E. (2017). Thwarted belongingness as an explanatory link between insomnia and suicidal ideation: Findings from three samples of military service members and veterans. Journal of Affective Disorders, 209, 114-123. doi: 10.1016/j.jad.2016.11.032

O'Connor, S. S., Carney, E., Jennings, K. W., Johnson, L. L., Gutierrez, P. M., & Jobes, D. A. (2016). Relative Impact of Risk Factors, Thwarted Belongingness, and Perceived Burdensomeness on Suicidal Ideation in Veteran Service Members. Journal of Clinical Psychology, 73(10), 1360-1369. doi:10.1002/jclp.22426

Gutierrez, P. M., Pease, J., Matarazzo, B. B., Monteith, L. L., Hernandez, T., & Osman, A. (2016). Evaluating the psychometric properties of the Interpersonal Needs Questionnaire and the Acquired Capability for Suicide Scale in military veterans. Psychological Assessment, 28(12), 1684-1694. doi: 10.1037/pas0000310

Joiner, T., Hom, M., Rogers, M., Chu, C., Stanley, I., Wynn, G., & Gutierrez, P. M. (2016). Staring Down Death: Is Abnormally Slow Blink Rate a Clinically Useful Indicator of Acute Suicide Risk? Crisis, 37(3), 212-217. doi: 10.1027/0227-5910/a000367

Gutierrez, P. M., Davidson, C., Friese, A., & Forster, J. (2016). Physical activity, suicide risk factors, and suicidal ideation in a veteran sample. Suicide and Life-Threatening Behavior, 46(3), 284-292. doi: 10.1111/sltb.1290

Gutierrez, P. M. (2015). Introduction to the special section: The costs and benefits of working with pooled data. Military Behavioral Health. e-pub ahead of print. doi: 10.1080/21635781.2015.1085932

Villate, J., O'Connor, S., Leitner, R., Kerbrat, A., Johnson, L., & Gutierrez, P. M. (2015). Suicide attempt characteristics among veterans and active duty servicemembers: A pooled data analysis. Military Behavioral Health, 3(4), 316-327. doi: 10.1080/21635781.2015.1093981

Tucker, R. P., Crowley, K., Davidson, C. L., & Gutierrez, P. M. (2015). Risk factors, warning signs, and drivers of suicide: What are they, how do they differ, and why does it matter? Suicide and Life-Threatening Behavior, 45(6), 679-689 . doi: 10.1111/sltb.12161

Petrik, M. L., Gutierrez, P. M., Berlin, J. S., & Saunders, S. M. (2015). Barriers and Facilitators of Suicide Risk Assessment in Emergency Departments: A Qualitative Study of Provider Perspectives. General Hospital Psychiatry, 37(6), 581-586. doi: 10.1016/j.genhosppsych.2015.06.018

Anestis, M. D., Joiner, T., Hanson, J. E., & Gutierrez, P. M. (2015). Response to commentary on the modal suicide decedent did not consume alcohol just prior to the time of death: An analysis with implications for understanding suicidal behavior. Journal of Abnormal Psychology, 124(2), 460-461. doi: 10.1037/abn0000062

Bodell, L., Forney, K. J., Keel, P., Gutierrez, P., & Joiner, T. E. (2014). Consequences of Making Weight: A Review of Eating Disorder Symptoms and Diagnoses in the United States Military. Clinical Psychology: Science and Practice, 21(4), 398-409. PMID: 25642105

Anestis, M. D., Soberay, K. A., Hernández, T. D., Joiner, T. E., & Gutierrez, P. M. (2014). Reconsidering the link between impulsivity and suicidal behavior. Personality and Social Psychology Review, 18 (4), 366-386. doi: 10.1177/1088868314535988

Anestis, M. D., Joiner, T., Hanson, J. E., & Gutierrez, P. M. (2014). The modal suicide decedent did not consume alcohol just prior to the time of death: An analysis with implications for understanding suicidal behavior. Journal of Abnormal Psychology, 123(4), 835-840. doi: 10.1037/a0037480

Johnson, L. L., O'Connor, S.S., Kaminer, B., Jobes, D. A., & Gutierrez, P. M. (2014). Suicide-Focused Group Therapy for Veterans. Military Behavioral Health, 0, 1-10. DOI: 10.1080/21635781.2014.963762

Rings, J. A., Forster, J., E., & Gutierrez, P. M. (2014). Exploring Prolonged Grief Disorder and its Relationship to Suicidal Ideation among Veterans. Military Behavioral Health, 2(3), 283-292. DOI: 10.1080/21635781.2014.963758

Ribeiro, J.D., Bender, T. W., Buchman, J. M., Nock, M. K., Rudd, M. D., Bryan, C.J., Lim, I. C., Baker, M. T., Knight, C., Gutierrez, P. M., & Joiner, T. E. Jr. (2014). An investigation of the interactive effects of the acquired capability for suicide and acute agitation on suicidality in a military sample. Depression and Anxiety, 00, 1-7. DOI: 10.1002/da.22240

Matarazzo, B. B., Barnes, S. M., Pease, J. L., Russell, L. M., Hanson, J. E., Soberay, K. A., & Gutierrez, P. M. (2014). Suicide risk among lesbian, gay, bisexual, and transgender military personnel and veterans: What does the literature tell us? Suicide and Life-Threatening Behavior, 44(2), 200-217. Doi: 10.1111/sltb.12073

Osman, A., Lamis, D. A., Freedenthal, S., Gutierrez, P. M., & McNaughton-Cassill, M. (2014). The Multidimensional Scale of perceived Social Support: Analyses of internal reliability, measurement invariance, and correlates across genders. Journal of Personality Assessment, 96(1), 103-112. doi: 10.1080/00223891.2013.838170

Gutierrez, P. M., Brenner, L. A., Rings, J. A., Devore, M. D., Kelly, P. J., Staves, P. J., Kelly, C. M., & Kaplan, M. S. (2013). A qualitative description of female veterans' deployment-related experiences and potential suicide risk factors. Journal of Clinical Psychology, 69(3), 923-935. doi: 10.1002/jclp.21997

York, J., Lamis, D. A., Friedman, L., Berman, A. L., Joiner, T. E., McIntosh, J. L., Silverman, M. M., Konick, L., Gutierrez, P. M., & Pearson, J. (2013). A systematic review process to evaluate suicide prevention programs: A sample case of community-based programs. Journal of Community Psychology, 41(1), 35-51.

Osman, A., Wong, J. L., Bagge, C. L., Freedenthal, S., Gutierrez, P. M., & Lozano, G. (2012). The Depression Anxiety Stress Scales—21 (DASS-21): Further examination of dimensions, scale reliability, and correlates. Journal of Clinical Psychology, 68(12), 1322-1338. doi: 10.1002/jclp.21908

Bahraini, N. H., Gutierrez, P. M., Harwood, J. E., Huggins, J. A., Hedegaard, H., Chase, M., & Brenner, L. A. (2012). The Colorado Violent Death Reporting System (COVDRS): Validity and utility of the Veteran status variable. Public Health Reports, 127, 304-309. PMID: 22547861

Rings, J. A., Alexander, P. A, Silvers, V. N., & Gutierrez, P. M. (2012). Adapting the safety planning intervention for use in a Veteran psychiatric inpatient group setting. Journal of Mental Health Counseling, 34(2), 95-110.

Gutierrez, P. M., Freedenthal, S., Wong, J. L., Osman, A., & Norizuki, T. (2012). Validation of the Suicide Resilience Inventory-25 (SRI-25) in adolescent psychiatric inpatient samples. Journal of Personality Assessment, 94(1), 53-61. doi:10.1080/00223891.2011.608755

Ribeiro, J. D., Pease, J. L., Gutierrez, P. M., Silva, C., Bernert, R. A., Rudd, M. D., & Joiner, T. E. Jr. (2012). Sleep problems outperform depression and hopelessness as cross-sectional and longitudinal predictors of suicidal ideation and behavior in young adults in the military. Journal of Affective Disorders, 136, 743-750. doi:10.1016/j.jad.2011.09.049

Osman, A., Bagge, C. L., Freedenthal, S., Gutierrez, P. M., & Emmerich, A. (2011). Development and evaluation of the Social Anxiety and Depression Life Interference-24 (SADLI-24) Inventory. Journal of Clinical Psychology, 67(1), 82-89. doi:10.1002/jclp.20728

Freedenthal, S., Lamis, D. A., Osman, A., Kahlo, D., & Gutierrez, P. M. (2011). Evaluation of the psychometric properties of the Interpersonal Needs Questionnaire-12 in samples of men and women. Journal of Clinical Psychology, 67, 609-623. doi:10.1002/jclp.20782

Osman, A., Freedenthal, S., Gutierrez, P. M., Wong, J. L., Emmerich, A., & Lozano, G. (2011). The Anxiety Depression Distress Inventory-27 (ADDI-27): A Short Version of the Mood and Anxiety Symptom Questionnaire-90. Journal of Clinical Psychology, 67, 591-608. doi:10.1002/jclp.20784

Osman, A., Gutierrez, P. M., Wong, J. L., Freedenthal, S., Bagge, C. L., & Smith, K. D. (2010). Development and Psychometric Evaluation of the Suicide Anger Expression Inventory—28. Journal of Psychopathology and Behavioral Assessment, 32, 595–608. doi:10.1007/s10862-010-9186-5

Osman, A., Gutierrez, P. M., Bagge, C. L., Fang, Q., & Emmerich, A. (2010). Reynolds Adolescent Depression Scale—Second Edition: A reliable and useful instrument. Journal of Clinical Psychology, 66(12), 1324-1345. doi: 10.1002/jclp.20727

Wortzel, H. S., Gutierrez, P. M., Homaifar, B. Y., Breshears, R. E., & Harwood, J. E. (2010). Surrogate endpoints in suicide research. Suicide and Life-Threatening Behavior, 40(5), 500-505. doi:10.1521/suli.2010.40.5.500

Breshears, R. E., Brenner, L. A., Harwood, J. E. F., & Gutierrez, P. M. (2010). Predicting suicidal behavior in veterans with traumatic brain injury: The utility of the Personality Assessment Inventory. Journal of Personality Assessment, 92(4), 349-355. doi:10.1080/00223891.2010.482011

Muehlenkamp, J. J., Cowles, M. L., & Gutierrez, P. M. (2010). Validity of the Self-Harm Behavior Questionnaire with diverse adolescents. Journal of Psychopathology and Behavioral Assessment, 32, 236-245. doi:10.1007/s10862-009-9131-7

Brenner, L. A., Terrio, H., Homaifar, B. Y., Gutierrez, P. M., Staves, P. J., Harwood, J. E. F., Reeves, D., Adler, L. E., Ivins, B. J., Helmick, K., & Warden, D. (2010). Neuropsychological test performance in soldiers with blast-related mild TBI. Neuropsychology, 24(2), 160-167. doi:10.1037/a0017966

Selby, E. A., Anestis, M. D., Bender, T. W., Ribeiro, J. D, Nock, M. K., Rudd, M. D., Bryan, C. J., Lim, I. C., Baker, M. T., Gutierrez, P. M., & Joiner, T. E., Jr. (2010). Overcoming the fear of lethal injury: Evaluating suicide in the military through the lens of the interpersonal-psychological theory of suicide. Clinical Psychology Review, 30, 298-307. doi:10.1016/j.cpr.2009.12.004

Osman, A., Gutierrez, P. M., Smith, K., Fang, Q., Lozano, G., & Devine, A. (2010). The Anxiety Sensitivity Index-3: Analyses of Dimensions, Reliability Estimates, and Correlates in Nonclinical Samples. Journal of Personality Assessment, 92(1), 45-52. doi:10.1080/00223890903379332

Osman, A., Gutierrez, P. M., Schweers, R., Fang, Q., Holguin-Mills, R. L., & Cashin, M. (2010). Psychometric Evaluation of the Body Investment Scale for Use with Adolescents. Journal of Clinical Psychology, 66(3), 259-276. doi:10.1002/jclp.20649

Osman, A., Gutierrez, P. M., Barrios, F., Wong, J. L., Freedenthal, S., & Lozano, G. (2010). Development and Initial Psychometric Properties of the UTSA Future Disposition Inventory. Journal of Clinical Psychology, 66(4), 1-20. doi: 10.1002/jclp.20660

Brausch, A. M. & Gutierrez, P. M. (2010). Differences in Non-Suicidal Self-Injury and Suicide Attempts in Adolescents. Journal of Youth and Adolescence, 39, 233-242. doi:10.1007/s10964-009-9482-0

Gutierrez, P. M. (2009). Suicidal thoughts: Essays on self-determined death [Review of the book]. American Journal of Psychiatry, 166(9), 1069-1070. doi:10.1176/appi.ajp.2009.09030305

Gutierrez, P. M., Brenner, L. A., Olson-Madden, J. H., Breshears, R., Homaifar, B. Y., Betthauser, L. M., Staves, P., & Adler, L. E. (2009). Consultation as a means of veteran suicide prevention. Professional Psychology: Research and Practice, 40(6), 586-592. doi:10.1037/a0016497

Muehlenkamp, J. J., Williams, K. L., Gutierrez, P. M., & Claes, L. (2009). Rates of non-suicidal self-injury in high school students across five years. Archives of Suicide Research, 13(4), 317-329. doi:10.1080/13811110903266368

Osman, A., Williams, J. E., Espenschade, K., Gutierrez, P. M., Bailey, J. R., & Chowdhry, O. (2009). Further evidence of the reliability and validity of the Multidimensional Anxiety Scale for Children (MASC) in Psychiatric inpatient samples. Journal of Psychopathology and Behavioral Assessment, 31, 202-214. doi: 10.1007/s10862-008-9095-z

Gutierrez, P. M., & Osman, A. (2009). Getting the best return on your screening investment: An analysis of the Suicidal Ideation Questionnaire and Reynolds Adolescent Depression Scale. School Psychology Review, 38, 200-217. Doi : 10.1080/02796015.2009.12087802

Gutierrez, P. M., & Brenner, L. A. (2009). Introduction to the special section: Helping military personnel and veterans from Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) manage stress reactions. Journal of Mental Health Counseling, 31(2), 95-100.

Homaifar, B. Y., Brenner, L. A., Gutierrez, P. M., Harwood, J. F., Thompson, C., Filley, C. M., Kelly, J. P., & Adler, L. E. (2009). Sensitivity and specificity of the Beck Depression Inventory-II (BDI-II) in individuals with traumatic brain injury (TBI). Archives of Physical Medicine and Rehabilitation, 90(4), 652-656. doi:10.1016/j.apmr.2008.10.028

Brausch, A. M., & Gutierrez, P. M. (2009). The role of body image and disordered eating as risk factors for depression and suicide ideation in adolescents. Suicide and Life-Threatening Behavior, 39(1), 58-71. doi:10.1521/suli.2009.39.1.58

Gutierrez, P. M., Brenner, L. A., & Huggins, J. A. (2008). A preliminary investigation of suicidality in psychiatrically hospitalized veterans with traumatic brain injury. Archives of Suicide Research, 12(4), 336–343. doi:10.1080/13811110802324961

Brenner, L. A., Gutierrez, P. M., Cornette, M. M., Betthauser, L. M., Bahraini, N., & Staves, P. J. (2008). A qualitative study of potential suicide risk factors in returning combat veterans. Journal of Mental Health Counseling, 30(3), 211-225.

Osman, A., Barrios, F. X., Gutierrez, P. M., Williams, J. E., & Bailey, J. (2008). Psychometric properties of the Beck Depression Inventory-II in nonclinical adolescent samples. Journal of Clinical Psychology, 64, 83-102. doi:10.1002/jclp.20433

Homaifar, B. Y., Brenner, L. A., Gutierrez, P. M., Harwood, J. E. F., Thompson, C., Filley, C. M., Kelly, J. P., & Adler, L. E. (2007, June). Aging with traumatic brain injury: An analysis of Beck Depression Inventory-II scores [Abstract]. The Clinical Neuropsychologist, 21(3), 395-396.

Thompson, C., Gutierrez, Brenner, L. A., Homaifar, B. Y., & Harwood, J. E. F. (2007, June). Veterans with traumatic brain injury: Preliminary norms for the Personality Assessment Inventory [Abstract]. The Clinical Neuropsychologist, 21(3), 406-407.

Muehlenkamp, J. J., & Gutierrez, P. M. (2007). Risk for suicide attempts among adolescents who engage in non-suicidal self-injury. Archives of Suicide Research, 11(1), 69-82. doi:10.1080/13811110600992902

Fliege, H., Kocalevent, R., Walter, O. B., Beck, S., Gratz, K. L., Gutierrez, P. M., & Klapp, B. F. (2006). Three assessment tools for deliberate self-harm and suicide behavior: Evaluation and psychopathological correlates. Journal of Psychosomatic Research, 61(1), 113-121. doi:10.1016/j.jpsychores.2005.10.006

Osman, A., Barrios, F. X., Kopper, B. A., Gutierrez, P. M., Williams, J. E., & Bailey, J. (2006). The Body Influence Assessment Inventory (BIAI): Development and initial validation. Journal of Clinical Psychology, 62(7), 923-942. doi:10.1002/jclp.20273

Gutierrez, P. M. (2006). Integratively assessing risk and protective factors for adolescent suicide. Suicide and Life-Threatening Behavior, 36(2), 129-135. doi:10.1521/suli.2006.36.2.129

Gutierrez, P. M., Muehlenkamp, J. J., Konick, L. C., & Osman, A. (2005). What role does race play in adolescent suicidal ideation? Archives of Suicide Research, 9(2), 177-192. doi:10.1080/13811110590904025

Osman, A., Gutierrez, P. M., Barrios, F. X., Bagge, C. L., Kopper, B. A., & Linden, S. (2005). The Inventory of Suicide Orientation - 30: Further validation with adolescent psychiatric inpatients. Journal of Clinical Psychology, 61(4), 481-497. doi:10.1002/jclp.20086

Muehlenkamp, J. J., Gutierrez, P. M., Osman, A., & Barrios, F. X. (2005). Validation of the Positive and Negative Suicide Ideation (PANSI) Inventory in a diverse sample of young adults. Journal of Clinical Psychology, 61(4), 431-445. doi:10.1002/jclp.20051

Konick, L. C., & Gutierrez, P. M. (2005). Testing a model of suicide ideation in college students. Suicide and Life-Threatening Behavior, 35(2), 181-192. doi:10.1521/suli.35.2.181.62875

Osman, A., Barrios, F. X., Gutierrez, P. M., Schwarting, B., Kopper, B. A., & Wang, M. C. (2005). Reliability and construct validity of the pain distress inventory. Journal of Behavioral Medicine, 28, 169-180. doi:10.1007/s10865-005-3666-1

Osman, A., Kopper, B. A., Barrios, F. X., Gutierrez, P. M., & Bagge, C. L. (2004). Reliability and validity of the Beck Depression Inventory – II with adolescent psychiatric inpatients. Psychological Assessment, 16(2), 120-132. doi:10.1037/1040-3590.16.2.120

Gutierrez, P. M., Watkins, R., & Collura, D. (2004). Suicide risk screening in an urban high school. Suicide and Life-Threatening Behavior, 34(4), 421-428. doi: 10.1521/suli.34.4.421.53741

Osman, A., Gutierrez, P. M., Muehlenkamp, J. J., Dix-Richardson, F., Barrios, F. X., & Kopper, B. A. (2004). The Suicide Resilience Inventory – 25: Development and preliminary psychometric properties. Psychological Reports, 94, 1349-1360. doi:10.2466/PR0.94.3.1349-1360

Gutierrez, P. M., Osman, A., Kopper, B. A., & Barrios, F. X. (2004). Appropriateness of the Multi-Attitude Suicide Tendency Scale for non-white individuals. Assessment, 11(1), 73-84. doi:10.1177/1073191103261041

Muehlenkamp, J. J., & Gutierrez, P. M. (2004). An investigation of differences between self-injurious behavior and suicide attempts in a sample of adolescents. Suicide and Life-Threatening Behavior, 34(1), 12-23. doi:10.1521/suli.34.1.12.27769

Osman, A., Barrios, F. X., Gutierrez, P. M., Kopper, B. A., Butler, A., & Bagge, C. L. (2003). The Pain Distress Inventory: Development and initial psychometric properties. Journal of Clinical Psychology, 59(7), 767-785. doi:10.1002/jclp.10173

Osman, A., Gutierrez, P. M., Jiandani, J., Kopper, B. A., Barrios, F. X., Linden, S. C., & Truelove, R. S. (2003). A preliminary validation of the Positive and Negative Suicide Ideation (PANSI) Inventory with normal adolescent samples. Journal of Clinical Psychology, 59(4), 493-512. doi:10.1002/jclp.10154

Watkins, R. L., & Gutierrez, P. M. (2003). The relationship between exposure to adolescent suicide and subsequent suicide risk. Suicide and Life-Threatening Behavior, 33 (1), 21-32. doi:10.1521/suli.33.1.21.22787

Osman, A., Breitenstein, J. L., Barrios, F. X., Gutierrez, P. M., & Kopper, B. A. (2002). The Fear of Pain Questionnaire-III: Further reliability and validity with nonclinical samples. Journal of Behavioral Medicine, 25(2), 155-173.

Osman, A., Barrios, F. X., Gutierrez, P. M., Wrangham, J. J., Kopper, B. A., Truelove, R. S., & Linden, S. C. (2002). The Positive and Negative Suicide Ideation (PANSI) Inventory: Psychometric evaluation with adolescent psychiatric inpatient samples. Journal of Personality Assessment, 79(3), 512-530. doi:10.1207/S15327752JPA7903_07

Valentiner, D. P., Gutierrez, P. M., & Blacker, D. (2002). Anxiety measures and their relationship to adolescent suicidal ideation and behavior. Journal of Anxiety Disorders, 16, 11-32. doi:10.1016/S0887-6185(01)00086-X

Deacon, B. J., Valentiner, D. P., Gutierrez, P. M., & Blacker, D. (2002). The Anxiety Sensitivity Index for Children: Factor structure and relation to panic symptoms in an adolescent sample. Behaviour Research and Therapy, 40(7), 839-852. doi:10.1016/S0005-7967(01)00076-6

Gutierrez, P. M., Osman, A., Barrios, F. X., Kopper, B. A., Baker, M. T., & Haraburda, C. M. (2002). Development of the Reasons for Living Inventory for Young Adults. Journal of Clinical Psychology, 58(4), 339-357. doi:10.1002/jclp.1147

Gutierrez, P. M., Osman, A., Barrios, F. X., & Kopper, B. A. (2001). Development and initial validation of the Self-Harm Behavior Questionnaire. Journal of Personality Assessment, 77(3), 475-490. doi:10.1207/S15327752JPA7703_08

Osman, A., Bagge, C. L., Gutierrez, P. M., Konick, L. C., Kopper, B. A., & Barrios, F. X. (2001). The Suicidal Behaviors Questionnaire - Revised (SBQ-R): Validation with clinical and non-clinical samples. Assessment, 8, 445-455. doi:10.1177/107319110100800409

Osman, A., Chiros, C. E., Gutierrez, P. M., Kopper, B. A., & Barrios, F. X. (2001). Factor structure and psychometric properties of the Brief Mizes Anorectic Cognitions Questionnaire. Journal of Clinical Psychology, 57(6), 785-799. doi:10.1002/jclp.1049

Osman, A., Gutierrez, P. M., Downs, W. R., Kopper, B. A., Barrios, F. X., & Haraburda, C. M. (2001). Development and psychometric properties of the Student Worry Questionnaire-30. Psychological Reports, 88, 277-290. doi:10.2466/PR0.88.1.277-290

Gutierrez, P. M., Rodriguez, P. J., & Garcia, P. (2001). Suicide risk factors for young adults: Testing a model across ethnicities. Death Studies, 25(4), 319-340. doi:10.1080/07481180151143088

Osman, A., Gilpin, A. R., Panak, W. F., Kopper, B. A., Barrios, F. X., Gutierrez, P. M., & Chiros, C. E. (2000). The Multi-Attitude Suicide Tendency Scale: Further validation with adolescent psychiatric inpatients. Suicide and Life-Threatening Behavior, 30(4), 377-385.

Gutierrez, P. M., Thakkar, R. R., & Kuczen, C. L. (2000). Exploration of the relationship between physical and/or sexual abuse, attitudes about life and death, and suicidal ideation in young women. Death Studies, 24(8), 675-688. doi:10.1080/07481180151143088

Thakkar, R. R., Gutierrez, P. M., Kuczen, C. L., & McCanne, T. R. (2000). History of physical and/or sexual abuse and current suicidality in college women. Child Abuse & Neglect, 24(10), 1345-1354. doi:10.1016/S0145-2134(00)00187-3

Gutierrez, P. M., Osman, A., Kopper, B. A., Barrios, F. X., & Bagge, C. L. (2000). Suicide risk assessment in a college student population. Journal of Counseling Psychology, 47(4), 403-413. doi:10.1037//0022-0167.47.4.403

McGrath, P. B., Gutierrez, P. M., & Valadez, I. M. (2000). Introduction of the College Student Social Support Scale (CSSSS): Factor structure and reliability assessment. Journal of College Student Development, 41(4), 415-426.

Osman, A., Barrios, F. X., Gutierrez, P. M., Kopper, B. A., Merrifield, T., & Grittmann, L. (2000). The Pain Catastrophizing Scale: Further psychometric evaluation with adult samples. Journal of Behavioral Medicine, 23, 351-365.

Gutierrez, P. M., Osman, A., Kopper, B. A., & Barrios, F. X. (2000). Why young people do not kill themselves: The Reasons for Living Inventory for Adolescents. Journal of Clinical Child Psychology, 29(2), 177-187. doi:10.1207/S15374424jccp2902_4

Gutierrez, P. M. (1999). Suicidality in parentally bereaved adolescents. Death Studies, 23(4), 359-370. doi:10.1080/074811899201000

Osman, A., Kopper, B. A., Linehan, M. M., Barrios, F. X., Gutierrez, P. M., & Bagge, C. L. (1999). Validation of the Adult Suicidal Ideation Questionnaire and the Reasons for Living Inventory in an adult psychiatric inpatient sample. Psychological Assessment, 11(2), 115-123. doi:10.1037//1040-3590.11.2.115

Osman, A., Gutierrez, P. M., Barrios, F. X., Kopper, B. A., & Chiros, C. E. (1998). The Social Phobia and Social Interaction Anxiety Scales: Evaluation of psychometric properties. Journal of Psychopathology and Behavioral Assessment, 20(3), 249-264. doi: 10.1023/A:1023067302227

Osman, A., Gutierrez, P. M., Kopper, B. A., Barrios, F. X., & Chiros, C. E. (1998). The Positive and Negative Suicide Ideation Scale: Development and validation. Psychological Reports, 28, 783-793.

Gutierrez, P. M., & Silk, K. R. (1998). Prescription privileges for psychologists: A review of the psychological literature. Professional Psychology: Research and Practice, 29(3), 213-222. doi:10.1037//0735-7028.29.3.213

Hagstrom, A. H., & Gutierrez, P. M. (1998). Confirmatory factor analysis of the Multi-Attitude Suicide Tendency Scale. Journal of Psychopathology and Behavioral Assessment, 20(2), 173-186.

Osman, A., Downs, W. R., Barrios, F. X., Kopper, B. A., Gutierrez, P. M., & Chiros, C. E. (1997). Factor structure and psychometric characteristics of the Beck Depression Inventory-II. Journal of Psychopathology and Behavioral Assessment, 19(4), 359-376. doi:10.1007/BF02229026

Gutierrez, P., King, C. A., & Ghazziudin, N. (1996). Adolescent attitudes about death in relation to suicidality. Suicide and Life-Threatening Behavior, 26(1), 8-18.

BOOK/CHAPTERS (9):

Gutierrez, P. M., & Hanson, J. E. (2018). Suicide. In E. L. Weiss & C. A. Castro (Eds.), American Military Life in the 21st Century: Social, Cultural, and Economic Issues and Trends (pp. 244-254). Santa Barbara, CA: ABC-CLIO.

Jobes, D. A., Comtois, K. A., Brenner, L. A., Gutierrez, P. M., & O'Connor, S. S. (2016). Lessons learned from clinical trials of the Collaborative Assessment and Management of Suicidality (CAMS). In R. O'Connor, S. Platt, & J. Gordon (Eds.), International handbook of suicide prevention: Research, policy, and practice, 2nd Edition (pp. 431-449). West Sussex, UK: Wiley-Blackwell.

Gutierrez, P. M., Brenner, L. A., Wortzel, H., Harwood, J. E. F., Leitner, R., Rings, J., & Bartlett, S. (2012). Blister packaging medication to increase treatment adherence and clinical response: Impact on suicide-related morbidity and mortality. In J. E. Lavigne (Ed.), Frontiers in suicide risk: Research, Treatment and Prevention. Hauppauge, NY: Nova Science Publishers, Inc.

Brenner, L. A., Gutierrez, P. M., Huggins, J., & Olson-Madden, J. (2011). Suicide and traumatic brain injury. In A. L. Berman & M. Pompili (Eds.), Medical conditions associated with suicide risk (pp. 299-307). Washington, DC: American Association of Suicidology.

Osman, A., Freedenthal, S., Fang, Q., Willis, J., Norizuki, T., & Gutierrez, P. M. (2011). The UTSA Future Disposition Inventory: Further analyses of reliability, validity, and potential correlates in non-clinical samples. In A. M. Columbus (Ed.), Advances in Psychology Research, Volume 85 (pp. 51-70). New York, NY: Nova Science Publishers.

Gutierrez, P. M., & Brenner, L. A. (2011). Highlight section: Helping military personnel/Veterans and families manage stress reactions and navigate reintegration. In A. J. Palmo, W. J. Weikel, & D. P. Borsos (Eds.), Foundations of mental health counseling, 4th Edition. Springfield, IL: Charles C. Thomas Publisher, Inc.

Gutierrez, P. M. (2011). The accidental suicidologist. In M. Pompili (Ed.), Suicide in the words of suicidologists. Hauppauge, NY: Nova Science Publishers, Inc.

Jobes, D. A., Comtois, K. A., Brenner, L. A., & Gutierrez, P. M. (2011). Clinical trial feasibility studies of the Collaborative Assessment and Management of Suicidality (CAMS). In R. O'Connor, S. Platt, & J. Gordon (Eds.), International handbook of suicide prevention: Research, policy, and practice. (pp. 383-400). West Sussex, UK: Wiley-Blackwell.

Gutierrez, P. M., & Osman, A. (2008). Adolescent suicide: An integrated approach to assessment of risk and protective factors. DeKalb, IL: Northern Illinois University Press.

PAPER PRESENTATIONS (99):

Gutierrez, P. M. & Joiner, T. E. (2019, September). Psychometric Properties of Suicide-Specific Measures and Their Clinical Utility. Implications for U.S. Military Treatment Facilities. Presented at the 30th World Congress of the International Association for Suicide Prevention, Derry-Londonderry, UK.

Joiner, T. E. & Gutierrez, P. M. (2019, September). Prediction of Suicide Ideation and Attempts in High Risk U.S. Military Service Members. Presented at the 30th World Congress of the International Association for Suicide Prevention, Derry-Londonderry, UK.

Gutierrez, P. M., O'Connor, S. S., Johnson, L. L., Hagman, S. H., Podlogar, M. C., & Jobes, D. A. (2019, August). Suicide-Specific Group Therapy for Veterans: Development and testing of CAMS-G. Presented at the VA/DOD Suicide Prevention Conference, Nashville, TN.

Gutierrez, P. M. (2019, August). Measurement of Suicide Outcomes in Clinical Research: Psychometric Properties of the Columbia Suicide Severity Rating Scale. Presented at the VA/DOD Suicide Prevention Conference, Nashville, TN.

Gutierrez, P. M. & Joiner, T. E. (2019, August). MSRC High-Impact Findings: An overview of 6 studies. Presented at the meeting of the Military Health System Research Symposium, Kissimmee, FL.

Gai, A. R., Gutierrez, P. M., & Joiner, T. E. (2019, August). Separation from Active Duty Service and Suicidality: Inaccurate Affective Forecasting? Presented at the meeting of the Military Health System Research Symposium, Kissimmee, FL.

Gutierrez, P. M. (2019, May). How narrative informs risk assessment and treatment planning. Presented at Aeschi 10, Vail, CO.

Witte, T., Stanley, I. H., Gutierrez, P. M., Anestis, M. D., & Ribeiro, J. (2019, April). Advancements in means safety for suicide prevention: Novel populations and approaches to messaging. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Gutierrez, P. M., O'Connor, S., Johnson, L. L., Jobes, D. A. (2019, April). Mental health services research to inform suicide prevention strategies in Veterans Affairs. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Buchman-Schmitt, J., Stanley, I. H., Chu, C., Gutierrez, P. M., Joiner, T., Hanson, J. E., & Gallyer, A. J. (2019, April). Military Suicide Research Consortium common data elements: Bifactor analysis and longitudinal predictive ability of suicide-related outcomes within a clinical sample. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Hom, M. A., Stanley, I. H., Duffy, M. E., Rogers, M. L., Hanson, J. E., Gutierrez, P. M., & Joiner T. E. (2019, April). Investigating patterns in the reporting of suicide attempt history across measures: A study of high-risk U.S. military service members. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Gutierrez, P. M., Joiner, T. E., & Hanson, J. E. (2019, April). Evidence-based suicide assessment in the U.S. Military. Presented at the Shoresh Meeting on Military Medicine, Tel Aviv, Israel.

Gutierrez, P. M., & Shelef, L. (2019, April). Evidence-based suicide assessment in the IDF. Presented at the Shoresh Meeting on Military Medicine, Tel Aviv, Israel.

Gutierrez, P. M., Joiner, T. E., & Hanson, J. E. (2018, September). Evidence-based suicide assessment. Presented at the European Symposium on Suicide & Suicidal Behavior, Ghent, Belgium.

Gutierrez, P. M., Joiner, T. E., & Buchman-Schmitt, J. (2018, August). Predicting suicidal ideation and behaviors with brief assessment protocols. Presented at the Military Health System Research Symposium, Kissimmee, FL.

Joiner, T. E., Gutierrez, P. M., Stanley, I. H., & Hom, M. A. (2018, August). A prospective investigation of factors associated with suicidal ideation severity and new-onset suicide attempts among high-risk U.S. military service members. Presented at the Military Health System Research Symposium, Kissimmee, FL.

Gutierrez, P. M., Hanson, J., & Joiner, T. (2018, April). Suicide assessment for military service members: And maybe everyone else? Presented at the 51st Annual Conference of the American Association of Suicidology, Washington, DC.

Poindexter, E., King, C. A., & Gutierrez, P. M. (2018, April). Psychotherapy strategies to target perceived burden on others and suicide risk. Presented at the 51st Annual Conference of the American Association of Suicidology, Washington, DC.

Comtois, K. A., Carter, G., Gutierrez, P. M., & Jobes, D. A. (2018, April). Suicide risk assessment: Should we do it? Why should we do it? What should we do? Presented at the 51st Annual Conference of the American Association of Suicidology, Washington, DC.

Gutierrez, P. M. & Joiner, T. (2017, November). The Military Suicide Research Consortium common data elements: Psychometric support, clinical, and research utility. Presented at the International Academy of Suicide Research meeting, Las Vegas, NV.

Joiner, T. & Gutierrez, P. M. (2017, November). The Military Suicide Research Consortium Common Data Elements: An examination of measurement invariance across enlisted service members, younger veterans, and older veterans. Presented at the International Academy of Suicide Research meeting, Las Vegas, NV.

Joiner, T. & Gutierrez, P. M. (2017, August). The Military Suicide Research Consortium common data elements: Measurement invariance across enlisted service members, younger veterans, and older veterans. Presented at the Military Health System Research Symposium, Kissimmee, FL.

Berman, L., McIntosh, J., Campbell, F., King, C., Jobes, D., Eastgard, S., Mazza, J., Gutierrez, P., Schmitz, B., & Miller D. (2017, April). AAS past presidents panel: Perspectives on the field and AAS at 50 years. Presented at the 50th Annual Conference of the American Association of Suicidology, Phoenix, AZ.

Fiske, A., Gutierrez, P., Nadorff, M., Muehlenkamp, J., & Anestis, M. (2017, April). An illustration of how student mentorship has progressed: Important research questions over the 50 years of Suicidology. Presented at the 50th Annual Conference of the American Association of Suicidology, Phoenix, AZ.

Drapeau, C. W., Muehlenkamp, J. J., Quinn-Lee, L., Cross, W., Quinnett, P. G., & Gutierrez, P. M. (2017, April). Innovating gatekeeper trainings: Incorporating per educators, postvention and cultural competencies, active learning strategies, and novel evaluative methods. Presented at the 50th Annual Conference of the American Association of Suicidology, Phoenix, AZ.

Chen, J. I., Gutierrez, P. M., Bahraini, N. (2017, April). Facilitators and barriers to use of standardized suicide risk assessment tools among veteran-serving clinicians. Presented at the 50th Annual Conference of the American Association of Suicidology, Phoenix, AZ.

Corona, C. D., Gutierrez, P. M., Wagner, B. M., & Jobes, D. A. (2017, April). Assessing the reliability of the CAMS rating scale using a generalizability study. Presented at the 50th Annual Conference of the American Association of Suicidology, Phoenix, AZ.

Gutierrez, P. M., & Joiner, T. (2017, April). The Military Suicide Research Consortium (MSRC): Overview, accomplishments and recommendations for implementation in other nations. Presented at the NATO HFM-275 Symposium on Military Suicide Prevention, Riga, Latvia.

Gutierrez, P. M., & Shelef, L. (2017, March). Predictive validity of suicide-specific measures. Presented at the 2017 Shoresh Conference on Military Medicine, Rockville, MD.

Gutierrez, P. M., & Joiner, T. (2016, August). The Military Suicide Research Consortium Common Data Elements: Psychometric Support, Clinical, and Research Utility. Presented at the Military Health System Research Symposium, Kissimmee, FL.

Gutierrez, P. M. (2016, April). The Interpersonal Needs Questionnaire and Acquired Capability for Suicide Scale: Valid and Reliable Measures for use with Veterans. In M. VanSickle (Chair), Measures. Presented at the 49th Annual Conference of the American Association of Suicidology, Chicago, IL.

O'Connor, S. S., Jobes, D. A., Gutierrez, P. M., Johnson, L. L., Jennings, K. A., & Carney, E. (2016, April). Applying Mediational and Qualitative Methods to Advance our Understanding of Suicidal ideation in Distinct Clinical Populations. Presented at the 49th Annual American Association of Suicidology conference, Chicago, IL.

Gutierrez, P. M., Pease, J., Matarazzo, B., Monteith, L., & Hernandez, T. How well do the Interpersonal Needs Questionnaire and the Acquired Capability for Suicide Scales work for military veterans? Presented at the IASR/AFSP International Summit on Suicide Research, New York, NY, October 14, 2015.

Villatte, J. L., O'Connor, S., Leitner, R., Kerbrat, A. H., Johnson, L. A., & Gutierrez, P. M. Differences in Risk Factors and Characteristics of Suicide Attempts between Active Duty Military Personnel and Veterans. Presented at the IASR/AFSP International Summit on Suicide Research, New York, NY, October 12, 2015.

Gutierrez, P. M., & Joiner, T. The Military Suicide Research Consortium: Clinical trials reducing suicide risk and increasing resilience. Presented at the Military Health Systems Research Symposium, Fort Lauderdale, FL, August 19, 2015.

Gutierrez, P. M. Advances in understanding suicide in the US military. Presented at the International Association for Suicide Prevention conference, Montreal, QC, Canada, June 18, 2015.

Cornette, M., Wintersteen, M., Gutierrez, P. M., Reidenberg, D., & McKeon, R. Youth warning signs for suicide: Results of a national expert consensus panel. Presented at the American Association of Suicidology annual conference, Atlanta, GA, April 17, 2015.

Crowley, K. J., Tucker, R., Davidson, C., & Gutierrez, P. M. Connecting over what "drives" suicide: Defining suicide-specific drivers and their utility for clinical risk. Presented at the American Association of Suicidology annual conference, Atlanta, GA, April 17, 2015.

Anestis, M., Bradley, B., Cornette, M., Denneson, L., & Gutierrez, P. M. On the front lines of military suicidology. Presented at the American Association of Suicidology annual conference, Atlanta, GA, April 17, 2015.

Crowley, K. J., Ballard, E., Tucker, R., Davidson, C., May, A. E., Klonsky, E. D., & Gutierrez, P. M. Improving imminent risk assessment: Conceptual and empirical considerations. Presented at the American Association of Suicidology annual conference, Atlanta, GA, April 16, 2015.

Gutierrez, P. M., & Shelef, L. (2015, March). Predictive Validity of Suicide-specific Measures. Shoresh military medicine conference, Ramat Gan, Israel.

Gutierrez, P. M., & Joiner, T. (2015, March). Military Suicide Research Consortium Treatment Studies. Shoresh military medicine conference, Ramat Gan, Israel.

Gutierrez, P. M. Veteran suicide risk assessment. Grand Rounds presentation at the University of Mississippi Medical Center, Department of Psychiatry and Human Behavior, Jackson, MS, September 5, 2014.

Gutierrez, P. M. Veteran suicide risk assessment. Presented at the American Psychological Association convention, Washington, DC, August 8, 2014.

Gutierrez, P. M. Is alcohol use really a direct risk factor for suicide? Presented at the Show Me You Care About Suicide Prevention Conference, Jefferson City, MO, July 15, 2014.

Gutierrez, P. M. Providing for our youngest Veterans: Similarities and Differences in College Student and Veteran Suicide Prevention Efforts. Presented at the Preventing Suicide Among Youth and Young Adults conference, Springfield, IL, April 25, 2014.

Chesin, M. S., Hughes, J., Andover, P., & Gutierrez, P. M. Developing and testing three novel adjunctive psychosocial interventions to prevent suicide and non-suicidal self-injury: An overview of the interventions, lessons learned, and preliminary outcomes. Presented at the American Association of Suicidology conference, Los Angeles, CA, April 10, 2014.

O'Connor, S. S., Villatte, J., & Gutierrez, P. M. Differences in characteristics of suicide attempts between active duty military personnel and veterans. Presented at the American Association of Suicidology conference, Los Angeles, CA, April 11, 2014.

Gutierrez, P.M. Toward a gold standard for suicide risk assessment for military personnel. Presented at the International Association for Suicide Prevention Congress, Oslo, Norway, September 27, 2013.

Gutierrez, P. M., Joiner, T., Blatt, A., & Castro, C. United States military suicide prevention research: Navigating challenges and capitalizing on opportunities. Presented at the International Academy of Suicide Research World Congress on Suicide, Montreal, Quebec, Canada, June 12, 2013.

Goodman, M., Gutierrez, P. M., Bossarte, R., Rasmusson, A. M., Brenner, L., & Stanley. B. Research updates and new directions for suicide prevention in the Veterans Administration. Discussant for symposium presented at the American Psychiatric Association annual meeting, San Francisco, CA, May, 19, 2013.

Gutierrez, P. M. Alcohol and suicide: A deadly cocktail or misinterpretation of data? Plenary address presented at the American Association of Suicidology conference, Austin, TX, April 26, 2013.

Gutierrez, P. M., Joiner, T., & Castro, C. Preventing suicide in the United States military: Research challenges and opportunities. Presented at the 14th European Symposium of Suicide & Suicidal Behavior, Tel Aviv-Jaffa, Israel, September 5, 2012.

Gutierrez, P. M., Castro, C., Fitek, D. J., Holloway, M., & Jobes, D. A. Status of DoD funded suicide research. Presented at the Annual DoD/VA Suicide Prevention Conference, Washington, DC, June 20, 2012.

Matarazzo, B., Gutierrez, P. M., & Silverman, M. M. The Self-Directed Violence Classification System: What it is and why it matters. Presented at the Annual DoD/VA Suicide Prevention Conference, Washington, DC, June 20, 2012.

Gutierrez, P. M., Fitek, D. J., Joiner, T., Holloway, M., Jobes, D., & Rudd, M. D. Status of Department of Defense funded suicide research. Featured Panel presentation at the American Association of Suicidology conference, Baltimore, MD, April 20, 2012.

Gutierrez, P. M. Navigating IRBs as a suicide researcher. Presented at the American Association of Suicidology conference, Baltimore, MD, April 19, 2012.

Kemp, J., Thompson, C., Brown, G. K., Brenner, L. A., & Gutierrez, P. M. VA continuum of care for suicidal Veterans. Panel presentation at the American Association of Suicidology conference, Portland, OR, April 16, 2011.

Gutierrez, P. M., & Lineberry, T. United States Army Medical Research and Materiel Command United States military suicide research: Activities and opportunities. Panel presentation at the American Association of Suicidology conference, Portland, OR, April 14, 2011.

Bahraini, N., Gutierrez, P. M., Brenner, L. A., Hedegaard, H., & Huggins, J. The Colorado Violent Death Reporting System (COVDRS): Exploring factors associated with suicide in VA and non-VA services utilizing Veterans. Presented at the American Association of Suicidology conference, Portland, OR, April 14, 2011.

Marshall, J., Gutierrez, P. M., Lineberry, T., & Jobes, D. United States Army Medical Research and Material Command United States military suicide research activities: Activities and opportunities. Panel presentation at the DOD/VA Annual Suicide Prevention Conference, Boston, MA, March 15, 2011.

Gutierrez, P. M., Bahraini, N., Basham, C. M., Brenner, L. A., Hedegaard, H., Denneson, L. M., & Dobscha, S. K. Lessons learned about veteran suicide from the Colorado and Oregon Violent Death Reporting Systems. Presented at the American Association of Suicidology conference, Orlando, FL, April 22, 2010.

Gutierrez, P. M. Blister packaging medication to increase treatment adherence and clinical response: Impact on suicide related morbidity and mortality. Presented at the 2010 DoD/VA Suicide Prevention Conference, Washington, DC, January 12, 2010.

Gutierrez, P. M. Theater of War. Plenary Panel member at the 2010 DoD/VA Suicide Prevention Conference, Washington, DC, January 12, 2010.

Bahraini, N., Gutierrez, P. M., Brenner, L. A., Hedegaard, H., Chase, M., & Shupe, A. The Colorado violent death reporting system: Exploring factors associated with suicide in VA and non-VA services utilizing veterans. Presented at the Centers for Disease Control and Prevention's NVDRS Reverse Site Visit, Denver, CO, May 14, 2009.

Leach, R. L., Breshears, R. E., Brenner, L. A., Homaifar, B. Y., Gutierrez, P. M., Gorgens, K. M., & Harwood, J. E. F. The utility of the Personality Assessment Inventory for predicting violence in veterans with traumatic brain injury. Presented at the Rehabilitation Psychology Conference, Jacksonville, FL, February 27, 2009.

Gutierrez, P. M. Collaborative assessment and management of suicide (CAMS): A feasibility study. DoD/VA Annual Suicide Prevention Conference, San Antonio, TX, January 13, 2009.

Gutierrez, P. M., Brenner, L. A., Homaifar, B. Y., & Olson-Madden, J. H. VA VISN 19 MIRECC research and clinical efforts at suicide prevention. Symposium presented at the American Psychological Association convention, Boston, MA, August 15, 2008.

Brausch, A. M., & Gutierrez, P. M. Body image and disordered eating in adolescent suicidality. Presented at the American Association of Suicidology conference, Boston, MA, April 17, 2008.

Gutierrez, P. M. Redefining diversity: The chronically suicidal veteran as one example. Presidential address at the American Association of Suicidology conference, Boston, MA, April 17, 2008.

Breshears, R. E., Brenner, L. A., & Gutierrez P. M. Predictive validity of the Personality Assessment Inventory in veterans with traumatic brain injury. Presented at the Rehabilitation Psychology Conference, Tucson, AZ, March 13, 2008.

King, C. A., Gutierrez, P. M., & Jobes, D. A. Looking back – looking ahead: American suicidology at mid-life. Plenary panel presentation at the American Association of Suicidology conference, New Orleans, LA, April 12, 2007.

Mazza, J. J., Reynolds, W. M., & Gutierrez, P. M. Screening for youth suicidal behavior revisited. Panel presentation at the American Association of Suicidology conference, New Orleans, LA, April 12, 2007.

Schumacher, M., Quinnett, P., & Gutierrez, P. M. QPRT suicide risk assessment and management course utility. Panel presentation at the American Association of Suicidology conference, New Orleans, LA, April 12, 2007.

Gutierrez, P. M. Change is good: What the past 40 years tell us about the future. Presidential address at the American Association of Suicidology conference, New Orleans, LA, April 12, 2007.

Gutierrez, P. M. Suicide in the young adult population. Presented at the Department of Veterans Affairs Employee Education System's Evidence-Based Interventions for Suicidal Persons conference, Denver, CO, February 8, 2007.

Rudd, M. D., Berman, L., Silverman, M. M., Gutierrez, P. M., & Schumacher, M. Warning signs for suicide: Theory, research, and clinical applications. Panel presented at the American Association of Suicidology conference, Seattle, WA, April 30, 2006.

Freedenthal, S. L., & Gutierrez, P. M. Adolescents' disclosures of suicidality: Who knows? Presented at the American Association of Suicidology conference, Seattle, WA, April 30, 2006.

Gutierrez, P. M. Shneidman Award Presentation – An integrated approach to assessing risk and protective factors for adolescent suicide. Presented at the American Association of Suicidology conference, Broomfield, CO, April 15, 2005.

Schumacher, M., & Gutierrez, P. M. Bipolar spectrum traits and suicide risk. Presented at the American Association of Suicidology conference, Broomfield, CO, April 15, 2005.

Gutierrez, P. M., & Osman, A. Prediction of adolescent suicide reattempts. Presented at the Kansas Conference in Clinical Child and Adolescent Psychology, Lawrence, KS, October 22, 2004.

Gutierrez, P. M., & Konick, L. C. Evaluation of school-based suicide prevention programs. Presented at the Suicide Prevention: Advancing the Illinois Strategic Plan conference, Springfield, IL, September 23, 2004.

Williams, J. E., Osman, A., Barrios, F., Kopper, B. A., & Gutierrez, P. M. Reliability and validity of the Inventory for Suicide Ideation – 30. Presented at the American Psychological Society conference, Chicago, IL, May 28, 2004.

Hovey, J. D., Freedenthal, S., Gutierrez, P. M., & Fernquist, R. Career development strategies in suicide research #1: Working with a mentor. Panel presented at the American Association of Suicidology conference, Miami, FL, April 15, 2004.

Conwell, Y., Silverman, M., Gutierrez, P. M., Konick, L. C., & Muehlenkamp, J. J. Career development strategies in suicide research #3: Publishing your findings. Workshop presented at the American Association of Suicidology conference, Miami, FL, April 16, 2004.

Konick, L. C., & Gutierrez, P. M. Suicide risk in college students: A test of a model. Presented at the 2004 American Association of Suicidology conference, Miami, FL, April 16, 2004.

Brausch, A. M., & Gutierrez, P. M. Does this magazine make me look fat? Media's impact on body image, depression, and eating. Presented at the Midwestern Psychological Association Conference, Chicago, IL, May 1, 2004.

Muehlenkamp, J. J., Swanson, J., & Gutierrez, P. M. Differences between self-injury and suicide on measures of depression and suicidal ideation. Presented at the Midwestern Psychological Association annual meeting, Chicago, IL, May 9, 2003.

Kaplan, M., Schultz, D., Gutierrez, P. M., Sanddal, N., & Fernquist, N. Suicide research: Working with a mentor. Panel presentation at the American Association of Suicidology annual conference, Santa Fe, NM, April 24, 2003.

Konick, L. C., & Gutierrez, P. M. Is spirituality a moderator of risk for suicide? Presented at the American Association of Suicidology annual conference, Santa Fe, NM, April 25, 2003.

Watkins, R. L., & Gutierrez, P. M. Exposure to peer suicide in college students. Presented at the American Association of Suicidology annual conference, Santa Fe, NM, April 25, 2003.

Gutierrez, P. M., Osman, A., Watkins, R. L., Konick, L. C., Muehlenkamp, J. J., & Brausch, A. M. Development and validation of the Suicide Resilience Inventory - 25 (SRI-25) in clinical and nonclinical samples. Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October, 19, 2002.

Konick, L. C., Brausch, A. M., Gutierrez, P. M., & Pawlowski, C. CBT in depressed kids: What factors moderate treatment effectiveness? Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October, 19, 2002.

Hovey, J. D., Gutierrez, P. M., & Jha, A. Measuring cultural risk factors in suicide research. Panel presented at the American Association of Suicidology annual conference, Atlanta, GA, April 19, 2001.

Gutierrez, P. M., Osman, A., Barrios, F. X., & Kopper, B. A. The Self-Harm Behavior Questionnaire. Presented at the American Association of Suicidology annual conference, Atlanta, GA, April 21, 2001.

Gutierrez, P. M., Collura, D., & Watkins, R. A case for regular suicide risk screening in high schools. Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October 14, 2000.

Osman, A., Gutierrez, P. M., Kopper, B. A., Barrios, F. X., Breitenstein, J. L., & Silich, N. Validity and utility of the Adolescent Psychopathology Scale (APS) with adolescent psychiatric inpatients. Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October 13, 2000.

Kopper, B. A., Gutierrez, P. M., Osman, A., & Barrios, F. X. Helping kids stay alive: The Reasons for Living Inventory - Adolescents. Presented at Western Psychological Association Annual Convention, Portland, OR, April 14, 2000.

Gutierrez, P. M., Rodriguez, P. J., & Foat, N. K. A model of late adolescent suicidality. Presented at the American Association of Suicidology annual conference, Houston, TX, April 15, 1999.

Gutierrez, P. M., Osman, A., Kopper, B. A., & Barrios, F. X. Quality of risk assessment with common measures. Presented at the American Association of Suicidology annual conference, Bethesda, MD, April 18, 1998.

POSTER PRESENTATIONS (69):

Gutierrez, P. M., Hindman, J., Brummett, S., Reed, J., & Gallanos, J. (2019, October). Public-Private Partnerships to Combat Suicide: The Colorado National Collaborative and Governor's Challenge to Prevent Suicide Among Service Members, Veterans, and their Families. Presented at the IASR/AFSP International Summit on Suicide Research, Miami Beach, FL.

Chen, J. I., Osman, A., Freedenthal, S. L., & Gutierrez, P. M. (2019, October). Examining the properties of the Reasons for Living Inventory within a veteran clinical sample. Presented at the IASR/AFSP International Summit on Suicide Research, Miami Beach, FL.

Fajardo, C. L., & Gutierrez, P. M. (2019, August). Re-evaluating low mood and self-perception as correlates of Veteran suicide. Presented at the VA/DOD Suicide Prevention Conference, Nashville, TN.

Stanley, I. H., Day, T. N., Gallyer, A. J., Shelef, L., Kalla, C., Gutierrez, P. M., & Joiner, T. E. (2019, August). Examining the influence of autism symptoms and unit cohesion on suicide risk among military personnel. Presented at the meeting of the Military Health System Research Symposium, Kissimmee, FL.

Soberay, K. A., Hanson, J. E., & Gutierrez, P. M. (2019, April). Health service utilization among service members at-risk for suicide. Presented at the 52nd Annual Meeting of the American Association of Suicidology, Denver, CO.

Stanley, I. H., Rogers, M. L., Hanson, J. E., Gutierrez, P. M., & Joiner, T. E. (2018, November). PTSD symptom clusters and suicidal behaviors among high-risk military service members: A three-month prospective investigation. To be presented at the Association for Behavioral and Cognitive Therapies, Washington, DC.

Peterson, A., Cifu, D. X., Joiner, T. E., Williams, R. L., Keane, T., Hinds, S. R., Gutierrez, P. M., & Kosten, T. R. (2018, August). Leveraging the synergistic power of team science: Lessons learned from DoD-funded research consortia. Presented at the Military Health System Research Symposium, Kissimmee, FL.

Soberay, K. A., Hanson, J. E., & Gutierrez, P. M. (2017, July). Military suicide research presence and impact in policy documents captured by altmetrics. Presented at the VA/DOD Suicide Prevention conference, Denver, CO.

Soberay, K. A., Plant, E. A., Hanson, J. E., & Gutierrez, P. M. (2017, July). Traumatic brain injury, severe insomnia, and suicidal behaviors in active duty military. Presented at the VA/DOD Suicide Prevention conference, Denver, CO.

Lavigne, J. E., Walsh, P., Zhou, M., & Gutierrez P. (2017, July). Cost-utility of blister packaging versus dispensing as usual all medications for veterans with post-traumatic stress disorder, major affective disorder, bipolar affective disorder, and/or schizophrenia: Results from a pragmatic randomized trial. Presented at the VA/DOD Suicide Prevention conference, Denver, CO.

Lavine, J. E., Zhou, M., & Gutierrez, P. (2017, May). Cost-utility of blister versus bulk packaging all medications for veterans with post-traumatic stress disorder, bipolar affective disorder, major affective disorder or schizophrenia: Results of a pragmatic randomized trial. Presented at the 22nd annual meeting of the International Society for Pharmacoeconomics and Outcomes Research, Boston, MA.

Acosta, M., Osman, A., Gutierrez, P. M., Bagge, C. L., Freedenthal, S., Wong, J. L, & Pirani, S. (2016, May). The Multidimensional Revenge Attitudes Inventory: Validation of Scores on a New Measure of Revenge. Presented at the meeting of the Association for Psychological Science, Chicago, IL.

Hanson, J. E., Soberay, K., Dwyer, M., Gutierrez, P. M., & Plant, A. (2016, April). Understanding the Relationship of TBI, Severe Insomnia, and Suicidal Behaviors in Active Duty, Veteran, and Civilian Populations. Presented at the 49th Annual Conference of the American Association of Suicidology, Chicago, IL.

Soberay, K., Dwyer, M., Hanson, J. E., Spinks, J., Soberay, A., & Gutierrez, P. M. (2016, April). The Dissemination of Military Research Understood through Altmetrics. Presented at the 49th Annual Conference of the American Association of Suicidology, Chicago, IL.

Gutierrez, P. M., Brenner, L., Wortzel, H., Forster, J., & Leitner, R. Lessons learned about suicide prevention and patient safety from a medication packaging intervention. Presented at the IASR/AFSP International Summit on Suicide Research, New York, NY, October 13, 2015.

Morris, B., O'Connor, S., Johnson, L. L., Jobes, D. A., Gutierrez, P. M., & Kaminer, B. B. Examining group differences between suicidal veterans classified as wish to live, ambivalent, or wish to die using the suicide index score. Presented at the American Association of Suicidology conference, Los Angeles, CA, April 11, 2014.

Davidson, C. L., Babson, K. A., Hostetter, T. A., Crowley, K. J., Forster, J. F., Gutierrez, P. M.. Exploring the relationship between physical activity and suicide risk among Veterans in the Behavioral Risk Factor Surveillance System Questionnaire. Poster presented at the Suicide and Self-Injury Special Interest Group at the annual Association of Behavioral and Cognitive Therapies Conference, Nashville, TN, November 22, 2013.

Soberay, K., Dwyer, M., Hanson, J., Ribeiro, J., Gronau, K., Gutierrez, P. M., & Maner, J. Exploring the MSRC common data elements: The relationship between TBI, severe insomnia, and suicidal behaviors in military populations. Presented at the American Psychological Association conference, Honolulu, HI, August 1, 2013.

Pease, J., Soberay, K., Dwyer, M., Gronau, K., & Gutierrez, P. M. Thwarted belonging makes a modest contribution to suicidal ideation after controlling for universalism and relationships. Presented at the American Psychological Association conference, Honolulu, HI, August 1, 2013.

Leitner, R., Gutierrez, P. M., Brenner, L., Wortzel, H., Forster, J. E., & Huggins, J. Psychometric properties of the Self-harm Behavior Questionnaire in Veterans. Presented at the American Psychological Association conference, Honolulu, HI, July 31, 2013.

Dwyer, M. M., Soberay, K., Hanson, J., & Gutierrez, P. M. Military suicide research consortium (MSRC). Presented at the American Association of Suicidology conference, Austin, TX, April 26, 2013.

Rings, J. A., Gutierrez, P. M., Harwood, J. E. F., & Leitner, R. Examining prolonged grief symptomatology and its relationship to self-directed violence among Veterans. Presented at the Veterans Affairs Mental Health Conference. Baltimore, MD, August 23, 2011.

Rings, J. A., Gutierrez, P. M., & Harwood, J. E. F. Prolonged grief disorder and its relationship to self-directed violence among Veterans: Preliminary findings. Presented at the Departments of Defense and Veterans Affairs Suicide Prevention Conference. Boston, MA, March 15, 2011.

Huggins, J., Homaifar, B.Y., Skopp, N.A., Reger, M., Gahm, G., Gutierrez, P., & Brenner, L.A. Suicide prevention through the transformation of data into information. Presented at the Departments of Defense and Veterans Affairs Suicide Prevention Conference. Boston, MA, March 15, 2011.

Betthauser, L. M., Allen, E., Brenner, L. A., & Gutierrez, P. M. Centrality of intimate relationships on failed belongingness and perceived burdensomeness in returning combat Veterans. Presented at the International Association for Relationship Research, Lawrence, KS, November, 2009.

Bahraini, N., Gutierrez, P. M., Brenner, L. A., Huggins, J., Hedegaard, H., Shupe, A., & Chase, M. The Colorado violent death reporting system: Exploring factors associated with suicide in VA and non-VA services utilizing veterans. Presented at the American Psychological Association conference, Toronto, Ontario Canada, August 6, 2009.

Brausch, A. M., & Gutierrez, P. M. Psychosocial factors related to non-suicidal self-injury in adolescents. Presented at the American Association of Suicidology annual conference, San Francisco, CA, April 17, 2009.

Ballard, E. D., Jobes, D., Brenner, L., Gutierrez, P. M., Nagamoto, H., Kemp, J., et al. Qualitative suicide status form responses of suicidal veterans. Presented at the American Association of Suicidology conference, Boston, MA, April 18, 2008.

Bahraini, N., Gutierrez, P. M., Brenner, L. A., Staves, P., Cornette, M., & Betthauser, L. Pain tolerance and links to increased suicide risk. Presented at the American Association of Suicidology conference, Boston, MA, April 18, 2008.

Cornette, M. M., DeBoard, R. L., Clark, D. C., Holloway, R. H., Brenner, L., Gutierrez, P. M., & Joiner, T. E. Examination of an interpersonal-behavioural model of suicide: Toward greater specificity in suicide risk prediction. Presented at the International Association for Suicide Prevention conference, Dublin, Ireland, August 31, 2007.

Brenner, L. A., Gutierrez, P. M., Cornette, M., Staves, P. J., & Betthauser, L. M. Veterans' experiences of habituation to painful stimuli, perceived burdensomeness and failed belongingness. Presented at the American Psychological Association conference, San Francisco, CA, August 19, 2007.

Fang, Q., Choma, K., Salvatore, A., Mack, T., Bailey, J., & Gutierrez, P. M. Validation of the Pain Distress Inventory using an adolescent inpatient sample. Presented at the Kansas Conference in Clinical Child and Adolescent Psychology, Lawrence, KS, October 19, 2006.

Brausch, A. M., & Gutierrez, P. M. Adolescent gender differences in reasons for living. Poster presented at the American Association of Suicidology conference, Seattle, WA, April 30, 2006.

Swanson, J. D., & Gutierrez, P. M. Gender, social support, and student suicidality. Poster presented at the American Association of Suicidology conference, Seattle, WA, April 30, 2006.

Kopper, B. A., Osman, A., Gutierrez, P. M., Williams, J. E., & Barrios, F. X. Suicide Resilience Inventory-25: Validation with normal and adolescent psychiatric inpatients. Poster presented at the 2005 APA conference, Washington, DC.

Kopper, B. A., Osman, A., Barrios, F. X., Gutierrez, P. M., & Williams, J. E. The Beck Depression Inventory-II with nonclinical and inpatient adolescents. Poster presented at the 2005 APA conference, Washington, DC.

Brausch, A. M., & Gutierrez, P. M. Ethnic differences in body image, affect, and eating behaviors and the impact of media exposure. Presented at the Association for the Advancement of Behavior Therapy conference, New Orleans, LA, November 11, 2004.

Muehlenkamp, J. J., & Gutierrez, P. M. Validation of the Self-Harm Behavior Questionnaire in adolescents. Presented at the Association for the Advancement of Behavior Therapy conference, New Orleans, LA, November 11, 2004.

Linden, S., Osman, A., Barrios, F. X., Kopper, B. A., Williams, J. E., & Gutierrez, P. M. Structure of the Adolescent Psychopathology Scale (APS) clinical subscales in psychiatric inpatients. Presented at the Association for the Advancement of Behavior Therapy conference, New Orleans, LA, November 11, 2004.

Osman, A., Williams, J. E., Barrios, F. X., Kopper, B. A., Gutierrez, P. M., Linden, S. C., & Carlson, N. Development of cutoff scores for the Beck scales in adolescent psychiatric inpatients. Presented at the Kansas Conference in Clinical Child and Adolescent Psychology, Lawrence, KS, October 21, 2004.

Osman, A., Barrios, F. X., Gutierrez, P. M., Kopper, B. A., Williams, J. E., Carlson, N., & Koser, K. Reliability and validity of the Multidimensional Anxiety Scale for Children and the Children's Depression Inventory. Presented at the Kansas Conference in Clinical Child and Adolescent Psychology, Lawrence, KS, October 21, 2004.

Osman, A., Gutierrez, P. M., Barrios, F. X., Kopper, B. A., Linden, S. C., Carlson, N., & Koser, K. The Reynolds Adolescent Depression Scale 2: Reliability and validity. Presented at the Kansas Conference in Clinical Child and Adolescent Psychology, Lawrence, KS, October 21, 2004.

Muehlenkamp, J. J., & Gutierrez, P. M. Are self-injurious behaviors and suicide attempts different points on the same continuum? Presented at the Suicide Prevention: Advancing the Illinois Strategic Plan conference, Springfield, IL, September 23, 2004.

Brausch, A. M., Swanson, J., & Gutierrez, P. M. Parent marital status, depression and suicide. Presented at the American Association of Suicidology conference, Miami, FL, April 16, 2004.

Konick, L. C., Gutierrez, P. M., Muehlenkamp, J. J., Watkins, R. L., Ward, K. E., & Haase, K. Development of the Spiritual Attitudes and Beliefs Inventory: Phase II. Presented at the Midwestern Psychological Association annual meeting, Chicago, IL, May 8, 2003.

Konick, L. C., Gutierrez, P. M., & Watkins, R. L. Adult Suicidal Ideation Questionnaire psychometrics. Presented at the American Association of Suicidology annual conference, Santa Fe, NM, April 25, 2003.

Gutierrez, P. M., & Muehlenkamp, J. J. Understanding differences between self-injurious behavior and suicide attempts in high school students. Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October, 18, 2002.

Gutierrez, P. M., Osman, A., Brausch, A. M., Muehlenkamp, J. J., Watkins, R. L., & Konick, L. C. Reliability and validity of the Beck scales in the assessment of suicide-related behaviors in adolescent psychiatric inpatients. Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October, 18, 2002.

Gutierrez, P. M., Osman, A., Watkins, R. L., & Muehlenkamp, J. J. Potential racial differences in adolescent suicide risk. Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October, 18, 2002.

Osman, A., Gutierrez, P. M., Kopper, B, A., Barrios, F. X., Boyle, T., & Duncan, A. The Inventory of Suicide Orientation - 30: Further validation with adolescent inpatients. Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October, 18, 2002.

Osman, A., Linden, S., Gutierrez, P. M., Barrios, F. X., Kopper, B. A., & Forman, K. Validity of the Adolescent Psychopathology Content Scales (APS) in Pediatric Medical Institute for Children (PMIC) inpatients. Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October, 18, 2002.

Konick, L. C., Wrangham, J. J., Gutierrez, P. M., Blacker, D., Watkins, R. L., Aalders, G., Giannerini, J., Miller, M. J., Rapp, J. M., Shayne, L. E., & Ward, K. E. Development of the Spiritual Attitudes and Beliefs Inventory (SABI). Presented at the annual meeting of the Midwestern Psychological Association, Chicago, IL, May 2, 2002.

Gutierrez, P. M., Wrangham, J., Konick, L., Osman, A., & Barrios, F. X. Does ethnicity influence adolescent suicide risk? Presented at the American Association of Suicidology annual conference, Bethesda, MD, April 12, 2002.

Wrangham, J., Gutierrez, P. M., Osman, A., & Barrios, F. X. Validation of the PANSI with minority young adults. Presented at the American Association of Suicidology annual conference, Bethesda, MD, April 12, 2002.

Konick, L. C., Brandt, L. A., & Gutierrez, P. M. School-based suicide prevention programs: A meta-analysis. Presented at the American Association of Suicidology annual conference, Bethesda, MD, April 12, 2002.

Gutierrez, P. M., Osman, A., Kopper, B. A., & Barrios, F. X. Use of the Multi-Attitude Suicide Tendency Scale with minority individuals. Presented at the meeting of the Midwestern Psychological Association, Chicago, IL, May 4, 2001.

Valentiner, D., Gutierrez, P. M., Deacon, B., & Blacker, D. Factor structure and incremental validity of the Anxiety Sensitivity Index for Children in an adolescent sample. Presented at the annual meeting of the Society for Research in Child Development, Minneapolis, MN, April 21, 2001.

Gutierrez, P.M., Rodriguez, P. J., & Garcia, P. Minority suicide risk. Presented at the American Association of Suicidology annual conference, Los Angeles, CA, April 13, 2000.

Kopper, B. A., Gutierrez, P. M., Osman, A., Barrios, F. X., Baker, M. T., & Haraburda, C. M. Reasons for Living Inventory for Young Adults: Psychometric properties. Presented for

Division 17 - Counseling Psychology - at the annual convention of the American Psychological Association, Washington, DC, August 5, 2000.

Kopper, B. A., Gutierrez, P. M., Osman, A., Barrios, F. X., & Bagge, C. L. Assessment of suicidal ideation in college students. Presented for Division 17 - Counseling Psychology - at the annual convention of the American Psychological Association, Washington, DC, August 5, 2000.

Gutierrez, P. M., Rubin, E. C., & Blacker, D. A preliminary investigation of the role of suicide exposure and attitudes about death on adolescent suicidal ideation. Presented at the Midwestern Psychological Association annual conference, Chicago, IL, May 4, 2000.

Martin, H., & Gutierrez, P. M. The role of mediating factors on the long-term relationship between early parental death and later depression and anxiety. Presented at the Midwestern Psychological Association Annual Conference, Chicago, IL, May 4, 2000.

Kopper, B. A., Osman, A., Gilpin, A. R., Panak, W. F., Barrios, F. X., Gutierrez, P. M., & Chiros, C. E. The Multi-Attitude Suicide Tendency Scale: Further validation with adolescent psychiatric inpatients. Presented at the annual convention of the American Psychological Association, Boston, MA August 22, 1999.

Kopper, B. A., Osman, A., Linehan, M. M., Barrios, F. X., Gutierrez, P. M., & Bagge, C. L. Validation of the Adult Suicide Ideation Questionnaire and the Reasons for Living Inventory in an adult psychiatric inpatient sample. Presented at the annual convention of the American Psychological Association, Boston, MA August 22, 1999.

Osman, A., Bagge, C. L., Barrios, F. X., Gutierrez, P. M., & Kopper, B. A. Receiver operating characteristic curve analyses of the Beck Depression Inventory - II in adolescent psychiatric inpatients. Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October 9, 1998.

Osman, A., Bagge, C. L., Gutierrez, P. M., Kopper, B. A., & Barrios, F. X. Validation of the Reasons for Living Inventory for Adolescents (RFL-A) in a clinical sample. Presented at the Kansas Conference in Clinical Child Psychology, Lawrence, KS, October 9, 1998.

Kopper, B. A., Osman, A., Hoffman, J., Gutierrez, P. M., & Barrios, F. X. Reliability and validity of the BDI-II with inpatient psychiatric adolescents. Presented at Division 12 - Clinical Psychology - at the annual convention of the American Psychological Association, San Francisco, CA, August 16, 1998.

Gutierrez, P. M., & Hagstrom, A. H. Uses for the Multi-Attitude Suicide Tendency Scale. Presented at the American Association of Suicidology annual conference, Bethesda, MD, April 17, 1998.

Gutierrez, P., & Williams, J. Children’s understanding of death. Presented at the Midwestern Psychological Association annual meeting, Chicago, IL, May 3, 1991.

GRANTS:

Current

1/20-10/23 NIMH R01MH121478; Scientific Advisory Board member for Leveraging EHR Data to Evaluate Key Treatment Decisions to Prevent Suicide-Related Behaviors. Principal Investigator Ronald Kessler, MD.

3/19-3/21 Military Suicide Research Consortium; Co-Principal Investigator (Joiner Co-PI); $789,962 for Increasing Connection to Care Among Military Service Members at Elevated Suicide Risk: A Randomized Controlled Trial of a Web-Based Intervention.

3/16-3/21 Department of Defense, Military Operational Medicine Research Program; Principal Investigator: jointly with Thomas Joiner, Ph.D., Florida State University; $17,894,035.00 [additional $2,105,965.00 for option period years 3-5] for Military Suicide Research Consortium: Extension to New Opportunities and Challenges.

Completed

1/18-9/19 Military Suicide Research Consortium; Co-Investigator (Johnson, PI); $148,982 for Three Year Follow-up of Study on Suicide Risk Assessments within Suicide-Specific Group Therapy Treatment for Veterans.

1/16-5/17 Department of Defense, Defense Suicide Prevention Office; Military Advisory Board Member for Community Partners in Suicide Prevention. A grant given to the American Association of Suicidology, Principal Investigator Craig Bryan, PsyD.

3/11-3/17 Department of Defense, Military Operational Medicine Research Program; Co-Investigator; $3,400,000 for A Randomized Clinical Trial of the Collaborative Assessment and Management of Suicidality vs. Enhanced Care as Usual for Suicidal Soldiers.

7/12-9/16 Military Suicide Research Consortium; Principal Investigator; $2,381,228 for Toward a Gold Standard for Suicide Risk Assessment for Military Personnel.

9/10-9/16 Department of Defense, Military Operational Medicine Research Program, Principal Investigator: jointly with Thomas Joiner, Ph.D., Florida State University; $15,000,000 (additional $15,000,000 going to FSU) for Military Suicide Research Consortium.

10/12-9/15 Department of Veterans Affairs National Center for Patient Safety; Advisory Board member (PI Monica Matthieu, Ph.D., LCSW); $569,222 for Patient Safety Center of Inquiry for Suicide Prevention.

3/11-2/13 Department of Defense, Military Operational Medicine Research Program; Consultant (PI Steven Vannoy, Ph.D., MPH); $1,354,386 for Development and Validation of a Theory Based Screening Process for Suicide Risk.

9/09-9/14 Department of Defense, Military Operational Medicine Research Program; Principal Investigator; $1,173,408 for Blister Packaging Medication to Increase Treatment Adherence and Clinical Response: Impact on Suicide-related Morbidity and Mortality.

5/09-5/10 Colorado TBI Trust Fund Education grant; $8427 to support the hosting of a conference of national experts in suicide safety planning and TBI rehabilitation.

5/08-5/09 Colorado TBI Trust Fund Education grant; $5,000 to support the hosting of a conference of national experts in assessment of TBI and suicide risk and the role of executive dysfunction in linking the two problems.

HONORS AND AWARDS:

2018 Military Health System Research Symposium (MHSRS) Outstanding Research Accomplishment (Team/Academia) Award, jointly with Thomas Joiner, PhD.

2018 Charles C. Gersoni Military Psychology Award, jointly with Thomas Joiner, PhD, American Psychological Association, Division 19, Society for Military Psychology.

2014 Roger J. Tierney Award for Service, American Association of Suicidology.

2005 Shneidman Award for Significant Contributions to Suicide Research, American Association of Suicidology

2003 Outstanding Young Alumni, Winona State University

PROFESSIONAL SERVICE:

8/19-present Section member for the Prevention Intervention Section on the Research Strategies Line of Effort in support of the President's Roadmap to Empower Veterans and End a National Tragedy of Suicide (PREVENTS).

10/18-present Member Colorado Team for the Governor's Challenge to Prevent Suicide Among Service Members, Veterans, and their Families, Substance Abuse and Mental Health Services Administration.

2018 Centers for Disease Control and Prevention, National Center for Injury Prevention and Control Extramural Research Program Office, Special Emphasis Panel Member, Research Grants for the Primary or Secondary Prevention of Opioid Overdose (RFA-CE-18-006)

9/17-9/18 Member U.S. Air Force Suicide Prevention Solutions Working Group (AF SPSWG)

1/16-present Member Colorado Steering Team, Colorado-National Collaborative for Suicide Prevention, Colorado Office of Suicide Prevention, Colorado Office of Public Health and Environment

10/15-6/18 University of Colorado School of Medicine Faculty Promotions Committee

2015	Centers for Disease Control and Prevention, National Center for Injury Prevention and Control Extramural Research Program Office, Special Emphasis Panel Member, Evaluating Innovative and Promising Strategies to Prevent Suicide among Middle-Aged Men (RFA-CE-15-004)
6/14-8/14	Expert Adviser for the Royal Australian & New Zealand College of Psychiatrists Clinical Practice Guidelines Project on Deliberate Self-harm, Prof. Gregory Carter, Chair
1/12-10/15	Department of Psychiatry Faculty Promotions Committee
1/12-present	Editorial Board Member, Archives of Suicide Research, Barbara Stanley, Ph.D., Editor-in-Chief
4/09-present	Associate Editor, Suicide and Life-Threatening Behavior, Thomas Joiner, Ph.D., Editor-in-Chief.
4/09-4/11	Past-president, Board position, of the American Association of Suicidology.
3/09-12/09	U. S. Army Suicide Reduction and Prevention Research Strategic Planning Workgroup, Soldier Identification and Case Management Expert Lead.
5/07-10/08	Member of the International Advisory Board for the Australian National Study of Self Injury (ANESSI), Professor Graham Martin, Director.
4/07-4/09	President of the American Association of Suicidology.
3/06-3/07	Reviewer for National Registry of Evidence-based Programs and Practices, Substance Abuse and Mental Health Services Administration.
4/05-4/07	President-Elect of the American Association of Suicidology.
2/04-4/09	Consulting Editor and Editorial Board member, Suicide and Life-Threatening Behavior, Morton M. Silverman, M.D., Editor-in-Chief.
11/02-6/06	Member, Illinois Suicide Prevention Strategic Planning Task Force, Illinois Department of Public Health.
3/02-1/06	Member, American Association of Suicidology Institutional Review Board.
4/00-4/03	Director, Research Division, American Association of Suicidology.
4/99-present	Ad hoc reviewer for Psychiatry Research; Journal of Personality Assessment; American Journal of Public Health; Internal Journal of Circumpolar Health; Death Studies; Social Problems; Journal of Adolescent Research; Child Abuse and Neglect; British Journal of Clinical Psychology; Journal of Clinical and Consulting Psychology; Journal of Abnormal Psychology; International Journal of

Psychology; Archives of Suicide Research; American Journal of Orthopsychiatry; Journal of Mental Health Counseling; Crisis.

1998-2002 Member, North Central Association Outcomes Endorsement Team for Auburn High School, Rockford, IL.

7/98-4/00 Chair, Publications Committee, American Association of Suicidology.

1998-2006 Director, Adolescent Risk Project, Auburn High School, Rockford, IL. Combined research and suicide risk screening project.

1997-2006 Faculty Associate of the Center for Latino and Latin-American Studies at Northern Illinois University.

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS:

12/15-present Society for Implementation Research Collaboration, Founding Member

2010-present International Academy for Suicide Research, Fellow

2007-present Colorado Psychological Association

2003-2010 International Academy for Suicide Research, Associate Member

1999-2019 APA Div. 12, Section VII, Clinical Emergencies and Crises

1998-2010 APA Div. 53, Society of Clinical Child and Adolescent Psychology

1997-2007 Midwestern Psychological Association

1996-present American Association of Suicidology

A2. Efficacy of a Computerized Cognitive Behavioral Treatment for Insomnia: Increasing Access to Insomnia Treatment to Decrease Suicide Risk
PI: Sarra Nazem, PhD

Summary of Progress: In the final quarter of the third year, we continued collecting 12-month follow-up assessment data. We have collected 12-month follow-up assessment data from 156 participants.

Regulatory:

Initial IRB approval date: October 3, 2017

Initial HRPO approval date: December 8, 2017

Continuing Review Approval Date: August 12, 2019

HRPO Continuing Review Acknowledgement: September 24, 2019

Recruitment:

Final enrollment: 226

Recruitment start date: March 26, 2018

Projected quarterly enrollment: Enrollment complete

Subjects assessed for eligibility this quarter: 0

Number excluded: 0
Did not meet inclusion/exclusion criteria: 0
Declined to participate: 0
Other: 0

Subjects enrolled this quarter: 0

Subjects withdrawn this quarter: 3
Reason(s): All three participants requested to be withdrawn, two in the 6-month follow-up assessment phase, and one in the 12-month follow-up assessment phase. All three cited a lack of interest; one additionally cited discontent with the assigned computer program.

Completed follow-up visits: 156

Scheduled follow-up visits: N/A

Dropped/Discontinued at follow-up: 2
No contact: 0
Withdrawn from study: Both participants died, causes unrelated to the study, on 12/19/18 and 4/21/19. Study team withdrew these participants in previous quarters.

No longer eligible: 0
Other: 0

Progress in relation to the statement of work tasks and objectives:

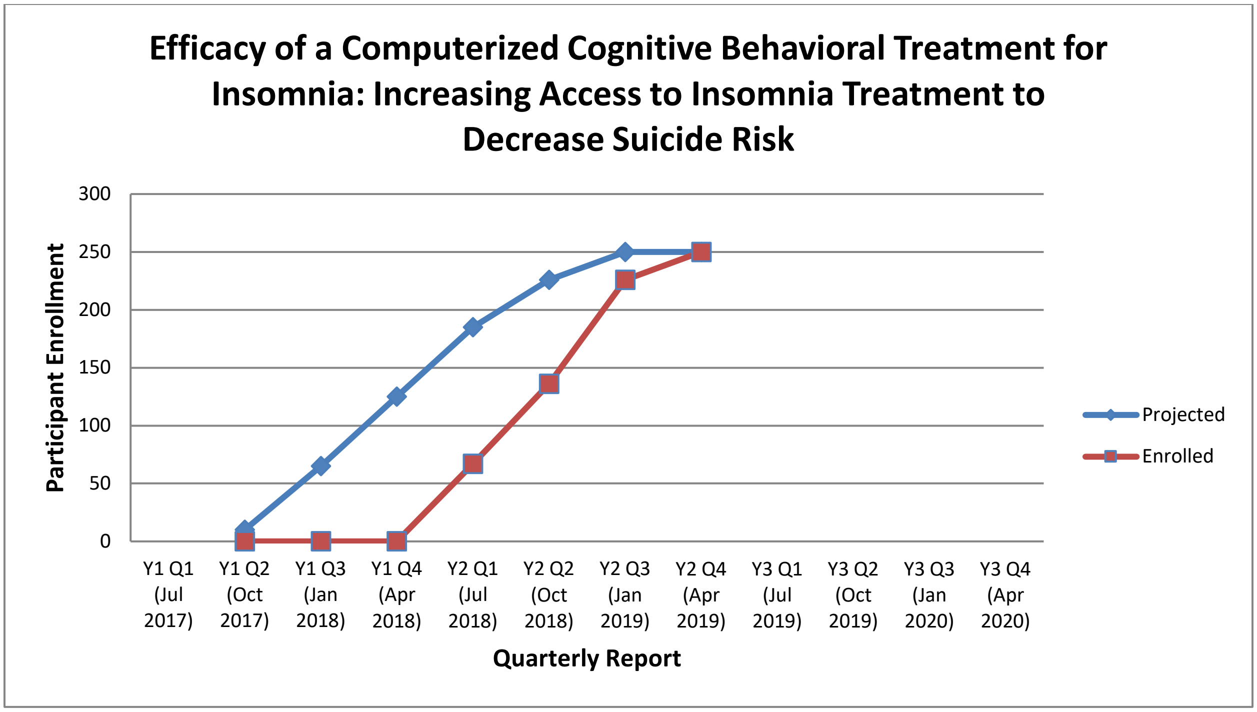
Task	Timeline	Progress
Major Task 1: Study Start Up	Months 1-12	Elements completed: study protocol refined, regulatory documents approved, staff hired & trained, web-based platform/database infrastructure finalized.
Major Task 2: Randomized Controlled Trial	Months 12-25	Completed recruitment, screening, enrollment, randomization, and collection of baseline data. Continued collection of post-intervention data.
Major Task 3: Follow-up Data	Months 21-444	Completed collection of 6-month post-intervention assessment data. Continued collection of 12-month follow-up assessment data this quarter.
Major Task 4: Final Reports	Month 48	N/A
Major Task 5: Ongoing Regulatory Compliance	Ongoing	All regulatory documentation is up to date.

Major findings, results, and/or significance for this project during this quarter: This quarter, data were collected for 59 participants at 12-month follow-up, for a cumulative total of 156 completed 12-month follow-up assessments. At quarter's end, the cumulative total number of participants finished with the study was 110. Initial (preliminary) analyses indicate that engagement in SHUTi, as defined by core completion, is consistent with reported data from civilian trials.

Goals for the next quarter: In the next quarter, we will continue collection of 12-month follow-up assessments. We will continue cleaning and preparing pre-intervention, post-intervention, and 6-month follow-up assessment data for analyses.

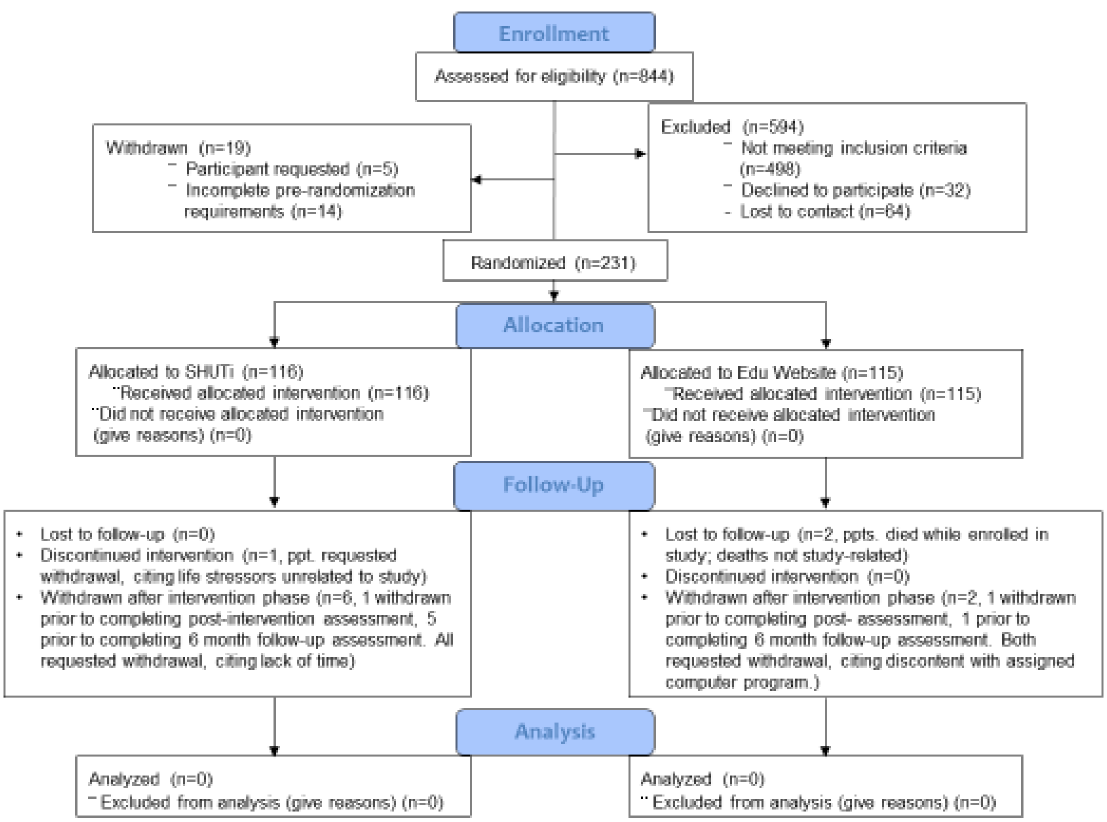
Problems, challenges and plans to address them: N/A

Publications, Presentations, and Media Requests: N/A



Number of participants that have completed study: 180
Attrition between enrollment and randomization: 7.6%

CONSORT Diagram



A3. Profiles of Behavioral Warning Signs for Suicide Attempts in the Prediction of Future Suicidality
PI: Courtney Bagge, PhD

Summary of Progress: The current study aims to prospectively examine whether specific behavioral warning signs (BWS), assessed at the time of hospitalization due to a recent suicide attempt, can predict post-discharge serious suicidal ideation and behavior. Knowledge about how specific patterns of BWS are associated with future suicidality would ultimately facilitate the selection of individualized treatment targets during hospitalization, inform discharge decisions regarding safety, forward evidence-based referrals, and optimize suicide prevention efforts for post hospitalization. We have completed Task 1 (Build Infrastructure for the Project) and have finished participant enrollment (i.e., Recruit and Consent Participants; Collect and Enter Original Data, Task 2). We have obtained HRPO approval for change in institution and just obtained approval from UMMC to transfer PHI (e.g., dates) for analysis.

Regulatory:

Initial IRB approval date: March 26, 2018 UMMC; September 24, 2019 UM

Initial HRPO approval date: May 15, 2018 UMMC; December 27, 2019 UM

Continuing Review Approval Date: March 21, 2019 UMMC

HRPO Continuing Review Acknowledgment: May 17, 2019 UMMC

Note: The PI transferred universities (from UMMC to UM). UMMC and UM have signed a DUA to transfer all data from UMMC to UM. This DUA was fully executed very recently (3/11/20). All data has now been transferred to UM.

Recruitment:

Final enrollment: 144

Recruitment start date: June 18, 2018

Projected quarterly enrollment: 16

Subjects assessed for eligibility this quarter: 0

Number excluded: 0

- Did not meet inclusion/exclusion criteria: 0
- Declined to participate: 0
- Other: 0

Subjects enrolled this quarter: 0

Subjects withdrawn this quarter: 0

Progress in relation to the statement of work tasks and objectives:

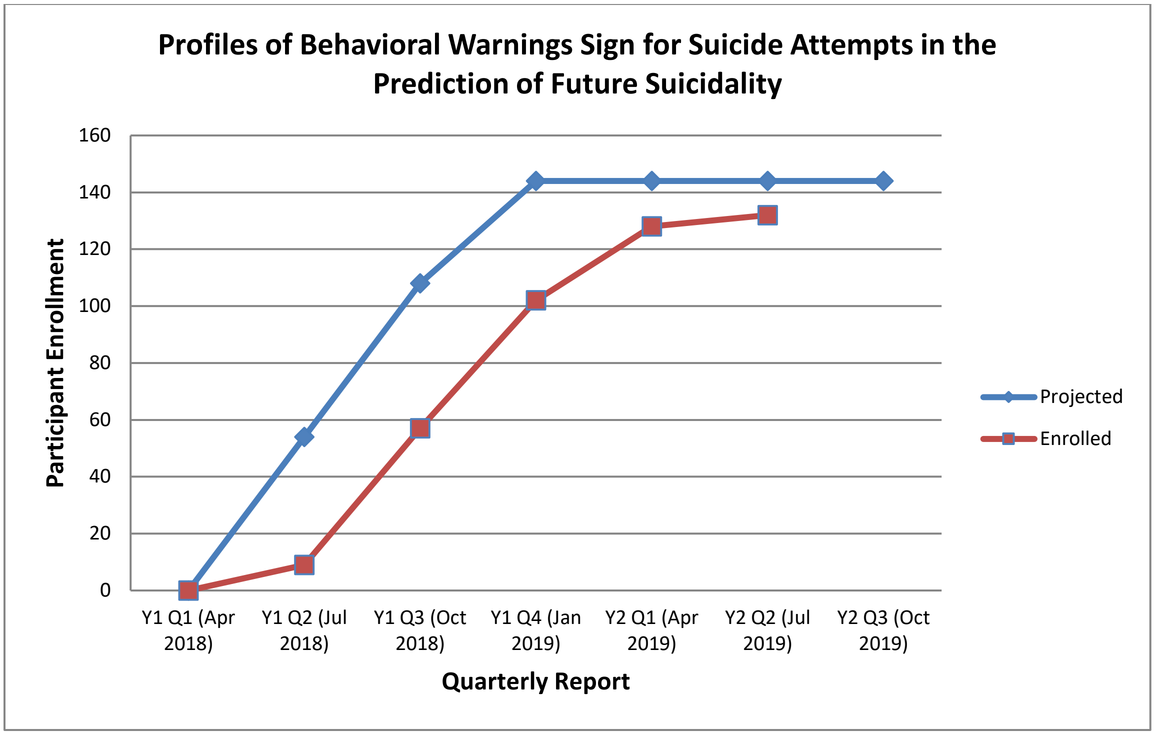
Task	Timeline	Progress
Build infrastructure for project.	Months 1-3 (UMMC) Complete	Complete
Recruit and consent participants; collect and enter data.	Months 4-16 (UMMC) Complete	We have fully completed 131 participants and 1 participant is a partial completion (this is 91% of what was expected)
Build infrastructure for project/Regulatory approvals	Months 18-19 (UM transition) Complete	We have received UM IRB approval and have HRPO approval for change in institution.
Reliability Coding of Assessments (20%) conducted and entered. Original and Reliability Lethality data coded.	Months 20-21 (UM) Complete	Reliability and Original Coding of Assessments (requiring and not requiring PHI) have now been coded and entered.
Task 3- Variables created across original and reliability data; data cleaned and compared across datasets	Months 22-23 (UM) In Progress	Variables have been created and data cleaning is in progress.

Major findings, results, and/or significance for this project during this quarter: N/A

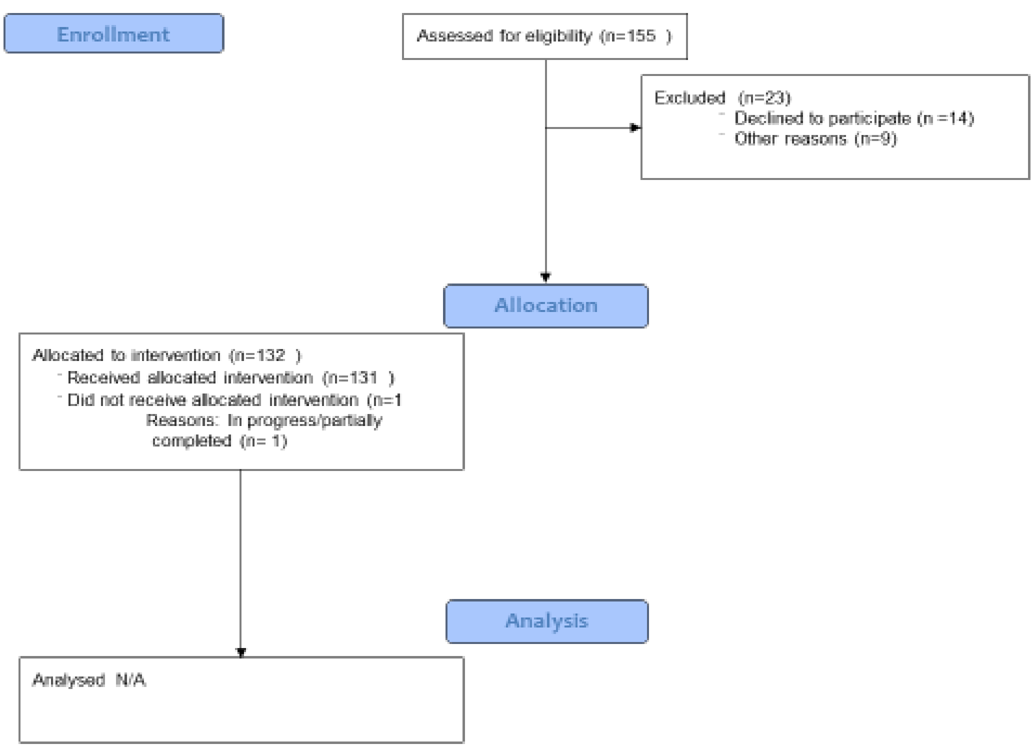
Goals for the next quarter: Data cleaned and comparison of all data between original and reliability datasets (including key follow-up dates).

Problems, challenges and plans to address them: The PI has been working with UMMC and UM to come to an agreement for transfer of all data to UM for this project. The DUA was recently executed (3/11/2020) and the data have been transferred. An additional factor that prolonged the time to receiving the fully executed DUA, and consulting with my data analyst, was the COVID-19 pandemic. The PI is requesting a no-cost extension in order to complete the study aims.

Publications, Presentations, and Media Requests: N/A



CONSORT Diagram



A4. Couples Crisis Response Planning to Reduce Post-Discharge Suicide Risk
PI: Alexis May, PhD

Summary of Progress: The study's objectives are to determine the needs of service members and their partners for suicide prevention interventions and test the effect of the C-CRP, a targeted single-session couples intervention on suicide ideation among post-9/11 military service members and veterans. This Quarter, we continued recruiting participants, both for the RCT and the online study. We also continued follow up interviews.

Regulatory:

Initial IRB approval date: April 1, 2019

Initial HRPO approval date: June 21, 2019

Continuing Review Approval: March 25, 2020

Research Monitor Change: The current research monitor stepped down due to new responsibilities. A new research monitor, Dr. Bryann DeBeer was approved by the IRB via an IRB amendment.

Lapses in Approval: Due to delays related to the pandemic, the IRB's review of the study's continuing review (CR) was delayed. The IRB expired on 3/20/20. All study activities were halted. The CR was reviewed and approved on 3/25/20. Study activities resumed that day. This was reported to MSRC at the time and HRPO in the current CR.

Recruitment:

Total Projected Enrollment: Online: Online: 50 couples; RCT: 82 (78 study; 4 pilot)

Recruitment Start Date: Online: August 9, 2019; RCT: July 26, 2019

Projected Quarterly Enrollment: Online: 30 couples; RCT: 18 couples

Subjects assessed for eligibility this quarter: Online: 28 couples RCT: 24

- Number excluded: Online: 25 couples RCT: 15 patients
  - Did not meet inclusion/exclusion criteria: Online: 14 couples RCT: 10 patients
  - Declined to participate: Online: 0 couples RCT: 2 patients
  - Other: Online: 1 couples (partner did not complete screener) RCT: 3 patients

Subjects enrolled this quarter: Online: 3 individuals (1 couple) RCT: 9 patients (8 couples)

Subjects withdrawn this quarter: Online: 0 RCT: 1 couples (discharged early)
Reason(s):

Completed follow-up visits? 1 mon: 5 completed; 0 missed; 3 mon: 2 completed, 0 missed; 6 month, 3 completed, 1 missed

Scheduled follow-up visits: 1 mon: 3 being scheduled; 3 mon: 0 being scheduled; 6 mon 2 being scheduled

Dropped/Discontinued at follow-up: 0 All participants have completed at least 1 follow up assessment

No contact: 0
Withdrawn from study: 0
No longer eligible: 0
Other: 0

Progress in relation to the statement of work tasks and objectives:

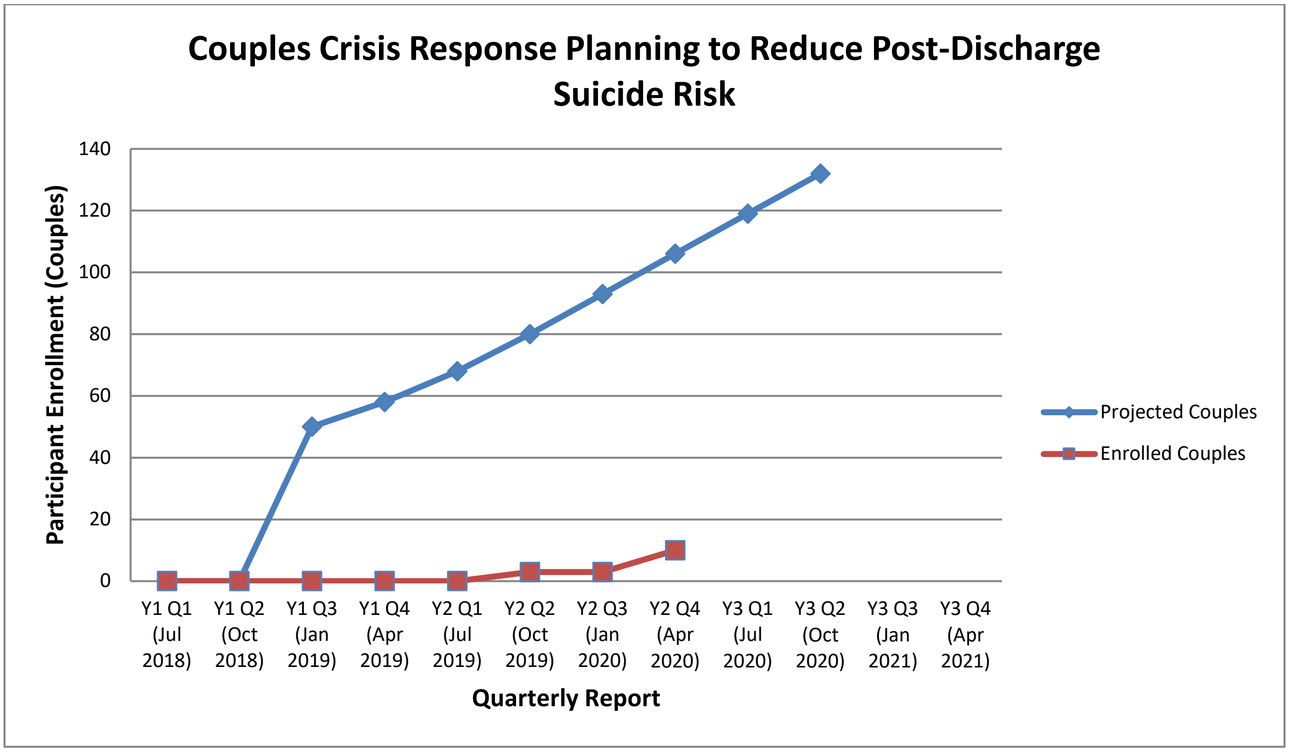
Task	Timeline	Progress
1. Obtain IRB approvals	Months 1-6	University of Utah IRB approval achieved 01 APR-19. HRPO approval achieved 21 JUN-19.
2. Hire and train research staff	Months 3-9	All staff have been hired and training is well underway.
3. Phase 1 data collection	Months 6-9	Recruitment continued this quarter. Ads were created were purchased MilitaryTimes.com in January. Ads were purchased on Rally Point in late March. RAs attended 1 event, two additional events were canceled due to COVID19.
4. Finalize CCRP protocol	Months 3-9	Following pilot tests, the protocol was finalized.
5. Phase 2 Data Collection	Months 10-30	Recruitment went well. 8 intervention sessions took place. Recruitment was paused on 30-MAR-20 due to shelter-at-home regulations for COVID19.
6. Data Analysis – Phase 1	Months 9-24	This is delayed until data collection of Phase 1 is complete.
7. Begin Phase 2 Follow Up Data Collection	Months 10-36	Follow up Data Collection continued. 5 1-month, 2 3-month, and 3 6-month assessments were completed. All participants have completed or scheduled at least 1 follow up assessment.

Major findings, results, and/or significance for this project during this quarter: N/A

Goals for the next quarter: During the next Quarter we will continue enrolling participants in the online portions of the study and completing follow up interviews via phone/telehealth with all enrolled participants. Protocol changes, including the addition of a staff member working night/weekend hours significantly helped recruitment and we hope this will continue. We will resume recruitment for the RCT when COVID19 precautions allow. We will also upload our data to the MSRC server next quarter. As all staff are working from home at this point, we are not in a position to deidentify and upload data.

Problems, challenges and plans to address them: COVID19 precautions have led us to pause in person recruitment of participants. Staff members are continuing to work on study related tasks from home. However, this pause will further delay our recruitment targets.

Publications, Presentations and Media Request: N/A



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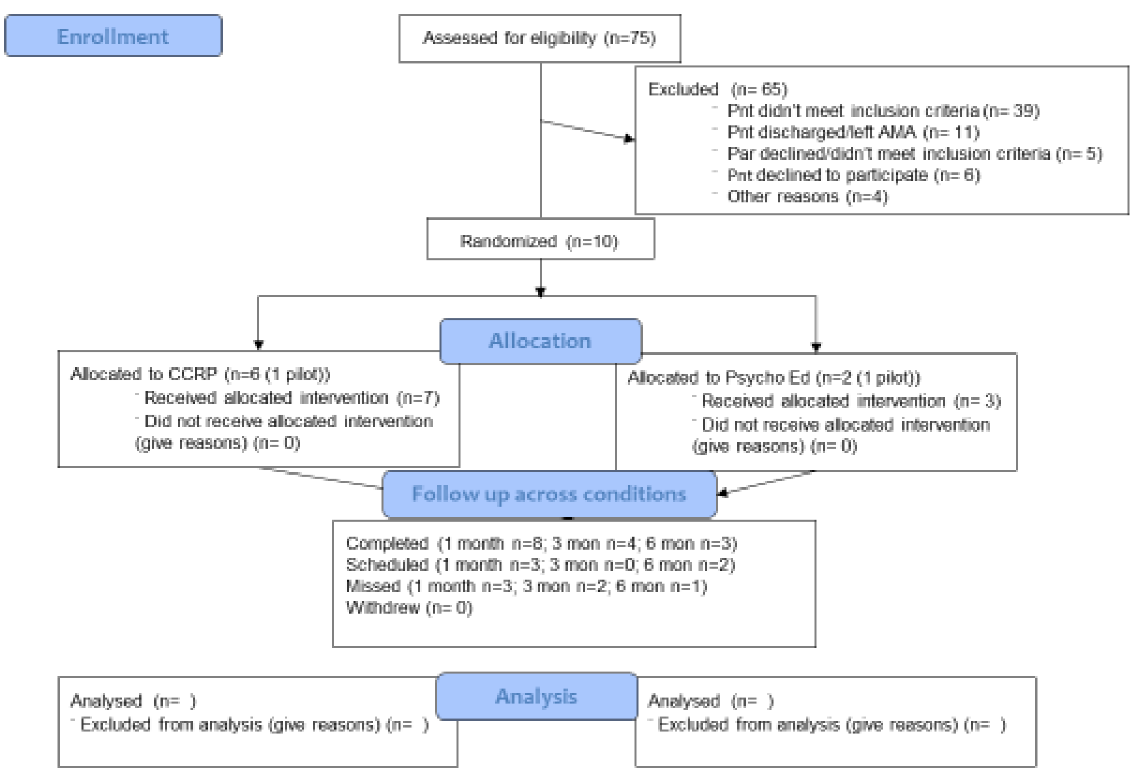


A5. Facilitating Assessment of At-Risk Sailors with Technology (FAAST)
PI: Lisa Brenner, PhD

Summary of Progress:
Data collection continued for the 101 Sailors enrolled at Joint Base Pearl Harbor-Hickam. There was a successful completion of mobile application based data collection from first wave of recruitment.

We obtained a letter of support from the Commanding Officer of the USS Theodore Roosevelt (CVN 71) on 2/11/2020. The document was submitted to HRPO on 2/23/2020 and HRPO acknowledgment was received 3/30/2020. We plan to enroll Sailors after the COVID-19 pandemic.

Regulatory:

Initial IRB approval date: May 10, 2019

Initial HRPO approval date: November 5, 2109

Recruitment:

Total Projected Enrollment: 950

Recruitment Start Date: December 9, 2019

Projected Quarterly Enrollment: 190

Subjects assessed for eligibility this quarter: 0

Number excluded: 0
Did not meet inclusion/exclusion criteria: 0
Declined to participate: 0
Other: 0

Subjects enrolled this quarter: 0

Subjects withdrawn this quarter: 0
Reason(s): N/A

Completed follow-up visits? 101

Progress in relation to the statement of work tasks and objectives:

Task	Timeline	Progress
Finalize job descriptions, advertise, and interview for project staff	Months 1-2 (April-May 2019)	Research staff has been hired.

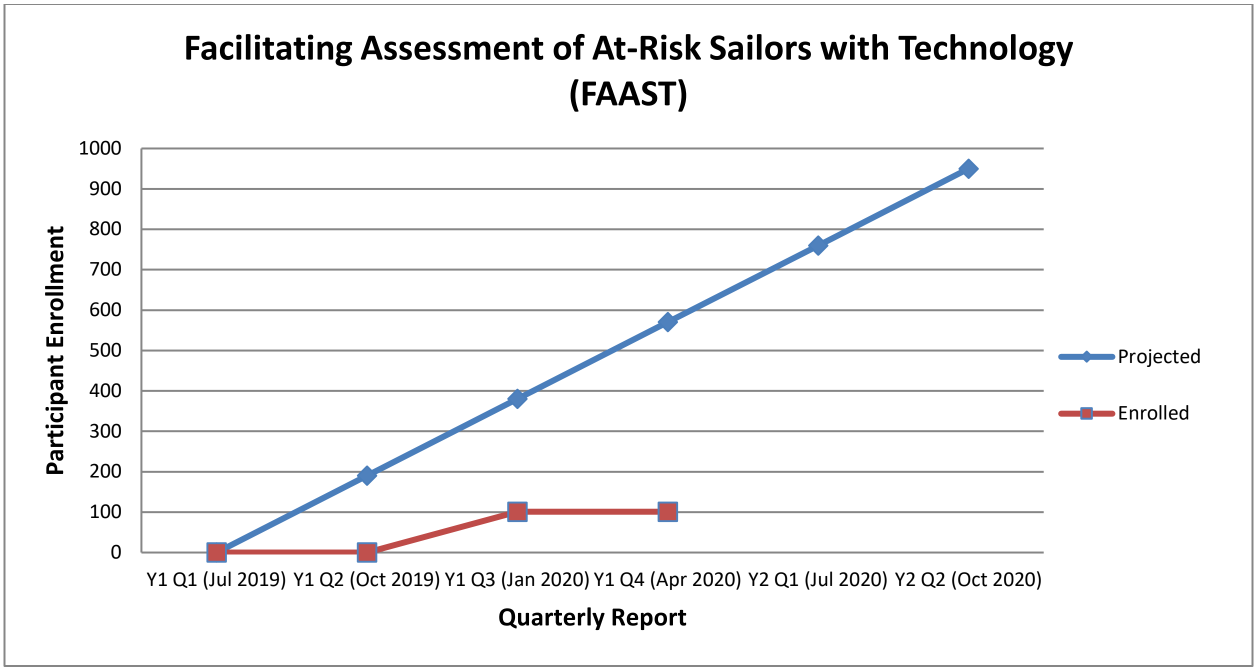
Coordinate IRB protocol submissions and HRPO submission	Months 1-7 (April-October 2019)	Local IRB, VA and HRPO approvals have been obtained.
Coordinate contract with Cogito Companion	Months 1-3 (April-June 2019)	The contract has been executed.
Oversee and facilitate creation of REDCap/MyCAP platforms and study databases	Months 1-3 (April-June 2019)	REDCap/MyCAP platform and databases have been created.
Coordinate trainings (e.g., monitoring Cogito dashboard, measures administration, regulatory, clinical and administrative outreach)	Months 1-6 (April-September 2019)	Trainings are implemented and ongoing.
Coordinate recruitment and travel logistics	Months 4-18 (July 2019-September 2020)	Capt Werbel obtained a letter of support from the Commanding Officer of the USS Theodore Roosevelt.
Recruit and consent participants for RCT (n = 950 active duty Sailors)	Months 4-18 (July 2019-September 2020)	No participants were recruited and enrolled this quarter.
Collect data via Cogito Companion app and REDCap/MyCAP (baseline, 3 months, biweekly surveys between baseline and 3-month follow up)	Months 4-18 (July 2019-September 2020)	Data collection is ongoing.
Monitor Cogito Daily Dashboard and MyCAP with outreach as needed	Months 4-18 (July 2019-September 2020)	Study clinicians are monitoring the dashboards every business day and are outreaching as needed.

Major findings, results, and/or significance for this project during this quarter: Documentation to pause recruitment during the COVID-19 pandemic was submitted to the local IRB on 3/25/2020. The IRB documented official acknowledgment of the pause to recruitment on 3/25/2020. The IRB letter was forwarded to MSRC and HRPO on 4/2/2020.

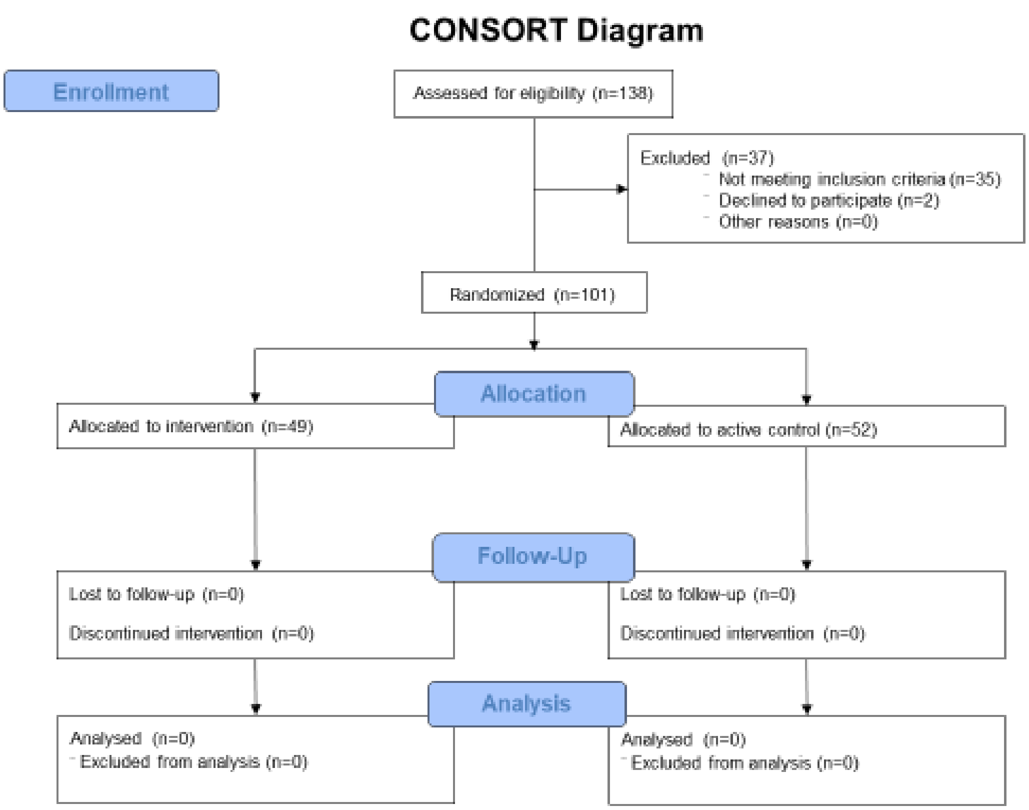
Goals for the next quarter: Project goals for next quarter include coordinating our next recruitment trip. We will continue data acquisition and quality checks.

Problems, challenges and plans to address them: During the COVID-19 pandemic, we plan to reduce personnel efforts on this study as we have paused recruitment.

Publications, Presentations and Media Request: N/A



Percentage of participants that completed study: 11%



A6. Suicide Risk and Sleep in Treatment: An Intensive Daily Sampling Study
PI: Lily Brown, PhD

Summary of Progress:
We have received IRB approval from the Naval Medical Center Camp Lejeune (NMCCL) and have submitted documentation to Human Research Protection Office (HRPO) for approval. We submitted a modification to change the demographic questionnaire, per the request from the Military Suicide Research Consortium (MSRC), which was approved. HRPO requested some changes to our informed consent, which required a modification to the protocol. Pending approval of that modification, the parent trial will require submission of continuing review. Pending approval of the parent trial continuing review, the MSRC trial will require one additional modification to fulfill a request from HRPO. Pending approval of the second modification, we will submit documentation to HRPO for approval. Of note, the parent trial is currently on pause in light of the COVID-19 outbreak.

Regulatory:

Initial IRB approval date: November 25, 2019

Initial HRPO approval date: Pending

Recruitment:

Total Projected Enrollment: 100

Recruitment Start Date: June 2020 (Projected)

Projected Quarterly Enrollment: 20

Progress in relation to the statement of work tasks and objectives:

Task	Timeline	Progress
Finalize self-report, interview, and digital phenotyping protocols/forms	1-3 months	Complete
Finalize consent form & human subjects protocol	1-3 months	Submitted IRB modification to change language in consent form per HRPO requirement
Coordinate with Sites for UPENN IRB protocol submission	1-3 months	Reliance agreement received from Penn, and Utah. NMCCL deemed other subawards as "not conducting research" due to no access to PHI.
Purchase Fitbit devices, related software, and computer	1-3 months	Partially purchased (10 devices) in July 2019, the remaining devices will be purchased upon receipt of HRPO approval.
Submit IRB protocol approvals to HRPO for pre-review, review, and final approval.	1-6 months	Submitted for review. We are ready to begin recruitment upon approval from HRPO.

Major findings, results, and/or significance for this project during this quarter: We have received IRB approval, including approval for a modification to alter the demographics form consistent with the request from the Military Suicide Research Consortium (MSRC). We submitted required documentation to HRPO, which required additional IRB modifications. One of those modifications is under review. Upon approval of this modification, the parent trial will require submission of a continuing review. Upon approval of the continuing review, we will need to submit an additional modification to the protocol per a requirement from HRPO. The parent trial recruitment and activities have been paused in light of the COVID-19 crisis.

In February 2019, the PI of the MSRC study (Lily Brown) and the PI of the parent trial (Craig Bryan) traveled to Camp Lejeune to meet the on-site team and to finalize study procedures. During this meeting, we met with leadership from Camp Lejeune, as well as representatives from the Institutional Review Board.

In August 2019, the PI and co-investigators (Taylor, Pruiksma, and Bryan) conducted an in-person training in the study procedures with study staff. Since August 2019, we have completed additional fidelity ratings with the study evaluators to ensure high inter-rater reliability.

We finalized our study database. We have received a reliance agreement from the University of Pennsylvania and the University of Utah to rely on the Naval Medical Center Camp Lejeune (NMCCL) IRB. We received approval from the IRB at the University of Texas Health Science Center at San Antonio to indicate that Dr. Pruiksma's participation in the study will not require access to human subjects data, thereby not requiring her to receive IRB approval. The NMCCL IRB deemed that co-investigators from subawards should not officially be included as co-investigators on the IRB (with the exception of Dr. Bryan, the parent trial PI) given that the researchers will not have access to PHI. We submitted IRB documentation to include these researchers (Drs. Taylor, Wiley, and Foa) as co-investigators, but the IRB removed them from the application because they will not have access to PHI.

Goals for the next quarter: In the next quarter we anticipate receiving approval of our IRB modification from NMCCL as well as receipt of approval from HRPO. We anticipate beginning recruitment for the study in the next quarter, depending on the COVID-19 crisis status.

Problems, challenges and plans to address them: The NMCCL IRB approval was delayed but has since been received. This occurred because the submission of our modification occurred at the same time as the submission of the continuing review for the parent study, resulting in a delay of review of the modification. To ensure that our project concludes on time, we are working with our statistician to begin to develop algorithms based on test data that can be easily altered with the receipt of actual study data.

Publications, Presentations and Media Request: N/A

Dissemination and Implementation: N/A

Leveraging: The current study is being conducted in partnership with a randomized controlled trial led by Dr. Craig Bryan. This partnership has saved money for the MSRC because the infrastructure of the parent trial is supporting the MSRC study. As the parent trial is ahead of schedule, this is also a benefit to the MSRC study in terms of finances and the likelihood of success of the MSRC study.

A7. A Brief Peer-Support Cognitive Behavioral Intervention for Military Life Transitions (Mil-iTransition) Following Medical and Physical Evaluation Boards PI: Marjan Holloway, PhD

Summary of Progress: The Mil-iTransition project has progressed in the following domains: (1) selection, hiring, and training of qualified staff consisting of one Research Coordinator with prior Marine Corps enlisted service experience, one consultant with prior Army service experience as a Psychologist leading the DoD Psychological Health Center of Excellence inTransition program, and one consultant with current duties as a Physical Evaluation Board Liaison Officer (PEBLO); (2) preparation of IRB protocols for Study I (interviews with service members) and Study 2 (pilot randomized controlled trial) as well as the development of a robust risk management plan; (3) submission of Study 1 IRB protocol (currently under review & revision); (4) development of a biographical narrative interview with service members transitioning out of service; (5) communication/coordination with the WRNMMC Medical Evaluation Board office leadership, resulting in a letter of support, invitations to attend PEBLO meetings, and enhancements to study recruitment procedures; (6) preparation of a first-draft Mil-iTransition intervention protocol; and (7) consultation and coordination with USU IRB administrators to overcome the challenges presented by the Information Management Control Officer (IMCO) processes.

Regulatory:

Initial IRB approval date: Pending

Initial HRPO approval date: Pending

Additional Regulatory Notes: On 01/14/2020, the study PI and 2 team members attended a USU presentation on the Office of People Analytics' (OPA) lengthy DoD review process for research involving surveys, interviews, and focus groups. On 01/29/2020, the study PI met with two key USU IRB administrators to discuss the most optimal path forward. Given concerns about the time restraints of the proposed study, a strong recommendation was provided to consider a population of a single Service Component, in particular, those in the US Navy. Enrollment of USN personnel would necessitate a survey clearance to be obtained only from the USN (with an estimation approval time of 30 days). Initial review of the Study 1 protocol was performed by the USU IRB on 02/27/2020 (following revisions requested by the IRB administrative team). The full committee made a decision to defer. The study Co-PI attended the IRB meeting; unfortunately, there was inadequate time for the full review of the protocol. A number of written recommendations have been received. We are currently working on addressing these and our estimated timeline for re-submission is in April 2020. The protocol is much stronger as a result and we fully expect a favorable review.

Recruitment:

Total Projected Enrollment: N1 = 25; N2 = 50

Recruitment Start Date: Pending (June 2020 estimated)

Projected Quarterly Enrollment: 10-15

Significant changes to the protocol: Based on a USU presentation by members of the Office of People Analytics (OPA) on 01/14/2020 and consultation with USU IRB on 01/29/2020, and concerns about the time restraints of the proposed study, we have decided to recruit only US Navy personnel.

Progress in relation to the statement of work tasks and objectives:

Task	Timeline	Progress
Major Task 1: Develop Qualitative Research and Pilot Randomized Controlled Trial (RCT) Study Protocol	Months 1-7	(1) Prepared IRB Protocols for 2 Studies (2) Developed Study Forms (3) Drafted Bio Narrative Interview
Major Task 2: Conduct Pilot RCT	Months 6-23	(1) Submitted Study 1 Protocol to IRB (2) Finalized Bio Narrative Interview (3) Drafted Mil-iTransition Manual (4) Coordinated Efforts with MEB Office
Major Task 3: Conduct Data Analysis	Months 6-24	Pending

Major findings, results, and/or significance for this project during this quarter:
Mil-iTransition is a peer-based intervention that (1) focuses on generating lessons learned from transition stories and (2) targets cognitions, coping, and safety. Study 1 consists of biographical narrative interviews to be conducted with service members who have received an "unfit for duty" notice following Medical and Physical Evaluation Boards (MEBs and PEBs). Themes identified from the interviews will inform the development of a peer-delivered intervention for service members found "unfit for duty" after the MEB and PEB processes. Study 2 will test the intervention using a pilot RCT.

There are no study findings to report for the fourth quarter of this project. The fourth quarter has primarily focused on the following activities: (1) revising the Study 1 IRB protocol based on USUHS IRB recommended revisions; (2) completing and submitting required documents for Navy Approval Survey Manager to approve Study 1 recruitment; (3) revising the consent form and human subjects protocol for Study 2, including recruitment fliers, study forms, risk management protocol, and Mil-iTransition intervention overview per the PI's guidance; (4) finalizing our personnel restructuring to meet the specific needs of this study, including hiring and training additional project-related staff members; and (5) preparing assessment guides, study team training procedures, and standard operating procedures.

The following activities have also been completed during the fourth quarter in order to best inform our work on this project:

1) Continued systematic review of literature on peer-supported interventions for veterans and military populations
2) Refined a detailed risk management protocol and drafted the Mil-iTransition intervention in collaboration with MAJ Aimee Ruscio (consultant)
3) Attended Study 1 initial IRB review meeting and began to address revisions recommended by reviewers
4) Attended WRNMMC PEBLO and MEB leadership meeting to learn more about the MEB/PEB process, finalize recruitment procedures, and secure a letter of support

5) Transitioned all staff to full-time temporary telework due to COVID-19 and held regular study-related video conference meetings
6) Generated a revised SOW based on consultation with MSRC to more accurately reflect our goals and overall study timeline

Goals for the next quarter: Project goals for the next quarter, as indicated on the SOW, will include the following:

1) Continue to hold regular meetings and conference calls, as needed, to advance project tasks and objectives
2) Finalize and submit consent form and PI-reviewed/approved human subjects protocol for Study 2 to USUHS IRB
3) Gain USU IRB and HRPO approvals by preferably June 2020
4) Consent Study 1 participants and conduct biographical narrative interviews
5) Conduct qualitative analysis of transcribed interviews and identify themes
6) Prepare study forms, database, randomization procedures, risk management guide, and regulatory binders for Study 2
7) Prepare comprehensive baseline and follow-up assessment guide and training procedures for Study 2
8) Prepare comprehensive research case management guide and training procedures for Study 2
9) Finalize Mil-iTransition manual for peer facilitators
10) Finalize adherence and competency rating forms. Facilitate and coordinate with sites for training, supervision, and adherence and competency checks for research case managers, peer facilitators, and blind follow-up assessors

Problems, challenges and plans to address them:
Problem 1. Spending is Not on Track with Budget Projections
Plan 1. We have begun to increase our spending based on the needs of the project.

Problem 2. PI's High Risk Pregnancy and 4-Month Maternity Leave; Co-PI Maternity Leave
Plan 1. PI returned to full-time work in January 2020. Her health status significantly impacted about 6-months of the research activities. While progress was made, it was not at the level anticipated and expected. The medical issues have been resolved; PI is now fully engaged to advance the study's objectives. One of the study Co-PIs is currently on maternity leave. No major impact is expected.

Problem 3. DoD Approval Processes for Surveys, Interviews, and Focus Groups (i.e., Based on the Paperwork Reduction Act)
Plan 2. Based on consultation with the MSRC Point of Contact, Ms. Gronau and the USU IRB, we have submitted the necessary forms to the Navy Approval Survey Manager. Recruitment will focus on USN personnel only.

Problem 4. Transition to Full-Time Telework Due to COVID-19 Pandemic
Plan 4. All staff have transitioned to full-time telework due to the COVID-19 pandemic. We have been meeting via teleconference multiple times each week to move the project forward; however, the group's productivity has been impacted by the current situation.

Publications, Presentations and Media Request: N/A

A8. Mobile Interpretation Bias Modification Clinical Trial
PI: Daniel Capron, PhD

Summary of Progress:

1) Assessed 73 participants for eligibility
2) Enrolled 4 participants and completed 1 follow-up

Regulatory:

Initial IRB approval date: April 4, 2019

Initial HRPO approval date: November 1, 2019

Continuing review approval date: March 4, 2020

HRPO continuing review acknowledgement: Pending

Recruitment:

Total Projected Enrollment: 114

Recruitment Start Date: November 2019

Projected Quarterly Enrollment: 26

Subjects assessed for eligibility this quarter: 55

Number excluded: 51
- Did not meet inclusion/exclusion criteria: 50
- Declined to participate: 0
- Other: 1

Subjects enrolled this quarter: 4

Subjects withdrawn this quarter: 0

Completed follow-up visits: 1

Scheduled follow-up visits: 2

Dropped/Discontinued at follow-up: 0

Progress in relation to the statement of work tasks and objectives:

Task	Timeline	Progress
Develop Infrastructure for Effective Study Implementation	Months 1-6	Complete

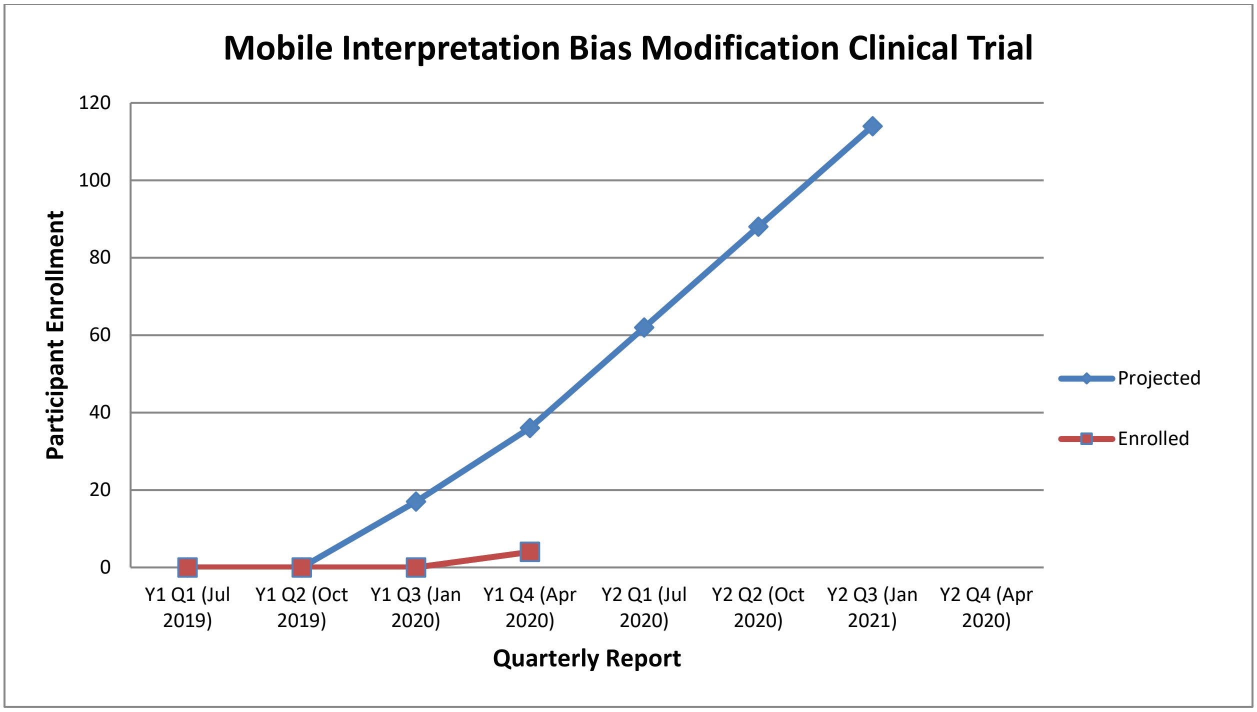
Randomized Controlled Trial	Months 7-21	Screened 73 total National Guard members, enrolled 4 and had one completed follow-up.
Data Analysis	Months 22-24	N/A

Major findings, results, and/or significance for this project during this quarter: N/A

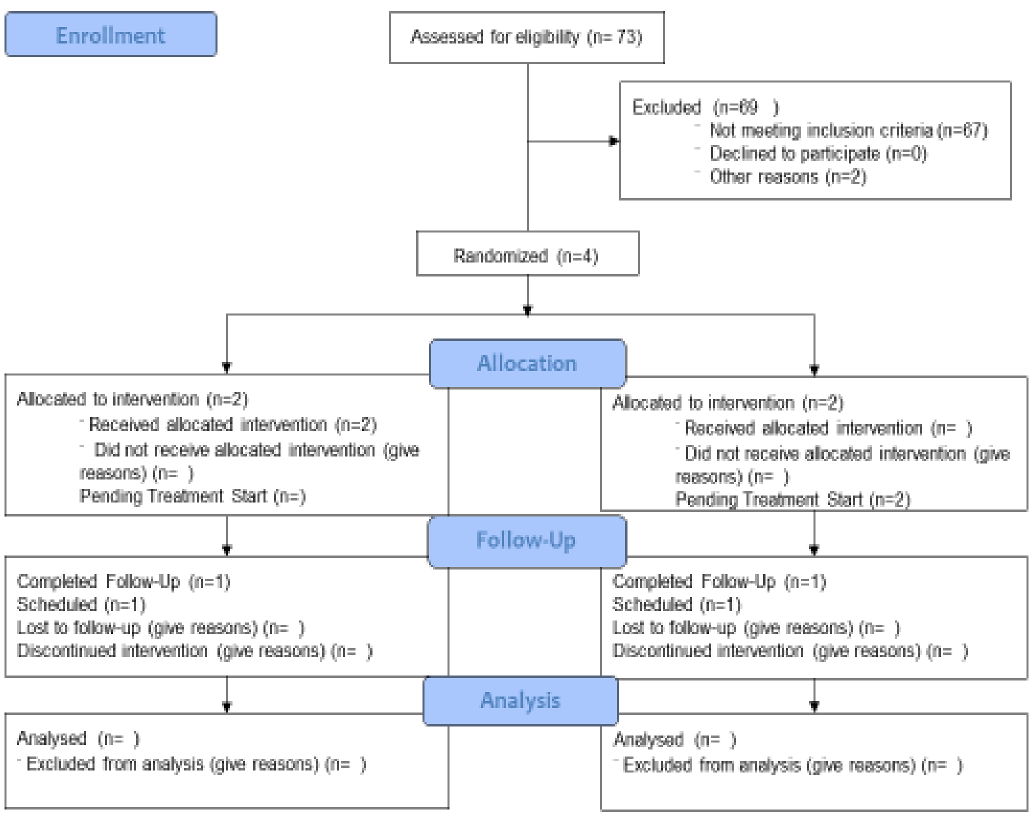
Goals for the next quarter: Our goal is to run enough participants to get back on pace for the trial.

Problems, challenges and plans to address them: We were surprised that of 73 screeners, only 4 met eligibility criteria. We are concerned that potential participants are hesitant to endorse even low levels of suicidal thoughts. We will continue to explore recruitment avenues to diversify potential participants.

Publications, Presentations and Media Request: N/A



CONSORT Diagram



A9. Personal & Professional Exposure to Suicide in Military Populations
PI: Julie Cerel, PhD

Summary of Progress: IRB approval for both phases of study. Submitted to HRPO. Working on determining if Army Office of Surveys is required. Have completed Army Office of Surveys paperwork but do not have Brigadier level or higher support yet at Kentucky Army National Guard or Ft. Sam Houston.

Regulatory:

Initial IRB approval date: September 17, 2019

Initial HRPO approval date: Pending

Recruitment:

Total Projected Enrollment: 2300

Recruitment Start Date: Pending

Projected Quarterly Enrollment: 115

Progress in relation to the statement of work tasks and objectives:

Task	Timeline	Progress
Prepare regulatory documents and research protocol	Months 1-11	Local IRB approval for study 1 and study 2. Submitted both studies to HRPO. Working on Army Office of Surveys paperwork. Waiting for determination about Army Office of Surveys.
Coordinate study staff	Months 2-4	A project coordinator and study employee have been hired.
Finalize measurement tools & data collection infrastructure	Months 1-8	Finalized study instruments for Study 1 and Study 2.

Major findings, results, and/or significance for this project during this quarter: N/A

Goals for the next quarter: Obtain HRPO approvals. Obtain Army Office of Survey approvals (if necessary). Begin recruitment for both studies.

Problems, challenges and plans to address them: Given changes in KY Army National Guard leadership, we have been trying to get on the calendar to brief leadership. A time was available and then the shutdown due to COVID-19 occurred. We are preparing IRB modifications to change study to online-only, including COVID-related anxiety and work questions and working to clear leadership.

Publications, Presentations and Media Request: N/A

A10. Bolstering the Implementation Quality and Impact of Zero Suicide Efforts in the Air Force
PI: Keith Aronson, PhD

Summary of Progress:

1. Only one base has agreed to continue in the pilot study due the Defense Health Agency's (DHA's) takeover of Air Force medical operations and the reorganization of the Air Force Medical Operations Agency (AFMOA), which was our contracting partner, to Air Force Medical Readiness Agency (AFMRA). Suicide prevention is no longer in AFMRA's portfolio.
2. Drs. Aronson and Perkins advised Dr. Gutierrez of this issue. He asked us to complete a revised statement of work and budget for a smaller study. We provided these materials to him and we await MSRC's decision.
3. We obtained the Broad Area Agreement (BAA) with the Air Force.

Regulatory:

Initial IRB approval date: Not Human Subjects Research Determination - November 15, 2019

Initial HRPO approval date: Concurrence with IRB Determination – February 21, 2020

Recruitment:

Total Projected Enrollment: N/A

Recruitment Start Date: N/A

Projected Quarterly Enrollment: N/A

Progress in relation to the statement of work tasks and objectives:

Task	Timeline	Progress
Write and submit PSU IRB HRP-594 Exemption Protocol	Month 1	The PSU HRP-594 was submitted and was approved by the PSU IRB on 11/15/19.
Write project staff job descriptions (i.e., ZICs) obtain all Pennsylvania State University hiring approvals, and advertise positions internally and externally.	Months 1-2	Each of these tasks has been completed.
Update training materials and develop implementation protocol document, implementation activity logs.	Months 1-3	Thus far, we have developed the outline of the ZIC training, identified the materials we already have, and updated those materials. We have yet to identify any other materials that need to be created.

Interview candidates for the three ZIC positions	Months 3-4	This step has been placed on hold. We only have one base continuing in the study. A revised statement of work is under review.
Obtain HRPO approval	Month 3	Complete
Train new staff on ZSSA, including the ZSSA Academy	Months 3-4	This step has been placed on hold. We only have one base continuing in the study. A revised statement of work is under review.
Deploy ZICs to pilot bases	Months 3-6	This step has been placed on hold. We only have one base continuing in the study. A revised statement of work is under review.
Provide on-going training and technical assistance to ZSSA project staff.	Month 3-24	This step has been placed on hold. We only have one base continuing in the study. A revised statement of work is under review.

Major findings, results, and/or significance for this project during this quarter: N/A

Goals for the next quarter:

1. Advertise, interview, and hire the one ZIC position and one data analyst position.
2. Complete development of ZIC three-day training.
3. Hold training with ZIC and deploy them to his or her base.
4. Develop ZSSA marketing and educational materials.
5. Continue to pursue Dr. Comtois and her team's ideas and contacts to assist us develop a new data collection plan.

Problems, challenges and plans to address them:

1. The overarching challenge to be addressed stem from the Air Force healthcare system transition to operating under DHA. This has happened without a clear plan. Given this change AFMRA could not make it mandatory for bases to continue in the Zero Suicide pilot study. In addition, DHA has assumed ownership of the data collection and analytic unit that had been run by AFMOA in the past. As a result, our ability to collect process/implementation data has been stymied. Our plan is to attempt to make direct contact with DHA and meet with them to discuss the project and its potential for impact.
2. As a result, we have provided Drs. Gutierrez and Joiner with a significantly revised proposal to reflect that we now only have access to one base.
3. We are pursuing alternative ideas and contacts about data collection strategies suggested to us by Dr. Comtois and her team.

Publications, Presentations and Media Request: N/A

TITLE: Interoceptive Deficits and Suicidality

PRINCIPAL INVESTIGATOR: April R. Smith

REPORT DATE: 6/10/2019

Table of Contents

1. INTRODUCTION:

Interoceptive deficits—a diminished ability to perceive the emotional and physiological condition of the body—is theorized to be necessary for self-injurious thoughts and behaviors (SITBs) to occur. Identifying novel risk factors that inform the prediction, treatment, and prevention of self-injurious thoughts and behaviors are sorely needed, especially among military populations. Evidence indicates that Service members experience proxies of interoceptive deficits (i.e., alexithymia, dissociation, pain tolerance) and that these proxies are associated with suicidality. Within a large military sample, the aim of the study was to: 1) test whether interoceptive deficits differentiate groups consistent with categorically distinct levels of suicide risk, 2) to test whether interoceptive deficits are positively associated with suicidal ideation, non-suicidal self-injury (NSSI), suicide attempt frequency, and suicide attempt lethality over and above existing risk factors, and 3) test whether Service members have a higher interoceptive deficits latent mean than civilians.

2. KEYWORDS:

Interoception, military, suicide, suicidality, suicidal ideation, suicide attempt

3. OVERALL PROJECT SUMMARY:

Goal 1: Obtain Institutional Review Board (IRB) approval

In accordance with our Statement of Work (SOW) we received approval from both Miami University and the Human Research Protection Office within three months.

Goal 2: Prepare CDE dataset

In accordance with our SOW we classified suicide groups within the MSRC dataset. Initially we proposed creating four groups: no suicidality, ideator/planner, single attempter, multiple attempter. However, in order to have appropriate power for tests we had to create three groups, such that we combined single and multiple attempters into one group.

Participants and procedures

This was a secondary data analysis using participants who were previously recruited from 25 independent studies funded by the MSRC and who indicated they had served in the military. As noted below, 10% of the data was used for conducting an exploratory factor analysis of the interoceptive deficits latent variable. The remaining 90% of the sample was used for all additional analyses and thus we describe the composition of that sample. The sample consisted of 3,764 individuals (79.6% males). The sample ranged in age from 18-88 (M = 33.34, SD = 14.21) and was predominately non-Hispanic (79.7%) and White (63.4%). The majority of participants (52.1%) reported being associated with the Army, see Table 1. Each primary study site obtained approval from their respective Institutional Review Board (IRB) to collect the initial data, and the authors of the current study received IRB approval to conduct secondary data analyses.

Objective lethality of most serious suicide attempt. Participants were asked to write a narrative account of their most lethal suicide attempt (*Thinking about the most lethal attempt, describe the details of the plan and method used. Use the space below. If you have never attempted to kill yourself with at least some intent to die, please leave the space below blank.*). Participants were also asked about the level of medical attention required for this suicide attempt, on the following scale: *0=no medical attention; 1=primary care doctor or nurse visit;*

2=emergency room visit; 3=hospital admission to a general medical floor; 4=hospital admission to an intensive care unit. Three doctoral students in clinical psychology used both the narrative description and the medical attention received to rate the lethality of the suicide attempt. The rating scheme was based on the Lethality of Suicide Attempt Rating Scale-II (LSARS-II; Berman, Shepherd, & Silverman, 2003) as modified by Witte and colleagues (2017), with some additional modifications for the present study. Participants who reported having never attempted suicide, and those for whom information was insufficient or unclear enough to provide an accurate lethality rating, received an LSARS score of 0. Lethality ratings for suicide attempts ranged 1 to 11, with higher scores indicating more lethal attempts (M = 4.84, SD = 2.30, range = 1-11).

One rater coded all participants, and each of the other two raters coded half of the participants, resulting in two rater pairs. If raters disagreed on whether an attempt had occurred or whether there was enough information to accurately rate the lethality, the study's principal investigator—a licensed clinical psychologist with substantial experience treating and researching suicidality—made a determination as to whether the case would be rated. The inter-rater reliability for LSARS scores for the two pairs of raters was excellent, with both pairs achieving reliability of .90.

Suicide study group. For analyses involving group comparisons, participants were assigned to one of three suicidality groups. Those with incomplete data on suicidality history and related variables were excluded from these analyses (n = 307). Participants were classified as Attempters (coded as group 2) if their LSARS score was greater than 0 (n = 1,078). Participants were classified as Ideators/planners (coded as group 1) if their LSARS score was 0, and either their DSI-SS score was greater than 0 or they endorsed lifetime suicidality on a separate CDE item (*Have you ever thought about or attempted to kill yourself?)* (n = 1,488). Lastly, participants were classified as No Suicidality (coded as group 0) if their LSARS score was 0, and their DSI-SS score was 0, and they did not endorse lifetime suicidality on the CDE item *Have you ever thought about or attempted to kill yourself?* (n = 918).

Goal 3: Complete preliminary analyses

In accordance with our SOW, we completed analyses for model validation, which included collecting online data from Amazon's Mechanical Turk to calculate correlations between the CDE-defined interoceptive deficits variable and existing measures of interoceptive deficits. We also completed the measurement model (i.e., exploratory factor analysis; EFA) for interoceptive deficits latent variable to determine which indicators should be retained. See detailed description below:

Participants and procedures

We collected data from a sample of participants recruited from Amazon's Mechanical Turk (MTurk; N = 134, 50.0% female, 80.6% white, average age = 37; see Table 1) to determine the validity of our proposed interceptive deficits latent variable. MTurk is an online recruitment website designed to match paid tasks to participants with the appropriate task characteristics.

Participation for the validation study was limited to individuals who indicated that they were located in the United States. To increase the validity of data collected online, only workers who had an approval rating of 90% or more were eligible to take part in the study. Additionally, two attention checks were included in the survey. One hundred seventy-five participants initiated the study and completed study measures. Participants who failed either attention check (n = 41) were excluded, resulting in a final sample of 134.

Measures

Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2012). The MAIA is a 32-item instrument that has participants rate how often statements apply to their general daily life on scale from 0 (*never*) to 5 (*always*). Scores for each of the measure's eight scales are calculated by averaging the scores of the individual items. The eight scales are: not distracting, not worrying, attention regulation, emotional awareness, self-regulation, body listening, and trusting. An example of an item is *I notice where in my body I am comfortable.* Internal reliability for this measure in the present study was excellent (Cronbach's alpha = .95).

Eating Disorder Inventory - Interoceptive Deficits subscale (Garner et al., 1983). This ten-item subscale measuring interoceptive deficits has participants rate answers on a scale from 1 (*never*) to 6 (*always*). An example item is *I don't know what is going on inside me.* Subscale scores were computed by summing items after some items were reverse-coded; higher scores indicate more severe deficits in interoceptive abilities. The Interoceptive Deficits subscale demonstrated good internal reliability in this sample (Cronbach's alpha = .88).

Toronto Alexithymia Scale (TAS; Bagby, Parker, & Taylor, 1994). This measure is the most widely used instrument for measuring alexithymia, which is closely related to interoceptive deficits (Brewer, Cook, & Bird, 2016). It contains 20 items. An example of an item is *It is difficult for me to find the right words for my feelings.* Items are rated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The TAS-20 demonstrated good internal reliability in this study (Cronbach's alpha = .86).

Proposed Interoceptive Deficits Latent Variable. To create our latent variable, we used three items from the PTSD CheckList (PCL; Weathers, Litz, Huska, & Keane, 1994) and one item from the Acquired Capability for Suicide Scale (ACSS; Riberio et al., 2014). The PCL is a standardized self-report measure that evaluates key symptoms related to PTSD. Participants rate how bothered they have been by a symptom over the past month using a 5-point scale ranging from 'Not at all' to 'Extremely'. The following items from this measure were used in analyses: a*void thinking about or talking about a stressful experience from the past or avoid having feelings related to it; feeling distant or cut off from other people; feeling emotionally numb or being unable to have loving feelings for those close to you.* The one Likert-type item from the ACSS assessed subjective pain tolerance and was phrased, *I can tolerate a lot more pain than most people.* Scores could range from 0 to 4, with higher scores indicating greater subjective pain tolerance. Similar self-reported items have been found to load onto a factor indexing discomfort and pain tolerance (Schmidt, Richey, & Fitzpatrick, 2006).

Results

The CDE-defined interoceptive deficits variable had acceptable internal consistency (α = .71). Crucially, the sum of the CDE-defined interoceptive deficits variable exhibited moderate-to-strong correlations with existing measures of interoceptive deficits (r = .51 with Eating Disorders Inventory—Interoceptive Deficits subscale; r = .45 with TAS; r = -.23 with MAIA total score; all ps < .01; see Supplemental Table 1). These correlations are similar in magnitude to the correlations among these existing measures of interoceptive deficits. Taken together this initial study demonstrates that the CDE-defined interoceptive deficits variable had adequate reliability and convergent validity with existing interoceptive deficits measures.

Goal 4: Complete data analyses

As outlined in our SOW, after establishing preliminary construct validity for our proposed interoceptive deficits latent variable, we proceeded to examine its psychometric properties in a large military sample. Provided the items demonstrated reasonable reliability and factor structure in the military sample, we planned to conduct our main analyses of interest, which was to test whether suicide groups differed on the interoceptive deficits latent mean and whether the interoceptive deficits variable associated with SITBs above and beyond other risk factors, which included gender, age, hopelessness, and PTSD symptoms.

As explained in our January 2019 progress report, we were unable to complete Aim 3, which was to test whether Service members have a higher interoceptive deficits latent mean than civilians as the civilian data were lacking key variables to complete this analysis.

Method

Measures

As noted above, all participants completed the 57-tiem Common Data Elements (CDE) assessment, which is a selection of items developed by the MSRC to assess suicide relevant constructs. Most items were taken from existing measures, though some were created by MSRC personnel. Our interoceptive deficits latent variable was created from these items.

Interoceptive deficits indicators.

A single-factor interoceptive deficits latent variable was specified using the same items as described in Study 1. However, as this was a military sample the PCL items were from the military version of the PCL (Weathers et al., 1994).

Current suicidal desire and ideation.

Current suicidal desire was assessed using the four-item Depressive Symptom Index – Suicidality Subscale (DSI-SS; Metalsky & Joiner, 1997; Joiner, Pfaff, Acres, 2002). Participants are asked about suicidal thoughts, suicidal plans, control over suicidal thoughts, and impulses for suicide in the past two weeks. For each question, participants select one of four answer options, scored from 0 to 3. The responses to the four items were summed, creating a total score ranging from 0 to 12 with higher scores indicating greater severity of suicidal desire and ideation. Internal reliability was excellent in the present sample, as indicated by a Cronbach's alpha of .91.

Lifetime number of suicide attempts.

Participants were asked "*How many times in your lifetime have you made an attempt to kill yourself during which you had at least some intent to die?*"

Lifetime number of NSSI acts.

Participants were asked "*How many times in your lifetime have your purposefully hurt yourself* without *wanting to die?"*

Covariates

Hopelessness. The CDEs included three items from the Beck Hopelessness Scale (BHS; Beck, Weissman, Lester, & Trexler, 1972) that were modified to a true/false answer option (*I happen to be particularly lucky, and I expect to get more of the good things in life than the* *average person; I don't expect to get what I really want; Things just won't work out the way I want them to)*. For the first item, a response of "true" is scored as 1 and "false" is scored as 0, for the second and third items a response of "true" is scored as 0 and a response of "false" is scored as 1. Responses to the items are summed to create a total score, ranging 0 to 3. Lower scores indicate greater hopelessness (i.e., higher scores indicate more hopefulness). Internal reliability was acceptable for the present sample (α = .76).

PTSD symptoms.

In addition to the three PCL items used in the creation of the interoceptive deficits latent variable, the CDEs included seven additional items from the PCL-M (*Having physical reactions [e.g., heart pounding, trouble breathing, sweating] when something reminded you of a stressful military experience?; Repeated, disturbing memories, thoughts, or images of a stressful military experience?; Repeated, disturbing dreams of a stressful military experience?; Suddenly acting or feeling as if a stressful military experience were happening again?; Avoiding activities or situations because they reminded you of a stressful military experience?; Being "super alert" or watchful or on guard?; Feeling jumpy or easily startled?*) We included these additional items as control variables in the structural regression analyses to demonstrate specificity of the effect of our latent variable, over and above other PCL-M items.

Data Analytic Strategy

Analyses were primarily completed in M*plus* version 7.3 (Muthén & Muthén, 1998–2012) using robust estimators (i.e., MLR), given that several outcome variables were non-normally distributed (e.g., NSSI frequency, suicide attempts). The covariance coverage matrix indicated that the proportion of pairwise present data ranged from .55-.98 for the No Suicidality group, and from .33-.99 for the Ideator/Planner group, and from .25-.99 for the Attempter group. Missing data resulted from a variety of factors, but were largely due to differing procedures for data collection across the sites. Missing data were handled using full information maximum likelihood (FIML) which is considered to be the best technique for handling missing data, especially when large amounts of data are missing (Enders, 2010). SPSS was used for descriptives, computing correlations, and computing reliabilities.

Preliminary analyses: Measurement model identification

Before testing any of the structural models, a measurement model (i.e., an exploratory factor analysis [EFA]) was tested on the CDE item-defined interoceptive deficits latent variable using a randomly selected subset (n = 410; 10%) of the full sample. Good fit was indicated by χ^2 (lower values indicate better fit), comparative fit index (CFI) ≥ .95, root mean square error of approximation (RMSEA) < .08, and standardized root mean square residual (SRMR) ≤ .08 (Hu & Bentler, 1999). The EFA included the estimation of only one factor and used Geomin rotation. The overall fit was adequate, (χ^2 = 8.57, df = 2, p = .01; CFI = 97; RMSEA = .09 [90% CI: .035, .158]; SRMR = .05). All factor loadings were significant (p < .001) and were between .29 and .95. Internal consistency was also adequate (α = .77).

We next proceeded to testing the model via confirmatory factor analysis (CFA) in the remainder of the sample (n = 3,750). The overall fit was excellent, (χ^2 = 5.44, df = 2, p = .07; CFI = 1.00; TLI = .99; RMSEA = .02 [90% CI: .000, .045]; SRMR = .02). Additionally, all factor loadings were statistically significant, p < .01. Internal consistency was also adequate (α = .76).

Multi-Group Confirmatory Factor Analysis

We followed the recommended sequence to evaluate CFA equivalence (i.e., invariance) across groups (Brown, 2014; Byrne, 2012): establishing the baseline models, testing the configural model, testing the factor loadings model (i.e. constraining loadings to equality), testing the intercepts model (i.e., constraining intercepts to equality), and finally, testing differences in latent means among the No Suicidality, Ideation/Planner, and Attempter groups. Residual variances were estimated freely between groups at each step in factorial equivalence testing, as constraining these to be equal between groups results in an overly strict equivalence criterion (Little & Slegers, 2005; see Byrne, 2012).

Traditionally, $\Delta\chi^2$ tests have been used to determine whether one model fits significantly worse than the other, where a significant value indicates non-invariance. However, recently researchers have contended that the $\Delta\chi^2$ test has a number of limitations “rendering it an impractical and unrealistic criterion upon which to base evidence of invariance” (Byrne, 2012, p. 256). Therefore, some have argued for using other metrics for invariance, for instance, that the multigroup model demonstrate good fit and that ΔCFI between the nested models is < .05 (Byrne, 2012; Little, 1997; Little & Slegers, 2005). Accordingly, $\Delta\chi^2$ values are reported, but were not used as an indicator of factorial invariance; instead we prioritized overall model fit and ΔCFI < .05.

Results

Baseline models

As can be seen in Table 2, the baseline models for all groups had excellent fit and no modification indices (MIs) were above 10.0. Within all groups except the No Suicidality group, all items significantly loaded onto the interoceptive deficits latent variable. Specifically, within the No Suicidality group, the loading for the “pain tolerance” item was nonsignificant (p = .58). However, given the overall good fit and lack of MIs above 10.0, we did not make any changes to the models.

Configural model

We next tested a configural model with no parameter constraints across groups. At this step, the baseline models are simultaneously evaluated. The model fit was excellent, see Table 3.

Factor loadings model

In this next step, we constrained all the factor loadings to equivalence across the three groups. This model did not produce good fit (see Table 3), indicating some level of non-invariance. We next examined MIs related to the factor loadings, and per Byrne’s (2012) recommendations, we relaxed only one constraint at a time and then re-estimated the model after each respecification. MIs indicated that the “emotionally numb” item was non-invariant in the No Suicidality group and “feeling distant” item was non-invariant in the Ideator group. After relaxing the “emotionally numb” item within the No Suicidality group and the “feeling distant” item within the Ideator group, the model demonstrated adequate fit and ΔCFI between the configural model and the factor loadings model was negligible (.01), see Table 3.

Intercepts model

The next step was to constrain the intercepts to be equal across the three groups, which produced a poor fitting model. Given this, we examined MIs and relaxed the constraints on the intercepts one at a time (Byrne, 2012). We ultimately freed intercepts for the following items in the No Suicidality group: “feeling distant”, “emotionally numb”, “avoid thinking about stressful experiences." Thus, the No Suicidality group had its own values for these intercepts, but the intercepts for the other two groups were constrained to equality. After freeing these intercepts in the No Suicidality group, model fit was acceptable and ΔCFI between the factor loading model and the intercepts models was below .05, see Table 3.

Latent means model

Given that each group had at least one loading and intercept in common, we were able to proceed to testing differences in latent means for a partially invariant model (Byrne, 2012). The No Suicidality group served as the reference group and thus its factor mean was fixed to zero. The latent means model demonstrated good fit, see Table 3. The Ideator factor mean (mean = 1.38) was significantly different than the No Suicidality group ($p < .01$), as was the Attempter factor mean (mean = 1.85, $p < .01$). In order to test whether the No Suicidality group and Attempter group differed from the Ideator group, we next set the Ideator group to serve as the reference group. As predicted, the Attempter factor mean was significantly greater than the Ideator group ($p < .01$), and the No Suicidality group was significantly less than the Ideator group ($p < .01$). In sum, we found that the Attempter group had the greatest elevations on the interoceptive deficits latent mean, with the Ideator group intermediary.

Testing the association between interoceptive deficits and SITBs

To determine whether interoceptive deficits were associated with SITB severity over and above other established SITB risk factors, PTSD symptoms, hopelessness, age, and gender were modeled as covariates. Results revealed that the interoceptive deficits latent variable was associated with suicidal ideation ($\beta = .40$, SE = .04, $p < .001$), NSSI ($\beta = .42$, SE = .04, OR = 2.86, $p < .001$), suicide attempts, ($\beta = .17$, SE = .05, OR = 1.44, $p < .001$), and attempt lethality ($\beta = .19$, SE = .04, $p < .001$) over and above these other covariates, see Tables 4-7.

Goal 5: Disseminate study findings

In accordance with our SOW, we disseminated our findings by presenting the work at the American Association for Suicidology and submitting a manuscript detailing the study results to *Suicide and Life Threatening Behavior*.

4. KEY RESEARCH ACCOMPLISHMENTS:

- Established a system for objectively coding suicide attempt lethality and had two raters rate over 1,000 attempts. Raters achieved excellent inter-rater reliability (.90)
- Presented study results at the American Association for Suicidology
- Submitted study results for publication at the leading journal for suicidology
- Based in part on these results, applied for and received funding for an intervention to test an intervention to improve interoception in Active Duty Service Members and Veterans from the Military Suicide Research Consortium

5. CONCLUSION:

Within a large military sample, our results confirm and extend a growing body of research which finds that interoceptive deficits are most pronounced in those who have attempted suicide. Specifically, among military members we found that people who have attempted suicide had greater interoceptive deficits than those with no suicide history, with people who have thought about or planned an attempt intermediary. Additionally, we found that interoceptive deficits had a stronger relationship (i.e., beta values were larger) with suicidal ideation, NSSI, and attempt lethality than any of the other risk factors included in the models, including PTSD symptoms, hopelessness, gender, and age. Our results have several important clinical implications. First, it may be worthwhile to consider assessing for interoceptive deficits when conducting suicide risk assessments with Service members. Second, experimental research finds that interoceptive deficits can be attenuated through relatively straightforward means, which suggests potential clinical applications. For example, looking at one's reflection in a mirror during interoceptive processing (i.e., counting one's heartbeats without taking one's pulse) has been associated with improved interoception (Ainley et al., 2012). Another study found that having people think about self-relevant stimuli, like one's name and hometown, led to better interoceptive accuracy (Ainley et al., 2013). This suggests that teaching people to be more attuned to certain aspects of the self holds promise as a way to improve interoceptive abilities and restore body regard.

6. PUBLICATIONS, ABSTRACTS, AND PRESENTATIONS:

a. List all manuscripts submitted for publication resulting from this project.

Smith, A.R., Dodd, D., Ortiz, S. N., Forrest, L. N., & Witte, T. K. (under review). Interoceptive deficits differentiate suicide groups and associate with self-injurious thoughts and behaviors in a military sample. *Suicide and Life Threatening Behavior.*

b. List presentations made during the last year (international, national, local societies, military meetings, etc.). Use an asterisk (*) if presentation produced a manuscript.

***Smith, A. R.** (2019, April). Associations between interoceptive deficits and suicidality in a large military sample. In **A. Smith** (chair), *Updates on the link between interoceptive deficits and suicidality: Testing longitudinal and objective methods*. Symposium conducted at the American Association for Suicidology, Denver, CO.

7. INVENTIONS, PATENTS AND LICENSES:

Nothing to report

8. REPORTABLE OUTCOMES:

Nothing to report

9. OTHER ACHIEVEMENTS:

Based in part on this work, we applied for and received a grant to test an intervention to improve interoception in Active Duty Service Members and Veterans from the Military Suicide Research Consortium.

Military Suicide Research Consortium (MSRC)
Department of Defense, Award #R02106
Title: Reconnecting: Improving interoception to reduce suicidal ideation in the military
Period: March 2019 – March 2021
Role: Principal Investigator
Total Awarded: $952,189

10. REFERENCES:

Ainley, V., Maister, L., Brokfeld, J., Farmer, H., & Tsakiris, M. (2013). More of myself: Manipulating interoceptive awareness by heightened attention to bodily and narrative aspects of the self. *Consciousness and Cognition*, *22*(4), 1231-1238.

Ainley, V., Tajadura-Jiménez, A., Fotopoulou, A., & Tsakiris, M. (2012). Looking into myself: The effect of self-focused attention on interoceptive sensitivity. *Psychophysiology, 49*(11), 1504-1508.

Bagby, R. M., Parker, J. D. A., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia Scale—Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research, 38*(1), 23 – 32.

Beck, A. T., Weissman, A., Lester, D., & Trexler, L. (1974). The measurement of pessimism: The Hopelessness Scale. *Journal of Consulting and Clinical Psychology*, *42*, 861-865.

Berman, A. L., Shepherd, G., & Silverman, M. M. (2003). The LSARS-II: Lethality of suicide attempt rating scale—updated. *Suicide and Life-Threatening Behavior*, *33*(3), 261-276.

Brown, T. A. (2014). *Confirmatory Factor Analysis for Applied Research*. Guilford Publications.

Byrne, B. M. (2012). *Structural Equation Modeling with Mplus: Basic Concepts, Applications, and Programming*. Routledge.

Enders, C. K. (2010). *Applied missing data analysis*. Guilford press.

Garner, D. M., Olmstead, M. P., & Polivy, J. (1983). Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. *International Journal of Eating Disorders, 2*, 15-34.

Joiner Jr, T. E., Pfaff, J. J., & Acres, J. G. (2002). A brief screening tool for suicidal symptoms in adolescents and young adults in general health settings: Reliability and validity data from the Australian National General Practice Youth Suicide Prevention Project. *Behaviour Research and Therapy*, *40*(4), 471-481.

Little, T. D. (1997). Mean and covariance structures (MACS) analyses of cross-cultural data: Practical and theoretical issues. *Multivariate Behavioral Research*, *32*(1), 53-76.

Little, R. J., & Slegers, D. W. (2005). Encyclopedia of Statistics in Behavioral Science. John Wiley & Sons, Ltd.

Mehling, W. E., Price, C., Daubenmier, J. J., Acree, M., Bartmess, E., & Stewart, A. (2012). The multidimensional assessment of interoceptive awareness (MAIA). *PLoS ONE, 7*(11), e48230.

Metalsky, G. I., & Joiner, T. E. (1997). The hopelessness depression symptom questionnaire. *Cognitive Therapy and Research, 21*, 359-384.

Muthén, L. K., & Muthén, B. O. (1998-2012). Mplus User's Guide. Seventh Edition. Los Angeles, CA: Muthén & Muthén

Ribeiro, J. D., Witte, T. K., Van Orden, K. A., Selby, E. A., Gordon, K. H., Bender, T. W., & Joiner Jr, T. E. (2014). Fearlessness about death: The psychometric properties and construct validity of the revision to the Acquired Capability for Suicide Scale. *Psychological Assessment, 26*(1), 115.

Weathers, F. W., Litz, B. T., Huska, J. A., & Keane, T. M. (1994). The PTSD checklist (PCL). *Unpublished scale available from the National Center for PTSD*. Retrieved from https://www.ptsd.va.gov/professional/assessment/documents/APCLM.pdf

Witte, T. K., Holm-Denoma, J. M., Zuromski, K. L., Gauthier, J. M., & Ruscio, J. (2017). Individuals at high risk for suicide are categorically distinct from those at low risk. *Psychological Assessment, 29*(4), 382-393.

Award expenditures to date:

Cumulative		Cumulative	
Personnel	$75,265.33	Travel	$4,044.68
Fringe Benefits	$12,897.68	Equipment/Facility Rental/User Fees	$0
Materials/Supplies	$2,135.31	Participant/Trainee Support	$0
Subject Costs	$0	Subaward/Contractual Costs	$0
Consultant Services	$9,500	Other Direct Costs	$0

Cumulative

Subtotal $103,843

Indirect Costs $46,123

Total $149,966

11. APPENDICES:

Appendix A. Tables

Table 1
Demographic characteristics for Study 1 and Study 2 samples

	Study 1 (*N* = 134)	Study 2 (*N* = 3764)
	n (%)	*n* (%)
Gender		
Male	66 (49.3)	2998 (79.6)
Female	67 (50.0)	674 (17.9)
Transgender	Not assessed	9 (0.2)
Other	1 (0.7)	1 (0.0)
Not reported	0 (0)	82 (2.2)
Race		
American Indian/Alaska Native	2 (1.5)	40 (1.1)
Asian	8 (6.0)	94 (2.5)
Black/African American	11 (8.2)	707 (18.8)
Native Hawaiian/Pacific Islander	1 (0.7)	8 (0.2)
White	108 (80.6)	2386 (63.4)
Multiracial	1 (0.7)	43 (1.1)
Other	3 (2.2)	376 (10.0)
Not reported	0 (0)	110 (2.9)
Ethnicity		
Hispanic	6 (4.5)	377 (10.0)
Not Hispanic	128 (95.5)	2999 (79.7)
Other	0 (0)	61 (1.6)
Not reported	0 (0)	327 (8.7)
Military service	Not assessed	
Currently serving	–	2392 (63.5)
Veteran	–	1346 (35.8)
Served but status unknown	–	26 (0.7)
Deployment	Not assessed	
No	–	1341 (35.6)
Yes	–	1550 (41.2)
Not reported	–	873 (23.2)
Military branch	Not assessed	
Army	–	1960 (52.1)
Air Force	–	176 (4.7)
Navy	–	471 (19.7)
Marine Corps	–	456 (12.1)
Coast Guard	–	26 (0.7)
Unspecified/Other	–	36 (1.0)
Not reported	–	369 (9.8)
Suicidality		
No suicidality	96 (71.6)	918 (24.4)
Ideation	30 (22.4)	1488 (39.5)
Attempt	8 (6.0)	1078 (28.6)

	M (*SD*)	*M* (*SD*)
Age	37.0 (11.8)	33.3 (14.2)

Note. In Study 1, ideation, planning, and attempting were each assessed. However, in Study 2, an assessment of suicide plans was not available. Thus, for Study 1 participants, the *ideation* category includes participants who reported ideation with no suicide plan and participants who reported ideation with a suicide plan.

Table 2

Fit indices for the baseline interoceptive deficits latent variable models among Study 2 suicidality groups

Group	χ^2 (*df*)	*p*	MLR scaling correction	CFI	TLI	RMSEA (90% CI)	SRMR
No suicidality	0.27 (2)	.88	1.318	1.000	1.020	.000 (.000, .033)	.004
Ideator	1.44 (2)	.49	1.050	1.000	1.004	.000 (.000, .047)	.013
Attempt	4.15 (2)	.13	1.018	0.990	0.971	.032 (.000, .075)	.027

Note. Total N = 3764, No suicidality n = 918, Ideation n = 1488, Attempt n = 1078. MLR = maximum likelihood with robust standard errors, CFI = comparative fit index, TLI = Tucker–Lewis Index, RMSEA = root mean square error of approximation, SRMR = standardized root mean square residual.

Table 3

Fit indices for the interoceptive deficits latent variable multigroup confirmatory factor analysis

Model	χ^2 (*df*)	CFI	TLI	RMSEA (90% CI)	SRMR	Model comp	$\Delta\chi^2$ (Δdf)	ΔCFI	ΔTLI	ΔRMSEA	ΔSRMR	Decision
M1: Configural	5.40 (6)	1.000	1.002	.000 (.000, .036)	.018	–	–	–	–	–	–	–
M2: Factor loadings	76.75** (14)	0.930	0.910	.062 (.049, .076)	.140	M1	71.35 (8)	.070	.092	.062	.122	Reject
M2a: Partial factor loadings	26.11* (12)	0.984	0.976	.032 (.015, .049)	.056	M1	20.71 (6)	.016	.026	.032	.038	Accept
M3: Intercepts	690.25** (19)	0.253	0.292	.175 (.164, .186)	.358	M2a	664.14 (7)	.731	.684	.143	.302	Reject
M3a: Partial intercepts	70.15** (17)	0.941	0.937	.052 (.040, .065)	.074	M2a	44.04 (5)	.043	.039	.020	.018	Accept
M4: Latent means	29.06* (13)	0.982	0.975	.033 (.017, .049)	.050	M3a	41.09 (4)	.041	.038	.019	.024	Accept

Note. Total N = 3764, No suicidality n = 918, Ideation n = 1488, Attempt n = 1078. CFI = comparative fit index, TLI = Tucker–Lewis Index, RMSEA = root mean square error of approximation, SRMR = standardized root mean square residual, model comp = model comparison.

* $p \leq .01$, **$p < .0001$

Table 4

Regression results of interoceptive deficits latent variable positively associating with suicide ideation over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	1.40	0.16	0.40 (0.33, 0.47)	< .001
Age	–0.01	0.00	–0.05 (–0.08, –0.02)	.002
Gender	–0.03	0.12	0.00 (–0.04, 0.03)	.81
Hopelessness	0.70	0.05	0.29 (0.25, 0.32)	< .001
PCL Memories	0.04	0.07	0.02 (–0.05, 0.09)	.56
PCL Dreams	–0.01	0.07	0.00 (–0.07, 0.07)	.91
PCL Flashback	0.05	0.07	0.02 (–0.04, 0.08)	.51
PCL Avoid reminders	0.03	0.06	0.02 (–0.04, 0.08)	.59
PCL On guard	–0.08	0.05	–0.04 (–0.09, 0.01)	.08
PCL Startled	0.18	0.05	0.09 (0.04, 0.15)	< .001
PCL Physical reactions	–0.15	0.07	–0.07 (–0.13, –0.01)	.02

Note. PCL = PTSD Checklist; PCL Memories = repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being “super alert” or watchful or on guard; PCL Startled = feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

Table 5

Regression results of interoceptive deficits latent variable associating with nonsuicidal self–injury over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	1.05	0.15	0.42 (0.33, 0.50)	< .001
Age	–0.03	0.00	–0.20 (–0.25, –0.16)	< .001
Gender	0.42	0.11	0.08 (0.04, 0.12)	< .001
Hopelessness	0.32	0.04	0.18 (0.14, 0.23)	< .001
PCL Memories	0.01	0.06	0.01 (–0.08, 0.09)	.87
PCL Dreams	–0.09	0.06	–0.06 (–0.13, 0.02)	.14
PCL Flashback	0.06	0.06	0.03 (–0.03, 0.10)	.32
PCL Avoid reminders	–0.11	0.05	–0.08 (–0.14, –0.01)	.03
PCL On guard	0.02	0.04	0.02 (–0.04, 0.08)	.59
PCL Startled	0.13	0.04	0.09 (0.03, 0.15)	< .01
PCL Physical reactions	0.00	0.06	0.00 (–0.07, 0.08)	.95

Note. PCL = PTSD Checklist; PCL Memories = repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being "super alert" or watchful or on guard; PCL Startled = feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

Table 6

Regression results of interoceptive deficits latent variable associating with suicide attempts over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	0.36	0.10	0.17 (0.05, 0.26)	< .001
Age	0.01	0.00	0.09 (0.06, 0.13)	< .001
Gender	0.22	0.09	0.04 (0.01, 0.08)	.02
Hopelessness	0.31	0.03	0.19 (0.15, 0.23)	< .001
PCL Memories	0.02	0.05	0.02 (–0.06, 0.09)	.66
PCL Dreams	0.02	0.05	0.02 (–0.05, 0.09)	.66
PCL Flashback	–0.02	0.05	–0.02 (–0.08, 0.05)	.63
PCL Avoid reminders	–0.02	0.04	–0.01 (–0.08, 0.05)	.68
PCL On guard	0.03	0.04	0.03 (–0.03, 0.08)	.39
PCL Startled	0.13	0.04	0.10 (0.05, 0.16)	< .001
PCL Physical reactions	0.01	0.05	0.00 (–0.06, 0.07)	.91

Note. PCL = PTSD Checklist; PCL Memories = repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being “super alert” or watchful or on guard; PCL Startled = feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

Table 7

Regression results of interoceptive deficits latent variable associating with suicide attempt lethality over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	0.56	0.13	0.19 (0.11, 0.28)	< .001
Age	0.01	0.00	0.04 (0.01, 0.08)	.01
Gender	0.08	0.11	0.01 (–0.02, 0.04)	.45
Hopelessness	0.23	0.04	0.11 (0.07, 0.15)	< .001
PCL Memories	–0.05	0.06	–0.03 (–0.10, 0.04)	.46
PCL Dreams	0.12	0.06	0.07 (0.00, 0.14)	.06
PCL Flashback	–0.05	0.07	–0.03 (–0.09, 0.04)	.46
PCL Avoid reminders	–0.10	0.05	–0.06 (–0.12, 0.00)	.07
PCL On guard	–0.01	0.05	–0.01 (–0.06, 0.05)	.81
PCL Startled	0.12	0.05	0.07 (0.02, 0.13)	.01
PCL Physical reactions	0.05	0.06	0.03 (–0.04, 0.09)	.46

Note. PCL = PTSD Checklist; PCL Memories = repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being "super alert" or watchful or on guard; PCL Startled = feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

Supplemental Table 1

Bivariate correlations among the latent interoceptive deficits variable and other measures of interoceptive deficits/awareness

	1	2	3	4
1. Proposed ID variable	−			
2. EDI–ID	.51**	−		
3. TAS	.45**	.60**	−	
4. MAIA	–.27**	–.40**	–.60**	−

Note. ID = interoceptive deficits, EDI = Eating Disorder Inventory–Interoceptive Deficits subscale, TAS = Toronto Alexithymia Scale total, MAIA = Multidimensional Assessment of Interoceptive Awareness total. ** $p < .001$

Appendix B. Copy of submitted article

Interoceptive deficits differentiate suicide groups and associate with self-injurious thoughts and behaviors in a military sample

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Abstract

Objective: Previous research shows that interceptive deficits are associated with harmful behaviors such as nonsuicidal self-injury (NSSI), eating disorder pathology, and suicide attempts. The present study replicates and extends this area of research by examining the association between interoceptive deficits and suicidality in a military sample.

Method: In Study 1, respondents to an online survey (*N*=134) answered self-report questionnaires related to interoceptive deficits. Study 2 consisted of a secondary data analysis of 3764 military service members who had previously completed questionnaires on interoceptive indicators, NSSI, suicide thoughts and attempts, and other psychopathology.

Results: Study 1 demonstrated that our interoceptive deficits latent variable had adequate psychometric properties. In Study 2 multigroup confirmatory factor analysis showed that scores on the interoceptive deficits latent variable were highest among suicide attempters, lowest among those with no suicide history, and intermediary among participants who had thought about but not attempted suicide. The interoceptive deficits latent variable was more strongly related to NSSI and suicidality than were posttraumatic stress disorder symptoms, hopelessness, gender, and age.

Conclusions: These results confirm—and extend to a military sample—previous research showing that interoceptive deficits can provide important information about suicide risk.

Keywords: interoception; interoceptive deficits; suicide; military; self-harm

Interoceptive deficits differentiate suicide groups and associate with self-injurious thoughts and behaviors in a military sample

Self-injurious thoughts and behaviors (SITBs), including nonsuicidal self-injury (NSSI) as well as suicide ideation, plans, and attempts are serious public health problems worldwide (World Health Organization [WHO], 2019). Although suicide occurs among people of all nationalities, genders, races, and ages, some groups have a particularly elevated risk for suicide. Veterans are one such group: according to a recent report by the Department of Veteran's Affairs (2018), the suicide rate for Veterans is 1.5 times higher (adjusting for age and sex) than the rate for non-Veteran adults. And although suicides among active duty military personnel have historically been comparable to or lower than civilian suicide rates (Reimann & Mazuchowski, 2018), suicide among active duty service members is a growing concern given sharp increases in the suicide rate for this population in recent years (Armed Forces Health Surveillance Center, 2012; Kuehn, 2009).

Given the prevalence and seriousness of suicide, it is crucial that researchers and healthcare providers strive to better understand risk factors for suicide attempts and deaths and develop stronger prevention and intervention programs to address SITBs. Previous research has established that even the strongest known risk factors for SITBs have low predictive power and only marginally improve prediction above chance (Franklin et al., 2017; Ribeiro et al., 2016). Clearly, explanatory factors for suicide risk must continue to be improved.

Interoceptive deficits are one promising risk factor for suicidal behavior that may yield greater predictive power than previously studied factors. Interoception is the ability to accurately perceive and interpret the sensations of the physical body, such as touch, temperature, emotions, pain, itch, hunger, fullness, cardiovascular activity, and respiratory activity (Craig, 2003). Interoceptive deficits refer to a disconnection from the physical body which can cause difficulty in truly understanding and knowing one's own body. This disconnection can have wide reaching negative effects (e.g., Paulus, Feinstein, Khalsa, 2019). Of most relevance to the present research is theoretical and empirical work suggesting that interoceptive deficits seem to facilitate an increased ability to engage in self-harming behaviors. Thus, within a military sample, the aim of the present study was to test whether interoceptive deficits differentiate between suicide groups (i.e., those with no suicidality, those with suicide ideation and/or planning, and those who have attempted suicide) and to test whether interoceptive deficits are associated with SITBs over and above established risk factors.

Muehlenkamp (2012) theorizes that interoception is an important component of body regard (how one perceives, cares for, and experiences the body). For example, if someone is disconnected from their body they may not feel protective and caring towards it which in turn should make it easier to engage in behaviors that harm the body. Furthermore, disconnection from the body may contribute to increased body objectification, and the more a body is seen as an object the easier it should be to harm. As detailed below, a burgeoning body of empirical research supports this theoretical supposition.

Research shows an association between self-harming behaviors and interoceptive deficits. For instance, people with eating disorders—who by definition chronically engage in behaviors that harm the physical body such as self-starvation or self-induced vomiting—are consistently shown to have greater interoceptive deficits than people without eating disorders (Fassino, Pierò, Gramaglia, & Abbate-Daga, 2004; Garner, 2004; Pollatos et al., 2008; Jenkinson, Taylor, & Laws, 2018). Similarly, individuals who engage in NSSI or attempt suicide appear to have greater interoceptive deficits than those without self-harming behaviors. Specifically, Franklin and colleagues (2012) found that young adults who self-injure took longer to perceive pain, perceived pain as less intense once detected, and tolerated higher pain intensities than young adults who do not self-injure. Ross and colleagues (2009) found that adolescents who self-injure report greater difficulty identifying and describing emotions than adolescents who do not self-injure. More recently, Forrest and colleagues (2015) compared interoceptive deficits across groups with varying suicidality, and found that (1) suicide attempters reported significantly greater interoceptive deficits than suicide ideators and planners, (2) attempters, ideators, and planners reported greater interoceptive deficits than non-suicidal controls, and (3) recent suicide attempters reported greater interoceptive deficits than those with more distal attempts. Additionally, people with eating disorders who also have a history of suicide attempts show greater interoceptive deficits than those with eating disorders alone (Forcano et al., 2009; Smith, Forrest, & Velkoff, 2018) or co-occurring NSSI (Favaro & Santonastaso, 1998; Muehlenkamp, Peat, Claes, & Smits, 2012; Smith, Forrest, & Velkoff, 2018). Taken together, there is clear and consistent evidence of an association between interoceptive deficits and engaging in self-harming behavior.

Research on the direction of the association between interoceptive deficits and self-harming behaviors supports the theorized causality. Prospective research in a non-clinical sample of adolescent girls found that interoceptive deficits predicted disordered eating one year later (Leon, Fulkerson, Perry, & Early-Zald, 1995). Moreover, among patients with anorexia nervosa, interoceptive deficits prospectively predicted greater eating disorder symptom severity five to ten years later (Bizeul, Sawosky, & Rigaud, 2001), and in a sample of women with eating disorders who were followed longitudinally for eight years, interoceptive deficits at baseline were greater among those who went on to attempt suicide during the course of the study versus those who did not (Franko et al., 2004).

Overall, past research demonstrates that interoceptive deficits are associated with SITBs, and that greater interoceptive deficits are associated with more methods of self-harm (e.g., eating disorder behavior and NSSI versus eating disorder behavior alone) and more dangerous SITBs (e.g., suicide attempts versus ideation). However, to our knowledge, no studies have examined the relation between interoceptive deficits and SITBs in a military sample. Extending the research on interoceptive deficits and SITBs to a military sample is important because of the elevated risk of death by suicide among those who have served in the military, and because evidence suggests that military populations have elevated rates of symptoms related to interoceptive deficits, such as emotional numbness and pain insensitivity (Guerra & Calhoun, 2011; Nademin et al., 2008; Shelef et al., 2014). Furthermore, interoceptive deficits have potential as a target for clinical intervention given that relatively simple and straightforward interventions can be used to improve interoception (Ainley et al., 2012; Aspell et al., 2013; Smith et al., in preparation).

The present study aimed to replicate existing research on the relation between interoception and SITBs while also expanding it to a military sample. In Study 1 we created an interoceptive deficits latent variable and tested its validity, and in Study 2 we tested whether the interoceptive deficits latent mean differed between those with no suicidality, those with suicide ideation and/or planning, and those who have attempted suicide. We hypothesized that the latent mean would significantly differ across all groups, with suicide attempters having the highest mean, those with no suicidality having the lowest mean, and those with suicide ideation and/or planning falling in between. Furthermore, we hypothesized that interoceptive deficits would be positively associated with SITBs and that this relation would hold controlling for other SITB risk factors.

Study 1

Because the main study (see Study 2) was a secondary data analysis, an existing measure of interoceptive deficits was not included. However, the Study 2 data included several items referred to as Common Data Elements (CDE), which are items that all investigators funded by the Military Suicide Research Consortium (MSRC) are asked to collect. Thus, the first and fourth author reviewed all the items included in the CDE assessment battery and independently selected items that were believed to tap the construct of "interoceptive deficits." These items were then reviewed and discussed, which led to the selection of four items that were believed to have the greatest face validity for interoceptive deficits: three items that assessed emotional numbness or disconnect and one item assessing pain tolerance (see item descriptions in Measures section). The purpose of Study 1 was to examine the convergent validity between these items and more established measures of interoceptive deficits in an independent sample.

Participants and procedures

We collected data from a sample of participants recruited from Amazon's Mechanical Turk (MTurk; $N = 134$, 50.0% female, 80.6% white, average age = 37; see Table 1) to determine the validity of our proposed interceptive deficits latent variable. MTurk is an online recruitment website designed to match paid tasks to participants with the appropriate task characteristics.

Participation for the validation study was limited to individuals who indicated that they were located in the United States. To increase the validity of data collected online, only workers who had an approval rating of 90% or more were eligible to take part in the study. Additionally, two attention checks were included in the survey. One hundred seventy-five participants initiated the study and completed study measures. Participants who failed either attention check ($n = 41$) were excluded, resulting in a final sample of 134.

Measures

Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al., 2012). The MAIA is a 32-item instrument that has participants rate how often statements apply to their general daily life on scale from 0 (*never*) to 5 (*always*). Scores for each of the measure's eight scales are calculated by averaging the scores of the individual items. The eight scales are: not distracting, not worrying, attention regulation, emotional awareness, self-regulation, body listening, and trusting. An example of an item is *I notice where in my body I am comfortable.* Internal reliability for this measure in the present study was excellent (Cronbach's alpha = .95).

Eating Disorder Inventory - Interoceptive Deficits subscale (Garner et al., 1983). This ten-item subscale measuring interoceptive deficits has participants rate answers on a scale from 1 (*never*) to 6 (*always*). An example item is *I don't know what is going on inside me.* Subscale scores were computed by summing items after some items were reverse-coded; higher scores indicate more severe deficits in interoceptive abilities. The Interoceptive Deficits subscale demonstrated good internal reliability in this sample (Cronbach's alpha = .88).

Toronto Alexithymia Scale (TAS; Bagby, Parker, & Taylor, 1994). This measure is the most widely used instrument for measuring alexithymia, which is closely related to interoceptive deficits (Brewer, Cook, & Bird, 2016). It contains 20 items. An example of an item is *It is difficult for me to find the right words for my feelings*. Items are rated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The TAS-20 demonstrated good internal reliability in this study (Cronbach's alpha = .86).

Proposed Interoceptive Deficits Latent Variable. To create our latent variable, we used three items from the PTSD CheckList (PCL; Weathers, Litz, Huska, & Keane, 1994) and one item from the Acquired Capability for Suicide Scale (ACSS; Riberio et al., 2014). The PCL is a standardized self-report measure that evaluates key symptoms related to PTSD. Participants rate how bothered they have been by a symptom over the past month using a 5-point scale ranging from 'Not at all' to 'Extremely'. The following items from this measure were used in analyses: *avoid thinking about or talking about a stressful experience from the past or avoid having feelings related to it; feeling distant or cut off from other people; feeling emotionally numb or being unable to have loving feelings for those close to you.* The one Likert-type item from the ACSS assessed subjective pain tolerance and was phrased, *I can tolerate a lot more pain than most people.* Scores could range from 0 to 4, with higher scores indicating greater subjective pain tolerance. Similar self-reported items have been found to load onto a factor indexing discomfort and pain tolerance (Schmidt, Richey, & Fitzpatrick, 2006).

Results

The CDE-defined interoceptive deficits variable had acceptable internal consistency ($\alpha = .71$). Crucially, the sum of the CDE-defined interoceptive deficits variable exhibited moderate-to-strong correlations with existing measures of interoceptive deficits ($r = .51$ with Eating Disorders Inventory—Interoceptive Deficits subscale; $r = .45$ with TAS; $r = -.23$ with MAIA total score; all $ps < .01$; see Online Supplemental Table 1). These correlations are similar in magnitude to the correlations among these existing measures of interoceptive deficits. Taken together this initial study demonstrates that the CDE-defined interoceptive deficits variable had adequate reliability and convergent validity with existing interoceptive deficits measures.

Study 2

After establishing preliminary construct validity for our proposed interoceptive deficits latent variable, we proceeded to examine its psychometric properties in a large military sample. Provided the items demonstrated reasonable reliability and factor structure in the military sample, we planned to conduct our main analyses of interest, which was to test whether suicide groups differed on the interoceptive deficits latent mean and whether the interoceptive deficits variable associated with SITBs above and beyond other risk factors, which included gender, age, hopelessness, and PTSD symptoms.

Method

Participants and procedures

This was a secondary data analysis using participants who were previously recruited from 25 independent studies funded by the MSRC and who indicated they had served in the military (see Witte et al., 2017 for a more detailed description of recruitment procedures). As noted below, 10% of the data was used for conducting an exploratory factor analysis of the interoceptive deficits latent variable. The remaining 90% of the sample was used for all additional analyses and thus we describe the composition of that sample. The sample consisted of 3764 individuals (79.6% males). The sample ranged in age from 18-88 ($M = 33.34$, $SD = 14.21$) and was predominately non-Hispanic (79.7%) and White (63.4%). The majority of participants (52.1%) reported being associated with the Army, see Table 1. Each primary study site obtained approval from their respective Institutional Review Board (IRB) to collect the initial data, and the authors of the current study received IRB approval to conduct secondary data analyses.

Measures

As noted above, all participants completed the 57-tiem Common Data Elements (CDE) assessment, which is a selection of items developed by the MSRC to assess suicide relevant constructs. Most items were taken from existing measures, though some were created by MSRC personnel. Our interoceptive deficits latent variable was created from these items.

Interoceptive deficits indicators. A single-factor interoceptive deficits latent variable was specified using the same items as described in Study 1. However, as this was a military sample the PCL items were from the military version of the PCL (Weathers et al., 1994).

Current suicidal desire and ideation. Current suicidal desire was assessed using the four-item Depressive Symptom Index – Suicidality Subscale (DSI-SS; Metalsky & Joiner, 1997; Joiner, Pfaff, Acres, 2002). Participants are asked about suicidal thoughts, suicidal plans, control over suicidal thoughts, and impulses for suicide in the past two weeks. For each question, participants select one of four answer options, scored from 0 to 3. The responses to the four items were summed, creating a total score ranging from 0 to 12 with higher scores indicating greater severity of suicidal desire and ideation. Internal reliability was excellent in the present sample, as indicated by a Cronbach's alpha of .91.

Lifetime number of suicide attempts. Participants were asked "*How many times in your lifetime have you made an attempt to kill yourself during which you had at least some intent to die?*"

Lifetime number of NSSI acts. Participants were asked "*How many times in your lifetime have your purposefully hurt yourself* without *wanting to die?"*

Objective lethality of most serious suicide attempt. Participants were asked to write a narrative account of their most lethal suicide attempt (*Thinking about the most lethal attempt, describe the details of the plan and method used. Use the space below. If you have never attempted to kill yourself with at least some intent to die, please leave the space below blank.*). Participants were also asked about the level of medical attention required for this suicide attempt, on the following scale: *0=no medical attention; 1=primary care doctor or nurse visit; 2=emergency room visit; 3=hospital admission to a general medical floor; 4=hospital admission to an intensive care unit.* Three doctoral students in clinical psychology used both the narrative description and the medical attention received to rate the lethality of the suicide attempt. The rating scheme was based on the Lethality of Suicide Attempt Rating Scale-II (LSARS-II; Berman, Shepherd, & Silverman, 2003) as modified by Witte and colleagues (2017), with some additional modifications for the present study. Participants who reported having never attempted suicide, and those for whom information was insufficient or unclear enough to provide an accurate lethality rating, received an LSARS score of 0. Lethality ratings for suicide attempts ranged 1 to 11, with higher scores indicating more lethal attempts (M = 4.84, SD = 2.30, range = 1-11).

One rater coded all participants, and each of the other two raters coded half of the participants, resulting in two rater pairs. If raters disagreed on whether an attempt had occurred or whether there was enough information to accurately rate the lethality, the study's principal investigator—a licensed clinical psychologist with substantial experience treating and researching suicidality—made a determination as to whether the case would be rated. The inter-rater reliability for LSARS scores for the two pairs of raters was excellent, with both pairs achieving reliability of .90.

Suicide study group. For analyses involving group comparisons, participants were assigned to one of three suicidality groups. Those with incomplete data on suicidality history and related variables were excluded from these analyses (n = 307). Participants were classified as Attempters (coded as group 2) if their LSARS score was greater than 0 (n = 1,078). Participants were classified as Ideators/planners (coded as group 1) if their LSARS score was 0, and either their DSI-SS score was greater than 0 or they endorsed lifetime suicidality on a separate CDE item (*Have you ever thought about or attempted to kill yourself?*)span style="font-family:'Times New Roman'"> (n = 1,488). Lastly, participants were classified as No Suicidality (coded as group 0) if their LSARS score was 0, and their DSI-SS score was 0, and they did not endorse lifetime suicidality on the CDE item *Have you ever thought about or attempted to kill yourself?* (n = 918).

Covariates

Hopelessness. The CDEs included three items from the Beck Hopelessness Scale (BHS; Beck, Weissman, Lester, & Trexler, 1972) that were modified to a true/false answer option (*I happen to be particularly lucky, and I expect to get more of the good things in life than the average person; I don't expect to get what I really want; Things just won't work out the way I want them to).* For the first item, a response of "true" is scored as 1 and "false" is scored as 0, for the second and third items a response of "true" is scored as 0 and a response of "false" is scored as 1. Responses to the items are summed to create a total score, ranging 0 to 3. Lower scores indicate greater hopelessness (i.e., higher scores indicate more hopefulness). Internal reliability was acceptable for the present sample (α = .76).

PTSD symptoms. In addition to the three PCL items used in the creation of the interoceptive deficits latent variable, the CDEs included seven additional items from the PCL-M (*Having physical reactions [e.g., heart pounding, trouble breathing, sweating] when something reminded you of a stressful military experience?; Repeated, disturbing memories, thoughts, or images of a stressful military experience?; Repeated, disturbing dreams of a stressful military experience?; Suddenly acting or feeling as if a stressful military experience were happening again?; Avoiding activities or situations because they reminded you of a stressful military experience?; Being "super alert" or watchful or on guard?; Feeling jumpy or easily startled?*) We included these additional items as control variables in the structural regression analyses to demonstrate specificity of the effect of our latent variable, over and above other PCL-M items.

Data Analytic Strategy

Analyses were primarily completed in *Mplus* version 7.3 (Muthén & Muthén, 1998–2012) using robust estimators (i.e., MLR), given that several outcome variables were non-normally distributed (e.g., NSSI frequency, suicide attempts). The covariance coverage matrix indicated that the proportion of pairwise present data ranged from .55-.98 for the No Suicidality group, and from .33-.99 for the Ideator/Planner group, and from .25-.99 for the Attempter group. Missing data resulted from a variety of factors, but were largely due to differing procedures for data collection across the sites. Missing data were handled using full information maximum likelihood (FIML) which is consideredo be the best technique for handling missing data, especially when large amounts of data are missing (Enders, 2010). SPSS was used for descriptives, computing correlations, and computing reliabilities.

Preliminary analyses: Measurement model identification

Before testing any of the structural models, a measurement model (i.e., an exploratory factor analysis [EFA]) was tested on the CDE item-defined interoceptive deficits latent variable using a randomly selected subset (n = 410; 10%) of the full sample. Good fit was indicated by χ^2 (lower values indicate better fit), comparative fit index (CFI) ≥ .95, root mean square error of approximation (RMSEA) < .08, and standardized root mean square residual (SRMR) ≤ .08 (Hu & Bentler, 1999). The EFA included the estimation of only one factor and used Geomin rotation. The overall fit was adequate, (χ^2 = 8.57, *df* = 2, *p* = .01; CFI = 97; RMSEA = .09 [90% CI: .035, .158]; SRMR = .05). All factor loadings were significant ($p < .001$) and were between .29 and .95. Internal consistency was also adequate (α = .77).

We next proceeded to testing the model via confirmatory factor analysis (CFA) in the remainder of the sample (n = 3,750). The overall fit was excellent, (χ^2 = 5.44, *df* = 2, *p* = .07; CFI = 1.00; TLI = .99; RMSEA = .02 [90% CI: .000, .045]; SRMR = .02). Additionally, all factor loadings were statistically significant, $p < .01$. Internal consistency was also adequate (α = .76).

Multi-Group Confirmatory Factor Analysis

We followed the recommended sequence to evaluate CFA equivalence (i.e., invariance) across groups (Brown, 2014; Byrne, 2012): establishing the baseline models, testing the configural model, testing the factor loadings model (i.e. constraining loadings to equality), testing the intercepts model (i.e., constraining intercepts to equality), and finally, testing differences in latent means among the No Suicidality, Ideation/Planner, and Attempter groups. Residual variances were estimated freely between groups at each step in factorial equivalence testing, as constraining these to be equal between groups results in an overly strict equivalence criterion (Little & Slegers, 2005; see Byrne, 2012).

Traditionally, $\Delta\chi^2$ tests have been used to determine whether one model fits significantly worse than the other, where a significant value indicates non-invariance. However, recently researchers have contended that the $\Delta\chi^2$ test has a number of limitations "rendering it an impractical and unrealistic criterion upon which to base evidence of invariance" (Byrne, 2012, p. 256). Therefore, some have argued for using other metrics for invariance, for instance, that the multigroup model demonstrate good fit and that ΔCFI between the nested models is < .05 (Byrne, 2012; Little, 1997; Little & Slegers, 2005). Accordingly, $\Delta\chi^2$ values are reported, but were not used as an indicator of factorial invariance; instead we prioritized overall model fit and ΔCFI < .05.

Results

Baseline models

As can be seen in Table 2, the baseline models for all groups had excellent fit and no modification indices (MIs) were above 10.0. Within all groups except the No Suicidality group, all items significantly loaded onto the interoceptive deficits latent variable. Specifically, within the No Suicidality group, the loading for the "pain tolerance" item was nonsignificant (p = .58). However, given the overall good fit and lack of MIs above 10.0, we did not make any changes to the models.

Configural model

We next tested a configural model with no parameter constraints across groups. At this step, the baseline models are simultaneously evaluated. The model fit was excellent, see Table 3.

Factor loadings model

In this next step, we constrained all the factor loadings to equivalence across the three groups. This model did not produce good fit (see Table 3), indicating some level of non-invariance. We next examined MIs related to the factor loadings, and per Byrne's (2012) recommendations, we relaxed only one constraint at a time and then re-estimated the model after each respecification. MIs indicated that the "emotionally numb" item was non-invariant in the No Suicidality group and "feeling distant" item was non-invariant in the Ideator group. After relaxing the "emotionally numb" item within the No Suicidality group and the "feeling distant" item within the Ideator group, the model demonstrated adequate fit and ΔCFI between the configural model and the factor loadings model was negligible (.01), see Table 3.

Intercepts model

The next step was to constrain the intercepts to be equal across the three groups, which produced a poor fitting model. Given this, we examined MIs and relaxed the constraints on the intercepts one at a time (Byrne, 2012). We ultimately freed intercepts for the following items in the No Suicidality group: "feeling distant", "emotionally numb", "avoid thinking about stressful experiences." Thus, the No Suicidality group had its own values for these intercepts, but the intercepts for the other two groups were constrained to equality. After freeing these intercepts in the No Suicidality group, model fit was acceptable and ΔCFI between the factor loading model and the intercepts models was below .05, see Table 3.

Latent means model

Given that each group had at least one loading and intercept in common, we were able to proceed to testing differences in latent means for a partially invariant model (Byrne, 2012). The No Suicidality group served as the reference group and thus its factor mean was fixed to zero. The latent means model demonstrated good fit, see Table 3. The Ideator factor mean (mean = 1.38) was significantly different than the No Suicidality group (p < .01), as was the Attempter factor mean (mean = 1.85, p < .01). In order to test whether the No Suicidality group and Attempter group differed from the Ideator group, we next set the Ideator group to serve as the reference group. As predicted, the Attempter factor mean was significantly greater than the Ideator group (p < .01), and the No Suicidality group was significantly less than the Ideator group (p < .01). In sum, we found that the Attempter group had the greatest elevations on the interoceptive deficits latent mean, with the Ideator group intermediary.

Testing the association between interoceptive deficits and SITBs

To determine whether interoceptive deficits were associated with SITB severity over and above other established SITB risk factors, PTSD symptoms, hopelessness, age, and gender were modeled as covariates. Results revealed that the interoceptive deficits latent variable was associated with suicidal ideation (β = .40, SE = .04, p < .001), NSSI (β = .42, SE = .04, OR = 2.86, p < .001), suicide attempts, (β = .17, SE = .05, OR = 1.44, p < .001), and attempt lethality (β = .19, SE = .04, p < .001) over and above these other covariates, see Tables 4-7.

Discussion

Within a large military sample, our results confirm and extend a growing body of research which finds that interoceptive deficits are most pronounced in those who have attempted suicide. Specifically, among military members we found that people who have attempted suicide had greater interoceptive deficits than those with no suicide history, with people who have thought about or planned an attempt intermediary.

Additionally, we found that interoceptive deficits had a stronger relationship (i.e., beta values were larger) with suicidal ideation, NSSI, suicide attempts, and attempt lethality than any of the other risk factors included in the models, including PTSD symptoms, hopelessness, gender, and age.

These findings extend and replicate past work and suggest that interoceptive deficits are a particularly promising construct to study in relation to SITBs among military personnel. Specifically, several studies find that proxies of interoceptive deficits are related to SITBs in military members. For example, in a sample of Operation Enduring Freedom/Operation Iraqi Freedom veterans, emotional numbing was positively and significantly associated with the likelihood of experiencing current suicidal ideation (Guerra & Calhoun, 2011). Moreover, alexithymia was positively and significantly associated with dissociation symptoms among Israeli soldiers (Evren & Can, 2007), and dissociation was positively associated with suicidal behavior among soldiers (Shelef et al., 2014). With respect to pain tolerance, Nademin ad colleagues (2008) identified that suicide decedents who served in the U.S. Air Force were perceived to exhibit higher pain tolerance as compared to Air Force personnel who had not died by suicide. Taken together, our findings add to this literature and suggest that interoceptive deficits are important to consider in relation to SITBs among individuals in the military.

Recent empirically informed theories of suicide highlight the importance of identifying factors that lead from suicide ideation to suicidal behavior (i.e., Klonsky & May, 2015; Joiner, 2005; Van Orden et al., 2010). However, currently there are few known risk factors that reliably differentiate ideators from attempters (May & Klonsky, 2016). Interoceptive deficits may be one such differentiating factor. Specifically, interoceptive deficits may lead to such disconnection from the self that the body comes to be seen as "other" and potentially even "non-human." There is a vast body of both scientific and historical work documenting the use of dehumanization as a means to perpetrate lethal injury (Haslam & Loughnan, 2014; Kteily, Bruneau, Waytz, & Cotterill, 2015; Smith, 2011). It is possible that interoceptive deficits allow for a dehumanization of the body which in turn facilitates self-injury.

Our results have several important clinical implications. First, it may be worthwhile to consider assessing for interoceptive deficits when conducting suicide risk assessments with Service members. Second, experimental research finds that interoceptive deficits can be attenuated through relatively straightforward means, which suggests potential clinical applications. For example, looking at one's reflection in a mirror during interoceptive processing (i.e., counting one's heartbeats without taking one's pulse) has been associated with improved interoception (Ainley et al., 2012). Another study found that having people think about self-relevant stimuli, like one's name and hometown, led to better interoceptive accuracy (Ainley et al., 2013). This suggests that teaching people to be more attuned to certain aspects of the self holds promise as a way to improve interoceptive abilities and restore body regard.

Several strengths of the current study are worth noting. First, we used a large, primarily male military sample, whereas much previous work on the topic has relied on female eating disorders samples (e.g., Dodd et al, 2018; Smith et al., 2018). Second, we employed MGCFA to test for latent mean differences, which has several advantages over traditional ANOVA-based group testing. Third, we demonstrated that interoceptive deficits positively associated with attempt lethality. This is a novel finding, as to our knowledge, this the first study to test for such an association.

When interpreting these results, however, it is important to keep in mind that the interoceptive deficits latent variable was only partially invariant across groups. This means that non-suicidal individuals, ideators, and attempters do not respond the same to all the items we used to measure interoceptive deficits, and thus, group comparisons are somewhat limited. Future research using more psychometrically sound measurements of interoception, such as the Multidimensional Assessment of Interoceptive Awareness (Mehling et al., 2012; Mehling, Acree, Stewart, Silas, & Jones, 2018), are needed, though this research would also benefit from considering an MGCFA approach before testing for group differences.

There are additional limitations to note, which further influence the interpretations of the results and inform future research. Perhaps the most significant limitation was the creation of an interoceptive deficits latent variable from items not specifically designed to measure this construct. However, we attempted to mitigate this limitation in a number of ways. First, we selected items that tapped both emotional numbing and physiological sensations relevant to self-injury, namely, pain tolerance. Much previous work has relied on a measure that primarily assesses emotional numbing with a few items that tap gut sensations (e.g., Dodd et al, 2018; Forrest et al., 2015; Smith et al., 2018), which are arguably less relevant to self-injury. Further, we employed rigorous validity checks including external validation in a separate sample and EFA testing in a subsample of the data. However, despite these checks, our interoceptive deficits latent variable still did not encompass all forms of interoception (e.g., cardiac awareness, gut sensations) and was partially invariant across groups. Another limitation was that suicide attempt was assessed via self-report. However, here again we employed rigorous validity checks by only including attempts that had narrative descriptions which were deemed by two independent raters to have been enacted upon with non-zero intent. An additional notable limitation was the cross-sectional design, which precludes any determination of directionality.

These limitations provide several clear directions for future research. First, researchers investigating interoceptive deficits need to think carefully about the construct of interoception and its measurement. Currently few self-report measures with strong psychometric properties exist. Although the MAIA appears to be the most comprehensive, some subscales have not demonstrated good reliability (Mehling et al., 2018), and not all subscales relate to SITBs (Rogers, Hagan, & Joiner, 2018). Additionally, self-report measures are prone to their own limitations, which could be exacerbated among individuals who have trouble perceiving their physiological sensations. In other words, if one is numb to their sensations, it is likely difficult to accurately report on them. Including objective assessments may thus be useful, but even with objective measurements caution is warranted. The heartbeat perception test (Schandry, 1981) is the most widely used assessment of interoceptive accuracy, however, several recent articles have questioned its validity along a number of dimensions (Murphy, Brewer, Hobson, Catmur, & Bird, 2018; Ring, Brener, Knapp, & Mailloux, 2015; Zamariola, Maurage, Luminet, & Corneille, 2018). Additionally, interoception is a broad construct and encompasses awareness of multiple physiological symptoms, so relying only on cardiac awareness risks being overly reductive. Further, recent research demonstrates that not all objectively assessed components of interoception (i.e., cardiac awareness, emotion awareness, pain awareness) are correlated and that cardiac awareness may be less relevant to SITBs than other components of interoception (Forrest & Smith, in preparation) Thus, going forward, multi-modal assessments are needed in order to determine whether some forms of deficits are more strongly related to SITBs than others.

Second, longitudinal data is needed to test prospective relations and determine whether interoceptive deficits are causally related to suicidal behavior. Longitudinal data could also help our understanding of how interoception develops and changes over time and within situations. Related, it will be important to test whether aspects of being in the military may increase and/or maintain interoceptive deficits, and whether deficits persist post-deployment and when individuals are no longer active duty.

Conclusion

These results suggest that interoceptive deficits can help differentiate suicide groups and that interoceptive deficits may provide important information about suicide risk among military members. However, given the limitations of the current study, future longitudinal research employing psychometrically sound measures of interoception is needed.

References

Ainley, V., Maister, L., Brokfeld, J., Farmer, H., & Tsakiris, M. (2013). More of myself: Manipulating interoceptive awareness by heightened attention to bodily and narrative aspects of the self. *Consciousness and Cognition, 22*(4), 1231-1238.

Ainley, V., Tajadura-Jiménez, A., Fotopoulou, A., & Tsakiris, M. (2012). Looking into myself: The effect of self-focused attention on interoceptive sensitivity. *Psychophysiology, 49*(11), 1504-1508.

Aspell, J. E., Heydrich, L., Marillier, G., Lavanchy, T., Herbelin, B., Blanke, O. (2013). Turning body and self inside out: Visualized heartbeats alter bodily self-consciousness and tactile perception. *Psychological Science, 24*, 2445-2453.

Bagby, R. M., Parker, J. D. A., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia Scale—Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research, 38*(1), 23 – 32.

Beck, A. T., Weissman, A., Lester, D., & Trexler, L. (1974). The measurement of pessimism: The Hopelessness Scale. *Journal of Consulting and Clinical Psychology*, *42*, 861-865.

Berman, A. L., Shepherd, G., & Silverman, M. M. (2003). The LSARS-II: Lethality of suicide attempt rating scale—updated. *Suicide and Life-Threatening Behavior*, *33*(3), 261-276.

Bizeul, C., Sadowsky, N., & Rigaud, D. (2001). The prognostic value of initial EDI scores in anorexia nervosa patients: A prospective follow-up study of 5–10 years. *European Psychiatry, 16*(4), 232-238.

Brewer, R., Cook, R., & Bird, G. (2016). Alexithymia: A general deficit of interoception. *Royal Society Open Science*, *3*(10), 150664.

Brown, T. A. (2014). *Confirmatory Factor Analysis for Applied Research*. Guilford Publications.

Craig, A. D. (2003). Interoception: The sense of the physiological condition of the body. *Current Opinion in Neurobiology*, *13*(4), 500-505.

Byrne, B. M. (2012). *Structural Equation Modeling with Mplus: Basic Concepts, Applications, and Programming*. Routledge.

Department of Veterans Affairs, Veterans Health Administration, Office of Mental Health and Suicide Prevention. (2018). Veteran suicide data report, 2005-2016. Retrieved from https://www.mentalhealth.va.gov/docs/data-sheets/OMHSP_National_Suicide_Data_Report_2005-2016_508.pdf.

Dodd, D. R., Smith, A. R., Forrest, L. N., Witte, T. K., Bodell, L., Bartlett, M., ... & Goodwin, N. (2018). Interoceptive deficits, nonsuicidal self-injury, and suicide attempts among women with eating disorders. *Suicide and Life-Threatening Behavior*, *48*(4), 438-448.

Enders, C. K. (2010). *Applied missing data analysis*. Guilford press.

Evren, C., & Can, S. (2007). Clinical correlates of dissociative tendencies in male soldiers with conversion disorder. *Israel Journal of Psychiatry and Related Science, 44*, 33–39.

Fassino, S., Pierò, A., Gramaglia, C., & Abbate-Daga, G. (2004). Clinical, psychopathological and personality correlates of interoceptive awareness in anorexia nervosa, bulimia nervosa and obesity. *Psychopathology, 37*(4), 168-174.

Favaro, A., & Santonastaso, P. (1998). Impulsive and compulsive self-injurious behavior in bulimia nervosa: Prevalence and psychological correlates. *The Journal of Nervous and Mental Disease, 186*(3), 157-165.

Forcano, L., Fernández-Aranda, F., Alvarez-Moya, E., Bulik, C., Granero, R., Gratacos, M., ... & Saus, E. (2009). Suicide attempts in bulimia nervosa: Personality and psychopathological correlates. *European Psychiatry*, *24*(2), 91-97.

Forrest, L. N., Smith, A. R., White, R. D., & Joiner, T. E. (2015). (Dis) connected: An examination of interoception in individuals with suicidality. *Journal of Abnormal Psychology*, *124*(3), 754-763.

Forrest, L. N., & Smith, A.R. (in preparation). A multi-measure examination of interoception in people with self-injurious behaviors.

Franklin, J. C., Aaron, R. V., Arthur, M. S., Shorkey, S. P., & Prinstein, M. J. (2012). Nonsuicidal self-injury and diminished pain perception: The role of emotion dysregulation. *Comprehensive Psychiatry*, *53*(6), 691-700.

Franklin, J. C., Ribeiro, J. D., Fox, K. R., Bentley, K. H., Kleiman, E. M., Huang, X., ... & Nock,

M. K. (2017). Risk factors for suicidal thoughts and behaviors: A meta-analysis of 50 years of research. *Psychological Bulletin, 143*(2), 18

Franko, D. L., Keel, P. K., Dorer, D. J., Blais, M. A., Delinsky, S. S., Eddy, K. T., ... & Herzog, D. B. (2004). What predicts suicide attempts in women with eating disorders?. *Psychological Medicine, 34*(5), 843-853.

Garner, D. M., Olmstead, M. P., & Polivy, J. (1983). Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. *International Journal of Eating Disorders, 2*, 15-34.

Guerra, V. S., & Calhoun, P. S. (2011). Examining the relation between posttraumatic stress disorder and suicidal ideation in an OEF/OIF Veteran sample. *Journal of Anxiety Disorders, 25*, 12–18.

Haslam, N., & Loughnan, S. (2014). Dehumanization and infrahumanization. *Annual Review of Psychology, 65*, 399-423.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55.

Jenkinson, P. M., Taylor, L., & Laws, K. R. (2018). Self-reported interoceptive deficits in eating disorders: A meta-analysis of studies using the eating disorder inventory. *Journal of Psychosomatic Research, 110*, 38-45.

Joiner, T. E. (2005). *Why People Die by Suicide*. Cambridge, MA: Harvard University Press.

Joiner Jr, T. E., Pfaff, J. J., & Acres, J. G. (2002). A brief screening tool for suicidal symptoms in adolescents and young adults in general health settings: Reliability and validity data from the Australian National General Practice Youth Suicide Prevention Project. *Behaviour Research and Therapy, 40*(4), 471-481.

Kteily, N., Bruneau, E., Waytz, A., & Cotterill, S. (2015). The ascent of man: Theoretical and empirical evidence for blatant dehumanization. *Journal of Personality and Social Psychology, 109*(5), 901-931.

Klonsky, E. D., & May, A. M. (2015). The three-step theory (3ST): A new theory of suicide rooted in the "ideation-to-action" framework. *International Journal of Cognitive Therapy, 8*(2), 114-129.

Leon, G. R., Fulkerson, J. A., Perry, C. L., & Early-Zald, M. B. (1995). Prospective analysis of personality and behavioral vulnerabilities and gender influences in the later development of disordered eating. *Journal of Abnormal Psychology, 104*(1), 140.

Little, T. D. (1997). Mean and covariance structures (MACS) analyses of cross-cultural data: Practical and theoretical issues. *Multivariate Behavioral Research, 32*(1), 53-76.

Little, R. J., & Slegers, D. W. (2005). Encyclopedia of Statistics in Behavioral Science. John Wiley & Sons, Ltd.

May, A. M., & Klonsky, E. D. (2016). What distinguishes suicide attempters from suicide ideators? A meta-analysis of potential factors. *Clinical Psychology: Science and Practice, 23*(1), 5-20.

Mehling, W. E., Acree, M., Stewart, A., Silas, J., & Jones, A. (2018). The Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA-2). *PloS one, 13*(12), e0208034.

Mehling, W. E., Price, C., Daubenmier, J. J., Acree, M., Bartmess, E., & Stewart, A. (2012). The multidimensional assessment of interoceptive awareness (MAIA). *PLoS ONE, 7*(11), e48230.

Metalsky, G. I., & Joiner, T. E. (1997). The hopelessness depression symptom questionnaire. *Cognitive Therapy and Research, 21*, 359-384.

Muehlenkamp, J. J. (2012). Body regard in nonsuicidal self-injury: Theoretical explanations and treatment directions. *Journal of Cognitive Psychotherapy, 26*(4), 331-347.

Muehlenkamp, J. J., Peat, C. M., Claes, L., & Smits, D. (2012). Self-injury and disordered eating: Expressing emotion dysregulation through the body. *Suicide and Life-Threatening*

Murphy, J., Brewer, R., Hobson, H., Catmur, C., & Bird, G. (2018). Is alexithymia characterised by impaired interoception? Further evidence, the importance of control variables, and the problems with the Heartbeat Counting Task. *Biological Psychology*, *136*, 189-197.

Muthén, L. K., & Muthén, B. O. (1998-2012). Mplus User's Guide. Seventh Edition. Los Angeles, CA: Muthén & Muthén

Nademin, E., Jobes, D. A., Pflanz, S. E., Jacoby, A. M., Ghahramanlou-Holloway, M., Campise, R., Joiner, T., Wagner, B. M., & Johnson, L. (2008). An investigation of interpersonal–psychological variables in Air Force suicides: A controlled-comparison study. *Archives of Suicide Research, 12,* 309–326.

Paulus, M. P., Feinstein, J. S., & Khalsa, S. S. (2019). An active inference approach to interoceptive psychopathology. *Annual Review of Clinical Psychology*, *15*, 97-122.

Pollatos, O., Kurz, A.-L., Albrecht, J., Schreder, T., Kleemann, A. M., Schöpf, V., . . . Schandry, R. (2008). Reduced perception of bodily signals in anorexia nervosa. *Eating Behaviors,* *9*(4), 381-388.

Ribeiro, J. D., Franklin, J. C., Fox, K. R., Bentley, K. H., Kleiman, E. M., Chang, B. P., & Nock, M. K. (2016). Self-injurious thoughts and behaviors as risk factors for future suicide ideation, attempts, and death: A meta-analysis of longitudinal studies. *Psychological Medicine*, *46*(2), 225-236.

Ribeiro, J. D., Witte, T. K., Van Orden, K. A., Selby, E. A., Gordon, K. H., Bender, T. W., & Joiner Jr, T. E. (2014). Fearlessness about death: The psychometric properties and construct validity of the revision to the Acquired Capability for Suicide Scale. *Psychological Assessment, 26*(1), 115.

Ring, C., Brener, J., Knapp, K., & Mailloux, J. (2015). Effects of heartbeat feedback on beliefs about heart rate and heartbeat counting: A cautionary tale about interoceptive awareness. *Biological Psychology*, *104*, 193-198.

Rogers, M. L., Hagan, C. R., & Joiner, T. E. (2018). Examination of interoception along the suicidality continuum. *Journal of Clinical Psychology*, *74*(6), 1004-1016.

Ross, S., Heath, N. L., & Toste, J. R. (2009). Non-suicidal self-injury and eating pathology in high school students. *American Journal of Orthopsychiatry*, *79*(1), 83-92.

Schandry, R. (1981). Heart beat perception and emotional experience. *Psychophysiology, 18*, 483-488.

Schmidt, N. B., Richey, J. A., & Fitzpatrick, K. K. (2006). Discomfort intolerance: Development of a construct and measure relevant to panic disorder. *Journal of Anxiety Disorders*, *20*(3), 263-280.

Shelef, L., Levi-Belz, Y., & Fruchter, E. (2014). Dissociation and acquired capability as facilitators of suicide ideation among soldiers. *Crisis, 35,* 388–397.

Smith, A. R., & Forrest, L. N. (in preparation). An experimental examination of self-guided progressive muscle relaxation to improve interoception.

Smith, A., Forrest, L., & Velkoff, E. (2018). Out of touch: Interoceptive deficits are elevated in suicide attempters with eating disorders. *Eating Disorders*, *26*(1), 52-65.

Smith D.L. (2011). *Less Than Human: Why We Demean, Enslave, and Exterminate Others.* Macmillan; New York: 2011

Van Orden, K. A., Cukrowicz, K. C., Witte, T. K., Braithwaite, S. R., Selby, E. A., & Joiner, T. E. (2010). The interpersonal theory of suicide. *Psychological Review, 117*(2), 575–600.

Weathers, F. W., Litz, B. T., Huska, J. A., & Keane, T. M. (1994). The PTSD checklist

(PCL). *Unpublished scale available from the National Center for PTSD*. Retrieved from https://www.ptsd.va.gov/professional/assessment/documents/APCLM.pdf

Witte, T. K., Holm-Denoma, J. M., Zuromski, K. L., Gauthier, J. M., & Ruscio, J. (2017). Individuals at high risk for suicide are categorically distinct from those at low risk. *Psychological Assessment, 29*(4), 382-393.

World Health Organization. (2019). Mental health: Suicide data. Retrieved from https://www.who.int/mental_health/prevention/suicide/suicideprevent/en/

Zamariola, G., Maurage, P., Luminet, O., & Corneille, O. (2018). Interoceptive accuracy scores from the heartbeat counting task are problematic: Evidence from simple bivariate correlations. *Biological Psychology*, *137*, 12-17.

Table 1

Demographic characteristics for Study 1 and Study 2 samples

	Study 1 (N = 134)	Study 2 (N = 3764)
	n (%)	n (%)
Gender		
Male	66 (49.3)	2998 (79.6)
Female	67 (50.0)	674 (17.9)
Transgender	Not assessed	9 (0.2)
Other	1 (0.7)	1 (0.0)
Not reported	0 (0)	82 (2.2)
Race		
American Indian/Alaska Native	2 (1.5)	40 (1.1)
Asian	8 (6.0)	94 (2.5)
Black/African American	11 (8.2)	707 (18.8)
Native Hawaiian/Pacific Islander	1 (0.7)	8 (0.2)
White	108 (80.6)	2386 (63.4)
Multiracial	1 (0.7)	43 (1.1)
Other	3 (2.2)	376 (10.0)
Not reported	0 (0)	110 (2.9)
Ethnicity		
Hispanic	6 (4.5)	377 (10.0)
Not Hispanic	128 (95.5)	2999 (79.7)
Other	0 (0)	61 (1.6)
Not reported	0 (0)	327 (8.7)
Military service	Not assessed	
Currently serving	–	2392 (63.5)
Veteran	–	1346 (35.8)
Served but status unknown	–	26 (0.7)
Deployment	Not assessed	
No	–	1341 (35.6)
Yes	–	1550 (41.2)
Not reported	–	873 (23.2)
Military branch	Not assessed	
Army	–	1960 (52.1)
Air Force	–	176 (4.7)
Navy	–	471 (19.7)
Marine Corps	–	456 (12.1)
Coast Guard	–	26 (0.7)
Unspecified/Other	–	36 (1.0)
Not reported	–	369 (9.8)
Suicidality		
No suicidality	96 (71.6)	918 (24.4)
Ideation	30 (22.4)	1488 (39.5)
Attempt	8 (6.0)	1078 (28.6)
	M (SD)	M (SD)
Age	37.0 (11.8)	33.3 (14.2)

Note. In Study 1, ideation, planning, and attempting were each assessed. However, in Study 2, an assessment of suicide plans was not available. Thus, for Study 1 participants, the *ideation* category includes participants who reported ideation with no suicide plan and participants who reported ideation with a suicide plan.

INTEROCEPTIVE DEFICITS IN THE MILITARY 1

Table 2

Fit indices for the baseline interoceptive deficits latent variable models among Study 2 suicidality groups

Group	χ^2 (*df*)	*p*	MLR scaling correction	CFI	TLI	RMSEA (90% CI)	SRMR
No suicidality	0.27 (2)	.88	1.318	1.000	1.020	.000 (.000, .033)	.004
Ideator	1.44 (2)	.49	1.050	1.000	1.004	.000 (.000, .047)	.013
Attempt	4.15 (2)	.13	1.018	0.990	0.971	.032 (.000, .075)	.027

Note. Total N = 3764, No suicidality n = 918, Ideation n = 1488, Attempt n = 1078. MLR = maximum likelihood with robust standard errors, CFI = comparative fit index, TLI = Tucker–Lewis Index, RMSEA = root mean square error of approximation, SRMR = standardized root mean square residual.

Table 3

Fit indices for the interoceptive deficits latent variable multigroup confirmatory factor analysis

Model	X^2 (*df*)	CFI	TLI	RMSEA (90% CI)	SRMR	Model comp	ΔX^2 (Δdf)	ΔCFI	ΔTLI	ΔRMSEA	ΔSRMR	Decision
M1: Configural	5.40 (6)	1.000	1.002	.000 (.000, .036)	.018	–	–	–	–	–	–	–
M2: Factor loadings	76.75** (14)	0.930	0.910	.062 (.049, .076)	.140	M1	71.35 (8)	.070	.092	.062	.122	Reject
M2a: Partial factor loadings	26.11* (12)	0.984	0.976	.032 (.015, .049)	.056	M1	20.71 (6)	.016	.026	.032	.038	Accept
M3: Intercepts	690.25** (19)	0.253	0.292	.175 (.164, .186)	.358	M2a	664.14 (7)	.731	.684	.143	.302	Reject
M3a: Partial intercepts	70.15** (17)	0.941	0.937	.052 (.040, .065)	.074	M2a	44.04 (5)	.043	.039	.020	.018	Accept
M4: Latent means	29.06* (13)	0.982	0.975	.033 (.017, .049)	.050	M3a	41.09 (4)	.041	.038	.019	.024	Accept

Note. Total N = 3764, No suicidality n = 918, Ideation n = 1488, Attempt n = 1078. CFI = comparative fit index, TLI = Tucker–Lewis Index, RMSEA = root mean square error of approximation, SRMR = standardized root mean square residual, model comp = model comparison.
* $p \leq .01$, **$p < .0001$

INTEROCEPTIVE DEFICITS IN THE MILITARY 1

Table 4

Regression results of interoceptive deficits latent variable positively associating with suicide ideation over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	1.40	0.16	0.40 (0.33, 0.47)	< .001
Age	−0.01	0.00	−0.05 (−0.08, −0.02)	.002
Gender	−0.03	0.12	0.00 (−0.04, 0.03)	.81
Hopelessness	0.70	0.05	0.29 (0.25, 0.32)	< .001
PCL Memories	0.04	0.07	0.02 (−0.05, 0.09)	.56
PCL Dreams	−0.01	0.07	0.00 (−0.07, 0.07)	.91
PCL Flashback	0.05	0.07	0.02 (−0.04, 0.08)	.51
PCL Avoid reminders	0.03	0.06	0.02 (−0.04, 0.08)	.59
PCL On guard	−0.08	0.05	−0.04 (−0.09, 0.01)	.08
PCL Startled	0.18	0.05	0.09 (0.04, 0.15)	< .001
PCL Physical reactions	−0.15	0.07	−0.07 (−0.13, −0.01)	.02

Note. PCL = PTSD Checklist; PCL Memories = repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being "super alert" or watchful or on guard; PCL Startled = feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

Table 5

Regression results of interoceptive deficits latent variable associating with nonsuicidal self-injury over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	1.05	0.15	0.42 (0.33, 0.50)	< .001
Age	−0.03	0.00	−0.20 (−0.25, −0.16)	< .001
Gender	0.42	0.11	0.08 (0.04, 0.12)	< .001
Hopelessness	0.32	0.04	0.18 (0.14, 0.23)	< .001
PCL Memories	0.01	0.06	0.01 (−0.08, 0.09)	.87
PCL Dreams	−0.09	0.06	−0.06 (−0.13, 0.02)	.14
PCL Flashback	0.06	0.06	0.03 (−0.03, 0.10)	.32
PCL Avoid reminders	−0.11	0.05	−0.08 (−0.14, −0.01)	.03
PCL On guard	0.02	0.04	0.02 (−0.04, 0.08)	.59
PCL Startled	0.13	0.04	0.09 (0.03, 0.15)	< .01
PCL Physical reactions	0.00	0.06	0.00 (−0.07, 0.08)	.95

Note. PCL = PTSD Checklist; PCL Memories = repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being "super alert" or watchful or on guard; PCL Startled = feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

Table 6

Regression results of interoceptive deficits latent variable associating with suicide attempts over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	0.36	0.10	0.17 (0.05, 0.26)	< .001
Age	0.01	0.00	0.09 (0.06, 0.13)	< .001
Gender	0.22	0.09	0.04 (0.01, 0.08)	.02
Hopelessness	0.31	0.03	0.19 (0.15, 0.23)	< .001
PCL Memories	0.02	0.05	0.02 (−0.06, 0.09)	.66
PCL Dreams	0.02	0.05	0.02 (−0.05, 0.09)	.66
PCL Flashback	−0.02	0.05	−0.02 (−0.08, 0.05)	.63
PCL Avoid reminders	−0.02	0.04	−0.01 (−0.08, 0.05)	.68
PCL On guard	0.03	0.04	0.03 (−0.03, 0.08)	.39
PCL Startled	0.13	0.04	0.10 (0.05, 0.16)	< .001
PCL Physical reactions	0.01	0.05	0.00 (−0.06, 0.07)	.91

Note. PCL = PTSD Checklist; PCL Memories = repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being "super alert" or watchful or on guard; PCL Startled = feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

Table 7

Regression results of interoceptive deficits latent variable associating with suicide attempt lethality over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	0.56	0.13	0.19 (0.11, 0.28)	< .001
Age	0.01	0.00	0.04 (0.01, 0.08)	.01
Gender	0.08	0.11	0.01 (−0.02, 0.04)	.45
Hopelessness	0.23	0.04	0.11 (0.07, 0.15)	< .001
PCL Memories	−0.05	0.06	−0.03 (−0.10, 0.04)	.46
PCL Dreams	0.12	0.06	0.07 (0.00, 0.14)	.06
PCL Flashback	−0.05	0.07	−0.03 (−0.09, 0.04)	.46
PCL Avoid reminders	−0.10	0.05	−0.06 (−0.12, 0.00)	.07
PCL On guard	−0.01	0.05	−0.01 (−0.06, 0.05)	.81
PCL Startled	0.12	0.05	0.07 (0.02, 0.13)	.01
PCL Physical reactions	0.05	0.06	0.03 (−0.04, 0.09)	.46

Note. PCL = PTSD Checklist; PCL Memories = repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being "super alert" or watchful or on guard; PCL Startled = feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

Supplemental Table 1

Bivariate correlations among the latent interoceptive deficits variable and other measures of interoceptive deficits/awareness

	1	2	3	4
1. Proposed ID variable	–			
2. EDI–ID	.51**	–		
3. TAS	.45**	.60**	–	
4. MAIA	−.27**	−.40**	−.60**	–

Note. ID = interoceptive deficits, EDI = Eating Disorder Inventory–Interoceptive Deficits subscale, TAS = Toronto Alexithymia Scale total, MAIA = Multidimensional Assessment of Interoceptive Awareness total. ** $p < .001$

A12. VOGEL FINAL REPORT

TITLE: Establishing Measurement Equivalence of MRSC Database Assessments Across Demographic Groups

PRINCIPAL INVESTIGATOR: David L. Vogel

REPORT DATE: July 30th, 2019

Table of Contents

1. **INTRODUCTION:** Narrative that briefly (one paragraph) describes the subject, purpose and scope of the research.

The objective of this project was to examine the psychometric properties of the assessments included in the MSRC database. ME/I and latent mean analyses were conducted using the sequential constraint imposition approach on the suicide and related risk factor measures. For the measures in which both the brief and full measure were collected, we examined the convergent validity of the two versions by examining how the measures predicted other scales included in the MSRC database.

2. **KEYWORDS:** Provide a brief list of keywords (limit to 20 words).

Measurement invariance, suicide, depression, post-traumatic stress disorder

3. **OVERALL PROJECT SUMMARY:** Provide a complete summary of the research accomplishments to date in direct alignment with respect to each task outlined in the approved Statement of Work. Include key methodology, and a description of any changes to originally proposed methods. Data supporting research conclusions, in the form of figures and/or tables, shall be embedded in the text, appended, or referenced to appended manuscripts.

Major Task 1 (Preparing Documents and Research Protocols) was completed with obtaining and maintaining HRPO and University IRB approvals.

Major Task 2 (Data Analysis and Reporting) Subtask 1 was completed by performing the measurement and mean invariance analyses for the suicide and related risk factor measures and validity analyses for the measures in which both brief and full scales were available. Brief summary results for the **Common Data Elements** and **Full Measures** included in the dataset are reported below.

Major Task 2 (Dissemination of Findings) Subtask 2 was completed by working to disseminate findings. This includes two national conference presentations (see point #6 for full references) and several in-progress manuscripts.

The Common Data Elements Measures

Measurement invariance analyses (configural, metric, and scalar) were examined for the measures across demographic groups (e.g., gender, race, ethnicity, education, relationship status, deployment status, branch, active duty status, military service, and combat experience). Goodness of fit for the models were assessed the Comparative Fit Index (CFI) and the Standardized Root Mean Square Residual (SRMR; Hu & Bentler, 1999). The Root Mean Square Error of Approximation (RMSEA) was also assessed in models with adequate numbers of items (Kenny, Kaniskan, & McCoach, 2015). ME/I model comparisons were examined based on changes in specific model fit indices (i.e., $\Delta CFI < .01$; Cheung & Lau, 2012; Meade, Johnson, & Braddy, 2008).

CDE - ASI: Five items from the cognitive concern subscale of the Anxiety Sensitivity Index-3 (Taylor et al., 2007) were included in the CDE dataset. A one-factor solution showed good fit across the demographic groups. Configural and metric invariance was found across all demographic groups. Scalar invariance was also found for gender, race, ethnicity, education, relationship status, deployment status, branch, and combat experience. Active duty status achieved partial scalar invariance by freeing one item intercept. Military service achieved partial scalar invariance after freeing two item intercepts. No significant latent mean differences were found for deployment status or combat experience, but there were significant latent mean differences across gender, military service, and active duty status.

CDE – AUDIT: Three items from the Alcohol Use Disorders Identification Test (Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998) were included in the CDE dataset. The model failed to converge for any of the groups, and so additional measurement analyses were not conducted. However, given there were both full and screener versions of the AUDIT, tests of dependent correlations were used to examine the differences between screener and full versions as they predict acquired capability to commit suicide (ACSS) and depression (BDI). The screener and full AUDIT both predicted similar variance of the ACSS, and neither significantly predicted the BDI.

CDE - BHS: Three items from the Beck Hopelessness Scale (Beck & Steer, 1988) were included in the CDE dataset. A one-factor solution showed perfect fit across the demographic groups. Because the BHS items are scored dichotomously, the metric invariance model is not identified under weighted least squares (probit) estimation. Therefore, results reflect the configural and scalar models and the difference between them as indication of measurement invariance. Configural and scalar invariance was found for all groups. No significant latent mean differences were found for gender and combat experience, but there were significant latent mean differences across ethnicity, education, relationship status, deployment status, military branch, active duty status, and military service.

CDE – BSS: Two items from the Beck Scale for Suicidal Ideation (Beck & Steer, 1991) were included in the CDE dataset. However, as the CDE BSS included only two items, measurement invariance analyses could not be completed. Given there were both full and screener versions of the BSS, tests of dependent correlations were used to examine the differences between screener and full versions of the BSS as they predict the acquired capability to commit suicide (ACSS) and depression (BDI). The screener and full BSS both predicted similar variance of the ACSS and the BDI.

CDE - DSI: Four items from the Depressive Symptom Index—Suicidality Subscale (DSI-SS; Metalsky & Joiner, 1997) were included in the CDE dataset. A one-factor solution showed good fit across all the demographic groups. Configural invariance was found for all groups. Metric invariance was found for gender, race, ethnicity, education, relationship status, deployment status, branch, and combat experience. Active duty and military service achieved partial metric invariance after freeing one factor loading. Scalar invariance was found for gender, race, ethnicity, education, relationship status, deployment status, active duty status, and combat experience. Partial scalar invariance was achieved for military branch and military service after freeing two item intercepts. The CDE DSI demonstrated no latent mean differences for combat experience and ethnicity, but showed latent mean differences across the other groups.

CDE - INQ: Five items from the thwarted belongingness subscale of the Interpersonal Needs Questionnaire (Van Orden, Cukrowicz, Witte, & Joiner, 2012) were included in the CDE dataset. A one-factor solution showed good fit across the demographic groups. Configural and metric invariance was achieved for all demographic groups. Scalar invariance was found for gender, race, ethnicity, education, relationship status, deployment status, branch, and combat experience. Partial invariance was found for active duty and military service were achieved after freeing one item intercept. The CDE INQ demonstrated no latent mean differences for combat experience and ethnicity, but showed latent mean differences across the other groups. Given there were both full and screener versions of the INQ, tests of dependent correlations were used to examine the differences between screener and full versions of the INQ as they predict the acquired capability to commit suicide (ACSS) and depression (BDI). While both predicted significant variance of the measures, the full INQ did predict significantly greater variance of the ACSS and the BDI than the screener version.

CDE – ISI: Five items from the Insomnia Severity Index (Morin, 1993) were included in the CDE dataset. A one-factor solution showed adequate-to-good fit across the demographic groups. Configural invariance was found for all demographic groups. Metric invariance was found for gender, race, ethnicity, education, relationship status, deployment status, active duty status, military service, and combat experience. Partial invariance was found for military branch was achieved by freeing one item intercept. Scalar invariance was found for gender, ethnicity, education, relationship status, deployment status, active duty status, and combat experience. Partial scalar invariance was found for race and military service after freeing one item intercept. Partial scalar invariance was found for military branch after freeing two item intercepts. The CDE ISI demonstrated no latent mean differences across deployment status, but showed latent mean differences across the other groups.

CDE – SBQ: All four items from the Suicidal Behaviors Questionnaire—Revised (Osman et al., 2001) were included in the CDE dataset. A one-factor solution showed good fit across the demographic groups. Sites 17 and 24 were excluded from analyses, due to the site's use of alternative scoring. Configural invariance was found for all demographic groups. Metric invariance was found for race, ethnicity, education, relationship status, deployment status, and combat experience. Partial metric invariance for gender, military branch, and active duty was found by freeing one item loading. Partial metric invariance for military service was found by freeing two item loadings. Scalar invariance as found for race, ethnicity, relationship status, deployment status, and combat experience. Partial scalar invariance was found for gender, education, and military service after freeing one item intercept. Partial scalar invariance was found for active duty after freeing two item intercepts. Partial scalar invariance was found for military branch after freeing four item intercepts. The CDE SBQ demonstrated no latent mean differences across ethnicity and combat experience, but showed latent mean differences across the other groups.

CDE – SIS: Four items from the subjective domain of the Suicide Intent Scale (Beck, Schuyler, & Herman, 1974) were included in the CDE dataset. A one-factor solution showed good fit across the demographic groups. Configural invariance was satisfied all demographic groups. Metric invariance was found for all demographic groups except military service. Partial metric invariance was found for military service after freeing one factor loading. Scalar invariance was found for all demographic groups except for military branch and military service. Partial scalar invariance was found for military service after freeing one item intercept. Partial scalar invariance was found for military branch after freeing two item intercepts. The CDE SIS demonstrated no latent mean differences across gender and ethnicity, but showed latent mean differences across the other groups.

CDE – PCLM: Eight items from the Posttraumatic Stress Disorder Checklist—Military Version (Weathers, Litz, Herman, Huska, & Keane, 1993) were included in the CDE dataset. Four items represented the symptom cluster of intrusions, two items represented the symptom cluster of avoidance, and two items represented the symptom cluster of hyperarousal. A one-factor solution demonstrated a poor fit across groups. However, a three-factor solution showed a good fit across all demographic groups. Configural, metric, and scalar invariance was found across all groups using this three factor solution. The CDE PCLM demonstrated no latent mean differences across ethnicity, but showed latent mean differences across the other groups. Given there were both full and screener versions of the PCLM, tests of dependent correlations were used to examine the differences between screener and full versions of the PCLM as they predict the acquired capability to commit suicide (ACSS). The screener and full PCLM both predicted similar variance of the ACSS.

CDE - PCLC: Eight items from the Posttraumatic Stress Disorder Checklist—Civilian Version (Weathers et al., 1993) were included in the CDE dataset. Four items represented the symptom cluster of intrusions, two items represented the symptom cluster of avoidance, and two items represented the symptom cluster of hyperarousal. The civilian version did not include military-related demographic groups. As such, analyses were conducted on gender, race, ethnicity, education, relationship status, active duty, and military service. A one-factor solution demonstrated a poor fit across groups. However, a three-factor solution showed a good fit across the assessed demographic groups. Configural, metric, and scalar was found for the assessed demographic groups. The CDE PCLC demonstrated no latent mean differences across ethnicity, but showed latent mean differences across the other assessed groups.

Full-Version Measures

ACSS: The Acquired Capability for Suicide Scale (Van Orden et al., 2008) is a 20-item measure. However, most studies do not use the full 20 items, and instead used a shorter version. Recently, Ribeiro et al. (2014) provided support for a 7-item version, specifically, focusing on Fearlessness About Death (FAD). In the current samples, a one-factor solution demonstrated a poor fit across groups. However, a one-factor solution with two method factors (i.e. one describing positively worded items, and one describing negatively worded items) showed a good fit across the assessed demographic groups, except for veterans. For veterans, the two-method factor model did not converge, potentially due to low sample size ($N = < 200$). Configural, metric, and scalar invariance was found for the other assessed demographic groups. The ACSS demonstrated no latent mean differences across race, ethnicity, and combat experience, but showed latent mean differences across the other assessed groups.

AUDIT: The Alcohol Use Disorder Identification Tool is a 10-item assessment of problematic alcohol consumption (Bush et al., 1998). While many studies use a total score when calculating composite scores, several recent studies have suggested a 2-factor (or even a 3-factor) solution (Bush & Bradley 1998). In the current samples, a one-factor solution demonstrated a poor fit across groups. However, we found that a 2-factor model best fits the data, and this model was used for subsequent analyses. These two factors represent consumption (items 1, 2, and 3) and problematic behaviors (items 4 – 10). Configural invariance of this two-factor model was found for all demographic groups. Metric and scalar invariance was found for gender, race, ethnicity, education, relationship status, deployment status, active duty status, and combat experience. Partial metric invariance was found for military branch and military service after freeing one factor loading. Partial scalar invariance was found for military branch and military service after freeing two item intercepts. The AUDIT demonstrated no latent mean differences across ethnicity and combat experience, but showed latent mean differences across the other groups.

BDI: The Beck Depression Inventory is a 21-item assessment of depressive symptoms. The 21 items load onto one of 3 first-order factors (Negative Attitude, Performance Difficulty, and Somatic Elements), which then subsequently load onto the second-order depression factor (Byrne et al. 2006; Byrne et al., 2007). Examination of one, two, and three-factor models in this study also suggested a three-factor provided the best fit. This three-factor correlated model provides the same fit as the higher-order model and thus this three-factor correlated model was used in subsequent analysis. The BDI was only collected in certain samples, and thus analyses were restricted to gender, race, relationship status, and military service. Configural and metric invariance was found for all demographic groups. Scalar invariance was found for gender and race. Partial scalar invariance was achieved for relationship status and military service after freeing one item intercept. The BDI demonstrated no latent mean differences across race, but showed latent mean differences across gender, relationship status, and military service.

INQ: The 15-item Interpersonal Needs Questionnaire (Van Orden, Cukrowicz, Witte, & Joiner, 2012) has two subscales, thwarted belongingness and perceived burdensomeness. In the validation paper (Van Orden et al., 2012), the researchers allowed items 11 and 12 to correlate, and also allowed the two latent constructs to correlate. Examination of one, two, and two-factor with correlated items (11 & 12) models in this study also suggested a two-factor with correlated items provided the best fit. The 15-item INQ was only collected in certain samples, and thus analyses were restricted to gender, education, relationship status, deployment status, active duty status, and current versus no military service. The INQ was found to demonstrate configural and metric invariance across these demographics groups. Configural, metric, and scalar was found for the other assessed demographic groups. Scalar invariance was found for gender, education, relationship status, deployment status, and active duty status. Partial scalar invariance was found for military service after freeing intercepts for three items. The INQ demonstrated latent mean differences across the assessed demographic groups.

PCLC: The Post-Traumatic Stress Checklist for Civilians is a 17-item assessment of post-traumatic stress symptoms. In the civilian samples, a three-factor solution demonstrated a poor fit across groups. However, we found that a four-factor model provided adequate fit to the data in each of the samples, and this model was used for subsequent analyses. These four factors represent current DSM clusters of reexperiencing, avoiding, numbing, and hyperarousal. The PCLC was only collected in certain samples, and thus analyses were restricted to gender, race, ethnicity, education, relationship status, and military service (i.e., veteran vs. no service). Configural and metric invariance was found for the assessed demographic groups. Scalar invariance was achieved for gender, race, ethnicity, education, and relationship status. Partial scalar invariance was achieved for military service after freeing one item intercept. The PCLC demonstrated no latent mean differences across education, and military service, but demonstrated significant differences across the other assessed demographic groups.

PCLM: The Post-Traumatic Stress Checklist for Military personnel is a 17-item assessment of post-traumatic stress symptoms. In the military samples, a three-factor solution demonstrated a poor fit across groups. However, we found that a four-factor model provided adequate fit to the data in each of the samples, and this model was used for subsequent analyses. These four factors represent current DSM clusters of reexperiencing, avoiding, numbing, and hyperarousal. The PCLM was only collected in certain samples, and thus analyses were restricted to gender, race, ethnicity, education, relationship status, deployment status, military branch, and combat experience. Configural and metric invariance was found for the assessed demographic groups. Scalar invariance was achieved for gender, race, ethnicity, education, relationship status, deployment status, and military branch. Partial scalar invariance was achieved combat experience after freeing one item intercept. The PCLM demonstrated no latent mean differences across gender, but demonstrated significant differences across the other assessed demographic groups.

BHS: The Beck Hopelessness Scale (Beck & Steer, 1988) is a 20-item assessment of negative views of the future. The BHS was only collected in certain samples, and thus analyses were restricted to gender, education, and military service (veteran vs. none only). Because the BHS items are scored dichotomously, the metric invariance model is not identified under weighted least squares (probit) estimation. Therefore, results reflect the configural and scalar models and the difference between them as indication of measurement invariance. Configural and scalar invariance was found for gender, education, and military service. No significant latent mean differences were found for education, but there were significant latent mean differences across gender and military service.

BSS: The Beck Scale for Suicidal Ideation (Beck & Steer, 1991) is a 21-item assessment of severity of suicidal ideation. The first 19 items are often used to create a total score. However, consistent with the extant literature a single factor did not initially provide a good fit. A good fit was achieved with the inclusion of several residual covariances within each group. Because the BSS items are scored on a 3-point scale, the metric invariance model is not defined for weighted least squares (probit) estimation. Therefore, measurement invariance was investigated using the configural and scalar invariant models and the difference between them. Configural and scalar invariance was found for the demographic groups assessed. Latent means did not differ across ethnicity groups (Hispanic vs. Non-Hispanic) but mean differences were observed across groups for each of the other demographic characteristics examined.

4. **KEY RESEARCH ACCOMPLISHMENTS:** Bulleted list of key research accomplishments emanating from this research. Project milestones, such as simply completing proposed experiments, are not acceptable as key research accomplishments. Key research accomplishments are those that have contributed to the major goals and objectives and that have potential impact on the research field.

- We determined whether the measures assessing suicide and related risk factors differ across groups of people (e.g., Gender, Branch, Active Duty, Race/Ethnicity, Deployment, Combat Experience). Brief summaries of the results are reported in the previous section.

- We compared the validity of shorter screening questionnaires used within the MSRC database to their longer, full questionnaires. Brief summaries of the results are reported in the previous section.

5. **CONCLUSION:** Summarize the importance and/or implications with respect to medical and /or military significance of the completed research including distinctive contributions, innovations, or changes in practice or behavior that has come about as a result of the project.

The Military Suicide Research Consortium has an important database containing information about mental health, suicide, and related factors of the military population. While many of the questions in the MSRC database are established mental health and suicide screening tools in civilian populations, most have not been verified across specific military demographic groups. As such, one of the main results of the current project was to establish the degree to which specific groups of service members ascribe similar meanings to questions and the general concepts assessed by these tools. Below we summarize the main findings consistent with the proposed goals:

1) <u>Measurement Invariance</u>: Current findings suggest that the measures included in the MSRC dataset all showed configural invariance (i.e. measures seem to be assessing the same general constructs across groups). The measures also generally showed metric invariance (i.e. the item factor loadings were be consistent across groups) suggesting that correlational and modeling analyses within each of the assessed demographic groups could be conducted. Furthermore, the measures largely showed scalar invariance (i.e. similar item intercepts across demographic groups), suggesting that mean comparisons could be interpreted across groups. However, while scalar invariance was generally found, only partial invariance was found in some cases. In particular, when partial invariance occurred, it was most common for military service (i.e., currently serving, veteran, and no service), suggesting that while the scales seem to reflect similar constructs across groups some caution may be warranted when comparing mean differences between those currently in the military and those not as they may be responding to specific items in different ways. Important latent mean differences were also found for the assessments across the demographic groups measured, extending previous work by identifying groups that display higher levels of suicide risk and enhancing the ability to target specific populations with prevention and outreach programming.

2) Brief and Full Measure Comparisons: Findings from the current investigation found that the brief screeners demonstrated construct and criterion validity. The analyses indicated that the brief and full assessments, generally, showed similar patterns of relationships with criterion variables (i.e., depression and suicide), particularly, when considering that a decrease in prediction is expected due to having fewer items. Implications suggest that the use brief screeners may be warranted as a faster way of screening for suicidality and related risk factors, when there is a need to decrease participant fatigue, as long as the practitioner or researcher is aware of a potential reduction in prediction.

Overall, these current findings suggest that the measures included in the dataset assess valid constructs across numerous civilian and military demographic groups, and can now be used with more confidence going forward.

6. **PUBLICATIONS, ABSTRACTS, AND PRESENTATIONS:**

   a. List all manuscripts submitted for publication resulting from this project. Include those in the categories of lay press, peer-reviewed scientific journals, invited articles, and abstracts. Each entry shall include the author(s), article title, journal name, book title, editors(s), publisher, volume number, page number(s), date, DOI, PMID, and/or ISBN.

      (1) Lay Press:
      (2) Peer-Reviewed Scientific Journals:
      (3) Invited Articles:
      (4) Abstracts:

   b. List presentations made during the last year (international, national, local societies, military meetings, etc.). Use an asterisk (*) if presentation produced a manuscript.

Vogel, D. L., Vidales, C. A., Heath, P. J., & Abraham, T. (accepted). *Post-traumatic stress checklist for military personnel: Invariance across subgroups of military populations*. APA, Chicago, IL.

Vogel, D. L., Vidales, C. A., Heath, P. A., & Abraham, T. (accepted). *Testing the validity of brief Suicide and clinical screeners for military personnel*. International Summit on Suicide Research. Miami, FL.

1. **INVENTIONS, PATENTS AND LICENSES:** List all inventions made and patents and licenses applied for and/or issued. Each entry shall include the inventor(s), invention title, patent application number, filing date, patent number if issued, patent issued date, national, or international.

Nothing to report.

2. **REPORTABLE OUTCOMES:** Provide a list of reportable outcomes that have resulted from this research. Reportable outcomes are defined as a research result that is or relates to a product, scientific advance, or research tool that makes a meaningful contribution toward the understanding, prevention, diagnosis, prognosis, treatment and /or rehabilitation of a disease, injury or condition, or to improve the quality of life. This list may include development of prototypes, computer programs and/or software (such as databases and animal models, etc.) or similar products that may be commercialized.

Nothing to report.

3. **OTHER ACHIEVEMENTS:** This list may include degrees obtained that are supported by this award, development of cell lines, tissue or serum repositories, funding applied for based on work supported by this award, and employment or research opportunities applied for and/or received based on experience/training supported by this award.

   For each section, 4 through 9, if there is no reportable outcome, state "Nothing to report."

Nothing to report.

4. **REFERENCES:** List all references pertinent to the report using a standard journal format (i.e., format used in *Science*, *Military Medicine*, etc.).

Beck, A. T., Schuyler, D., & Herman, I. (1974). *Development of suicidal intent scales*. Charles Press Publishers.

Beck, A. T., & Steer, R. A. (1988). *Manual for the Beck hopelessness scale*. San Antonio, TX: Psychological Corporation.

Bush, K., Kivlahan, D. R., McDonell, M. B., Fihn, S. D., & Bradley, K. A. (1998). The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. *Archives of Internal Medicine, 158*, 1789-1795.

Cheung, G. W., & Lau, R. S. (2012). A direct comparison approach for testing measurement invariance. *Organizational Research Methods, 15*, 167-198.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.

Kenny, D. A., Kaniskan, B., & McCoach, D. B. (2015). The Performance of RMSEA in Models With Small Degrees of Freedom. *Sociological Methods & Research, 44*, 486–507.

Meade, A. W., Johnson, E. C., & Braddy, P. W. (2008). Power and sensitivity of alternative fit indices in tests of measurement invariance. Journal of applied psychology, 93(3), 568.

Metalsky, G. I., & Joiner, T. E. (1997). The hopelessness depression symptom questionnaire. *Cognitive Therapy and Research, 21*, 359-384.

Morin, C. M. (1993). Insomnia: *Psychological assessment and management*. Guilford Press.

Osman, A., Bagge, C. L., Gutierrez, P. M., Konick, L. C., Kopper, B. A., & Barrios, F. X. (2001). The Suicidal Behaviors Questionnaire-Revised (SBQ-R): validation with clinical and nonclinical samples. *Assessment, 8*, 443-454.

Taylor, S., Zvolensky, M. J., Cox, B. J., Deacon, B., Heimberg, R. G., Ledley, D. R., ... & Coles, M. (2007). Robust dimensions of anxiety sensitivity: development and initial validation of the Anxiety Sensitivity Index-3. *Psychological Assessment, 19*, 176-188.

Van Orden, K. A., Cukrowicz, K. C., Witte, T. K., & Joiner Jr, T. E. (2012). Thwarted belongingness and perceived burdensomeness: Construct validity and psychometric properties of the Interpersonal Needs Questionnaire. *Psychological Assessment, 24*, 197-215.

Van Orden, K. A., Witte, T. K., Gordon, K. H., Bender, T. W., & Joiner, T. E. (2008). Suicidal desire and the capability for suicide: Tests of the interpersonal-psychological theory of suicidal behavior among adults. *Journal of Consulting and Clinical Psychology, 76*, 72-83.

Weathers, F. W., Litz, B. T., Herman, D. S., Huska, J. A., & Keane, T. M. (1993, October). *The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility. In annual convention of the international society for traumatic stress studies*. San Antonio, TX (Vol. 462).

5. **APPENDICES:** Attach all appendices that contain information that supplements, clarifies or supports the text. Examples include original copies of journal articles, reprints of manuscripts and abstracts, a curriculum vitae, patent applications, study questionnaires, and surveys, etc.

Award expenditures to date:

Cumulative

Personnel ____ $74,802.67_________

Fringe Benefits ____ $15,904.38_______

Materials/Supplies _________

Subject Costs______________

Consultant Services __________

Cumulative

Travel ____ $1,944.64____________

Equipment/Facility Rental/User Fees ________

Participant/Trainee Support_______

Subaward/Contractual Costs ___________

Other Direct Costs ___ $8,198.00______

Cumulative

Subtotal _____$100,849.69___________

Indirect Costs ____ $48,911.28_____________

Total ____ $149,760.97_____________

A13. FINAL REPORT

TITLE: Three Year Follow-up of Study on Suicide Risk Assessments within Suicide-Specific Group Therapy Treatment for Veterans

PRINCIPAL INVESTIGATOR: Lora L. Johnson, PhD

REPORT DATE: 11/12/19

Table of Contents

1. INTRODUCTION:

This project is a follow-up to our previous work that showed that Veterans at high risk of suicide can be managed safely in a group format. There was no evidence of contagion or worsening of suicide-related symptoms as a result of participating in these groups. Overall, patients got better over time, making the original study a clinical success even though the majority of study hypotheses were not supported. The literature already supports several individual suicide-specific interventions for patients at high risk of suicide, and our findings suggest that it is worth the time and effort to also develop suicide-specific group interventions for patients at high risk of suicide. Our ongoing challenge is to determine how suicide-specific group interventions can be deployed to offer rapid symptom reduction, long-term resolution of suicidal crises, and increased skill attainment to help the largest number of high risk for suicide patients develop lives worth living with purpose and meaning in the most clinically efficient and cost-effective manner possible. The intent of conducting this three year follow-up study is to gather data that may demonstrate the long-term safety of a suicide-specific group therapy, while also investigating the extent to which mechanisms found to be significant correlates of clinical symptoms in our original study are associated with long-term pragmatic outcomes, such as suicide attempts, hospitalizations, and outpatient behavioral health treatment.

2. KEYWORDS:

suicide prevention, group therapy, Veteran service members, longitudinal, mixed method design

3. OVERALL PROJECT SUMMARY:

The study team accomplished all tasks outlined in the approved Statement of Work, including the following: 1) finalizing consent forms and human subjects protocol, 2) finalizing a semi-structured assessment, 3) training study staff to abstract data from the Computerized Patient Record System, 4) double abstraction of medical records on 137 Veterans by two separate research team members, 5) recruitment and interviewing of 30 Veterans with semi-structured interview, 6) transcription of qualitative data, 7) performing qualitative analyses according to specifications, and 8) performing quantitative analyses according to specifications.

Specific to the quantitative analyses, a series generalized linear and logistic mixed models were conducted to measure the associations between group cohesion, working alliance, session attendance and health service utilization and suicide attempts 3 years following completion of the suicide-focused group therapy. Study findings suggest that overall group therapy session attendance at 1 or 3 months was not significantly associated with elevated risk of inpatient hospitalization. There were no deaths by suicide observed during the 3-year follow-up period, as well.

Table 1. Three Year Risk of Inpatient Psychiatric Hospitalization

	Odds Ratio	Std. Err.	Lower CI	Upper CI	*p*
1-month sessions	1.18	0.16	0.90	1.55	0.23
3-month sessions	1.04	0.05	0.94	1.15	0.42

Due to the infrequent occurrence of suicide attempts during the 3-year follow-up period (16 Veterans total), the longitudinal models would not converge. Therefore, a series of cross-sectional logistic regression models were conducted and found no statistically significant associations between group attendance at 1 or 3 months and risk of suicide attempt.

Table 2. Three Year Risk of Suicide Attempts

	Odds Ratio	Std. Err.	Lower CI	Upper CI	*p*
Year 1					
1-month sessions	1.21	0.31	0.74	1.99	0.45
3-month sessions	0.94	0.08	0.79	1.12	0.52
Year 2					
1-month sessions	1.15	0.46	0.53	2.53	0.72
3-month sessions	1.21	0.20	0.88	1.68	0.24
Year 3					
1-month sessions	0.76	0.19	0.47	1.24	0.28
3-month sessions	0.97	0.09	0.81	1.16	0.71

Analyses that included group cohesion and working alliance were limited to those Veterans who attended at least 1 group therapy session, reducing the sample size to 93 participants. With this new denominator, it was observed that a greater number of sessions attended during the first month was significantly associated with greater likelihood of inpatient psychiatry hospitalization during the 3-year follow up (OR = 1.63, Std. Err = 0.38, $p = 0.03$; 95% CI = 1.04, 2.57). A significant association was also found between greater group cohesion at 1 month and reduced likelihood of inpatient psychiatry hospitalization during the 3-year follow up (OR = 0.94, Std. Err = 0.03, $p = 0.04$; 95% CI = 0.88, 0.997). No significant associations were observed between 3-month session attendance, group cohesion, or working alliance and subsequent inpatient psychiatric hospitalization.

Analysis of health services data resulted in a significant association between 1-month group cohesion and outpatient mental health treatment attendance (IRR = 1.08, Std. Err = 0.03, $p = 0.03$; 95% CI = 1.01, 1.11). Similarly, analyses demonstrated a significant association between 3-month group cohesion and outpatient mental health treatment attendance (IRR = 1.05, Std. Err = 0.02, $p < 0.01$; 95% CI = 1.02, 1.08). Results also suggested that Veterans who reported lower working alliance with the group facilitators at 1-month attended significantly more outpatient substance use treatment sessions (IRR = 0.73, Std. Err = 0.08, $p < 0.01$; 95% CI = 0.59, 0.91). No significant associations were observed between session attendance, group cohesion, or working alliance and report of suicidal ideation, outpatient psychopharmacology sessions, or Psychiatric or suicide-related emergency department visits. Greater engagement with ongoing suicide-focused group therapy sessions across the 3-year follow-up window was significantly associated with greater session attendance at both 1- (IRR = 1.57, Std. Err = 0.34, $p = 0.04$; 95% CI = 1.03, 2.40) and 3-months (IRR = 1.34, Std. Err = 0.10, $p < 0.001$; 95% CI = 1.16, 1.55). Additionally, higher group cohesion (IRR = 1.07, Std. Err = 0.03, $p = 0.02$; 95% CI = 1.01, 1.13) and lower working alliance (IRR = 0.79, Std. Err = 0.08, $p = 0.02$; 95% CI = 0.65, 0.95) at 3-months were significantly associated with greater engagement with ongoing suicide-focused group therapy sessions.

Specific to the qualitative analysis, Drs. O'Connor and Jobes reviewed each transcription to identify themes related to Veterans' experiences in the suicide-focused group therapy. Findings were discussed and a final set of identified themes that describe Veterans' experience were determined, including skills acquisition, group cohesion, barriers to attending, and experiences disclosing and listening to others' disclosure about suicidality.

Themes Regarding Suicide-Focused Group Therapy

Most Helpful Aspects of Group Therapy

- Freedom to share information and knowing others dealt with similar issues
- Hearing others speak about their problems helped Veterans put their own problems into perspective
- 75% felt that the issues most related to their suicidal ideation were discussed in group

Least Helpful Aspects of Group Therapy

- Half the Veterans reported that they could not think of anything unhelpful about the group
- Several Veterans found the social aspect of group difficult
- Some Veterans disliked when content overlapped with substance use issues or was not focused on suicide prevention

Barriers to Attending/Engaging Group Therapy

- Over half of participants reported transportation as the primary barrier to attending group
- Other barriers
    - Social Anxiety
    - Depression/Lack of motivation
    - Difficult to communicate personal information
    - Regarding communication, 70% of Veterans reported that prior to group they had never communicated suicidal thoughts to anyone
- A general theme was that Veterans did not want to burden others with their mental health issues

Discussion about Suicide in Group

- 1/3 found this to be difficult or embarrassing
- 1/3 had initial reservations that decreased over time
- 1/3 had no problems sharing information about suicide
- Some Veterans were clearly uncomfortable sharing personal information and were probably not a good fit for the group modality

Hearing about suicide in Group

- 50% felt a sense of belongingness with other Veterans
- Others reported sympathizing or gaining insight
- Very few reported being distressed
- Everyone denied that the group ever made them feel more suicidal

Skills Learned as a Result of Group

- 50% reported learning better communication skills
- 40% also reported learning skills related to emotion regulation and distress tolerance

Group Cohesion

- Veterans consistently reported evidence of group cohesion as a result of their group experience
- Major themes related to group cohesion
  - Felt understood and supported
  - Developed friendships
  - Positive to see each other recover
  - With those who have similar problems

Accomplished Treatment Goals

- 66% felt that they had accomplished their goals in treatment
  - Developed insight
  - In touch with reasons for living
  - Fulfilled obligation
- Only 2 Veterans reported not even partially accomplishing their goals

Impacted Desire to Continue in VA Care

- 55% of Veterans reported that the group positively impacted their desire to continue with VA care
  - Reinforced VA care
  - Developed friendships

How Group Contributed to Recovery after Hospitalization

- The group was most recognized as providing support for recovery
- Additional remarks from Veterans
  - Skills, insight, motivation
  - Felt accountable to group
  - Continuity of care

Preference for Group or Individual Therapy if Suicidal

- 40% would choose group modality
  - Group cohesion
  - Learn from others
  - Contribute to others
  - Communicate to others
- 30% reported a preference for individual treatment
  - Social anxiety
  - Privacy concerns
  - Individually tailored care
- 30% would choose to attend both

Experience using the Suicide Status Form

On Psychiatry Unit

- Most Veterans did not recall completing the SSF on the unit
- 35% found it helpful (e.g., good engagement tool, examined issues)
- 25% did not find it to be helpful

In Group

- Most Veterans found the SSF Tracking Form to be helpful
- Purpose was clearly understood
- Recognized that the assessment is only effective if Veterans are honest when completing

4. KEY RESEARCH ACCOMPLISHMENTS:

- Demonstrated no evidence of iatrogenic effect of the suicide-focused group therapy, as no Veterans died by suicide during the 3-year follow-up period. Additionally, no Veterans interviewed with the semi-structured interview reported that the group ever made them feel more suicidal.
- Determined that group cohesion is associated with long-term, pragmatic services outcomes associated with greater recovery in the 3-years following completion of the suicide focused group therapy. Specifically, higher group cohesion among group members was associated with less likelihood of inpatient psychiatric hospitalization and greater engagement in outpatient mental health therapy sessions.
- Found that there may be elements of group attendance associated with increased use of inpatient psychiatry in the long-term follow-up period. However, we were unable to determine the extent to which this is due to aspects of the group itself or patient characteristics.
- Captured Veterans' personal experiences with the group therapy, which were generally positive and indicate perceptions of strengths and weaknesses of the group modality to reduce suicide risk.

5. CONCLUSION:

The suicide-focused group therapy developed and tested at the Robley Rex Veterans Affairs Medical Center was, in part, created at the behest of suicidal Veterans wanting a group modality to assist with suicide risk reduction. Study findings demonstrate that the group is not associated with increased risk of mortality, debunking a common fear in the field of suicide prevention that allowing individuals with lived experience of suicidality to speak openly about their struggles and recovery would increase their risk of suicide. However, there are unique characteristics of military service members that warrant caution in generalizing results to the general population. Having a common service background perhaps increases the likelihood of group members developing group cohesion, which was the major active mechanism of the group process associated with positive recovery in the follow-up period. Since the initial MSRC study conducted in years 2012-2015, there has been a growing interest in using group modalities within military settings for suicide prevention. Results from this follow-up study will inform strategies for suicide prevention for military personnel that are transitioning back to the community during the high-risk, post-hospitalization period. It also informs future research that needs to be conducted, investigating for instance, why those

Veterans who attended the group more frequently in the first month were more likely to be hospitalized for psychiatric reasons in the 3-year follow-up period. We found in our initial study that treatment attendance was associated with significantly less suicidal ideation at the 1-month follow-up. Perhaps we can learn why session attendance appeared to be beneficial for clinical severity but not for use of acute care psychiatric services over time. Or perhaps this finding challenges our assumption that inpatient psychiatric hospitalization is a proxy variable for worse outcomes, when in actuality it could represent a greater desire to seek appropriate clinical services to avoid a suicide attempt. Regardless, the current study provides data essential to inform future efforts in suicide prevention that include a group modality for suicidal Veterans.

6. PUBLICATIONS, ABSTRACTS, AND PRESENTATIONS:

a. Manuscripts submitted for publication resulting from this project.

(1) Lay Press: Nothing to Report
(2) Peer-Reviewed Scientific Journals: Manuscript in Preparation
(3) Invited Articles: Nothing to Report
(4) Abstracts: Nothing to Report

b. Presentations made during the last year. –

Gutierrez, P.M., O'Connor, S.S., Johnson, L.J., Hagman, S.H., Podlogar, M.C., Jobes, D.A. (August 28, 2019) Suicide-Specific Group Therapy for Veterans: Development and testing of CAMS-G. Presentation at the VA/DoD Suicide Prevention Conference, Nashville, TN.

O'Connor, S.S., Johnson, L.J. (May 2019). Contribute, Belong, and Recover: Suicide-Focused Group Therapy for Veteran Service Members. Presentation for the May 2019 Injury Control Research Center for Suicide Prevention webinar series on promoting connectedness for Veterans and active duty Military personnel.

Gutierrez, P.M., O'Connor, S.S., Johnson, L.J., Jobes, D.A. (April 26, 2019). Mental Health Services Research to Inform Suicide Prevention Strategies in Veterans Affairs: Presentation at the American Association of Suicidology (AAS) 52^{nd} Annual Conference, Denver, CO.

Marcum, J.K., **Johnson, L.** (January 18, 2019). Identifying and Developing Strategies to Augment the Mission to Eliminate Veteran Suicide [Webinar]. Employee Education System (EES), Department of Veterans Affairs National Social Work and Care Management Quality, Safety and Value Committee.

7. INVENTIONS, PATENTS AND LICENSES:

Nothing to Report

8. REPORTABLE OUTCOMES:

Nothing to report. The initial study contributed through the creation of a treatment manual for a group therapy to treat suicidal Veterans. This long-term follow-up study was specifically focused on determining long-term outcomes rather than creating new materials.

9. OTHER ACHIEVEMENTS:

The research team is currently seeking funding for a multi-site randomized clinical trial of this group approach.

10. REFERENCES:

None included

11. APPENDICES:

We have included a copy of the semi-structured questionnaire used for the qualitative aspect of the study.

Award expenditures to date:

Cumulative	**Cumulative**
Personnel __$9,749.60_	Travel __$5,315.38_____
Fringe Benefits _$3,249.87_	Equipment/Facility Rental/User Fees _$0.00___
Materials/Supplies _$729.99__	Participant/Trainee Support_$0.00__
Subject Costs__$1,260.00____	Subaward/Contractual Costs __$92,291.69_
Consultant Services _$15,660.00_	Other Direct Costs _$1,558.20__

Cumulative

Subtotal ___$129,814.73___

Indirect Costs ___$17,504.61_____

Total __$147,319.34___

Semi-structured Interview for 3-Year Follow-up Study

1. When you think on the group therapy experience, what comes to mind?
2. What did you find most helpful about the treatment? Least helpful?
3. (For Veterans in the SSF condition) What was your experience completing this form (show them the initial SSF) on the inpatient psychiatry unit? Were there things that were particularly helpful/not helpful?
4. What were your expectations for the suicide-focused group therapy?
5. What were the barriers for you attending the group?
6. How much had you talked with family, friends, or other Veterans about suicide before the group?
7. What were your first impressions of the group?
    a. How was it different or similar to other group experiences that you have had?
    b. What was it like discussing your thoughts and feelings about suicide in front of other people?
    c. What was it like hearing about other people's thoughts and feelings about suicide?
    d. After the first session, did you think that you would return? Why or why not?
8. Do you think that the issues that are most closely related to what was making you suicidal were discussed in the group?
9. Do you think that you learned any new skills to apply when you were feeling suicidal or to prevent you from feeling suicidal?
    a. If so, what were they?
10. One of the topics we are interested in discussing is group cohesion, which is really about the relationships and bonds you might have formed with other group members. What can you tell me about the relationships you built with other group members?
11. Did you form any relationships with other group members in which you supported each other outside of group sessions?
12. What did you like and dislike about the way that group leaders conducted the group?
13. Did you ever worry about disclosing too much information or sensitive information about your suicidality in the group? Did you ever worry about that type of information being used against you in any way?
14. What factors influenced the number of sessions that you attended?
15. Did you feel like you accomplished your goals related to the group therapy?
16. Have you attended any suicide-focused group therapy sessions since you completed the study?
    a. If so, how many?
    b. If not, why not?
17. Did your group experience impact your desire to continue in VA care? How so?
18. (For Veterans in the SSF condition) Do you remember completing the written assessment with 5 or 6 questions at the beginning of each group session? (show them the form)
    a. Was this helpful?
    b. Did you think that it added any value to the group?
    c. What do you think was the purpose of completing this form?

19. Do you think that the group ever made you feel more suicidal? If so, what was it about the group that did this?
20. Overall, as you think about your experience being in the group, how do you think it contributed to your recovery after your inpatient psychiatry stay? Did it help you feel less suicidal?
21. What would have made the group better?
22. If you had the option of group versus individual treatment for suicidality, which would you choose and why?
23. Any final comments or recommendations?

A14. FINAL REPORT

TITLE: Enhancing Identification of Suicide Risk among Military Service Members and Veterans: A Machine Learning Approach to Suicidality

PRINCIPAL INVESTIGATOR: Andrew K. Littlefield, PhD

REPORT DATE: 1/30/2020

Table of Contents

1. INTRODUCTION:

The purpose of the current project is to determine the extent to which machine learning approaches can optimize the classification of several suicidal thoughts and behaviors using data available in the Common Data Elements (CDE). More specifically, this project compared model performance (as indexed by area under the curve; AUC) among multiple models that sought to classify various suicidal thoughts and behaviors: 1) non-attempters/non-ideators vs. ideators/non-attempters vs. attempters, 2) current (past two weeks) suicide ideation (vs. no current ideation), 3) current suicide impulses (vs. no current suicide impulses), 4) current suicide plan (vs. not current suicide plan), 5) lifetime suicide attempt history (vs. lack of attempt history), 6) amongst attempters: highest level of attempt lethality (medical attention) for the attempt participants considered most lethal, and 7) amongst attempters: level of suicide intent during most recent attempt. This project also compared model performance as a function of feature selection (using individual CDE items vs. factor scores informed by exploratory factor analysis) and subsample analysis (i.e., analyses within 18 subsamples of the CDE, such as military active participants, including three subsamples informed by latent class analysis, such as a class comprised of mostly male, young, military active participants).

2. KEYWORDS:

suicidality, machine learning, military, random forest, elastic net, ensemble method, latent class analysis

3. OVERALL PROJECT SUMMARY:

Below is a complete summary of the research accomplishments to date in direct alignment with respect to each task outlined in the approved Statement of Work.

<u>TASK 1- Initial IRB (Local and HRPO) Approval</u>

Milestones included preparing IRB materials at the prime site (Texas Tech University; TTU) as well as the three subcontract institutions (University of Mississippi Medical Center; UMMC, University of Rochester; UR, and Harvard University, Harvard), obtaining IRB approval, preparing and submitting HRPO materials, and receiving HRPO approval.

The prime site, TTU, received IRB approval (under exempt) on 1/16/2018 and HRPO approval on 3/22/2018.

The subcontract sites received IRB approval as follows: 2/7/18 at UMMC (the project was determined to be "not regulated" given the data were previously assessed and no identifying information was involved in the dataset), 2/6/2018 at UR, and 1/26/2018 at Harvard.

HRPO approval was obtained for all subcontract sites on 3/20/2018.

TASK 2- Data Cleaning and Examine Variable Distributions

The distribution of all CDE variables were initially examined to determine endorsement rates and patterns of missing to inform which variables would be used to create the seven primary outcomes for this project. Variable descriptions were also used to determine the coding scheme to create the seven primary outcomes, as informed by the expert opinions of multiple suicide content experts on this project.

Information about CDE variables that were used to create the dependent variables of interest are presented in Appendix 1. Notably, to ensure generalizability and transparency, we refer to some CDE variables, where the scoring has been minimally changed (e.g., range from 1-7 changed to range from 0-6), as recoded (e.g., RCDE5). Table 1 presents descriptive information for the dependent variables used within this project.

Lifetime History of Suicidality:
A three-level lifetime history of suicidality variable was created, with 0 = no suicide ideation/attempt, 1 = suicide ideation/no attempt, and 2 = suicide attempt history.

This variable was scored as a "2" if there was a score of 1 on any relevant suicide attempt item (each recoded to indicate absence [0]/presence [1]). Specifically, these items were recoded such that a score of $\geq$ 4 on item RCDE5, or score of 3 on item RCDE5_Schmidt, or score of $\geq$ 1 on items CDE13 or CDE14 indicated "presence of a suicide attempt" and scores of 0 indicated "no attempt."

This variable was scored as a "1" if participants were not previously coded as a "2" and there was a score of 1 on any relevant suicide ideation item (recoded below to indicate absence [0]/presence [1]). Specifically, these items (lifetime suicide ideation [RCDE5, RCDE5_Schmidt], past year suicide ideation [CDE6, and RCDE6_Schmidt], and current (past two weeks) suicide ideation [CDE1, CDE2, CDE3, CDE4]) were recoded such that scores $\geq$ 1 indicated "presence of at least some ideation" and scores of 0 indicated "no ideation".

This variable was scored as a "0" if there was a score of "0" on all absence [0]/presence [1] items referenced above (RCDE5, RCDE5_Schmidt, CDE13, CDE14, CDE6, RCDE6_Schmidt, CDE1, CDE2, CDE3, CDE4). A missing code was given to those who were missing on all of these items.

Current (Past 2 Weeks) Suicide Ideation:

A binary "current suicide ideation" variable with 0 = no current ideation, 1 = current ideation, was created.

This variable was scored as a "1" if there was a score of 1 on any relevant current suicide ideation item (recoded below to indicate absence [0]/presence [1]). Specifically, these items (CDE1, CDE2, CDE3, CDE4) were recoded such that scores $\geq$ 1 indicated "presence of at least some current ideation" and scores of 0 indicated "no current ideation".

Current (Past 2 Weeks) Suicidal Impulses:
A binary "current suicide impulses" variable with 0 = no current suicide impulses, 1 = current suicide impulses, was created.

Specifically, item CDE4 was recoded such that scores of $\geq$ 1 indicated "presence of current suicide impulses" and scores of 0 indicated "no current suicidal impulses."

Current (Past 2 Weeks) Suicide Plan:

A binary "current suicide plan" variable with 0 = no current suicide plan, 1 = current suicide plan, was created.

Specifically, item CDE2 was recoded such that scores of $\geq$ 1 indicated "presence of current suicide plan" and scores of 0 indicated "no current suicide plan."

Lifetime Suicide Attempt:

A binary "lifetime suicide attempt" variable with 0 = no attempt, 1 = presence of attempt, was created.

This variable was scored as a "1" if there was a score of 1 on any relevant suicide attempt item (each recoded to indicate absence [0]/presence [1]). Specifically, these items were recoded such that a score of $\geq$ 4 on item RCDE5, or score of 3 on item RCDE5_Schmidt, or score of $\geq$ 1 on items CDE13 or CDE14 indicated "presence of a suicide attempt" and scores of 0 indicated "no attempt."

Amongst Lifetime Attempters- Highest Level of Attempt Lethality:
A four-level attempt lethality (medical attention) variable was created, with 0 = no medical attention required, 1 = doctor visit/ER visit, 2 = admission to general medical floor, and 3 = ICU (intensive care unit from RCDE16). Notably, this rating is from the suicide attempt that lifetime attempters considered their most lethal attempt.

Amongst Lifetime Attempters- Level of Suicide Intent for Most Recent Attempt:
A binary "suicide intent" variable with 0 = no intent, 1 = at least some intent, was created from CDE11 responses whereby the participant was asked to select the **BEST** choice for their most recent "time you hurt yourself on purpose with some intention of dying."

Specifically, item CDE11 was recoded such that scores of $\geq$ 1 (i.e., part of me intended to die and part of me did not" or "I intended to die") indicated "presence of suicide intent" and scores of 0 (i.e., I did not intend to die) indicated "no suicide intent." Notably, this rating is from the most recent suicide attempt from lifetime attempters.

Table 1.
Dependent Variables

Variables	N	%
Lifetime History of Suicidality		
0 No Ideation/No Attempt	1411	23.29%
1 Ideation/No Attempt	2072	34.20%
2 Attempt	2575	42.51%
Total (Valid Responses)	6058	
Current Suicide Ideation		
0 Absent	2651	43.83%
1 Present	3398	56.17%
Total (Valid Responses)	6049	
Current Suicide Impulses		
0 Absent	3738	62.54%
1 Present	2239	37.46%
Total (Valid Responses)	5977	
Current Suicide Planning		
0 Absent	4659	77.29%
1 Present	1369	22.71%
Total (Valid Responses)	6028	
Lifetime Suicide Attempt		
0 Absent	3483	57.49%
1 Present	2575	42.51%
Total (Valid Responses)	6058	
Suicide Attempt- Lethality		
0 No Medical Attention	746	35.24%
1 Doc/ED visit (No Admission)	578	27.30%
2 Admission to Medical Floor	403	19.04%
3 Admission to ICU	390	18.42%
Total (Valid Responses)	2117	
Suicide Attempt- Intent		
0 Absent (I did not attend to die)	129	5.45%
1 Present (Ambiguous/Intended)	2237	94.55%
Total (Valid Responses)	2366	

Notes. Current = past 2 weeks; Suicide Attempt Lethality = Amongst lifetime suicide attempters, this is the lethality rating for the attempt that they considered their most lethal. Suicide Attempt Intent = Amongst lifetime suicide attempters this is the intent rating [best choice option] for their most recent suicide attempt.

Demographic Variables

Demographic information was used to 1) create a priori demographic subgroups and 2) create latent variable demographic classes to determine the extent to which machine leaning approaches can optimize the classification of suicidal outcomes within a given subset/class. Information about demographic variables that were used to create the subgroup variables of interest are presented in Appendix 2. Table 2 presents descriptive information for the demographic variable categories used within this project. The subgroup of non-Hispanic was not considered in the a priori demographic subgroups, given non-Hispanic Caucasians and non-Hispanic African Americans were specified as separate a priori subgroups. Further, the racial category of "Other" was not considered as an a priori demographic group, given this category was included in the latent class analysis of subgroups. Notably, all subgroups were used within the latent class analysis of demographics (see below) with the exception of deployment (which is inherently conditioned on military service status) and relationship status (to reduce the complexity of the latent class analysis). In total, 15 a priori subgroups were considered (i.e., military active/current service, veteran, civilian, deployed, not deployed, female, male, African American/Non-Hispanic, Hispanic, Caucasian/Non-Hispanic, single, married, divorced/separated, younger [18-34 years old], older [greater than 34 years old]) in addition to three latent demographic subgroups (described below under Task 3).

CDE Independent Variables

Information about CDE variables that were used as independent variables are presented in Appendix 3. The research team originally considered 32 variables from the CDE as independent variables/features: three items from the Beck Hopelessness Inventory (BHS, Beck, Weissman, Lester, & Trexler, 1974; e.g., "I don't expect to get what I really want"), five items from the Interpersonal Needs Questionnaire (INQ, Van Orden et al., 2012; e.g., "These days, other people care about me"), five items from the Anxiety Sensitivity Index (ASI, Taylor et al., 2007; e.g., "When my thoughts seem to speed up, I worry that I might be going crazy"), eight items from the PTSD checklist (PCL, Weathers et al., 1991; Weather et al., 1994; e.g., feeling jumpy or easily startled?), three items from the Alcohol Use Disorder Identification Test (AUDIT, Bush, Kivlahan, McDonnel, Fihn, & Bradley, 1998; e.g., "How often do you have six or more drinks on one occasion?"), five items from the Insomnia Severity Index (ISI, Bastein, Vallieres, & Morin, 2001; e.g., "How satisfied/dissatisfied are you with your current sleep pattern?"), and three additional items (i.e., "How often do you use prescription drugs more often or at greater quantities than prescribed?"; "How often do you use other substances (e.g., marijuana, cocaine, heroin, meth, pills, etc.)?"; "How many behavioral health treatment sessions have you attended in the past 3 months?"). Initial exploratory factor analysis (see below) indicated the item "How many behavioral health treatment sessions have you attended in the past 3 months?" did not load consistently onto any identified factors and was thus subsequently dropped from further analysis. Other variables were not included as independent variables for multiple reasons: (1) items reflected lifetime functioning rather than recent functioning (e.g., "Have you ever been hospitalized or treated in an emergency room following a head or neck injury?"), (2) items consisted of demographic variables that may reflect study enrollment biases (e.g., some studies included only civilians or Veterans), (3) items were directly related with suicidal outcomes (e.g., "How certain were you that the method you had chosen would be lethal?"). This resulted in 31 variables included as independent variables/features for subsequent analyses. Notably, many of

Table 2
Demographic Variables

Subgroup Analysis	LCA Analysis	Variables	Overall N	%
	X	**Military Service Status**		
X		1 Active Military/Current Service	2651	45.16%
X		2 Veteran	1478	25.18%
X		3 Civilian/No Service	1741	29.66%
		Total (Valid Responses)	5870	
		Deployment		
X		1 Deployed	1741	54.27%
X		2 Not Deployed	1467	45.73%
		Total (Valid Responses)	3208	
	X	**Sex**		
X		1 Male	3960	65.44%
X		2 Female	2091	34.56%
		Total (Valid Responses)	6051	
	X	**Age**		
X		0 Young (18-34)	4239	69.51%
X		1 Old (35 and older)	1859	30.49%
		Total (Valid Responses)	6098	
	X	**Relationship Status**		
X		1 Married	1672	35.43%
X		2 Single	2100	44.50%
X		3 Divorced/Separated	947	20.07%
		Total (Valid Responses)	4719	
	X	**Race**		
X		1 Caucasian	4153 (4002 NH)	68.42%
X		2 African American	1020 (994 NH)	16.81%
		3 Other	896 (337 NH)	14.77%
		Total (Valid Responses)	6069	
	X	**Ethnicity**		
X		1 Hispanic	531	09.36%
		2 Non-Hispanic	5145	90.64%
		Total (Valid Responses)	5676	

Notes. Subgroup analysis= algorithms ultimately conducted within this specific demographic subgroup; LCA analysis= variable was used to create demographic latent classes (whereby algorithms were conducted within each latent class). NH = non-Hispanic. Importantly, for the a priori subgroup analyses the Caucasia and African American subgroups were also Non-Hispanic.

these variables have been presented previously (please see Ringer et al., 2018 for detailed information).

TASK 3- Conduct Mixture Analysis and Exploratory Factor Analysis

Milestones included determining the optimal number of latent classes to retain for mixture analyses, assigning participants to most likely class to compare difference in rates of demographic outcomes (e.g., military status) across classes, conducting exploratory factor analyses on available measures to create psychometrically enhanced measures of independent variables, and coordinating with data analysis team to review main analytic plan.

Prior to all subsequent analyses, the MSRC dataset was split into a training dataset (i.e., 80% of the sample in which models were developed) and a testing dataset (i.e., 20% of the sample in which models were validated).

Determining the optimal number of latent classes to retain for mixture analyses.

In addition to the subsamples defined a priori, latent class analysis (LCA) was used to identify latent classes with similar demographic characteristics. Variables used as indicators for the latent classes included sex (male or female), race (African American, Caucasian, or other), ethnicity (Hispanic or non-Hispanic), relationship status (divorced/separated, married, or single), age (young [i.e., 18-34 years old] or older), and military service status (civilian, veteran, or active military).

LCAs were conducted in M*plus* version 8 (Muthén, & Muthén, 1998-2017). We considered the possibility of up to five latent classes, limiting the total number to increase the likelihood that each class would characterize a meaningful percentage of participants. LCAs were conducted within the training dataset, then replicated within the testing dataset. Full information maximum likelihood with robust standard errors was used to handle missing data. Model fit was evaluated using Akaike information criterion (AIC), Bayesian information criterion (BIC), and sample-size adjusted BIC (SSABIC). After determining the appropriate number of latent classes, participants were placed in the latent class with the highest posterior probability of membership.

AIC, BIC, and SSABIC improved as latent classes were added, suggesting the five-class solution provided the best fit to the data. However, as classes were added, the solutions began identifying classes that were previously accounted for by the a priori designations (e.g., the four-class solution identified a class that contained over 80% of all Hispanic participants) and were thus redundant with the a priori designations of subsamples. Further, although the three-class solution yielded subgroup sizes more amenable to machine learning approaches (i.e., the smallest size in the training dataset was n=1005), the four- and five-class solutions began producing groups with notably smaller sample sizes (i.e., the smallest size in the training dataset was n=308 for the four-class solution and 232 for the five-class solution). Thus, the three-class solution was chosen; the entropy of this model (.81) supported the approach of placing participants into their most likely class.

The class solutions were consistent across the training and testing datasets (see Table 3). Among the most distinguishing features of Class 1 (29% of the training sample; 23% of the testing sample) is that most of the participants were civilian (100% of the training sample; 98.39% of the testing sample) and female (77.70% female in the training sample and 85.5% in the testing sample). For Class 2 (47% of the training sample, 51% of the testing sample), the most distinguishing features were that these participants were young (100% young in both training and testing samples), primarily male (76.7% and 78.7% in the respective training and testing samples), and reported actively serving in the military (81.02% of the training sample and 77.42% of the testing sample). Class 3 (24% of the training sample and 26% of the testing sample) consisted of primarily male (82.2% and 87.10% in the respective training and testing samples), older (91.8% and 89% in the respective training and testing samples), and military involved participants (less than 7% of Class 3 identified as civilian within the training and testing samples; see Table 3 for more details regarding the demographic composition of the three classes). In total, 18 subsamples (15 a priori groups + three latent classes) were examined across all outcomes, models, and feature selection approaches.

Conducting exploratory factor analyses on available measures to create psychometrically enhanced measures of independent variables.

Exploratory factor analysis (EFA) originally considered the 31 independent variables/features described in Task 2 (see Appendix 3). Several steps were involved in conducting the EFA analysis; all initial steps occurred within the training dataset. First, missing values on the 31 variables were imputed using Maximum Likelihood within Mplus. Imputation was used to estimate missing data in order to base the EFA analyses on the same independent variable set that would be subsequently used within the machine learning analyses. Given the responses for all items were either binary (e.g., True/False items for the BHS items) or ordered polytomous (i.e., consisted of discrete, Likert-like categories), all values were imputed as categorical. Second, the 31 variables (including original non-missing values and imputed values) were included in EFA conducted within Mplus that considered 1-9 factor solutions. More specifically, the EFAs used the weighted least square with means and variances adjusted (WLSMV) estimator with a geomin (oblique) rotation (this rotation allows for the factors to be correlated). Third, model fit and interpretability of the various factor solutions were used to determine the appropriate number of factors to retain. Fourth, a confirmatory factor analysis (CFA) was conducted within the testing dataset (involving the 31 variables described above and using imputed values for missing data) to validate the EFA solution.

Not surprisingly, model fit improved as the number of factors increased (e.g., RMSEA = .029, CFI = .952 for the eight factor solution; RMSEA = .022, CFI = .975 for the nine factor solution). However, the nine-factor solution included a factor where none of the 31 items exhibited their strongest loading onto this factor. Furthermore, the eight-factor solution exhibited a very interpretable solution (largely consistent to the solution identified in Ringer et al. 2018; see Ringer et al. for more details): the three BHS items loaded most strongly onto one factor (Factor 1), the five INQ items loaded most strongly onto one factor (Factor 2), the five ASI items loaded most strongly onto one factor (Factor 3), six items from the PCL loaded onto one factor (Factor 4; all items except "Being 'super alert' or watchful or on guard" and "Feeling jumpy or easily startled"; see Factor 7), the five ISI items loaded onto one factor (Factor 5), the three AUDIT

Table 3
LCA Solution

Dataset		n (%)	Male (%)	Hispanic (%)	Young (%)	White (%)	Black (%)	Other (%)	Married (%)	Single (%)	Divorced (%)	Serving (%)	Veteran (%)	Civilian (%)
Training	Class 1	1215 (29)	22.30	4.60	77.70	77.42	11.57	11.01	49.94	37.86	12.21	0.00	0.00	100.00
	Class 2	1951 (47)	76.70	12.80	100.00	63.64	16.56	19.79	30.36	58.09	11.56	81.02	9.93	9.02
	Class 3	1005 (24)	82.20	8.60	8.20	67.87	21.17	11.05	36.36	21.57	42.07	20.71	72.51	6.78
		n (%)	Male (%)	Hispanic (%)	Young (%)	White (%)	Black (%)	Other (%)	Married (%)	Single (%)	Divorced (%)	Serving (%)	Veteran (%)	Civilian (%)
Testing	Class 1	475 (23)	14.50	3.60	71.70	77.90	11.91	10.19	46.35	39.02	14.63	0.00	1.61	98.39
	Class 2	1070 (51)	78.70	12.10	100.00	64.42	17.40	18.18	30.71	58.47	10.82	77.42	10.00	12.58
	Class 3	540 (26)	87.10	7.40	11.00	69.61	21.67	8.72	41.06	21.52	37.42	22.00	72.00	6.01

items loaded onto one factor (Factor 6), the two other items from the PCL loaded onto one factor (Factor 7; i.e., "Being 'super alert' or watchful or on guard" and "Feeling jumpy or easily startled"), and the two remaining items (i.e., "How often do you use prescription drugs more often or at greater quantities than prescribed?" and "How often do you use other substances (e.g., marijuana, cocaine, heroin, meth, pills, etc.?") loaded onto one factor (Factor 8).

That is, all respective subscales were identified as factors, with the exception that the PCL was best represented by two separate factors. One additional two-item factor captured shared variance regarding using prescription drugs not as prescribed and other drug use behaviors.

A CFA of this model was estimated within the training dataset (treating all factor indicators as ordered polytomous), resulting in excellent model fit (i.e., RMSEA = .048, CFI = .981). Thus, this factor solution was used to create eight new variables by outputting factor scores from this solution for both the training and testing dataset.

This resulted in the training and testing datasets to be used for the machine learning approaches (i.e., the seven suicidal outcomes based on available data in the CDE, the 31 variables included in the EFA as indicators, including imputed values for missing on the features, and the 8 factor scores [estimated using the Maximum A Posteriori [MAP] method] informed by the aforementioned EFA/CFA solutions). For each outcome (including the total sample and the 18 subsamples), participants were removed who had missing values on the respective outcomes prior to conducting machine learning analyses. Two sets of features (independent variables) were used for each analysis: one consisting of the 31 CDE variables, and another consisting on the eight factors described above. Four primary types of models (logistic regression, elastic net regression, random forests, stacked ensemble) were trained on the entire sample and within each subsample. Model performance (as indexed by AUC) was compared across: (a) samples (to determine if models trained within just the subsamples showed enhanced performance to models trained on the entire sample), (b) modeling approach, and (c) feature selection approach.

TASK 4- IRB/HRPO Approval at new Co-investigator sites

Co-investigators Drs. Bagge and Kleiman on the study switched institutions during the period of funding (Dr. Bagge from University of Mississippi Medical Center to University of Michigan, Dr. Kleiman from Harvard University to Rutgers, the State University of New Jersey. Milestones included preparing IRB materials at the new sites, obtaining IRB approval, preparing and submitting HRPO materials at the new sites, and receiving HRPO approval.

Rutgers, the State University of New Jersey, received IRB approval on 7/1/2019 and University of Michigan received IRB approval on 9/16/2019.

HRPO approval was obtained for both University of Michigan and Rutgers, the State University of New Jersey on 10/15/2019.

TASK 5 – Conduct Machine Learning (ML) Analyses

Milestones included developing ML algorithms within the entire sample by using random forests, elastic net regularization, stacked ensembles, and general linear models (based on both manifest values of independent variables/features and latent factor scores), optimizing these algorithms within the a priori demographic groups and the three latent classes, determining the extent to which ensemble methods increase classification accuracy compared to non-ensemble ML approaches, and coordinating study findings with team members.

More specifically, all machine learning analyses were conducted in RStudio (RStudio Team, 2018). All analysis was performed with trainList() from the caret package (Kuhn, 2008; Kuhn & Johnson, 2013). trainList() acts as a wrapper for a large number of algorithms to be conducted simultaneously and for the specification of the number of distinct values used for each tuning parameter, while generating defaults for each of the tuning parameters. For random forests (RF), we used the randomForest package (Liaw & Wiener, 2002) with 10 values of mtry (the fraction of predictors selected for creating each tree) and 1,000 trees. The glmnet package (Friedman, Hastie, & Tibshirani, 2010) was used in the implementation of the elastic net (EN), using seven values for alpha, the mixing parameter, and 40 values of lambda, the penalty parameter. Stacked ensembles (SE; i.e., models that estimate and combine multiple machine learning algorithms into one overall model) were estimated with the h2o.automl() from the h2o package (LeDell et al., 2019). Briefly, 20 models with various tuning parameters (see http://docs.h2o.ai/h2o/latest-stable/h2o-docs/automl.html for more details; algorithms include a near-default Deep Neural Net, an Extremely Randomized Forest, a random grid of XGBoost gradient boosting machines, a random grid of H2O gradient boosting machines, and a random grid of Deep Neural Nets) were considered. For general linear models (GLM), the glm function was used for binary outcomes and the multinom option from the nnet package (Venables & Ripley, 2002) was used for multinomial outcomes. These models do not included tuning parameters (for analyses involving the multinom package, decay was set to zero to specify a standard multinomial general linear model).

For all models involving the caret package, repeated 10-fold cross validation with 5 repeats was used to validate the models within the training data. To determine the optimal tuning parameters, models involving binary outcomes were optimized on area under the receiver operating characteristic curve (AUC) whereas models involving multinomial outcomes were optimized on accuracy using the one standard error rule (i.e., choosing the most parsimonious model whose error is no more than one standard error above the error of the best model; see Hastie, Tibshirani, & Friedman, 2009). The best models from the training dataset where then validated on the testing dataset. AUCs were calculated using the pROC package (Robin, Turck, Hainard, Tiberti, Lisacek, Sanchez, & Müller, 2011); for consistency across outcomes, the multiclass.roc option was used to calculate AUCs for the multinomial outcomes using the method described by Hand and Till (2001).

For each of the seven outcomes and for each of the four primary types of models (i.e., GLM, EN, RF, and SE), models were trained on the full training sample using either the 8 factor scores or the 31 individual CDE items. These models were then used within the total testing dataset as well as the 18 subsamples (15 a priori demographic groups + 3 LCA demographic groups) to determine how models trained on the entire training dataset performed within the entire testing data as well as the subgroups within the testing dataset. To determine the impact of training models within the various subgroups, 18 models (one for each subgroup) were estimated within training dataset and evaluated within the respective subgroups in the testing dataset (based on either the factor scores or the individual CDE items). Thus, for each of the four primary types of models, 74 AUCs were calculated using the testing dataset, resulting in 296 AUCs for each outcome and 2,072 AUCs total across the seven outcomes.

Further, variable importance (i.e., the extent to which a given variable contributes to a given model's performance) was calculated for three of the primary types of models (GLM, EN, and EF; variable importance is not available for SE) based on models trained using the entire training sample for both the factor scores and individual CDE items. Given that the variable importance metrics vary across model type, the rank of each variable's importance was calculated within model and averaged across models (consistent with recommendations by Kuhn & Johnson, 2013). This resulted in 39 ranks (31 ranks based on the individual variables + 8 ranks based on the factor scores) for each of the three primary models. Given that variable importance of the top features was consistent across models, the average of variable importance across outcomes is reported. Further, considering that models predicting attempt characteristics (i.e., lethality and level of intent) did not perform much better than chance in the total sample (i.e., average AUC = .524 and .632 for lethality and intent, respectively), variable importance from these models were not considered when calculating average variable importance across models.

Lifetime History of Suicidality: Model Performance

Table 4 shows the AUCs for the GLM, EN, RF, and SE analyses for the 19 samples considered (total sample plus 18 subsamples), using either the individual CDE items or the 8 factor scores, and whether the model was trained on the entire sample or within a given subsample.

For the overall sample, AUCs across models and feature selection ranged from .742 (RF using factor scores) to .769 (SE individual CDE items), suggesting similar classification performance across models and feature selection approach. Overall, performance was slightly better for models utilizing the individual CDE items rather than the factor scores, though this difference was slight.

Regarding the subsample analyses, the average AUC for models trained on the entire sample and applied to the subsamples was .743, whereas the average AUC for models trained on the respective subsamples and applied to the respective subsamples was .735, suggesting little utility of training models within specific subsamples based on demographic characteristics.

Overall, the machine learning approaches were comparable to utilizing a standard GLM within these data to classify non-attempters/non-ideators vs. ideators/non-attempters vs. attempters, and algorithms developed in the entire sample did as well as algorithms developed within specific subsamples. This general pattern of findings extended to the other outcomes (see below).

Current (Past 2 Weeks) Suicide Ideation: Model Performance

Table 5 shows the AUCs for the GLM, EN, RF, and SE analyses for suicide ideation. For the overall sample, AUCs across models and feature selection ranged from .809 (EN using factor scores) to .834 (SE using individual CDE items), suggesting similar classification performance across models and feature selection approach. Performance was slightly better for models utilizing the individual CDE items rather than the factor scores.

Regarding the subsample analyses, the average AUC for models trained on the entire sample and applied to the subsamples was .811, whereas the average AUC for models trained on the respective subsamples and applied to the respective subsamples was .810, suggesting little utility of training models within specific subsamples based on demographic characteristics.

Current (Past 2 Weeks) Suicide Impulses: Model Performance

Table 6 shows the AUCs for the GLM, EN, RF, and SE analyses for suicide impulses. For the overall sample, AUCs across models and feature selection ranged from .777 (EN and RF using factor scores) to .797 (SE using individual CDE items), suggesting similar classification performance across models and feature selection approach. Performance was slightly better for models utilizing the individual CDE items rather than the factor scores.

Regarding the subsample analyses, the average AUC for models trained on the entire sample and applied to the subsamples was .786, whereas the average AUC for models trained on the respective subsamples and applied to the respective subsamples was .788, suggesting little utility of training models within specific subsamples based on demographic characteristics.

Current (Past 2 Weeks) Suicide Plan: Model Performance

Table 7 shows the AUCs for the GLM, EN, RF, and SE analyses for suicide plan. For the overall sample, AUCs across models and feature selection ranged from .706 (RF using factor scores) to .734 (SE using individual CDE items), suggesting similar classification performance across models and feature selection approach. Performance was slightly better for models utilizing the individual CDE items rather than the factor scores.

Regarding the subsample analyses, the average AUC was identical (to three decimal places; .732) for models trained on the entire sample and applied to the subsamples as well as models trained on the respective subsamples and applied to the respective subsamples, suggesting little utility of training models within specific subsamples based on demographic characteristics.

Lifetime Suicide Attempt: Model Performance

Table 8 shows the AUCs for the GLM, EN, RF, and SE analyses for lifetime suicide attempt. For the overall sample, AUCs across models and feature selection ranged from .701 (RF using factor scores) to .734 (SE using individual CDE items), suggesting similar classification performance across models and feature selection approach. Performance was slightly better for models utilizing the individual CDE items rather than the factor scores.

Table 4. Areas under the Receiver-Operating Curve (AUC) in the testing sample across models, features, and subsamples for classifying non-attempters/non-ideators vs. ideators/non-attempters vs. attempters.

	General Linear Model				Elastic Net				Random Forest				Stacked Ensemble			
	FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained	
Sample Used	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE
Total Training Sample	0.752	0.763	-	-	0.751	0.763	-	-	0.742	0.767	-	-	0.744	0.769	-	-
Military Active	0.711	0.773	0.773	0.784	0.709	0.770	0.766	0.781	0.678	0.770	0.745	0.772	0.749	0.779	0.764	0.779
Deployed	0.745	0.773	0.745	0.770	0.737	0.766	0.737	0.767	0.716	0.780	0.716	0.763	0.744	0.779	0.760	0.762
Not Deployed	0.766	0.770	0.777	0.757	0.770	0.775	0.771	0.776	0.757	0.773	0.751	0.768	0.756	0.777	0.748	0.770
Veteran	0.696	0.696	0.702	0.705	0.692	0.696	0.701	0.700	0.678	0.700	0.665	0.704	0.688	0.692	0.646	0.684
Civilian	0.714	0.740	0.708	0.715	0.719	0.743	0.702	0.722	0.724	0.745	0.717	0.745	0.721	0.757	0.727	0.740
Female	0.717	0.720	0.712	0.714	0.721	0.731	0.711	0.726	0.716	0.740	0.691	0.734	0.719	0.729	0.705	0.713
Male	0.767	0.779	0.769	0.787	0.763	0.776	0.765	0.781	0.751	0.775	0.741	0.772	0.752	0.778	0.769	0.782
African American-NH	0.703	0.720	0.711	0.709	0.702	0.713	0.709	0.714	0.699	0.714	0.678	0.708	0.701	0.738	0.699	0.709
Hispanic	0.752	0.763	0.753	0.762	0.751	0.763	0.751	0.763	0.746	0.765	0.742	0.768	0.747	0.772	0.753	0.764
Caucasian-NH	0.769	0.775	0.769	0.768	0.766	0.778	0.766	0.777	0.761	0.778	0.756	0.777	0.758	0.779	0.769	0.782
LCA Class 1	0.733	0.738	0.720	0.728	0.729	0.736	0.720	0.723	0.714	0.729	0.710	0.735	0.754	0.777	0.703	0.735
LCA Class 2	0.699	0.713	0.670	0.677	0.705	0.721	0.681	0.692	0.707	0.735	0.699	0.701	0.761	0.781	0.757	0.762
LCA Class 3	0.769	0.782	0.727	0.725	0.767	0.781	0.718	0.731	0.757	0.780	0.723	0.755	0.754	0.781	0.733	0.751
Single	0.721	0.736	0.730	0.731	0.722	0.735	0.727	0.741	0.711	0.733	0.716	0.728	0.711	0.737	0.729	0.738
Married	0.760	0.759	0.755	0.755	0.756	0.762	0.756	0.764	0.759	0.771	0.752	0.759	0.764	0.775	0.748	0.756
Divorced/Separated	0.712	0.727	0.705	0.703	0.702	0.715	0.680	0.685	0.674	0.699	0.663	0.701	0.689	0.737	0.652	0.662
Younger (< 35 years old)	0.761	0.776	0.760	0.769	0.760	0.776	0.759	0.773	0.749	0.778	0.748	0.775	0.764	0.779	0.761	0.777
Older (> 34 years old)	0.728	0.730	0.717	0.722	0.727	0.732	0.711	0.721	0.722	0.737	0.707	0.736	0.721	0.737	0.717	0.725
Average AUC	0.736	0.749	0.733	0.738	0.734	0.749	0.730	0.741	0.724	0.751	0.718	0.744	0.737	0.761	0.730	0.744

Note. General Linear Model = general linear model with a logit link function; Elastic Net = elastic net with alpha and lambda as tuning parameters; Random Forest = Random Forest with 1,000 trees and number of variables available for splitting at each tree node (mtry) as a tuning parameter; Stacked Ensemble = stacked ensemble model developed using the AutoML feature of the H2O package. LCA = participants with similar demographic characteristics as identified by latent class analysis; FS Trained = models trained using the full training sample; SS Trained = models trained using the demographic subsamples; Factor = models using the eight factors identified among 31 CDE variables; CDE = models using the 31 individual CDE variables. NH = non-Hispanic.

Table 5. Areas under the Receiver-Operating Curve (AUC) in the testing sample across models, features, and subsamples for current ideation vs. non-ideation.

	General Linear Model				Elastic Net				Random Forest				Stacked Ensemble			
	FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained	
Sample Used	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE
Total Training Sample	0.816	0.828			0.809	0.822			0.817	0.832			0.820	0.834		
Military Active	0.842	0.844	0.847	0.850	0.839	0.844	0.840	0.849	0.834	0.847	0.838	0.846	0.720	0.738	0.718	0.720
Deployed	0.857	0.858	0.859	0.864	0.855	0.860	0.853	0.862	0.848	0.860	0.840	0.860	0.723	0.755	0.720	0.730
Not Deployed	0.827	0.826	0.832	0.832	0.824	0.830	0.824	0.835	0.818	0.835	0.812	0.831	0.828	0.830	0.820	0.834
Veteran	0.793	0.805	0.804	0.803	0.794	0.800	0.806	0.811	0.792	0.804	0.805	0.810	0.796	0.807	0.805	0.805
Civilian	0.788	0.815	0.830	0.842	0.771	0.805	0.809	0.843	0.817	0.839	0.838	0.849	0.713	0.720	0.724	0.738
Female	0.801	0.814	0.810	0.823	0.789	0.812	0.801	0.818	0.813	0.829	0.818	0.814	0.703	0.823	0.820	0.818
Male	0.820	0.833	0.822	0.833	0.816	0.828	0.817	0.829	0.817	0.831	0.819	0.827	0.822	0.837	0.825	0.835
African American-NH	0.795	0.816	0.797	0.803	0.780	0.800	0.781	0.798	0.772	0.794	0.788	0.790	0.717	0.735	0.674	0.721
Hispanic	0.822	0.833	0.822	0.834	0.814	0.830	0.814	0.831	0.823	0.838	0.821	0.832	0.736	0.745	0.737	0.742
Caucasian-NH	0.839	0.840	0.840	0.841	0.839	0.844	0.836	0.844	0.845	0.853	0.843	0.849	0.746	0.751	0.745	0.748
LCA Class 1	0.814	0.821	0.824	0.823	0.813	0.818	0.819	0.826	0.815	0.822	0.818	0.821	0.818	0.829	0.819	0.818
LCA Class 2	0.787	0.810	0.745	0.745	0.772	0.805	0.750	0.760	0.816	0.813	0.749	0.760	0.809	0.827	0.745	0.761
LCA Class 3	0.832	0.839	0.817	0.810	0.828	0.837	0.821	0.826	0.824	0.838	0.818	0.832	0.831	0.841	0.817	0.825
Single	0.800	0.823	0.822	0.831	0.791	0.811	0.805	0.826	0.798	0.811	0.807	0.820	0.801	0.825	0.821	0.831
Married	0.836	0.828	0.828	0.822	0.834	0.834	0.832	0.833	0.823	0.835	0.818	0.831	0.833	0.837	0.830	0.831
Divorced/Separated	0.782	0.784	0.785	0.776	0.779	0.784	0.787	0.788	0.784	0.777	0.778	0.788	0.659	0.694	0.668	0.682
Younger (< 35 years old)	0.832	0.843	0.834	0.843	0.824	0.840	0.828	0.840	0.829	0.842	0.828	0.842	0.834	0.847	0.836	0.849
Older (> 34 years old)	0.797	0.803	0.799	0.798	0.793	0.804	0.793	0.803	0.810	0.813	0.796	0.808	0.808	0.813	0.802	0.805
Average AUC	0.815	0.824	0.818	0.821	0.808	0.822	0.812	0.823	0.816	0.827	0.813	0.823	0.775	0.794	0.774	0.783

Note. General Linear Model = general linear model with a logit link function; Elastic Net = elastic net with alpha and lambda as tuning parameters; Random Forest = Random Forest with 1,000 trees and number of variables available for splitting at each tree node (mtry) as a tuning parameter; Stacked Ensemble = stacked ensemble model developed using the AutoML feature of the H2O package. LCA = participants with similar demographic characteristics as identified by latent class analysis; FS Trained = models trained using the full training sample; SS Trained = models trained using the demographic subsamples; Factor = models using the eight factors identified among 31 CDE variables; CDE = models using the 31 individual CDE variables. NH = non-Hispanic.

Regarding the subsample analyses, the average AUC for models trained on the entire sample and applied to the subsamples was .725, whereas the average AUC for models trained on the respective subsamples and applied to the respective subsamples was .727.

Amongst Lifetime Attempters- Highest Level of Attempt Lethality: Model Performance

Table 9 shows the AUCs for the GLM, EN, RF, and SE analyses for level of suicide attempt lethality among lifetime attempters. For the overall sample, AUCs across models and feature selection ranged from .512 (GLM using factor scores) to .541 (RF using individual CDE items), suggesting similarly poor classification performance across models and feature selection approach. The average AUC for models trained on the entire sample and applied to the subsamples (.523) was nearly identical to models trained within the subsamples (.522). Overall, these models failed to classify level of highest lethality among attempters much beyond chance levels.

Amongst Lifetime Attempters- Level of Suicide Intent for Most Recent Attempt: Model Performance

Table 10 shows the AUCs for the GLM, EN, RF, and SE analyses for level of suicide intent among lifetime attempters. For the overall sample, AUCs across models and feature selection ranged from .576 (RF using factor scores) to .667 (EN using individual CDE items). The range of AUCs was wider compared to other outcomes, though models did not perform much better than chance levels when using models trained on the overall training sample.

Regarding the subsample analyses, the average AUC for models trained on the entire sample and applied to the subsamples was .645, whereas the average AUC for models trained on the respective subsamples and applied to the respective subsamples was .665, suggesting little utility of training models within specific subsamples based on demographic characteristics.

Notably, there was a greater range of AUCs among the subsamples for suicide intent compared to other outcomes (i.e., .436 for females using SE with factor scores to .880 for deployed participants using RF with factor scores). This variability is not surprising, given this outcome was limited to those with a lifetime suicide attempt and low variability of this outcome within the entire sample (i.e., only 129 participants with a lifetime suicide attempt history reported no intent to die). Thus, when analyses are broken into smaller groups of participants across the training and testing datasets, model performance estimates are unstable.

Variable Importance

The average rank of variable importance for GLM, RF, and EN models across all outcomes (except the two outcomes related to attempt characteristics) based on the factor scores or the 31 CDE items are shown in Tables 11 and 12, respectively. For models based on factor scores, the two most important factors were based on items from the INQ and BHS, whereas the two least important factors were based on items from the AUDIT and PCL items related to alertness/startle sensitivity

Table 6. Areas under the Receiver-Operating Curve (AUC) in the testing sample across models, features, and subsamples for current suicide impulses vs. non-suicide impulses.

	General Linear Model				Elastic Net				Random Forest				Stacked Ensemble			
	FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained	
Sample Used	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE
Total Training Sample	0.782	0.793			0.777	0.790			0.777	0.790			0.784	0.797		
Military Active	0.800	0.805	0.807	0.796	0.801	0.810	0.803	0.811	0.791	0.813	0.795	0.809	0.803	0.811	0.805	0.807
Deployed	0.802	0.807	0.810	0.804	0.804	0.807	0.803	0.812	0.786	0.812	0.791	0.809	0.803	0.813	0.780	0.812
Not Deployed	0.795	0.799	0.800	0.786	0.799	0.808	0.800	0.807	0.791	0.814	0.785	0.812	0.801	0.808	0.801	0.807
Veteran	0.778	0.776	0.794	0.776	0.777	0.768	0.794	0.793	0.775	0.784	0.780	0.788	0.784	0.787	0.791	0.788
Civilian	0.782	0.786	0.782	0.786	0.769	0.792	0.769	0.792	0.776	0.790	0.776	0.790	0.754	0.784	0.781	0.793
Female	0.787	0.785	0.767	0.787	0.786	0.781	0.764	0.786	0.779	0.779	0.764	0.779	0.770	0.787	0.767	0.790
Male	0.789	0.796	0.791	0.797	0.785	0.795	0.787	0.796	0.781	0.797	0.779	0.795	0.790	0.802	0.788	0.797
African American-NH	0.793	0.807	0.803	0.808	0.790	0.798	0.795	0.808	0.758	0.795	0.797	0.789	0.780	0.793	0.800	0.813
Hispanic	0.787	0.796	0.787	0.795	0.784	0.795	0.785	0.795	0.783	0.797	0.787	0.795	0.789	0.800	0.792	0.800
Caucasian-NH	0.792	0.795	0.793	0.793	0.788	0.798	0.788	0.796	0.790	0.802	0.793	0.799	0.794	0.804	0.793	0.800
LCA Class 1	0.797	0.756	0.805	0.789	0.796	0.742	0.807	0.805	0.786	0.770	0.785	0.805	0.798	0.806	0.797	0.795
LCA Class 2	0.766	0.787	0.742	0.740	0.749	0.785	0.736	0.746	0.772	0.769	0.743	0.738	0.765	0.787	0.739	0.742
LCA Class 3	0.783	0.792	0.766	0.766	0.779	0.791	0.773	0.781	0.776	0.795	0.772	0.781	0.785	0.799	0.768	0.777
Single	0.789	0.804	0.802	0.809	0.786	0.800	0.797	0.811	0.787	0.796	0.777	0.803	0.792	0.806	0.802	0.807
Married	0.802	0.802	0.791	0.792	0.801	0.802	0.799	0.802	0.794	0.809	0.785	0.800	0.804	0.814	0.794	0.799
Divorced/Separated	0.751	0.742	0.763	0.706	0.748	0.747	0.760	0.744	0.748	0.752	0.751	0.753	0.753	0.756	0.764	0.744
Younger (< 35 years old)	0.792	0.802	0.794	0.802	0.787	0.801	0.788	0.801	0.787	0.801	0.793	0.798	0.793	0.805	0.793	0.803
Older (> 34 years old)	0.773	0.778	0.780	0.766	0.771	0.773	0.776	0.781	0.766	0.776	0.765	0.780	0.774	0.788	0.775	0.782
Average AUC	0.786	0.790	0.788	0.783	0.783	0.789	0.785	0.793	0.779	0.792	0.779	0.790	0.785	0.797	0.785	0.792

Note. General Linear Model = general linear model with a logit link function; Elastic Net = elastic net with alpha and lambda as tuning parameters; Random Forest = Random Forest with 1,000 trees and number of variables available for splitting at each tree node (mtry) as a tuning parameter; Stacked Ensemble = stacked ensemble model developed using the AutoML feature of the H2O package. LCA = participants with similar demographic characteristics as identified by latent class analysis; FS Trained = models trained using the full training sample; SS Trained = models trained using the demographic subsamples; Factor = models using the eight factors identified among 31 CDE variables; CDE = models using the 31 individual CDE variables. NH = non-Hispanic.

Table 7. Areas under the Receiver-Operating Curve (AUC) in the testing sample across models, features, and subsamples for current suicide plan vs. no-suicide plan.

	General Linear Model				Elastic Net				Random Forest				Stacked Ensemble			
	FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained	
Sample Used	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE
Total Training Sample	0.725	0.733			0.716	0.729			0.706	0.721			0.724	0.734		
Military Active	0.778	0.792	0.783	0.794	0.776	0.787	0.777	0.791	0.745	0.774	0.757	0.786	0.778	0.781	0.780	0.799
Deployed	0.808	0.814	0.812	0.811	0.805	0.814	0.805	0.817	0.761	0.798	0.778	0.797	0.808	0.801	0.810	0.817
Not Deployed	0.745	0.768	0.744	0.764	0.743	0.757	0.745	0.758	0.723	0.753	0.724	0.750	0.745	0.755	0.746	0.760
Veteran	0.690	0.675	0.688	0.679	0.689	0.688	0.694	0.689	0.686	0.699	0.693	0.703	0.691	0.683	0.688	0.684
Civilian	0.706	0.718	0.711	0.719	0.688	0.711	0.693	0.722	0.714	0.721	0.676	0.706	0.703	0.723	0.707	0.734
Female	0.704	0.690	0.706	0.686	0.692	0.698	0.696	0.701	0.688	0.705	0.698	0.700	0.703	0.702	0.705	0.708
Male	0.736	0.751	0.739	0.750	0.730	0.744	0.729	0.747	0.714	0.730	0.714	0.730	0.735	0.745	0.737	0.750
African American-NH	0.763	0.763	0.741	0.709	0.758	0.758	0.737	0.737	0.753	0.753	0.702	0.705	0.757	0.740	0.739	0.737
Hispanic	0.728	0.732	0.728	0.734	0.719	0.731	0.719	0.732	0.709	0.728	0.709	0.724	0.720	0.730	0.717	0.742
Caucasian-NH	0.724	0.724	0.724	0.723	0.719	0.719	0.719	0.727	0.709	0.712	0.712	0.726	0.724	0.726	0.724	0.740
LCA Class 1	0.735	0.727	0.722	0.721	0.734	0.733	0.729	0.734	0.731	0.734	0.713	0.730	0.735	0.733	0.713	0.739
LCA Class 2	0.708	0.692	0.691	0.663	0.687	0.707	0.682	0.685	0.686	0.701	0.655	0.683	0.766	0.784	0.739	0.739
LCA Class 3	0.736	0.754	0.703	0.726	0.729	0.746	0.715	0.724	0.710	0.733	0.706	0.721	0.735	0.745	0.709	0.727
Single	0.745	0.760	0.756	0.760	0.735	0.755	0.742	0.762	0.731	0.751	0.731	0.744	0.744	0.762	0.754	0.759
Married	0.782	0.781	0.780	0.774	0.782	0.782	0.781	0.784	0.740	0.769	0.735	0.774	0.783	0.775	0.751	0.772
Divorced/Separated	0.716	0.741	0.732	0.726	0.694	0.723	0.724	0.738	0.702	0.697	0.677	0.710	0.714	0.724	0.674	0.680
Younger (< 35 years old)	0.730	0.739	0.731	0.738	0.720	0.735	0.720	0.736	0.702	0.724	0.714	0.731	0.729	0.735	0.730	0.740
Older (> 34 years old)	0.723	0.720	0.713	0.716	0.718	0.721	0.714	0.726	0.726	0.732	0.699	0.706	0.722	0.727	0.716	0.727
Average AUC	0.736	0.741	0.734	0.733	0.728	0.739	0.729	0.739	0.718	0.733	0.711	0.729	0.738	0.742	0.730	0.742

Note. General Linear Model = general linear model with a logit link function; Elastic Net = elastic net with alpha and lambda as tuning parameters; Random Forest = Random Forest with 1,000 trees and number of variables available for splitting at each tree node (mtry) as a tuning parameter; Stacked Ensemble = stacked ensemble model developed using the AutoML feature of the H2O package. LCA = participants with similar demographic characteristics as identified by latent class analysis; FS Trained = models trained using the full training sample; SS Trained = models trained using the demographic subsamples; Factor = models using the eight factors identified among 31 CDE variables; CDE = models using the 31 individual CDE variables. NH = non-Hispanic.

Table 8. Areas under the Receiver-Operating Curve (AUC) in the testing sample across models, features, and subsamples for current lifetime suicide attempt vs. no lifetime attempt.

	General Linear Model				Elastic Net				Random Forest				Stacked Ensemble			
	FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained	
Sample Used	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE
Total Training Sample	0.728	0.738			0.730	0.738			0.701	0.740			0.733	0.743		
Military Active	0.720	0.735	0.718	0.730	0.721	0.730	0.719	0.730	0.717	0.734	0.695	0.724	0.720	0.738	0.718	0.720
Deployed	0.727	0.744	0.715	0.733	0.727	0.738	0.723	0.730	0.717	0.750	0.694	0.735	0.723	0.755	0.720	0.730
Not Deployed	0.708	0.721	0.711	0.687	0.710	0.717	0.711	0.714	0.715	0.712	0.689	0.697	0.709	0.713	0.712	0.668
Veteran	0.718	0.722	0.739	0.738	0.712	0.718	0.732	0.738	0.702	0.713	0.697	0.731	0.713	0.723	0.705	0.714
Civilian	0.706	0.718	0.714	0.708	0.716	0.725	0.717	0.725	0.719	0.726	0.728	0.746	0.713	0.720	0.724	0.738
Female	0.700	0.699	0.699	0.691	0.704	0.709	0.703	0.705	0.697	0.711	0.679	0.709	0.703	0.699	0.717	0.705
Male	0.748	0.757	0.749	0.759	0.745	0.752	0.746	0.754	0.741	0.753	0.729	0.754	0.747	0.762	0.748	0.758
African American-NH	0.719	0.732	0.711	0.728	0.714	0.723	0.710	0.724	0.721	0.719	0.693	0.709	0.717	0.735	0.674	0.721
Hispanic	0.734	0.740	0.734	0.738	0.732	0.738	0.732	0.738	0.732	0.741	0.727	0.742	0.736	0.745	0.737	0.742
Caucasian-NH	0.744	0.746	0.745	0.742	0.741	0.747	0.743	0.748	0.739	0.750	0.739	0.754	0.746	0.751	0.745	0.748
LCA Class 1	0.752	0.759	0.761	0.768	0.747	0.752	0.755	0.763	0.744	0.753	0.750	0.757	0.750	0.763	0.742	0.767
LCA Class 2	0.691	0.696	0.684	0.663	0.698	0.704	0.695	0.695	0.698	0.708	0.688	0.670	0.696	0.691	0.688	0.690
LCA Class 3	0.729	0.738	0.727	0.720	0.730	0.737	0.729	0.733	0.721	0.739	0.723	0.738	0.731	0.744	0.727	0.735
Single	0.704	0.712	0.712	0.703	0.703	0.712	0.708	0.715	0.703	0.712	0.700	0.703	0.706	0.711	0.709	0.714
Married	0.790	0.794	0.783	0.779	0.788	0.796	0.789	0.794	0.801	0.801	0.791	0.797	0.797	0.803	0.786	0.798
Divorced/Separated	0.667	0.696	0.674	0.696	0.663	0.676	0.667	0.686	0.631	0.670	0.639	0.662	0.659	0.694	0.668	0.682
Younger (< 35 years old)	0.725	0.733	0.724	0.724	0.727	0.734	0.726	0.732	0.717	0.736	0.708	0.732	0.727	0.734	0.727	0.728
Older (> 34 years old)	0.741	0.746	0.748	0.756	0.737	0.743	0.741	0.751	0.743	0.745	0.747	0.749	0.742	0.751	0.751	0.760
Average AUC	0.724	0.733	0.725	0.726	0.723	0.731	0.725	0.732	0.719	0.732	0.712	0.728	0.725	0.735	0.722	0.729

Note. General Linear Model = general linear model with a logit link function; Elastic Net = elastic net with alpha and lambda as tuning parameters; Random Forest = Random Forest with 1,000 trees and number of variables available for splitting at each tree node (mtry) as a tuning parameter; Stacked Ensemble = stacked ensemble model developed using the AutoML feature of the H2O package. LCA = participants with similar demographic characteristics as identified by latent class analysis; FS Trained = models trained using the full training sample; SS Trained = models trained using the demographic subsamples; Factor = models using the eight factors identified among 31 CDE variables; CDE = models using the 31 individual CDE variables. NH = non-Hispanic.

Table 9. Areas under the Receiver-Operating Curve (AUC) in the testing sample across models, features, and subsamples for highest level of lethality among suicide attempters.

	General Linear Model				Elastic Net				Random Forest				Stacked Ensemble			
	FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained	
Sample Used	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE
Total Training Sample	0.512	0.533			0.516	0.516			0.521	0.541			0.526	0.525		
Military Active	0.507	0.521	0.549	0.496	0.488	0.528	0.565	0.500	0.543	0.532	0.547	0.594	0.523	0.514	0.573	0.524
Deployed	0.519	0.574	0.528	0.510	0.487	0.484	0.518	0.500	0.571	0.586	0.552	0.660	0.581	0.587	0.500	0.617
Not Deployed	0.472	0.440	0.555	0.548	0.488	0.556	0.540	0.563	0.499	0.470	0.514	0.592	0.543	0.518	0.541	0.537
Veteran	0.516	0.509	0.490	0.503	0.500	0.508	0.500	0.500	0.514	0.507	0.479	0.507	0.483	0.461	0.494	0.510
Civilian	0.570	0.557	0.557	0.521	0.565	0.532	0.579	0.540	0.551	0.579	0.546	0.538	0.574	0.522	0.498	0.537
Female	0.501	0.519	0.491	0.499	0.505	0.501	0.504	0.500	0.515	0.512	0.498	0.512	0.537	0.507	0.520	0.483
Male	0.527	0.539	0.538	0.529	0.524	0.526	0.554	0.544	0.529	0.565	0.526	0.564	0.546	0.521	0.541	0.528
African American-NH	0.514	0.561	0.516	0.469	0.500	0.533	0.500	0.500	0.515	0.549	0.525	0.551	0.529	0.513	0.502	0.484
Hispanic	0.512	0.527	0.509	0.518	0.500	0.514	0.523	0.515	0.503	0.538	0.514	0.536	0.510	0.521	0.518	0.532
Caucasian-NH	0.511	0.520	0.509	0.519	0.521	0.505	0.514	0.507	0.515	0.528	0.503	0.523	0.521	0.542	0.525	0.517
LCA Class 1	0.543	0.545	0.507	0.506	0.500	0.550	0.550	0.500	0.546	0.559	0.531	0.551	0.545	0.536	0.536	0.481
LCA Class 2	0.506	0.529	0.500	0.494	0.512	0.500	0.500	0.495	0.520	0.528	0.522	0.531	0.513	0.517	0.513	0.502
LCA Class 3	0.502	0.460	0.460	0.506	0.507	0.500	0.500	0.475	0.510	0.455	0.455	0.461	0.512	0.540	0.481	0.474
Single	0.526	0.538	0.510	0.494	0.529	0.514	0.534	0.500	0.566	0.563	0.523	0.541	0.553	0.520	0.479	0.490
Married	0.493	0.554	0.498	0.553	0.507	0.503	0.519	0.508	0.532	0.505	0.560	0.527	0.555	0.531	0.522	0.562
Divorced/Separated	0.513	0.510	0.530	0.551	0.526	0.534	0.547	0.562	0.497	0.565	0.495	0.548	0.520	0.540	0.508	0.534
Younger (< 35 years old)	0.496	0.515	0.496	0.503	0.498	0.495	0.505	0.497	0.495	0.526	0.496	0.520	0.518	0.533	0.538	0.509
Older (> 34 years old)	0.523	0.536	0.517	0.555	0.534	0.508	0.526	0.555	0.559	0.558	0.533	0.555	0.537	0.503	0.502	0.480
Average AUC	0.514	0.526	0.515	0.515	0.511	0.516	0.527	0.515	0.526	0.535	0.518	0.545	0.533	0.524	0.516	0.517

Note. General Linear Model = general linear model with a logit link function; Elastic Net = elastic net with alpha and lambda as tuning parameters; Random Forest = Random Forest with 1,000 trees and number of variables available for splitting at each tree node (mtry) as a tuning parameter; Stacked Ensemble = stacked ensemble model developed using the AutoML feature of the H2O package. LCA = participants with similar demographic characteristics as identified by latent class analysis; FS Trained = models trained using the full training sample; SS Trained = models trained using the demographic subsamples; Factor = models using the eight factors identified among 31 CDE variables; CDE = models using the 31 individual CDE variables. NH = non-Hispanic.

For analyses based on the 31 individual CDE items, items 25 ("These days, I feel like I belong" from the INQ), 29 ("When my thoughts seem to speed up, I worry that I might be going crazy" from the ASI), 54 ("Problems Waking" from the ISI), 32 ("When I have trouble thinking clearly, I worry that there is something wrong with me" from the ASI), and 28 ("These days, I have many supportive friends" from the INQ) were the five most important items, whereas items 36 ("Suddenly acting or feeling as if a stressful experience were happening again (as if you were reliving it)?" from the PCL), 35 ("Repeated, disturbing dreams of a stressful experience?" from the PCL), 48 ("How often do you have six or more drinks on one occasion?" from the AUDIT), 49 ("How often do you use prescription drugs more often or at greater quantities than prescribed?"), and 46 ("How often do you have a drink containing alcohol?" from the AUDIT). were the five least important items. Taken together, variable importance across models suggests factor scores based on INQ items were the most important compared to other factors, and an INQ item assessing belongingness was the best ranked individual variable across models. Individual items from the INQ had the best average rank (7.4) compared to all other scale-derived items when variable importance was calculated for the individual CDE items.

Supplemental Analyses

In addition to the primary analyses detailed above and included in the statement of work, nine other machine learning approaches (i.e., k-nearest neighbor, gradient boosting machine, neural network, C5.0 algorithm, naïve Bayes, classification and regression trees, linear discriminant analysis, support vector machines, multivariate adaptive regression splines) were considered in addition to the four modeling approaches (GLM, RF, EN, and SE) highlighted here. Each modeling approach considered a range of tuning parameter settings (with the exception of linear discriminant analysis, which does not involve tuning parameters) and were optimized within the total sample and the various subsamples (i.e., in parallel to the approaches detailed above).

In all, including the models detailed above, 38 models were optimized for each approach (e.g., two models based on data from the overall training sample using either factor scores or CDE items, 36 models construed within the 18 subsamples from the training sample using either factor scores or CDE items). Given there were 13 approaches considered (i.e., the four primary models and the nine supplemental models noted above), 494 models were optimized for each outcome, resulting in 3,458 final models developed for this project (note that each final, optimized model was selected from a larger range of models with various tuning parameter settings, with the exception of models with no tuning parameters such as GLM).

Despite the scope of these modeling efforts, the results from the supplemental analyses regarding model performance were very consistent with the results detailed above: within the CDE dataset, GLM performs roughly as well as a vast range of machine learning approaches, and there was little evidence of increased performance by constructing models within a range of demographic groups or by using factors scores compared to individual items.

Table 10. Areas under the Receiver-Operating Curve (AUC) in the testing sample across models, features, and subsamples for some intent to die vs. not intent to die among suicide attempters.

	General Linear Model				Elastic Net				Random Forest				Stacked Ensemble			
	FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained		FS Trained		SS Trained	
Sample Used	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE	Factor	CDE
Total Training Sample	0.662	0.625			0.662	0.667			0.576	0.640			0.559	0.661		
Military Active	0.712	0.717	0.735	0.764	0.700	0.730	0.711	0.744	0.610	0.683	0.703	0.702	0.499	0.735	0.681	0.746
Deployed	0.843	0.765	0.835	0.699	0.814	0.840	0.835	0.790	0.708	0.764	0.880	0.773	0.492	0.843	0.803	0.745
Not Deployed	0.499	0.635	0.600	0.641	0.513	0.558	0.538	0.595	0.463	0.554	0.496	0.620	0.575	0.572	0.628	0.731
Veteran	0.643	0.645	0.580	0.574	0.623	0.640	0.621	0.548	0.657	0.612	0.611	0.620	0.650	0.657	0.620	0.642
Civilian	0.660	0.592	0.631	0.512	0.709	0.681	0.697	0.667	0.533	0.689	0.588	0.590	0.530	0.651	0.533	0.457
Female	0.565	0.547	0.571	0.560	0.557	0.564	0.549	0.557	0.524	0.591	0.526	0.540	0.526	0.436	0.562	0.614
Male	0.714	0.677	0.685	0.659	0.729	0.728	0.720	0.709	0.589	0.681	0.638	0.625	0.565	0.718	0.705	0.673
African American-NH	0.601	0.515	0.631	0.623	0.559	0.567	0.581	0.604	0.560	0.656	0.534	0.589	0.649	0.564	0.519	0.618
Hispanic	0.647	0.613	0.651	0.608	0.649	0.652	0.651	0.655	0.542	0.624	0.542	0.635	0.554	0.646	0.554	0.647
Caucasian-NH	0.653	0.632	0.616	0.606	0.667	0.669	0.655	0.635	0.530	0.618	0.558	0.600	0.662	0.657	0.501	0.616
LCA Class 1	0.778	0.764	0.802	0.781	0.770	0.766	0.784	0.791	0.760	0.762	0.796	0.805	0.594	0.776	0.797	0.791
LCA Class 2	0.667	0.610	0.646	0.603	0.669	0.669	0.661	0.658	0.603	0.672	0.612	0.626	0.580	0.628	0.619	0.577
LCA Class 3	0.838	0.835	0.797	0.765	0.837	0.847	0.825	0.828	0.809	0.832	0.754	0.787	0.617	0.844	0.712	0.722
Single	0.731	0.663	0.744	0.669	0.730	0.736	0.735	0.752	0.607	0.748	0.681	0.736	0.485	0.728	0.710	0.755
Married	0.684	0.584	0.780	0.640	0.654	0.665	0.735	0.713	0.536	0.578	0.713	0.700	0.635	0.641	0.669	0.728
Divorced/Separated	0.717	0.801	0.658	0.553	0.691	0.715	0.688	0.682	0.877	0.656	0.643	0.587	0.660	0.765	0.575	0.677
Younger (< 35 years old)	0.650	0.622	0.656	0.623	0.659	0.664	0.661	0.664	0.579	0.636	0.595	0.634	0.553	0.655	0.620	0.657
Older (> 34 years old)	0.672	0.603	0.710	0.579	0.652	0.645	0.664	0.642	0.544	0.631	0.619	0.655	0.560	0.651	0.594	0.676
Average AUC	0.681	0.655	0.685	0.637	0.676	0.684	0.684	0.680	0.611	0.665	0.638	0.657	0.576	0.675	0.633	0.671

Note. General Linear Model = general linear model with a logit link function; Elastic Net = elastic net with alpha and lambda as tuning parameters; Random Forest = Random Forest with 1,000 trees and number of variables available for splitting at each tree node (mtry) as a tuning parameter; Stacked Ensemble = stacked ensemble model developed using the AutoML feature of the H2O package. LCA = participants with similar demographic characteristics as identified by latent class analysis; FS Trained = models trained using the full training sample; SS Trained = models trained using the demographic subsamples; Factor = models using the eight factors identified among 31 CDE variables; CDE = models using the 31 individual CDE variables. NH = non-Hispanic.

Table 11. Average rank of variable importance for general linear models, random forest, and elastic net across all non-suicide characteristic outcomes for models utilizing factor scores.

	Model			Summary of Ranks	
Variable	General Linear Model Rank	Elastic Net Rank	Random Forest Rank	Average Rank Across Models	Rank of Average Rank
Factor 1 (BHS items)	3.8	2.2	3.2	3.07	2
Factor 2 (INQ items)	1.4	1.6	1.4	1.47	1
Factor 3 (ASI items)	2.8	3.6	3.6	3.33	3
Factor 4 (6 PCL items)	5	5.6	5.4	5.33	6
Factor 5 (ISI items)	4.6	4.6	4.4	4.53	4
Factor 6 (AUDIT items)	5.4	8	8	7.13	8
Factor 7 (2 PCL items)	7.4	5.8	6.4	6.53	7
Factor 8 (2 drug use items)	5.6	4.6	3.6	4.60	5

Note. General Linear Model = general linear model with a logit link function; Elastic Net = elastic net with alpha and lambda as tuning parameters; Random Forest = Random Forest with 1,000 trees and number of variables available for splitting at each tree node (mtry) as a tuning parameter; Factor 1 = three items from Beck Hopelessness Inventory (BHS); Factor 2 = five items from the Interpersonal Needs Questionnaire (INQ); Factor 3 = five items from the Anxiety Sensitivity Index (ASI); Factor 4 = six items from the PTSD Check List (PCL); Factor 5 = five items from the Insomnia Severity Index (ISI); Factor 6 = three items from the Alcohol Use Disorder Identification Test (AUDIT); Factor 7 = two items from the PTSD Check List (PCL) related to alertness/startle sensitivity; Factor 8 = two items assessing drug use.

Table 12. Average rank of variable importance for general linear models, random forest, and elastic net across all non-suicide characteristic outcomes for models utilizing individual CDE items.

	Average Rank Across Outcomes			Summary of Ranks	
Variable	General Linear Model	Elastic Net Rank	Random Forest Rank	Average Rank Across Models	Rank of Average Rank
CDE21 (BHS)	21.2	9.8	30.8	20.60	25
CDE22 (BHS)	15.2	2	29.2	15.47	13
CDE23 (BHS)	9.6	1.4	29	13.33	10
CDE24 (INQ)	23.2	20	6.2	16.47	16
CDE25 (INQ)	2	4.8	1	2.60	1
CDE26 (INQ)	18.2	16.6	3.2	12.67	7
CDE27 (INQ)	19.8	16	2.8	12.87	8
CDE28 (INQ)	13.6	13.6	3.4	10.20	5
CDE29 (ASI)	7	7.4	8.4	7.60	2
CDE30 (ASI)	17.4	22.8	16.2	18.80	22
CDE31 (ASI)	17	12.2	12.2	13.80	11
CDE32 (ASI)	11.2	9	7.8	9.33	4
CDE33 (ASI)	27.2	14.8	10.4	17.47	17
CDE34 (PCL)	16	21.8	17.8	18.53	19
CDE35 (PCL)	15.6	29.4	23.4	22.80	29
CDE36 (PCL)	22	25.4	22.8	23.40	31
CDE37 (PCL)	13.8	19	13.8	15.53	14
CDE38 (PCL)	19.6	18.4	15.6	17.87	18
CDE39 (PCL)	20	18.8	17	18.60	20
CDE40 (PCL)	20.2	28.4	19.4	22.67	28
CDE41 (PCL)	14	14.4	10.4	12.93	9
CDE46 (AUDIT)	18.2	25.6	21	21.60	26
CDE47 (AUDIT)	6.8	10.8	27	14.87	12
CDE48 (AUDIT)	18.6	24.6	25.2	22.80	29
CDE49	19.2	18.4	27.4	21.67	27
CDE50	13	17	27.2	19.07	24
CDE52 (ISI)	22.4	21.2	13.2	18.93	23
CDE53 (ISI)	20.6	21	14.6	18.73	21
CDE54 (ISI)	4.4	6.6	13.6	8.20	3
CDE55 (ISI)	15.8	14.4	18	16.07	15
CDE56 (ISI)	13.2	10.4	8	10.53	6

Note. General Linear Model = general linear model with a logit link function; Elastic Net = elastic net with alpha and lambda as tuning parameters; Random Forest = Random Forest with 1,000 trees and number of variables available for splitting at each tree node (mtry) as a tuning parameter; BHS = Beck Hopelessness Inventory; INQ = Interpersonal Needs Questionnaire; ASI = Anxiety Sensitivity Index (ASI); PCL = PTSD Check List (PCL); ISI = Insomnia Severity Index (ISI); AUDIT = Alcohol Use Disorder Identification Test (AUDIT).

TASK 6 – Manuscript Preparation and Dissemination of Findings

Milestones included preparing manuscripts based on study findings, disseminating findings via published research, conferences, and white paper for military.

A manuscript is currently being prepared based on the summary of the results above and will be submitted to publication within the grace period of the project period. The primary focus has been on distilling down the myriad analyses from this project, given it is typical within the machine learning-suicidology literature to only focus on one type of outcome paired with one type of machine learning approach within one overall sample. Expenses related to conference travel were limited in this secondary-data project. Travel funds were extinguished in order to provide an update of this project to members of the MSRC in May 2018. Once the results of this study are published, our team will work with the MSRC Dissemination and Implementation Core to develop a white paper and to determine how to best disseminate findings with actionable recommendations to military treatment facilities, the Defense Suicide Prevention Office, and other military contexts.

4. KEY RESEARCH ACCOMPLISHMENTS:

*An extensive set of analyses utilizing the CDE dataset suggests easy to implement and interpretable modeling approaches perform roughly as well as machine learning methods to classify participants on various suicide-related outcomes

*Despite utilizing a conservative approach for feature selection and model validation, the CDE features were able to reasonably classify participants on a range of suicide-related outcomes, with the exception of outcomes related to attempt characteristics

*Across outcomes and modeling approaches, there was consistent evidence that items from the Interpersonal Needs Questionnaire were important variables contributing to model performance, suggesting these items should be a part of assessment batteries of suicide-related outcomes

*There was little evidence that optimizing models within specific subgroups meaningfully enhanced model performance, suggesting assessment batteries could be standardized across various groups (e.g., military active individuals, veterans)

*Factor scores based on latent variables derived from the individual CDE items did not outperform the use of individual CDE items, suggesting that scale items or mean values based on scales may perform equivalently when developing risk algorithms

5. CONCLUSION: Consistent with emerging work from larger scale studies (i.e., Army STARRS) involving machine learning and suicidal behaviors in the military (see Zuromski et al., 2019), the current findings (based on a vast range of machine learning approaches utilized within the CDE dataset) suggest these modern analytic methods perform generally as well as traditional, general linear models in terms of accurately classifying suicide-related outcomes.

Specifically, Zuromski et al. found that a general linear model had a classification performance (AUC = .78) that was slightly better than an ensemble model (similar to the SE modeling approach utilized in these data; AUC = .73) to prospectively predict suicide attempts using traditional measures of suicide risk (see Zuromski et al., 2019, for more details). Further, the current findings suggest that risk algorithms could be standardized across a range of demographic groups, given there was essentially no evidence of meaningful enhancement in classification performance when models were developed within multiple subgroups. Feature selection method (i.e., factor scores based on existing scales vs. using individual items) also did not appear to meaningfully impact classification performance.

The findings from the current project have important implications for the military and other stakeholders. First, the current findings provide guidance on items and scales that may be particularly relevant in classifying suicide-related outcomes. We recommend that items from the INQ be incorporated into standard assessment batteries. Second, the current work suggests that there should be robust evidence that a more complex modeling approach (e.g., RF) has clear benefit over simpler, more transparent models (e.g., GLM) before being adopted by the military or other stakeholders. Despite recent criticisms of traditional modeling approaches, these models have transparent model parameters that can easily be interpreted (at least in comparison to some blackbox machine learning approaches, such as RF or SE). That is, everything should be made “as simple as possible, but not more simple” – the military (and other stakeholders) should require well-vetted evidence of enhanced performance for utilizing a less simple approach within real-world settings. Third, it appears to be practical to develop standardized assessment batteries rather than batteries specific to a certain demographic group (e.g., military active personal vs. veterans), as models were generally similar across all subgroups examined.

It is important to note that our conclusions and recommendations must be viewed within the limitations of this project. All analyses were based on self-reported, cross-sectional assessments involving a relatively common assessment battery. Other types of data (e.g., data involving non-self-reported measures, data involving prospective assessments, including intensive longitudinal designs) may yield conclusions that differ from our current findings. It is also unclear what population participants from the CDE represent, given these data were collected across a range of studies involving samples of various populations. Despite these limitations, the current findings are bolstered by emerging findings from larger-scale projects (e.g., Zuromski et al., 2019) that are consistent with the current results and extensive subgroup analysis, which guards against (to some extent) concerns related to the admixture of populations inherent in the CDE dataset.

6. PUBLICATIONS, ABSTRACTS, AND PRESENTATIONS:

Littlefield, Bagge, Glenn, Kleiman, Millner, Jaccobi, & Cooke (in preparation). Machine Learning to Classify Suicidal Thoughts and Behaviors: Implementation within the Common Data Elements used by the Military Suicide Research Consortium.

7. INVENTIONS, PATENTS AND LICENSES:

Nothing to Report

8. REPORTABLE OUTCOMES:

Nothing to Report (beyond what has been summarized in Key Research Accomplishments and Conclusion sections above)

9. OTHER ACHIEVEMENTS:

Nothing to Report

10. REFERENCES:

Bastien, C. H., Vallières, A., & Morin, C. M. (2001). Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Medicine*, *2*(4), 297-307.

Beck, A. T., Weissman, A., Lester, D., & Trexler, L. (1974). The measurement of pessimism: The hopelessness scale. *Journal of Consulting and Clinical Psychology*, *42*(6), 861-865.

Bush, K., Kivlahan, D. R., McDonell, M. B., Fihn, S. D., & Bradley, K. A. (1998). The AUDIT alcohol consumption questions (AUDIT-C): An effective brief screening test for problem drinking. *Archives of Internal Medicine*, *158*(16), 1789-1795.

Franklin, J.C. (2019) Psychological primitives can make sense of biopsychosocial factor complexity in psychopathology. *BMC Med,* **17,** 187.

Friedman, J., Hastie, T., & Tibshirani, R. (2010). Regularization paths for generalized linear models via coordinate descent. *Journal of statistical software*, *33*(1), 1.

Hand, D. J., & Till, R. J. (2001). A simple generalisation of the area under the ROC curve for multiple class classification problems. *Machine learning*, *45*(2), 171-186.

Hastie, T, R. Tibshirani, & J. Friedman (2009). The Elements of Statistical Learning 2nd ed. Springer.

Kuhn, M. (2008). Building predictive models in R using the caret package. *Journal of Statistical Software*, *28*(5), 1-26.

Kuhn, M., & Johnson, K. (2013). Applied predictive modeling (Vol. 26). New York: Springer. Chicago

LeDell, E., Gill, N., Aiello, S., Fu, A., Candel, A., Click, C., Kraljevic, T., Nykodym, T., Aboyoun, P., Kurka, M., & Malohlava, M. (2019). h2o: R Interface for 'H2O'. R package version 3.26.0.10. https://github.com/h2oai/h2o-3

Liaw, A., & Wiener, M. (2002). Classification and Regression by randomForest. R News 2(3), 18-22.

Muthén, L.K. and Muthén, B.O. (1998-2017). Mplus User's Guide. Eighth Edition. Los Angeles, CA: Muthén & Muthén

Ringer, F. B., Soberay, K. A., Rogers, M. L., Hagan, C. R., Chu, C., Schneider, M., ... & Gutierrez, P. M. (2018). Initial validation of brief measures of suicide risk factors: Common data elements used by the Military Suicide Research Consortium. *Psychological Assessment*, *30*(6), 767-778.

Robin, X., Turck, N., Hainard, A., Tiberti, N., Lisacek, F., Sanchez, J.C., & Müller, M. (2011). pROC: an open-source package for R and S+ to analyze and compare ROC curves. BMC Bioinformatics, 12, p. 77. DOI: 10.1186/1471-2105-12-77 <http://www.biomedcentral.com/1471-2105/12/77/>

RStudio Team (2015). RStudio: Integrated Development for R. RStudio, Inc., Boston, MA URL http://www.rstudio.com/.

Tantithamthavorn, C., McIntosh, S., Hassan, A. E., & Matsumoto, K. (2016). An empirical comparison of model validation techniques for defect prediction models. *IEEE Transactions on Software Engineering*, *43*(1), 1-18.

Taylor, S., Zvolensky, M. J., Cox, B. J., Deacon, B., Heimberg, R. G., Ledley, D. R., ... & Coles, M. (2007). Robust dimensions of anxiety sensitivity: Development and initial validation of the Anxiety Sensitivity Index-3. *Psychological Assessment*, *19*(2), 176-188.

Van Orden, K. A., Cukrowicz, K. C., Witte, T. K., & Joiner Jr, T. E. (2012). Thwarted belongingness and perceived burdensomeness: Construct validity and psychometric properties of the Interpersonal Needs Questionnaire. *Psychological Assessment*, *24*(1), 197-215.

Venables, W. N. & Ripley, B. D. (2002) Modern Applied Statistics with S. Fourth Edition. Springer, New York.

Weathers, F., Huska, J., & Keane, T. (1991). *The PTSD checklist military version (PCL-M).* Boston, MA: National Center for PTSD.

Weathers, F. W., Litz, B. T., Herman, D., Huska, J., & Keane, T. (1994). *The PTSD checklist-civilian version (PCL-C).* Boston, MA: National Center for PTSD.

Zuromski, K. L., Bernecker, S. L., Gutierrez, P. M., Joiner, T. E., King, A. J., Liu, H., ... & Stein, M. B. (2019). Assessment of a risk index for suicide attempts among US Army soldiers with suicide ideation: analysis of data from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *JAMA network open*, *2*(3), e190766-e190766.

11. APPENDICES

Appendix 1. Raw CDE variables used to create the seven dependent variables.

Variable	Label	Value	Response Options
CDE1	(DSI-SS_1) Thoughts	0	I do not have thoughts of killing myself
		1	Sometimes I have thoughts of killing myself
		2	Most of the time I have thoughts of killing myself
		3	I always have thoughts of killing myself
CDE2	(DSI-SS_2) Plans	0	I am not having thoughts about suicide
		1	I am having thoughts about suicide but have not formulated any plans
		2	I am having thoughts about suicide and am considering possible ways of doing it
		3	I am having thoughts about suicide and have formulated a definite plan
CDE3	(DSI-SS_3) Control	0	I am not having thoughts about suicide
		1	I am having thoughts about suicide but have these thoughts completely under my control
		2	I am having thoughts about suicide but have these thoughts somewhat under my control
		3	I am having thoughts about suicide but have little or no control over these thoughts
CDE4	(DSI-SS_4) Impulse	0	I am not having impulses to kill myself
		1	In some situations I have impulses to kill myself

		2	In most situations I have impulses to kill myself
		3	In all situations I have impulses to kill myself
RCDE5	(SBQ_1) Have you ever thought about or attempted to kill yourself?	0	Never
		1	It was just a brief passing thought
		2	I have had a plan at least once to kill myself but did not try to do it
		3	I have had a plan at least once to kill myself and really wanted to die
		4	I have attemptedto kill myself, but did not want to die
		5	I have attempted to kill myself, and really hoped to die
		6	Any attempter regarless of intent - coded for bagge
RCDE5_Schmidt	Combined responses; (SBQ_1) Have you ever thought about or attempted to kill yourself?	0	Never
		1	It was just a brief passing thought
		2	I have had a plan at least once to kill myself but did not try to do it
		3	I have attempted to kill myself, but did not want to die OR and really hoped to die
CDE6	(SBQ_2) How often have you thought about killing yourself in the past year?	0	Never
		1	Rarely (1 time)
		2	Sometimes (2 times)
		3	Often (3-4 times)
		4	Very Often (5 or more times)
RCDE6_Schmidt	(SBQ_2) How often have you thought about killing yourself in the past year?	0	Never
		1	Rarely-1 time
		2	Sometimes-2 times
		3	Often-3 to 4 times
		4	Very Often-5 or more times
			Illegible

			NA
			Missing
CDE11	(SIS_3) At the time, what extent did you intend to die?	0	I did not intend to die
		1	Part of me intended to die and part of me did not
		2	I intended to die.
CDE13	How many times in your lifetime have you made an attempt to kill yourself during which you had at least some intent to die?	Free Entry	Not Applicable
CDE14	Since you enrolled in this study or the last assessment (whichever is most recent), how many times have you made an attempt to kill yourself during which you had at least some intent to die?	Free Entry	Not Applicable
CDE16	Thinking about the most lethal attempt, describe the level of medical attention it required (If you have never attempted to kill yourself with at least some intent to die, please leave this question blank):	0	No medical attention required
		1	Primary care doctor or nurse visit
		2	Emergency room visit
		3	Hospital admission to a general medical floor
		4	Hospital admission to an Intensive Care Unit (ICU)

Appendix 2. Raw CDE variables used to create demographic groups.

Variable	Label	Value	Response Options
Gender	Gender	1	male
		2	female
		3	transgender
		4	intersex
		5	prefer not to say
		6	other
Age	Age in years		
Race	Race	1	White/Caucasian
		2	Black/African American
		3	Native American/Native Alaskan
		4	Asian
		5	Pacific Islander
		6	Multiracial
		7	Other (sometimes Hispanic)
Ethnicity	Are you Hispanic/Latino?	1	Hispanic
		2	Non-Hispanic
		3	other
Relationship_Status	Relationship status	1	Married
		2	Single
		3	Cohabitating
		4	Widowed
		5	Divorced/Separated
		7	other
Deployment	Were you deployed?	1	Yes
		2	No

Any_Service	Any Military Service Past or Present	1	Currently Serving
		2	Veteran
		3	No Military Service
		4	served but unclear if still serving (cougle)

Appendix 3. CDE variables used as independent variables/features.

Variable	Label	Value	Response Option
CDE21	(BHS) I happen to be particularly lucky, and I expect to get more of the good things in life than the average person.	0	TRUE
		1	FALSE
CDE22	(BHS) I dont expect to get what I really want	0	TRUE
		1	FALSE
CDE23	(BHS) Things just wont work out the way I want them to	0	TRUE
		1	FALSE
CDE24	(INQ) These days, other people care about me.	1	Not at all true for me
		2	2
		3	3
		4	Somewhat true for me
		5	5
		6	6
		7	Very True for me
CDE25	(INQ) These days, I feel like I belong.	1	Not at all true for me
		2	2
		3	3
		4	Somewhat true for me
		5	5
		6	6
		7	Very True for me
CDE26	(INQ) These dadys, I feel that there are people I can turn to in times of need.	1	Not at all true for me
		2	2
		3	3
		4	Somewhat true for me
		5	5
		6	6
		7	Very True for me
CDE27	(INQ) These days, I am close to other people.	1	Not at all true for me
		2	2
		3	3
		4	Somewhat true for me
		5	5
		6	6

		7	Very True for me
CDE28	(INQ) These days, I have many supportive friends.	1	Not at all true for me
		2	2
		3	3
		4	Somewhat true for me
		5	5
		6	6
		7	Very True for me
CDE29	(ASI) When my thoughts seem to speed up, I worry that I might be going crazy.	1	Very little
		2	A little
		3	Some
		4	Much
		5	Very much
CDE30	(ASI) When my mind goes blank, I worry that there is something terribly wrong with me.	1	Very little
		2	A little
		3	Some
		4	Much
		5	Very much
CDE31	(ASI) When I feel "spacey" or spaced out, I worry that I may be mentally ill.	1	Very little
		2	A little
		3	Some
		4	Much
		5	Very much
CDE32	(ASI) When I have trouble thinking clearly, I worry that there is something wrong with me.	1	Very little
		2	A little
		3	Some
		4	Much
		5	Very much
CDE33	(ASI) When I cannot keep my mind on a task, I worry that I might be going crazy.	1	Very little
		2	A little
		3	Some
		4	Much
		5	Very much
CDE34	(PCL) Repeated, disturbing memories, thoughts, or images of a stressful military experience?	1	Not at all
		2	A little bit
		3	Moderately
		4	Quite a bit
		5	Extremely
CDE35	(PCL) Repeated, disturbing dreams of a stressful military experience?	1	Not at all
		2	A little bit

		3	Moderately
		4	Quite a bit
		5	Extremely
CDE36	(PCL) Suddenly acting or feeling as if a stressful military experience were happening again (as if you were reliving it)?	1	Not at all
		2	A little bit
		3	Moderately
		4	Quite a bit
		5	Extremely
CDE37	(PCL) Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience?	1	Not at all
		2	A little bit
		3	Moderately
		4	Quite a bit
		5	Extremely
CDE38	(PCL) Avoiding thinking about or talking about a stressful military experience or avoiding having feelings related to it?	1	Not at all
		2	A little bit
		3	Moderately
		4	Quite a bit
		5	Extremely
CDE39	(PCL) Avoiding activities or situations because they reminded you of a stressful military experience?	1	Not at all
		2	A little bit
		3	Moderately
		4	Quite a bit
		5	Extremely
CDE40	(PCL) Being "super alert" or watchful or on guard?	1	Not at all
		2	A little bit
		3	Moderately
		4	Quite a bit
		5	Extremely
CDE41	(PCL) Feeling jumpy or easily startled?	1	Not at all
		2	A little bit
		3	Moderately
		4	Quite a bit
		5	Extremely
CDE46	(AUDIT) How often do you have a drink containing alcohol?	0	Never
		1	Monthly or less
		2	2-4 times a month
		3	2-3 times a week
		4	4 or more times a week

CDE47	(AUDIT) How many standard drinks containing alcohol do you have on a typical day?	0	zero, 1 or 2
		1	3 or 4
		2	5 or 6
		3	7 to 9
		4	10 or more
CDE48	(AUDIT) How often do you have six or more drinks on one occasion?	0	Never
		1	Less than monthly
		2	Monthly
		3	Weekly
		4	Daily or almost daily
CDE49	How often do you use prescription drugs more often or at greater quantities than prescribed?	0	Never
		1	Monthly or less
		2	2-4 times a month
		3	2-3 times a week
		4	4 or more times a week
CDE50	How often do you use other substances (e.g., marijuana, cocaine, heroin, meth, pills, etc.)?	0	Never
		1	Monthly or less
		2	2-4 times a month
		3	2-3 times a week
		4	4 or more times a week
CDE52	(ISI) Difficulty falling asleep	0	None
		1	Mild
		2	Moderate
		3	Severe
		4	Very Severe
CDE53	(ISI) Difficulty staying asleep	0	None
		1	Mild
		2	Moderate
		3	Severe
		4	Very Severe
CDE54	(ISI) Problems waking	0	None
		1	Mild
		2	Moderate
		3	Severe
		4	Very Severe
CDE55	(ISI) How satisfied/dissatisfied are you with your current sleep pattern?	0	Very Satisfied
		1	Satisfied
		2	Moderately satisfied
		3	dissatisfied

		4	Very dissatisfied
CDE56	(ISI) To what extent do you consider your sleep problems to INTERFERE with your daily functioning (e.g., daytime fatigue, mood, ability to function at work/daily chores, concentration, memory, mood etc.) CURRENTLY?	0	Not at all interfering
		1	A little
		2	Somewhat
		3	Much
		4	Very Much interfering

Award expenditures to date (note we are still in the 60 day grace period for further billing and thus these numbers are not final; the final invoice will be sent within 60 days of the end of the award, per the contract):

Cumulative	**Cumulative**
Personnel $29,533.40	Travel $1,207.26
Fringe Benefits $6,993.27	Equipment/Facility Rental/User Fees 0
Materials/Supplies $0	Participant/Trainee Support 0
Subject Costs $0	Subaward/Contractual Costs $130,105.96
Consultant Services $5,000	Other Direct Costs $0

Cumulative

Subtotal $172,839.89___

Indirect Costs $53,946.01

Total $226,785.90

A15. Military Suicide Research Consortium Action Brief
Research Finding and Recommendations for Military Applications

Action Brief Guide

The Military Suicide Research Consortium (MSRC) is part of an ongoing strategy to implement a multidisciplinary research approach to military suicide prevention. Funded by the Military Operational Research Program (MOMRP), with Defense Health Program funding, and managed by the Congressionally Directed Medical Research Programs (CDMRP), this innovative cutting-edge consortium aims to enhance the military's ability to quickly identify those at risk for suicide and provide effective evidence-based prevention and treatment strategies.

In an effort to promote the dissemination and implementation of practical, evidence-based strategies resulting from MSRC-funded research, all completed MSRC-funded studies are reviewed for "actionable research findings." These actionable findings could impact Department of Defense (DoD) policy and practice or inform areas for further study. Each publication using MSRC data is evaluated to determine if the finding is of sufficient evidence and relevance to warrant dissemination beyond academic publications and presentations. If there is sufficient evidence, an MSRC Action Brief is created to inform Department of Defense leadership and generate conversation. If the recommendation does not indicate the need for an action brief, then only a report confirming the publication was reviewed is created.

MSRC has adopted the following categories of recommendation:

Further research
- Do not disseminate – insufficient evidence and no research methodology implications
- Disseminate to researchers only – insufficient evidence to support but research implications

Disseminate information
- Disseminate to researchers only – some evidence, needs further study
- Disseminate as informational findings – no specific actions to recommend

Recommendations for Action
- Recommend do not use - evidence of harm
- Recommend as pilot change in policy or practice with evaluation
- Recommend for general change in policy or practice

The MSRC has adopted Centers for Disease Control (CDC) Continuum of Evidence of Effectiveness[1] as the basis for determining sufficient evidence for dissemination. For observational and prevalence studies, an adapted version is used that is consistent with epidemiological methods. The scope of the literature review for the Action Brief is limited to what is required to make the CDC evidence determination specific to the MSRC funded study findings, and does not replace a systematic review of the literature.

The MSRC Action Briefs are reviewed by the MSRC funded study PI, experts in suicide research and implementation science, as well as military policy and practice leaders. There may be conflicting opinions on how to interpret any study's results. When these occur, they are noted as CAVEATs.

Action Briefs are supported by the Military Suicide Research Consortium (MSRC), funded by the Office of the Assistant Secretary of Defense for Health Affairs under Award No. (W81XWH-16-2-0003 & W81XWH-16-2-0004). Opinions, interpretations, conclusions and recommendations are those of the Military Suicide Research Consortium and are not necessarily endorsed by the Department of Defense.

1. Puddy, R. W. & Wilkins, N. (2011). Understanding Evidence Part 1: Best AvailableResearch Evidence. A Guide to the Continuum of Evidence of Effectiveness. Atlanta, GA: Centers for Disease Control and Prevention. https://www.cdc.gov/violenceprevention/pdf/understanding_evidence-a.pdf

Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

Veterans contact the healthcare system within one month of attempted suicide

Recommendation: ☐ Further research
- ☐ Do not disseminate – insufficient evidence and no research methodology implications
- ☐ Disseminate to researchers only – insufficient evidence to support but research implications

X Disseminate information
- ☐ Disseminate to researchers only – some evidence, needs further study
- **X** Disseminate as informational findings – no specific actions to recommend

☐ Recommendations for Action
- ☐ Recommend do not use - evidence of harm
- ☐ Recommend as pilot change in policy or practice with evaluation
- ☐ Recommend for general change in policy or practice

Recommended Change (if any)

Implications for Policy or Practice	**Stakeholder/Proponent**
• None	•

MSRC Study Information: Bagge (PI), Warning Signs for Suicide Attempts.

Key Points:
- Many people who attempt suicide, including those who die by suicide, have contact with the healthcare system in the days to weeks before attempting.[1]
- This study utilized medical records of Veterans who attempted suicide (N = 93) and then received VHA hospitalization care, and sought to understand patterns of pre-attempt general medical providers' patient contacts, suicide screening, and efforts to reduce suicide risk relative to patient age.[2]
- **As found in civilian studies, Veterans had a healthcare visit 27 days, on average, prior to attempting suicide, regardless of their age (50+ v. Less than 50 years of age).**[2]
- Veterans over 50 were less likely than younger Veterans to have been screened for impulsivity or access to firearms, and less likely to have documented efforts to reduce risk via safety planning, mental health treatment referral, or consideration for psychiatric hospitalization.[2]
- This study is limited by the relatively small sample, use of chart review methods, and these findings may not generalize to nonveterans or Veterans who do not present for care at a VHA hospital.[2]
- Additional research concerning these patterns in active duty populations may inform efforts to proactively identify and treat suicide risk among service members who may also contact the healthcare system prior to enacting self-directed violence.

Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

Veterans contact the healthcare system within one month of attempted suicide

Evaluation of Research Finding – CDC Continuum of Evidence of Effectiveness

	Well-Supported/ Supported	Promising/Emerging/ Undetermined	Unsupported/ Harmful
Effect		**Observational Study:** Demonstrates some significant associations between age group and specific domains of suicide risk screening, suicide-specific interventions, and referral to treatment.	
Internal Validity		**Observational Study:** Utilized retrospective chart review data at 3 VHA hospitals, with most cases from 1 site. Rigorous chart review methods were implemented.	
Type of Evidence		**Observational Study:** Findings may not generalize to nonveteran populations, also not able to infer causation regarding the associations of interest.	
Independent Replication		**Partial Replication:** Findings were consistent with previous studies of nonveteran populations, and partially replicated estimate of healthcare contact prior to death by suicide among civilians.[1]	
Implementation Guidance		**None:** Informational/Observational study, no products/services to implement.	
External and Ecological Validity		**Real-world Informed:** Veteran sample collected from VHA health records. Not specific to an active duty population.	

Note: Strength of evidence ratings adapted for observational methods based on the CDC Continuum of Evidence of Effectiveness.

References:
1. Ahmedani, B. K. *et al.* Health Care Contacts in the Year Before Suicide Death. *J. Gen. Intern. Med.* **29**, 870–877 (2014).
2. Simons, K., Van Orden, K., Conner, K. R. & Bagge, C. Age differences in suicide risk screening and management prior to suicide attempts. *Am. J. Geriatr. Psychiatry* **0**, (2019).*

* Denotes MSRC-funded study.

This Action Brief is supported by the Military Suicide Research Consortium (MSRC), funded by the Office of the Assistant Secretary of Defense for Health Affairs under Award No. (W81XWH-16-2-0003 & W81XWH-16-2-0004). Opinions, interpretations, conclusions and recommendations are those of the Military Suicide Research Consortium and are not necessarily endorsed by the Department of Defense.

Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

'Window to Hope' Reduces Hopelessness for Veterans with Moderate-to-Severe TBI

Recommendation: ☐ Further research

☐ Do not disseminate – insufficient evidence and no research methodology implications

☐ Disseminate to researchers only – insufficient evidence to support but research implications

X Disseminate information

☐ Disseminate to researchers only – some evidence, needs further study

X Disseminate as informational findings – no specific actions to recommend

☐ Recommendations for Action

☐ Recommend do not use - evidence of harm

☐ Recommend as pilot change in policy or practice with evaluation

☐ Recommend for general change in policy or practice

Recommended Change (if any)

Change in Policy or Practice	Context/Stakeholder
• None	•

MSRC Study Information: Brenner (PI), Window to Hope: Evaluating a Psychological Treatment for Hopelessness among Veterans with Traumatic Brain Injury (TBI) and Pilot Study of an Active Control Problem Solving Therapy for Suicide Prevention (PST-SP) Among Veterans with Moderate to Severe TBI

Key Points:

- Veterans with Traumatic Brain Injury (TBI) are at increased risk of suicide[1]
- One-third of individuals with TBI suffer some degree of hopelessness[2].
- Window to Hope (WtoH) is a group Cognitive Behavior Therapy (CBT) intervention designed for people with hopelessness six months after moderate-to-severe TBI and adapted for use among US Veterans.
- Veterans randomized to WtoH (n = 15 analyzed) had significantly lower scores on the Beck Hopelessness Scale compared to the control condition[3].
- WtoH was not associated with statistically significant reductions in symptoms of depression or suicidal ideation[3].
- Findings from a multi-stage pilot adaptation study indicate that WtoH can be adapted to diverse settings, including for use among Veterans with TBI. Qualitative and quantitative measures of client and therapist satisfaction indicated that the adapted WtoH was perceived by Veterans and VA treatment providers to be acceptable, appropriate, and feasible to treat hopelessness among Veterans with TBI.[4]
- Given that most service members who have experienced a moderate to severe TBI will be separated from military active duty by six months post-injury, adaptation and evaluation of WtoH for mild TBI should be considered for Veteran (vs. military) health care settings.
- Findings from this small RCT suggest that WtoH may be an effective suicide-specific intervention for suicidal Veterans with TBI, additional study with larger samples is warranted.

Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

'Window to Hope' Reduces Hopelessness for Veterans with Moderate-to-Severe TBI

Evaluation of Research Finding – CDC Continuum of Evidence of Effectiveness

	Well-Supported/ Supported	Promising/Emerging/ Undetermined	Unsupported/ Harmful
Effect		**Some Evidence of Effectiveness:** Although significant reductions in primary outcome of hopelessness in two independent RCTs including Veteran (N = 37 analyzed)[3] and Australian civilian populations (N = 17 analyzed)[5] were found with small sample sizes, no effect for secondary outcomes of depression symptoms or suicidal ideation.	
Internal Validity	**True Experimental Design:** Eligible patients randomized to WtoH condition in both Veteran[3] and civilian[5] studies.		
Type of Evidence	**Randomized Controlled Trial:** Two RCTs in different populations[3,5].		
Independent Replication	**Program Replication with Evaluation Replication:** This study utilized Veteran population[3] and replicated findings from a study of Australian civilians.[5] The original study[5] and this replication[3] included patients with moderate-to-severe TBI, and included hopelessness (BHS[6]) as the primary outcome[3,5].		
Implementation Guidance		**Partial:** A detailed Veteran manual and materials are available upon request from the Rocky Mountain MIRECC for implementation[3].	
External and Ecological Validity	**Two or More Applied Studies – Different Settings:** Original study[5] with civilians in Australia and adaptation for American Veterans[3] both conducted with TBI patients in "real world" settings via recruitment from active clinical rehab services. Demonstrates strong ecological validity for Veterans given that the treatment was adapted for US Veterans in the setting of relevance.		

References:

1. Brenner, L. A., Ignacio, R. V. & Blow, F. C. Suicide and Traumatic Brain Injury Among Individuals Seeking Veterans Health Administration Services. *J. Head Trauma Rehabil.* **26**, 257 (2011).
2. Simpson, G. & Tate, R. Suicidality after traumatic brain injury: demographic, injury and clinical correlates. *Psychol. Med.* **32**, 687–697 (2002).
3. Brenner, L. A. *et al.* Window to hope: A randomized controlled trial of a psychological intervention for the treatment of hopelessness among Veterans with moderate to severe traumatic brain injury. *J. Head Trauma Rehabil.* **33**, E64–E73 (2017).*
4. Matarazzo, B. B. *et al.* Cross-cultural adaptation of the Window to Hope: A psychological intervention to reduce hopelessness among US Veterans with traumatic brain injury. *Brain Inj.* **28**, 1238–1247 (2014).*
5. Simpson, G. K., Tate, R. L., Whiting, D. L. & Cotter, R. E. Suicide Prevention After Traumatic Brain Injury: A Randomized Controlled Trial of a Program for the Psychological Treatment of Hopelessness. *J. Head Trauma Rehabil.* **26**, 290 (2011).
6. Beck, A. T. *BHS, Beck hopelessness scale: manual*. (Psychological Corp; Harcourt Brace Jovanovich, 1993).

* Denotes MSRC-funded study.

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Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

Crisis Response Planning to Prevent Suicidal Thoughts and Behavior

Recommendation: ☐ Further research

- ☐ Do not disseminate – insufficient evidence and no research methodology implications
- ☐ Disseminate to researchers only – insufficient evidence to support but research implications

☐ Disseminate information

- ☐ Disseminate to researchers only – some evidence, needs further study
- ☐ Disseminate as informational findings – no specific actions to recommend

X Recommendations for Action

- ☐ Recommend do not use - evidence of harm
- **X** Recommend as pilot change in policy or practice with evaluation
- ☐ Recommend for general change in policy or practice

Recommended Change (if any)

Change in Policy or Practice	Context/Stakeholder
• Crisis Response Planning (with and without telephone follow-up) should be piloted with evaluation alongside lethal means counseling as a part of standard MTF care for military personnel who present with signs and symptoms of suicidality	• Military treatment settings (that do not currently incorporate Crisis Response Planning domains into existing suicide crisis actions)

MSRC Study Information: Bryan (PI), Brief interventions for short-term suicide risk reduction in military populations

Key Points:

- Brief interventions are needed to address suicide in Emergency Departments and Outpatient Clinics[1], including military treatment facilities.
- Crisis Response Planning is a single session intervention for suicidal patients who seek psychiatric crisis services and includes assessment, supportive listening, and identification of internal coping skills, reasons for living[2], supportive others, crisis services, and referral to treatment[3].
- **Crisis Response Planning decreased the odds of attempted suicide among suicidal soldiers**[3] compared to contracting for safety (standard of care in the treatment setting), and was associated with faster reductions in suicidal ideation.
- Neither CRP nor contracting for safety included lethal means counseling but CRP has been implemented alongside lethal means counseling as part of overall treatment.
- Additional studies are needed to replicate this finding in larger samples.
- CAVEAT: Safety Planning, which includes all elements of Crisis Response Planning *plus* lethal means counseling is endorsed by the VA/DoD Clinical Practice Guideline for the Assessment and Management of Patients at Risk for Suicide[4] and implementing just Crisis Response Planning could be seen as incomplete.

Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

Crisis Response Planning to Prevent Suicidal Thoughts and Behavior

Evaluation of Research Finding – CDC Continuum of Evidence of Effectiveness

	Well-Supported/ Supported	Promising/Emerging/ Undetermined	Unsupported/ Harmful
Effect		**Some Evidence of Effectiveness:** Planned analyses with three groups were not sufficiently powered, and CRP arms were combined for analysis. Marginally significant effect of treatment on odds of attempted suicide, and small-medium effect of treatment upon suicidal ideation[3].	
Internal Validity	**True Experimental Design:** Initially randomized design, then treatment conditions were combined to address power concerns[3].		
Type of Evidence	**True Experimental Design:** Initially randomized design, then treatment conditions were combined to address power concerns[3].		
Independent Replication		**Partial Program Replication Without Evaluation Replication:** CRP replicates components of other evidence-based brief interventions to reduce suicide risk[5,6].	
Implementation Guidance	**Comprehensive:** Web-based resources, in-person trainings, written materials, and post-training consultations[3].		
External and Ecological Validity		**Real-World Informed:** High ecological validity for active duty personnel and MTF clinicians given study setting in context of relevance[7].	

References:

1. Hogan, M. F. & Grumet, J. G. Suicide prevention: An emerging priority for health care. *Health Aff. (Millwood)* **35**, 1084–1090 (2016).
2. Bryan, C. J., Oakey, D. N. & Harris, J. A. Reasons for living among U.S.. Army personnel thinking about suicide. *Cogn. Ther. Res.* **42**, 758–768 (2018).*
3. Bryan, C. J. *et al.* Effect of crisis response planning vs. contracts for safety on suicide risk in U.S. Army Soldiers: A randomized clinical trial. *J. Affect. Disord.* **212**, 64–72 (2017).*
4. The Assessment and Management of Suicide Risk Work group. *VA/DOD Clinical Practice Guideline for The Assessment and Management of Patients at Risk for Suicide*. 142 https://www.healthquality.va.gov/guidelines/MH/srb/VADoDSuicideRiskFullCPGFinal5088919.pdf (2019).
5. Stanley, B. *et al.* An emergency department intervention and follow-up to reduce suicide risk in the VA: Acceptability and effectiveness. *Psychiatr. Serv.* **67**, 680–683 (2016).
6. Miller, I. W. *et al.* Suicide prevention in an emergency department population: the ED-SAFE study. *JAMA Psychiatry* **74**, 563–570 (2017).
7. Bryan, C. J. *et al.* Use of crisis management interventions among suicidal patients: Results of a randomized controlled trial. *Depress. Anxiety* **35**, 619–628 (2018).*

* Denotes MSRC-funded study.

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Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

The Virtual Hope Box is Accessible and Effective for Increasing Coping Self-Efficacy among Suicidal Veterans

Recommendation: ☐ Further research
- ☐ Do not disseminate – insufficient evidence and no research methodology implications
- ☐ Disseminate to researchers only – insufficient evidence to support but research implications

☐ Disseminate information
- ☐ Disseminate to researchers only – some evidence, needs further study
- ☐ Disseminate as informational findings – no specific actions to recommend

X Recommendations for Action
- ☐ Recommend do not use - evidence of harm
- **X** Recommend as pilot change in policy or practice with evaluation
- ☐ Recommend for general change in policy or practice

Implications for Policy or Practice	Stakeholder/Proponent
• Implement integration of the Virtual Hope Box to improve suicide-focused coping for service members at elevated risk. Evaluate effectiveness, acceptability, appropriateness, and feasibility to specific military settings/contexts.	• MTF Clinicians
• In addition to mental health referral, implement integration of the Virtual Hope Box to improve suicide-focused coping for Service Members at elevated risk.	• Chaplains, Military & Family Life Counselors, Fleet & Family Services, Marine Corps Community Services

MSRC Study Information: Bush (PI), Effectiveness of a Virtual Hope Box Smartphone App in Enhancing Veteran's Coping with Suicidal Ideation: A Randomized Clinical Trial

Key Points:
- A Hope Box or Hope Kit is a physical container filled with items that remind someone of reasons for living, and can serve as "a powerful and personal reminder of their connection to life that can be used when feeling suicidal" (p.268)[2]. The Hope Box was developed as a strategy as part of an evidence-based psychotherapy, cognitive therapy for suicidal patients.

The Virtual Hope Box is Accessible and Effective for Increasing Coping Self-Efficacy among Suicidal Veterans

- A pilot study was conducted to develop a Virtual Hope Box that could be delivered as a smartphone app[3]. This app was then tested via a randomized controlled trial that included military Veterans who had reported suicidal ideation during mental health treatment[4]. The app was also vetted for usability in a small sample of active duty Service Members (n = 10).
- Veterans with suicidal ideation who were engaged in active mental health treatment and who received the Virtual Hope Box reported increased ability to manage the demands of recovery (i.e., Coping Self-Efficacy) relative to Veterans who did not receive the app. Specifically, there was a statistically significant increase in Veterans' ability to "stop unpleasant thoughts and emotions"[4].
- There was no statistically significant effect of the Virtual Hope Box for increasing Veterans' perceived ability to "enlist support from family or friends," and there was no significant treatment effects of the Virtual Hope Box with regard to changes in suicidal ideation or reasons for living.
- Veterans who received the Virtual Hope Box were more likely to make use of this resource when compared to control group Veterans who received only printed materials with information on stress management and emotional regulation[4].
- **The Virtual Hope Box app is an acceptable, feasible, and highly accessible adaptation**[3] **of a physical hope box that that can be used to improve coping for Veterans with suicidal ideation who were engaged in mental health care.**

Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

The Virtual Hope Box is Accessible and Effective for Increasing Coping Self-Efficacy among Suicidal Veterans

Evaluation of Research Finding – CDC Continuum of Evidence of Effectiveness

	Well-Supported/ Supported	Promising/Emerging/ Undetermined	Unsupported/ Harmful
Effect		**Some Evidence of Effectiveness:** Rigorous evaluation via an RCT[4] with suicidal Veterans (N = 118) that demonstrated one statistically significant effect of the Virtual Hope Box with regard to Coping Self-Efficacy. This established clinical practice has not been tested as a standalone intervention via two or more rigorous evaluations.	
Internal Validity	**True Experimental Design:** Randomized Controlled Trial with suicidal Veterans assigned to Virtual Hope Box or enhanced usual care conditions[4].		
Type of Evidence	**Randomized Controlled Trial**		
Independent Replication		**Partial Program Replication without Evaluation Replication:** Partial replication of established clinical practice that is a component of evidence-based practices for treating suicidality. No independent replication for the efficacy of the Virtual Hope Box.	
Implementation Guidance	**Comprehensive:** The Virtual Hope Box is accessible as a free download for Android and iOS smartphones, and has been downloaded more than 450,000 times as of October 2019. Built-in tutorials guide users through steps needed to utilize each aspect of the app, and have been rigorously field tested to ensure acceptability and usability[3]. A clinician's guide is also available via DHA Connected Health (formerly, the National Center for Telehealth and Technology; available from **https://health.mil/Reference-Center/Publications/2018/06/27/Virtual-Hope-Box-Clinician-Guide**		
External and Ecological Validity	**Two or More Applied Settings:** The Virtual Hope Box has been widely disseminated and implemented, including via the Suicide Prevention Resource Center, Department of Veterans Affairs, Department of Defense, and College Counseling Centers.		

References:

1. Beck, A. T., Kovacs, M. & Weissman, A. Hopelessness and Suicidal Behavior: An Overview. *JAMA* **234**, 1146–1149 (1975).
2. Berk, M. S., Henriques, G. R., Warman, D. M., Brown, G. K. & Beck, A. T. A cognitive therapy intervention for suicide attempters: An overview of the treatment and case examples. *Cogn. Behav. Pract.* **11**, 265–277 (2004).
3. Bush, N. E. *et al.* A Virtual Hope Box smartphone app as an accessory to therapy: Proof-of-concept in a clinical sample of veterans. *Suicide Life. Threat. Behav.* **45**, 1–9 (2015).
4. Bush, N. E. *et al.* A virtual hope box: Randomized controlled trial of a smartphone app for emotional regulation and coping with distress. *Psychiatr. Serv.* **68**, 330–336 (2017).
5. Castillo-Sánchez, G., Camargo-Henríquez, I., Muñoz-Sánchez, J. L., Franco-Martín, M. & Torre-Díez, I. de la. Suicide Prevention Mobile Apps: Descriptive Analysis of Apps from the Most Popular Virtual Stores. *JMIR MHealth UHealth* **7**, e13885 (2019).

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Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications
Half of American Adults are Exposed to Death by Suicide

Recommendation: ☐ Further research
- ☐ Do not disseminate – insufficient evidence and no research methodology implications
- ☐ Disseminate to researchers only – insufficient evidence to support but research implications

☐ Disseminate information
- ☐ Disseminate to researchers only – some evidence, needs further study
- ☐ Disseminate as informational findings – no specific actions to recommend

X Recommendations for Action
- ☐ Recommend do not use - evidence of harm
- **X** Recommend as pilot change in policy or practice with evaluation
- ☐ Recommend for general change in policy or practice

Implications for Policy or Practice	Stakeholders/Proponents
• Raise awareness of the potentially wide exposure of a suicide death.	• Leadership • Casualty Assistance Officers
• Consider assessing exposure to suicide (e.g., family members, friends, leadership, peers) when conducting intakes of military and dependents.	• Behavioral Health Clinicians

MSRC Study Information: Cerel (PI), Military Bereavement Study

Key Points:
- Schneidman's[2] estimate of 6 survivors per suicide death has been the conventional assumption in suicide prevention for decades. Other research estimated that between 4 and 20 people survive each suicide death, depending on the nature of the relationship.[3]
- No previous studies have rigorously assessed and estimated the level of exposure to other's suicides in the general US population.
- Nearly half (47%) of adults surveyed in Kentucky were exposed to suicide, with estimated 135 people surviving each death by suicide.
- Replicating this finding, a national survey found approximately half (51%) of American adults reported exposure to suicide.[4]
- This is important because it appears that **people in the US are much more personally exposed to suicide than was previously known**.

Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications
Half of American Adults are Exposed to Death by Suicide

Evaluation of Research Finding – CDC Continuum of Evidence of Effectiveness

	Well-Supported/ Supported	Promising/Emerging/ Undetermined	Unsupported/ Harmful
Effect	**Prevalence Study:** Large proportion of US adults: 135 survivors per suicide death, 51% of the population exposed.		
Internal Validity	**Prevalence Study:** Rigorous phone survey at State-level and representative survey at National level.		
Type of Evidence	**Prevalence Study:** Probabilistic observational estimates.		
Independent Replication		**Partial Replication:** State-level estimate replicated through collaboration with representative nationwide study.	
Implementation Guidance		**None:** Helpful information, no products/services.	
External and Ecological Validity		**Real-world Informed:** Not specific to military population; 10% of the sample was Veterans.	

References:

1. Cerel, J. et al. How many people are exposed to suicide? Not six. Suicide Life. Threat. Behav. (2018). doi:10.1111/sltb.12450*
2. Shneidman E. Prologue: fifty–eight years. In: Shneidman ES, editor. On the nature of suicide. San Francisco (CA): Jossey-Bass, 1969: 1–30.
3. Berman, A. L. Estimating the Population of Survivors of Suicide: Seeking an Evidence Base. Suicide Life. Threat. Behav. 41, 110–116 (2011).
4. Feigelman, W., Cerel, J., McIntosh, J. L., Brent, D. & Gutin, N. Suicide exposures and bereavement among American adults: Evidence from the 2016 General Social Survey. J. Affect. Disord. 227, 1–6 (2018).

* Denotes MSRC-funded study.

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Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

Exposure to Suicide Death is Associated with Symptoms of Psychopathology

Recommendation: ☐ Further research
- ☐ Do not disseminate – insufficient evidence and no research methodology implications
- ☐ Disseminate to researchers only – insufficient evidence to support but research implications

☐ Disseminate information
- ☐ Disseminate to researchers only – some evidence, needs further study
- ☐ Disseminate as informational findings – no specific actions to recommend

X Recommendations for Action
- ☐ Recommend do not use - evidence of harm
- **X** Recommend as pilot change in policy or practice with evaluation
- ☐ Recommend for general change in policy or practice

Implications for Policy or Practice	Stakeholder/Proponent
• In addition to family history of suicide, recommend that clinicians assess closeness and impact of suicide loss. For instance, "have you been close to anyone who has died by suicide?"	• Behavioral Health Clinicians
• Possible need for death notification and formal sources of information after a suicide that extend beyond next-of-kin.	• Leadership • Casualty Assistance Officers

MSRC Study Information: Cerel (PI), Military Bereavement Study

Key Points:
- The consistency of estimates from the State[1] and National[2] surveys included in this brief suggest that many Americans (45%) perceive disruptive impacts from the suicide deaths of people they have known personally.
- A third of American adults (35%) reported they were "emotionally distressed" by a suicide.[2]
- **More exposure to suicide was associated with increased risk of depression, anxiety, Post-Traumatic Stress Disorder (PTSD), and prolonged grief**.[1]
- People who reported being highly impacted by another person's suicide reported higher levels of suicidal ideation and greater symptoms of depression, anxiety, and PTSD.[1]
- Younger age and female sex were associated with greater perceived impact of suicide exposure, but race, marital status, and rural-urban status were not.[1]

Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

Exposure to Suicide Death is Associated with Symptoms of Psychopathology

Evaluation of Research Finding – CDC Continuum of Evidence of Effectiveness

	Well-Supported/ Supported	Promising/Emerging/ Undetermined	Unsupported/ Harmful
Effect	**Prevalence Estimates:** Large proportion of US adults: 35-45% of the population reported significant distress.[1,2]	**Survey Study:** Effects on suicidal ideation and mental health outcomes based on one statewide study.[1]	
Internal Validity	**Prevalence Estimates:** Rigorous phone survey at State-level and representative survey at National level.	**Survey Study:** Rigorous phone survey at State-level.	
Type of Evidence	**Prevalence Estimates:** Probabilistic observational estimates.	**Survey Study:** Single group cross-sectional survey.	
Independent Replication		**Partial Replication:** State-level estimate of impact and disruption replicated through collaboration with representative nationwide study.	
Implementation Guidance		**None:** Helpful information, no products/services to implement per se.	
External and Ecological Validity		**Real-world Informed:** Not specific to military population; 10% of the sample was Veterans.	

References:

1. Cerel, J. et al. Suicide exposure in the population: Perceptions of impact and closeness. Suicide Life. Threat. Behav. 47, 696–708 (2017).*
2. Feigelman, W., Cerel, J., McIntosh, J. L., Brent, D. & Gutin, N. Suicide exposures and bereavement among American adults: Evidence from the 2016 General Social Survey. J. Affect. Disord. 227, 1–6 (2018).

* Denotes MSRC-funded study.

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Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

Caring Contacts via Text Messages for Suicide Prevention among Soldiers & Marines

Recommendation: ☐ Further research
- ☐ Do not disseminate – insufficient evidence and no research methodology implications
- ☐ Disseminate to researchers only – insufficient evidence to support but research implications

☐ Disseminate information
- ☐ Disseminate to researchers only – some evidence, needs further study
- ☐ Disseminate as informational findings – no specific actions to recommend

X Recommendations for Action
- ☐ Recommend do not use - evidence of harm
- **X** Recommend as pilot change in policy or practice with evaluation
- ☐ Recommend for general change in policy or practice

Implications for Policy or Practice	Stakeholder/Proponent
• Consider implementing Caring Contacts with active duty service members at risk for suicide as augmentation to behavioral health care to reduce risk.	• Military Treatment Facility
• Pilot and evaluate the use of Caring Contacts outside of the MTFs	• Military & Family Life Counselors (MFLC), Marine Corps Community Services, and others

MSRC Study Information: Comtois (PI), Military Continuity Project

Key Points:
- Several studies have found brief non-demanding messages of care and concern to be effective for reducing suicide-specific outcomes.[1–6]
- However, Caring Contacts studies have been limited by small sample sizes, the absence of detailed follow-up interviews in addition to administrative records and have generally yielded modest treatment effects.[7–9]
- As augmentation to standard care of suicidal active duty Marines and Soldiers, **Caring Contacts delivered via text messages caused a reduction in the odds of attempted suicide (9% vs. 15%) and modestly reduced the odds of having any suicidal ideation (80% vs 88%) over one year**.[10]
- However, this study found no statistically significant effect of Caring Contacts via text message on (a) number of hospitalizations to prevent suicide, (b) past 2 weeks suicidal ideation at 12-month follow-up, or (c) the intensity and frequency of suicidal thoughts and behavior, if any occurred[10].
- CAVEAT: Because the primary aims of assessing impact on hospitalization and current ideation were non-significant, this study could be seen as a null trial.

Evaluation of Research Finding – CDC Continuum of Evidence of Effectiveness

	Well-Supported/ Supported	Promising/Emerging/ Undetermined	Unsupported/ Harmful
Effect	**Mixed Findings:** Multiple RCTs with significant treatment effects, and multiple quasi-experimental designs with significant treatment effects[2]. Military study showed no effect on hospitalization as predicted but did show effect for suicide attempt[10]. In addition, several studies with null findings in diverse contexts and with different message formats[7].		
Internal Validity	**True Experimental Design**		
Type of Evidence	**Randomized Controlled Trial/Meta-analysis**		
Independent Replication	**Program Replication w/ Evaluation Replication:** Multiple independent replications with diverse populations and multiple methods of message delivery.[11–13]		
Implementation Guidance		**Partial:** Message content and procedures are well articulated but not yet published. Clinical infrastructure and technology to organize delivery are under-developed.	
External and Ecological Validity	**Two or More Applied Studies—Different Settings:** Military: Replication of non-military studies in a large sample of military personnel using text messaging.[10] Non-Military: Replication of original US finding in multi-national RCT and RCTs in Australia and Iran.[5–7]		

References:

1. Luxton, D. D., June, J. D. & Comtois, K. A. Can postdischarge follow-up contacts prevent suicide and suicidal behavior? A review of the evidence. *Crisis* **34**, 32–41 (2013).
2. Inagaki, M., Kawashima, Y., Yonemoto, N. & Yamada, M. Active contact and follow-up interventions to prevent repeat suicide attempts during high-risk periods among patients admitted to emergency departments for suicidal behavior: a systematic review and meta-analysis. *BMC Psychiatry* **19**, 44 (2019).
3. Carter, G. L., Clover, K., Whyte, I. M., Dawson, A. H. & D'Este, C. Postcards from the EDge project: Randomised controlled trial of an intervention using postcards to reduce repetition of hospital treated deliberate self poisoning. *Br. Med. J.* **331**, 805–807 (2005).
4. Hassanian-Moghaddam, H., Sarjami, S., Kolahi, A.-A. & Carter, G. L. Postcards in Persia: Randomised controlled trial to reduce suicidal behaviours 12 months after hospital-treated self-poisoning. *Br. J. Psychiatry* **198**, 309–316 (2011).
5. Motto JA. Suicide prevention for high-risk persons who refuse treatment. *Suicide Life. Threat. Behav.* **6**, 223–30 (1976).
6. Motto, J. A. & Bostrom, A. G. A randomized controlled trial of postcrisis suicide prevention. *Psychiatr. Serv.* **52**, 828–833 (2001).
7. Milner, A. J., Carter, G., Pirkis, J., Robinson, J. & Spittal, M. J. Letters, green cards, telephone calls and postcards: systematic and meta-analytic review of brief contact interventions for reducing self-harm, suicide attempts and suicide. *Br. J. Psychiatry* **206**, 184–190 (2015).
8. Hoge, C. W. Suicide Reduction and Research Efforts in Service Members and Veterans—Sobering Realities. *JAMA Psychiatry* (2019). doi:10.1001/jamapsychiatry.2018.4564
9. Stein, M. B., Kessler, R. C. & Ursano, R. J. Reframing the Suicide Prevention Message for Military Personnel. *JAMA Psychiatry* (2019). doi:10.1001/jamapsychiatry.2018.3943
10. Comtois, K. A. *et al.* Effect of augmenting standard care for military personnel with brief caring text messages for suicide prevention: A randomized clinical trial. *JAMA Psychiatry* **76**, 474–483 (2019).*
11. Motto, J. A. & Bostrom, A. G. Follow-up for parasuicidal patients. *Psychiatr. Serv.* **52**, 1254-a-1254 (2001).
12. Hassanian-Moghaddam, H., Sarjami, S., Kolahi, A.-A., Lewin, T. & Carter, G. Postcards in Persia: A twelve to twenty-four month follow-up of a randomized controlled trial for hospital-treated deliberate self-poisoning. *Arch. Suicide Res.* **21**, 138–154 (2017).
13. Carter, G. L., Clover, K., Whyte, I. M., Dawson, A. H. & D'Este, C. Postcards from the EDge: 5-year outcomes of a randomised controlled trial for hospital-treated self-poisoning. *Br. J. Psychiatry* **202**, 372–380 (2013).

* Denotes MSRC-funded study.

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Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

Home-based Mental Health Evaluation (HOME) Program for Veterans after Psychiatric Inpatient Care

Recommendation: ☐ Further research
- ☐ Do not disseminate – insufficient evidence and no research methodology implications
- ☐ Disseminate to researchers only – insufficient evidence to support but research implications

X Disseminate information
- ☐ Disseminate to researchers only – some evidence, needs further study
- **X** Disseminate as informational findings – no specific actions to recommend

☐ Recommendations for Action
- ☐ Recommend do not use - evidence of harm
- ☐ Recommend as pilot change in policy or practice with evaluation
- ☐ Recommend for general change in policy or practice

Implications for Policy or Practice	Stakeholder/Proponent
• None	•

MSRC Study Information: Matarazzo (PI), Home-Based Mental Health Evaluation (HOME) to Assist Suicidal Veterans with the Transition from Inpatient to Outpatient Settings: A Multi-Site Interventional Trial

Key Points:
- Discharge from inpatient psychiatric care is associated with increased risk of suicidal behavior during the days and weeks afterwards[1], including among Veterans[2] and active duty Service Members[3].
- This study integrated several different evidence-based strategies within a single home-based intervention, the HOME program[4,5]. The focus of the intervention was to ensure ongoing refinement and implementation of safety planning, connection to outpatient services, and follow-up phone contacts until outpatient care was established[4].
- In addition to promoting engagement in outpatient follow-up care, home visits also allowed providers to ensure that means safety measures had been implemented effectively in the settings in which they are meant to be used[4].
- A nonrandomized trial compared Veterans from two VA medical centers that provided the HOME program with two that provided enhanced usual care[4].
- Most Veterans enrolled in the HOME program completed at least one follow-up phone call and most completed a home visit[4].
- **Participants who were admitted to a psychiatric inpatient unit and subsequently discharged after enrollment in the HOME program were 1.33 times more likely (92% v. 75%) to engage in follow-up care compared to Veterans receiving enhanced usual care[4].**

Evaluation of Research Finding – CDC Continuum of Evidence of Effectiveness

	Well-Supported/ Supported	Promising/Emerging/ Undetermined	Unsupported/ Harmful
Effect		**Some Evidence of Effectiveness**: One multisite trial with Veterans (N = 302) that demonstrated clinically significant effects with regard to outpatient treatment engagement after hospitalization.[4] Enhanced engagement in treatment in the multisite trial was consistent with a smaller clinical demonstration and treatment development project.[5]	
Internal Validity	**Quasi-Experimental:** Nonrandomized controlled trial at VA Medical Centers with allocation to treatment condition based on site (2 HOME & 2 E-CARE)[4].		
Type of Evidence	**Quasi-Experimental:** Nonrandomized controlled trial.[5]		
Independent Replication		**Partial Program Replication without Evaluation Replication:** One multisite trial[4] replicated findings from a treatment development trial[5]. However, no independent replication has been completed.	
Implementation Guidance		**Partial:** Detailed descriptions of HOME program components are reported in published papers[4,5]. Treatment fidelity measures and detailed manuals are available upon request from the authors.	
External and Ecological Validity		**Real-World Informed:** The HOME Program was developed and tested in the setting of relevance, VA Medical Centers and follow-up care[4,5]. Has not yet been implemented in two or more applied settings.	

References:

1. Chung, D. T. *et al.* Suicide rates after discharge from psychiatric facilities: A systematic review and meta-analysis. *JAMA Psychiatry* **74**, 694 (2017).
2. Valenstein, M. *et al.* Higher-risk periods for suicide among VA patients receiving depression treatment: Prioritizing suicide prevention efforts. *J. Affect. Disord.* **112**, 50–58 (2009).
3. Luxton, D. D., Trofimovich, L. & Clark, L. L. Suicide Risk Among U.S. Service Members After Psychiatric Hospitalization, 2001–2011. *Psychiatr. Serv.* **64**, 626–629 (2013).
4. Matarazzo, B. B. *et al.* Efficacy of the Home-Based Mental Health Evaluation (HOME) Program for Engaging Patients in Care After Hospitalization. *Psychiatr. Serv.* appi.ps.201900002 (2019) doi:10.1176/appi.ps.201900002.
5. Matarazzo, B. B. *et al.* Connecting veterans at risk for suicide to care through the home program. *Suicide Life. Threat. Behav.* **47**, 709–717 (2017).

This Action Brief is supported by the Military Suicide Research Consortium (MSRC), funded by the Office of the Assistant Secretary of Defense for Health Affairs under Award No. (W81XWH-16-2-0003 & W81XWH-16-2-0004). Opinions, interpretations, conclusions and recommendations are those of the Military Suicide Research Consortium and are not necessarily endorsed by the Department of Defense.

Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

Suicidality is More Accurately Predicted via Machine Learning using Many Variables

Recommendation: ☐ Further research
- ☐ Do not disseminate – insufficient evidence and no research methodology implications
- ☐ Disseminate to researchers only – insufficient evidence to support but research implications

X Disseminate information
- **X** Disseminate to researchers only – some evidence, needs further study
- ☐ Disseminate as informational findings – no specific actions to recommend

☐ Recommendations for Action
- ☐ Recommend do not use - evidence of harm
- ☐ Recommend as pilot change in policy or practice with evaluation
- ☐ Recommend for general change in policy or practice

Recommended Change (if any)

Implications for Policy or Practice	Stakeholder/Proponent
• None	• None

MSRC Study Information: Ribeiro (PI), Short-Term Prediction of Suicidal Behaviors on a Large Scale

Key Points:
- Prediction of suicidal thoughts and behaviors using conventional risk/protective factors is not much better than chance[1].
- Machine Learning and other sophisticated quantitative methodologies have demonstrated promising results by including hundreds to thousands of variables for the prediction of suicidality, including among active duty Service Members[2].
- Focusing on assessment of short-term outcomes (days to weeks), using large samples, and employing sophisticated quantitative methods may improve the prediction of suicidal thoughts and behaviors[3].
- A large sample (N = 1021) of adults recruited online who reported past history of self-directed violence completed measures of implicit associations, psychopathology, suicide risk factors, and demographics[3].
- Machine Learning methods were used to predict suicidal thoughts and behaviors across follow-up time points based on baseline data[3].
- **Complex machine learning models with many variables (approx. 50 predictors) were found to more accurately predict short-term suicide-specific outcomes relative to conventional univariate approaches.**
- These findings suggest that clinical assessment of suicide risk may be enhanced via the implementation of decision support tools that include machine learning methods that promote consideration of complex interactions among many variables. These findings also demonstrate that relatively fewer variables (approx. 50) may be sufficient for meaningful predictions of suicide risk.

Evaluation of Research Finding – CDC Continuum of Evidence of Effectiveness

	Well-Supported/ Supported	**Promising/Emerging/ Undetermined**	**Unsupported/ Harmful**
Effect	**Longitudinal Risk Prediction Study:** Non-interventional study to assess prediction of suicidal thoughts and behavior. Found strong predictive utility of Machine Learning models (AUC: .83 to .89).		
Internal Validity		**Web-based Study:** Rigorous measures were taken to ensure reliable and valid responding. However, the anonymous online format prevented definitive determination of dropout that was due to suicidal behavior or death by suicide[3].	
Type of Evidence		**Single Group Design:** Longitudinal risk prediction study with non-representative international sample of adults with past history of self-directed violence.[3]	
Independent Replication		**Partial Replication:** Findings of machine learning models were consistent with other such studies[2], however no other studies of short-term risk exist for a more direct replication[3].	
Implementation Guidance		**Emerging:** Findings inform an ongoing trial to evaluate this model as a decision-support tool among active duty Service Members. No materials or specific implementation of such tools was included within the scope of this study[3].	
External and Ecological Validity		**Real-world Informed:** Findings may not be generalizable due to lack of external validation, and possible overfitting of machine learning models[3].	

Note. Ratings based on modified continuum of evidence for non-interventional longitudinal study.

References:

1. Franklin, J. C. *et al.* Risk factors for suicidal thoughts and behaviors: A meta-analysis of 50 years of research. *Psychol. Bull.* **143**, 187–232 (2017).
2. Kessler, R. C. *et al.* Predicting suicides after psychiatric hospitalization in US Army soldiers: the Army Study To Assess Risk and Resilience in Servicemembers (Army STARRS). *JAMA Psychiatry* **72**, 49–57 (2015).
3. Ribeiro, J. D., Huang, X., Fox, K. R., Walsh, C. G. & Linthicum, K. P. Predicting Imminent Suicidal Thoughts and Nonfatal Attempts: The Role of Complexity. *Clin. Psychol. Sci.* **7**, 941–957 (2019).

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Military Suicide Research Consortium Action Brief - Research Finding and Recommendations for Military Applications

Valid and Reliable Suicide Risk Assessment for Active Duty Personnel

Recommendation: ☐ Further research
- ☐ Do not disseminate – insufficient evidence and no research methodology implications
- ☐ Disseminate to researchers only – insufficient evidence to support but research implications

☐ Disseminate information
- ☐ Disseminate to researchers only – some evidence, needs further study
- ☐ Disseminate as informational findings – no specific actions to recommend

X Recommendations for Action
- ☐ Recommend do not use - evidence of harm
- **X** Recommend as pilot change in policy or practice with evaluation
- ☐ Recommend for general change in policy or practice

Implications for Policy or Practice	Stakeholder/Proponent
• If clinicians are not using an evidence-based suicide risk assessment measure, consider implementing one of these four measures following a positive screening.	• Military Treatment Facilities • Others assessing (not just screening) for suicide risk in service members

MSRC Study Information: Peter Gutierrez, PhD and Thomas Joiner, PhD; Toward a Gold Standard for Suicide Risk Assessment for Military Personnel

Key Points:
- Four commonly utilized suicide risk assessment measures: Columbia-Suicide Severity Rating Scale interview, full-version (C-SSRS),[1] Self-Harm Behavior Questionnaire (SHBQ) interview,[2] self-report Suicidal Behaviors Questionnaire-Revised (SBQ-R),[3,4] and self-report Beck Scale for Suicide Ideation (BSS),[5,6] were found to be valid and reliable when used with active duty U.S. service members at risk for suicide with the exception of predictive validity.[7]
- Only study to assess the psychometric properties of standardized suicide-specific assessment tools used with military personnel.[7]
- All **four measures are appropriate for use when treating service members and may improve treatment planning and progress tracking**.
- Clinicians should evaluate ease of administration, available scoring and interpretation guidelines in selecting which of these measures to adopt.
- Predictive validity analyses are being completed and will be released as soon as possible.
- Further implementation research is warranted once the predictive validity has been established.

Evaluation of Research Finding – CDC Continuum of Evidence of Effectiveness

	Well-Supported/ Supported	**Promising/Emerging/ Undetermined**	**Unsupported/ Harmful**
Effect		**Some Evidence of Effectiveness:** Demonstration of reliability and validity except predictive validity.	
Internal Validity		**Non-Experimental Design:** Counterbalancing of measures to account for ordering effects.	
Type of Evidence		**Single Group Design:** Cross-sectional analysis w/ counterbalancing, pending analysis of longitudinal outcomes.	
Independent Replication	**Program Replication w/ Evaluation Replication:** Several independent replications across diverse populations.		
Implementation Guidance	**Comprehensive:** Suicidal Behaviors Questionnaire-Revised (SBQ-R), Beck Scale for Suicide Ideation (BSS), & Columbia Suicide Severity Rating Scale (C-SSRS).	**Partial:** Self-Harm Behavior Questionnaire (SHBQ).	
External and Ecological Validity	**Military:** • Demonstrated reliability and validity among active duty personnel.[7] **Non-Military:** Applied studies in 2 or more different settings.[1,4,8,9]		

References:

1. Posner, K. *et al.* The Columbia–Suicide Severity Rating Scale: Initial Validity and Internal Consistency Findings From Three Multisite Studies With Adolescents and Adults. *Am. J. Psychiatry* **168**, 1266–1277 (2011).
2. Gutierrez, P. *Adolescent suicide: an integrated approach to the assessment of risk and protective factors*. (Northern Illinois University Press, 2008).
3. Osman, A. *et al.* The Suicidal Behaviors Questionnaire-Revised (SBQ-R):Validation with Clinical and Nonclinical Samples. *Assessment* **8**, 443–454 (2001).
4. Aloba, O., Ojeleye, O. & Aloba, T. The psychometric characteristics of the 4-item Suicidal Behaviors Questionnaire-Revised (SBQ-R) as a screening tool in a non-clinical sample of Nigerian university students. *Asian J. Psychiatry* **26**, 46–51 (2017).
5. Beck, A. T. & Steer, R. A. *Beck Scale for Suicide Ideation Manual*. (The Psychological Corporation, 1993).
6. Beck, A. T., Brown, G. K. & Steer, R. A. Psychometric characteristics of the Scale for Suicide Ideation with psychiatric outpatients. *Behav. Res. Ther.* **35**, 1039–1046 (1997).
7. Gutierrez, P. M. *et al.* Psychometric Properties of Four Commonly Used Suicide Risk Assessment Measures: Applicability to Military Treatment Settings. *Mil. Behav. Health* 1–8 (2019). doi:10.1080/21635781.2018.1562390*
8. Interian, A. *et al.* Use of the Columbia-Suicide Severity Rating Scale (C-SSRS) to classify suicidal behaviors. *Arch. Suicide Res.* **22**, 278–294 (2018).
9. Gutierrez, P. M., Osman, A., Barrios, F. X. & Kopper, B. A. Development and initial validation of the Self-Harm Behavior Questionnaire. *J. Pers. Assess.* **77**, 475–490 (2001).

* Denotes MSRC-funded study.

This Action Brief is supported by the Military Suicide Research Consortium (MSRC), funded by the Office of the Assistant Secretary of Defense for Health Affairs under Award No. (W81XWH-16-2-0003 & W81XWH-16-2-0004). Opinions, interpretations, conclusions and recommendations are those of the Military Suicide Research Consortium and are not necessarily endorsed by the Department of Defense.

Military Suicide Research Consortium Publication Report – Research Finding and Recommendations for Military Applications

Problem-Solving Therapy for Suicide Prevention (PST-SP) is Acceptable and Feasible for Veterans with TBI

Recommendation: ☐ Further research
- ☐ Do not disseminate – insufficient evidence and no research methodology implications
- ☐ Disseminate to researchers only – insufficient evidence to support but research implications

X Disseminate information
- **X** Disseminate to researchers only – some evidence, needs further study
- ☐ Disseminate as informational findings – no specific actions to recommend

☐ Recommendations for Action
- ☐ Recommend do not use - evidence of harm
- ☐ Recommend as pilot change in policy or practice with evaluation
- ☐ Recommend for general change in policy or practice

Reference:

Barnes, S. M. *et al.* Problem-solving therapy for suicide prevention in veterans with moderate-to-severe traumatic brain injury. *Rehabil. Psychol.* **62**, 600–608 (2017).

Abstract:

Objective: Develop and test the acceptability and feasibility of Problem-Solving Therapy for Suicide Prevention (PST-SP), a group intervention aimed at improving problem solving and preventing suicide, among Veterans with hopelessness and moderate-to-severe traumatic brain injury (TBI). Research Method: Following treatment development, 16 U.S. Veterans with moderate-to-severe TBI and a Beck Hopelessness Scale score ≥ 4 participated in an acceptability and feasibility pilot study of PST-SP at a Veterans Affairs Medical Center. Participants completed the Client Satisfaction Questionnaire-8 (CSQ-8) and Narrative Evaluation of Intervention Interview (NEII) after participating in PST-SP. Results: PST-SP was developed for Veterans with moderate-to-severe TBI and hopelessness. Seventy-five percent ($n = 12$) of participants enrolled in the pilot study attended $\geq$ 80% of PST-SP sessions. Participants reported high satisfaction with PST-SP (CSQ-8 $M = 27.8$ out of 32; $SD = 4.78$; range 14 –32) and described the intervention as valuable, beneficial, and without negative effects (NEII). Conclusions/Implications: Results from measures of acceptability and attendance suggest that PST-SP is an acceptable and feasible intervention for Veterans with hopelessness and moderate-to-severe TBI. Findings support readiness to examine efficacy of the intervention in a Phase II randomized controlled trial.

MSRC Study Information: Brenner (PI), Window to Hope: Evaluating a Psychological Treatment for Hopelessness among Veterans with Traumatic Brain Injury (TBI) and Pilot Study of an Active Control Problem Solving Therapy for Suicide Prevention (PST-SP) Among Veterans with Moderate to Severe TBI

This Publication Report is supported by the Military Suicide Research Consortium (MSRC), funded by the Office of the Assistant Secretary of Defense for Health Affairs under Award No. (W81XWH-16-2-0003 & W81XWH-16-2-0004). Opinions, interpretations, conclusions and recommendations are those of the Military Suicide Research Consortium and are not necessarily endorsed by the Department of Defense.

A16. DISSERTATION AWARD FINAL REPORTS

Dissertation Final Report - Bauer

Report Date ___08/30/2019_____

Reporting period from ____09/01/2018___________ to ____08/31/2019_____________

Awardee _____Brian Ward Bauer___________________________________

Institution ____University of Southern Mississippi________________________________

Project Title___Using Nudges to Mitigate the Effects of Cognitive Biases in Veterans__

Expenditures (as applicable):

Materials/Supplies: _$99___________

Subject Costs: _$1,901.20_($0.40 fee for every 1 participant on Mturk)

Travel: _$0

Other Direct Costs: _$0_____________

Total: _$2,000_____________

The total number of participants is 1,358 (based on a power analysis and our experience using Mturk and seeing how many people miss validity checks, attention checks, etc.) and Amazon charges $.40 for every participant. Given this, the total comes out to (1,358 x .4) + (1,358) = 1901.2; SPSS was $99 for a total of $2000.20.

Abstract (no more than 500 words)

Background: The neoclassical economic model assumes that humans are unemotional, calculating, economical maximizers who have unbounded rationality, willpower, and selfishness. Recently, behavioral economics challenged this view by positing that humans have bounded rationality, and are susceptible to faulty mental processes (e.g., cognitive biases) which can interfere with rational decision making. Taking such psychological phenomena into account has increased our understanding of human behavior and enabled researchers to create more potent interventions for influencing behavior. One such behavioral economic intervention is a ‘nudge’ – a small feature that attracts attention and changes the environment where people make decisions to ultimately increase the probability of enacting a desired behavior. Nudges have only recently been used in suicide research, and initial studies find that nudges could yield positive, modest

effects in a cost- and time-effective manner. The current study seeks to replicate prior findings - that nudges can influence people to engage with suicide prevention resources - in a Veteran population.

Methods: This study was approved by the first-author's Institutional Review Board (IRB#: IRB-18-41). A sample of 1,358 US veterans over the age of 18 and currently living in the United States are being recruited online through Amazon's Mechanical Turk (MTurk) platform. Sample size was determined using power analysis as well as previous studies citing sizeable amounts of participants being removed due to failed validity checks, attention checks, etc. Participants are randomly put into one of five groups (three nudge groups, two control groups) and asked to complete the same observable outcome: filling out a safety plan. Participants are told that the survey is asking about mental health and treatment seeking behaviors. Participants are being paid $1.00 for the ten-minute survey.

Results: Data collection remains ongoing. Analyses will include chi-square analyses to understand group differences for count data (i.e., frequency of people who completed safety plan in each group). Second, nudge conditions will be collapsed into a binary grouping: unengaged (did not engage to any nudge) and engaged (engaged with one of the nudges). For this, a series of Poisson logistic regression models will be tested to help understand whether possible correlates are significantly related to responding to a nudge. Given that nudges tend to yield small effect sizes, equivalence testing will be conducted for all non-significant results using two-one sided t-tests (TOST) to understand if these differences are small enough to be considered practically unimportant. Correlation analyses will be performed to understand basic relationships between study variables.

Conclusions: Findings may provide further support for nudges as a cost- and time-effective interventions to use with suicide prevention materials. In addition, this study may lay additional foundation for evidenced-based messaging in the area of suicide prevention.

Brief statement on plans to disseminate information (e.g., planned presentations and/or publications):

Results will be submitted at a suicide-specific academic conference (e.g., American Association for Suicidology Annual Conference). Results will be submitted for publication in a peer-reviewed academic journal in the area of psychology or economics.

Note: Please also send us any presentation citations and/or publications that this funding supported and include the following disclaimer for future use:

> **When presenting MSRC funded studies at professional meetings or conferences include the language:** "This work was in part supported by the Military Suicide Research Consortium (MSRC), funded by the Office of the Assistant Secretary of

Defense for Health Affairs under Award No. (W81XWH-16-2-0004). Opinions, interpretations, conclusions and recommendations are those of the author and are not necessarily endorsed by the MSRC or the Department of Defense."

For manuscripts or/and publications include the language: “This work was in part supported by the Military Suicide Research Consortium (MSRC), an effort supported by the Office of the Assistant Secretary of Defense for Health Affairs under Award No. (W81XWH-16-2-0004). Opinions, interpretations, conclusions and recommendations are those of the author and are not necessarily endorsed by the MSRC or the Department of Defense."

Please submit the final report to Kelly Soberay at Kelly.Soberay@va.gov and send notification of publications and presentations as a result of this funding. Thank you.

Dissertation Final Report - Boffa

Report Date: 8/20/19

Reporting period from: September 1, 2018 – August 31, 2019

Awardee: Joseph Boffa, MS

Institution: Florida State University

Project Title: Mitigating Suicidal Thought Suppression: Development and Evaluation of a Novel Intervention for New-Onset Suicide Risk among Military Personnel and Civilians

Expenditures (as applicable):

Materials/Supplies:	$145
Subject Costs:	$1,855
Travel:	$0
Other Direct Costs:	$0
Total:	$2,000

Abstract

Background: As rates of suicide have increased among military personnel and Veterans, there have been calls for novel suicide prevention interventions. One potential target of such interventions is experiential avoidance (EA), with the hypothesis that reducing the degree to which individuals are distressed by and maladaptively cope (i.e., avoid) with suicidal ideation (SI) will reduce their risk of engaging in suicidal behaviors. This project involves the development and evaluation of a single-session, web-based intervention (i.e., Re-Evaluating Suicidal Thoughts [REST]) that uses psychoeducation to reduce distress associated with SI and mindfulness exercises to provide adaptive coping skills to individuals with current SI. It is hypothesized that, compared to controls, individuals assigned to REST will report lower EA of SI after one week, and less severe SI at 1 month. Moreover, it is expected that reductions in EA will mediate decreases in SI severity.

Methods: Of the 108 participants proposed for this study, 53 individuals have been enrolled and randomized to condition. The majority of the present sample is female (73.5%) and Caucasian (64.2%). Roughly half of the sample was recruited from the local community, and 7.5% of participants reported military service. At baseline, participants completed measures of SI severity (i.e., Beck Scale for Suicidal Ideation [BSS]) and EA of SI (i.e., Acceptance and Action

Questionnaire for Suicidal Ideation [AAQ-SI]). They were then randomized to complete the REST intervention plus safety planning or safety planning only. EA of SI was measured one week after baseline, and SI severity one-month and three-months after baseline.

Results: Although this sample is not yet fully powered to draw any conclusions, preliminary data promisingly appear to support study hypotheses. Individuals assigned to REST evince greater reductions in EA of SI from baseline to week-one follow-up ($F[1,50] = 14.24$, $p < .01$, partial $\eta^2 = .30$). Moreover, there is a time x condition interaction observed for change in BSS SI severity after one-month ($F[1,50] = 8.91$, $p < .01$, partial $\eta^2 = .21$) driven by greater reductions among the REST condition. Results of mediation analyses support that the effects of REST on decreased SI severity is accounted for by reductions in EA of SI (Indirect effect: B = .59, 95% confidence interval [.21, 1.08]).

Conclusions: Preliminary evidence supports that individuals with SI do experience EA (i.e., distress and avoidance) in relation to their thoughts about suicide, and that this construct is highly malleable through brief intervention. If this same pattern of results is borne out by the full sample, this will encourage application of REST as an intervention for individuals with SI that improves upon treatment as usual (i.e., safety planning). Because of its portability as a computerized intervention, REST would help to address the dire need for interventions to reduce issues of access to suicide prevention interventions due to cost, time constraints, or stigma.

Brief statement on plans to disseminate information (e.g., planned presentations and/or publications): When completed the results of this trial will certainly be submitted for publication to leading journals, and will likely be submitted for presentation prior to publication at the annual meeting of the American Association for Suicidology (AAS). I have also submitted a protocol with my internship site at the Southeastern Louisiana Veterans Health Care System with the intention of submitting a Pilot Grant application to conduct a feasibility study with REST exclusively among a Veteran sample.

Dissertation Final Report - Martinez

Report Date: August 31 2019

Reporting period from September 1 2018 to August 31 2019

Awardee: Hannah R. Martinez

Institution: Uniformed Services University of the Health Sciences

Project Title: Individual and Dyadic Characteristics in Intimate Partner Relationships Associated with Suicide in Military Psychiatric Inpatients

Expenditures (as applicable):

Materials/Supplies:	$2,000
Subject Costs:	$0
Travel:	$0
Other Direct Costs:	$0
Total:	$0

Budget Justification:

Materials/Supplies: NVivo Qualitative Analysis Software, Nuance Dragon transcription software, monitor for study use, materials for consenting and recruitment efforts [i.e., folders, recorders, encrypted hard drives, printer ink, printer paper, locked bags], purchase of the BHS for use in study, books on qualitative analysis/grounded theory to ensure proper training and standardization of practices among study team.

Subject Costs: None, participants in this study are not compensated for their participation.

Travel: Previously allocated to travel costs for the 52nd annual American Association of Suicidology Conference to present preliminary data. However, the grant was not used in this manner for the following reasons: (1) Due to delayed permission from the IRB for data collection, data was not fully collected or prepared for presentation at the time of the conference and (2) Conference travel was funded by the MSRC Pre-Conference Research Training Day travel award.

Other Direct Costs: None.

Abstract:

Introduction. Suicide within the United States (U.S.) military is a prominent public health concern. Intimate partner relationship dissolution is implicated in 50% of U.S. military suicide deaths. Despite the prominence of this proximal risk indicator, there is a lack of systematic understanding of specific relational characteristics and dynamics within intimate partner relationships that precipitate, maintain, and/or exacerbate risk for suicide.
Purpose. This dissertation project addresses gaps in the suicidology literature by quantitatively and qualitatively examining relational characteristics and dynamics within intimate partner relationships among individuals at high risk for eventual death by suicide. More specifically, the broad objective is (1) to characterize romantic attachment style, relationship self-efficacy, relationship satisfaction, and conflict-induced distress in relation to suicidal thoughts and/or behaviors and (2) to explore the phenomenon of romantic relationships within the context of suicidal service members.
Methods: This is a cross-sectional, mixed methods study. Participants (service members and beneficiaries) will be recruited from a military psychiatric inpatient facility following admission for a suicide-related event. Self-report and clinician-administered measures, along with a semi-structured interview were administered within the first two weeks of psychiatric admission. Qualitative data was be audio-recorded, transcribed, and thematically coded. The target sample size was 55.

*Due to restraints from the relevant IRB regarding the timely start of this project, recruitment is still ongoing at this time and thus results and conclusions are unavailable.

Brief statement on plans to disseminate information (e.g., planned presentations and/or publications):

This project will be presented in accordance with dissertation defense procedures at the Uniformed Services University both publicly and privately. After acceptance, aspects of the project will be presented in formal and informal formats, to include psychology, psychiatry, social work, and military specific meetings and supervisions. Aspects of the project will be presented for presentation at the annual conferences held by organizations such as the American Association of Suicidology and the Association for Behavioral and Cognitive Therapies.

Dissertation Final Report - Forrest

Lauren Forrest
MSRC Dissertation Award Final Report
9/11/2019

Awardee Name: Lauren Forrest

Phone and Email Address: 801-510-5287; forresln@miamioh.edu

Project Title: Interoception as a Novel Predictor of Self-Injurious Behaviors

Sponsor: Military Suicide Research Consortium/Department of Defense

Funded Award Period: 9/1/2016–8/31/2017 with NCE from 9/1/2017 to 8/1/2019

I am writing to submit the final report for my MSRC Dissertation Award. The receipt of this award was fundamental in me finishing my dissertation project, as it allowed me to recruit 54 participants who had recently engaged in nonsuicidal self-injury or attempted suicide and offer them financial compensation for their participation. I completed study recruitment in February 2019 and successfully defended my dissertation in June 2019. The project abstract is below, followed by the budget justification.

Project Abstract
Introduction: Every year millions of people engage in self-injurious behaviors (SIBs). Despite research advances, rates of self-injury remain high while prediction remains weak. Novel, robust self-injury correlates must be identified. One potential self-injury correlate is impaired interoception—i.e., inaccurately detecting the body's physiological sensations. The current study examined whether interoceptive accuracy (the ability to accurately monitor sensations) and sensibility (self-reported judgment of one's typical ability to perceive sensations) for cardiac sensations and pain differed between people with and without SIBs. **Method:** Fifty-five adults with no history of self-injurious thoughts and behaviors (72.7% women) and 54 adults with recent SIB (nonsuicidal self-injury [n = 39] or a suicide attempt [n = 15]; 88.9% women) participated in the study. Interoceptive accuracy for cardiac sensations was assessed using the heartbeat tracking task and interoceptive accuracy for pain was assessed with a metric developed for the current study. Interoceptive sensibility for cardiac sensations and pain were assessed with self-report measures. **Results:** Participants with and without SIBs exhibited similar interoceptive accuracy for cardiac sensations. In addition, groups exhibited similar interoceptive sensibility for cardiac sensations and pain. However, interoceptive accuracy for pain was significantly lower among the SIB group compared to the No SIB group. **Conclusion:** People with and without self-injury did not differ on their self-reported interoceptive sensibility for cardiac sensations and pain. While groups also exhibited similar interoceptive accuracy for cardiac sensations, interoceptive accuracy for pain—i.e., a sensation clearly relevant to self-injury—was diminished among people with SIBs. Overall, interoceptive impairment may vary by domain and sensation type. Diminished interoceptive accuracy for sensations relevant to the pathophysiology of self-injury may be a novel SIB correlate.

Budget Justification (from application)

Materials/Supplies: 0

Subject Costs: The full $2000 award will be dedicated to compensating research participants for their time. I propose to compensate all participants for their baseline study participation and to have a raffle for participation in the follow-up portion. Specifically, participants' subject identification numbers will be entered into a raffle once for each follow-up completed, and subject identification numbers will be selected randomly to offer payment for the follow-up portion. The payments I will offer will vary based on the study portion (i.e., baseline vs. follow-up), participants' self-injurious behavior (SIB) history (i.e., absent vs. present), and whether participants are military-relevant. The payments are listed in the table below.

Subject group	Portion	Amount ($)	Participants	Total ($)
No SIBs				
Civilian	Baseline	0	100	0
Military	Baseline	5	50	250
SIBs				
Civilian	Baseline	5	100	500
	Follow-up	20	10	200
Military	Baseline	15	50	750
	Follow-up	30	10	300
			Grand Total	**2000**

Travel: 0

Other Direct Costs: 0

Budget Breakdown (Please list whole dollar amounts only; amount not to exceed $2000)

Materials/Supplies $0

Subject Costs $955

Travel* $0

Other Direct Costs $0

Total $955

I would like to highlight that I spent approximately half of the awarded funds. This is due to several factors. First, I originally offered participants recruited through my department's research participant pool the choice to be compensated via partial course credit or cash payment. The majority of these participants elected to receive course credit, and the majority of the participants in the study came from my department's research participant pool. Second, participant recruitment was more difficult than expected. At the project outset, I aimed to recruit 100 participants with recent self-injurious behaviors. I anticipated that approximately half of the participant group would have recent nonsuicidal self-injury and the other half would have a recent suicide attempt. My plan was to compare interoceptive abilities between people with and without self-injurious behaviors and then to further compare interoceptive abilities between people with nonsuicidal self-injury and people with suicide attempts. Over a 2.5-year period of regular recruitment efforts (i.e., emails, posting study flyers, advertising around campus, advertising to the research participant pool), I recruited only 54 people who qualified to be included in the self-injurious behavior group. Accordingly, I revised my data analytic plan to focus only on comparing interoceptive abilities between people with vs. without recent self-injurious and to drop the within-self-injury-group analyses. While 55 participants provided adequate power for my revised analyses, this left me with additional funds. Third, I expected that approximately 85% of my self-injury participants would complete the follow-up portion of the study, yet only 55% of participants completed the full follow-up portion. For these three reasons, I was not able to expend all the funds, which will be returned to the MSRC.

Closing Summary
I very much appreciate the MSRC's support of this project and the team's understanding of my project's timeline and awards of no cost extensions. Please let me know if I can answer additional questions about the project.

Respectfully submitted,

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Psychological Services

Autism-Related Traits and Suicide Risk Among Active Duty U.S. Military Service Members

Ian H. Stanley, Taylor N. Day, Austin J. Gallyer, Leah Shelef, Carmel Kalla, Peter M. Gutierrez, and Thomas E. Joiner

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Psychological Services

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Autism-Related Traits and Suicide Risk Among Active Duty U.S. Military Service Members

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Suicide rates within the U.S. military are elevated. The interpersonal theory of suicide, supported within military samples, suggests that social disconnectedness confers risk for suicide. Autism spectrum disorder (ASD) is characterized by symptoms—difficulties in social communication/interaction (SCI) and restricted and repetitive behaviors (RRBs)—that contribute to social disconnectedness. To our knowledge, no study has examined ASD-related traits and suicide risk among active duty U.S. military service members. Participants included 292 active duty U.S. military service members (*M* [*SD*] age = 28.67 [7.40] years, 68.5% male, 78.1% White). The Autism Spectrum Quotient, Repetitive Behaviours Questionnaire–2 for Adults, Self-Injurious Thoughts and Behaviors Interview–Short Form, and Interpersonal Needs Questionnaire assessed for SCI difficulties, RRBs, suicidal symptoms, and interpersonal theory of suicide constructs (i.e., perceived burdensomeness, thwarted belongingness), respectively. Elevated levels of SCI difficulties and RRBs were associated with increased odds of reporting suicidal thoughts and behaviors occurring since joining the military, controlling for the number of years of service and suicidal symptoms occurring prior to joining the military. Perceived burdensomeness and thwarted belongingness statistically accounted for the relationship between ASD-related traits and suicidal ideation occurring since joining the military; a rival mediator, emotion dysregulation, was not a significant mediator. Among active duty U.S. military service members, greater ASD-related traits were associated with an increased likelihood of reporting suicidal thoughts and behaviors occurring since joining the military. Clinical efforts targeting perceived burdensomeness and thwarted belongingness might reduce suicide risk among military service members with elevated ASD-related traits.

Impact Statement

Findings of this study suggest that active duty U.S. military service members with elevated autism-related traits may be at an increased risk of experiencing suicidal thoughts and behaviors during their tenure in the military. Moreover, findings suggest that therapeutically targeting perceptions of burdensomeness and thwarted belongingness might decrease suicide risk among military service members experiencing elevated autism-related traits.

Keywords: autism spectrum disorder, social disconnectedness, suicide risk, military, interpersonal theory of suicide

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Rates of suicide in the U.S. military have risen steadily in recent years (Smith, Doidge, Hanoa, & Frueh, 2019). One factor that has been shown to be associated with increased suicide risk among U.S. military service members is social disconnectedness (Nock et al., 2013). Indeed, the interpersonal theory of suicide posits that individuals will desire suicide if they experience two indices of social disconnectedness—that is, perceived burdensomeness (i.e., viewing one's death as worth more than one's life to others, self-hate) and thwarted belongingness (i.e., feeling lonely, absence of reciprocal care)—and perceive these states as intractable (Van Orden et al., 2010). The interpersonal theory of suicide states that social disconnectedness is necessary, albeit not sufficient, for engaging in fatal or nonfatal suicide attempts. Thus, identifying sources of perceived burdensomeness and thwarted belongingness—and therapeutically impacting these psychological states—is theorized to decrease suicide risk (Joiner, Van Orden, Witte, & Rudd, 2009). A recent meta-analysis of the interpersonal theory of suicide has found support for the theory's propositions, including within military samples, although effect sizes are modest (Chu et al., 2017). Thus, it is essential to consider social disconnectedness in suicide risk conceptualization among U.S. military service members.

Social disconnectedness can manifest in myriad ways, including as part of psychiatric disorders for which deficits in social functioning are a core feature, such as autism spectrum disorder (ASD). According to the fifth edition of the *Diagnostic and Statistical Manual for Mental Disorders* (*DSM–5;* American Psychiatric Association, 2013), ASD is defined as the experience of difficulties in social communication and interaction (SCI) as well as restricted, repetitive behaviors, interests, or activities (RRBs). More severe ASD-related traits are associated with higher perceptions of social disconnectedness, in part due to a lack of social problem-solving abilities (Jobe & Williams White, 2007). Complementary research has identified social problem-solving deficits as correlates of suicidal ideation via mediational pathways of perceived burdensomeness and thwarted belongingness (Chu et al., 2018). It follows, then, that ASD traits may be one theoretically relevant factor to consider in the etiology of suicide risk; this may be true as well among military personnel—a point to which we return below.

A nascent body of research has found elevated rates of suicidal ideation and attempts among individuals with ASD (e.g., Horowitz et al., 2018; Pelton & Cassidy, 2017; Richa, Fahed, Khoury, & Mishara, 2014). Suicide is also a leading cause of premature mortality in individuals with ASD (Hirvikoski et al., 2016). In one population-based study comparing the incidence of suicide in individuals with versus without ASD, Kirby et al. (2019) found an unadjusted relative risk ratio of 1.56 (95% CI [1.08, 2.26]). However, the mechanisms through which suicide risk is elevated in ASD are poorly understood (Cassidy & Rodgers, 2017), limiting opportunities for the provision of clinical actions to mitigate suicide risk. In a nonclinical sample of young adults, Pelton and Cassidy (2017) found that (a) greater SCI difficulties were associated with higher levels of suicide risk (as defined by a composite variable of lifetime suicidal ideation and suicide attempts) and (b) this association was mediated by perceived burdensomeness and thwarted belongingness in separate models. The effect sizes detected in Pelton and Cassidy's (2017) study were medium in magnitude, underscoring clinical significance. Thus, constructs of the interpersonal theory of suicide might explain elevated suicide risk in ASD. To our knowledge, except for Pelton and Cassidy (2017), no other published studies have examined ASD and suicide risk within the framework of the interpersonal theory of suicide.

There are several limitations of existing work examining ASD-related traits, the interpersonal theory of suicide, and suicide risk that necessitate further study. First, regarding the two core ASD symptom domains, although SCI difficulties have face validity and empirical support for contributing to perceptions of social disconnectedness (i.e., perceived burdensomeness, thwarted belongingness; Pelton & Cassidy, 2017), it is also true that RRBs might be linked to social disconnectedness via, for instance, one providing facts about a topic of interest without establishing a reciprocal conversation (Leekam, Prior, & Uljarevic, 2011). Thus, when considering the interpersonal theory of suicide as a potential explanatory link between ASD-related traits and suicide risk, research must consider both core components of ASD. Second, the interpersonal theory of suicide posits that social disconnectedness confers risk for suicidal desire (cf. suicidal ideation), specifically. By contrast, the theory does not posit a main effect of social disconnectedness on suicidal behaviors (although it does predict that the interaction between social disconnectedness and suicidal capacity predicts suicidal behaviors). Thus, to extend past work (Pelton & Cassidy, 2017), research investigating the explanatory effects of perceived burdensomeness and thwarted belonging should specifically examine suicidal ideation as the outcome variable. Third, the theory additionally hypothesizes that it is the simultaneous presence of perceived burdensomeness and thwarted belongingness that confers risk for suicidal ideation; thus, research should examine these constructs within the same model.

Furthermore, examining the intersection of ASD-related traits and suicide risk within a military sample has immense practical and clinical relevance. There are an estimated 1,288,596 active duty U.S. military service members (Department of Defense, 2016). This represents a large, heterogeneous cross section of the U.S. population—and it is expected that a nontrivial proportion of service members may experience ASD-related traits. To our knowledge, estimates on this proportion within the U.S. military are unknown, although it is likely that individuals serving in the U.S. military experience mild ASD-related traits (rather than moderate-to-severe traits that might be a basis for nonenrollment in the Armed Forces). Given the elevated rate of suicide among U.S. military service members (Smith et al., 2019) and the demonstrated link between ASD-related traits and suicide risk in nonmilitary samples (e.g., Pelton & Cassidy, 2017), it is important to examine the extent to which ASD-related traits are associated with indicators of suicide risk among U.S. military service members.

The Present Study

The purpose of this study was to examine ASD-related traits in relation to indicators of suicide risk among active duty U.S. military service members. More specifically, we endeavored to describe the relationship between ASD-related traits and suicidal ideation, plans, and attempts occurring (a) prior to joining the military (i.e., premilitary) and (b) since joining the military (i.e., perimilitary). We also aimed to determine if perceived burdensomeness and thwarted belongingness statistically mediated the association between ASD-related traits and perimilitary suicidal ideation. We hypothesized that higher levels of two core domains of ASD-related traits—SCI difficulties and RRBs—would each be associated with increased risk of reporting premilitary and perimilitary suicidal ideation, plans, and attempts. Moreover, we hypothesized that perceived burdensomeness and thwarted belongingness would serve as parallel mediators of the associations between (a) SCI difficulties and perimilitary suicidal ideation and (b) RRBs and perimilitary suicidal ideation.

To determine the specificity of perceived burdensomeness and thwarted belongingness as mediators of the association between ASD-related traits and perimilitary suicidal ideation, we examined emotion dysregulation as a rival mediator. Emotion dysregulation was chosen because deficits in emotion regulation underlie ASD (Mazefsky et al., 2013) and because one facet of emotion dysregulation—difficulties with cognitive reappraisal—is associated with increased suicide risk (Kudinova et al., 2016). Although we caution against hypothesizing a null effect, we view a nonsignificant mediation effect for a rival mediator to be evidence suggesting specificity of our proposed central mediators (i.e., perceived burdensomeness and thwarted belongingness). We also hypothesized that perceived burdensomeness and thwarted belongingness remain significant mediators of the associations between SCI difficulties and RRBs and perimilitary suicidal ideation, even after controlling for the rival mediator (i.e., emotion dysregulation).

Method

Participants and Procedures

Participants were 292 active duty U.S. military service members aged 18 years or older (M [SD] = 28.67 [7.40] years). Regarding gender, 68.5% (n = 200) identified as male, 30.5% (n = 89) identified as female, and 1.0% (n = 3) either declined to state or indicated other. Regarding race, 78.1% (n = 228) identified as White/Caucasian, 11.0% (n = 32) Black/African American, 5.1% (n = 15) Asian/Pacific Islander, 2.1% (n = 6) Native American/Alaskan Native, and 3.8% (n = 11) other. Regarding ethnicity, 12% (n = 35) identified as Hispanic or Latino/a. Participants reported an average of 7.77 years of military service (SD = 6.62 years). Regarding military branch, 43.8% (n = 128) reported Army, 19.9% (n = 58) Air Force, 21.2% (n = 62) Navy, 14.0% (n = 41) Marine Corps, and 1.0% (n = 3) Coast Guard. Overall, 57.2% (n = 167) reported a deployment history and 25.0% (n = 73) reported combat exposure.

Participants were recruited from TurkPrime, a provider of survey panels (Litman, Robinson, & Abberbock, 2017). Participants were presented with a web-based informed consent form via Qualtrics and were required to correctly answer three multiple-choice questions about the consent form to proceed with the survey. Consenting participants then completed a 25-min battery of self-report questionnaires via Qualtrics. Following participation, participants were presented with national mental health resources, including the National Suicide Prevention Lifeline (1-800-273-TALK) and the Veterans Crisis Line (https://www.veteranscrisisline.net). Participants received compensation commensurate with the duration of the study and the platform through which they entered the survey, consistent with TurkPrime practices. The university's institutional review board (IRB) approved procedures prior to data collection.

Several safeguards were implemented to ensure valid and reliable data were collected. First, reCAPTCHA verification was utilized to protect against survey bot responses (Google, 2018). Second, all participants were presented with two open-ended validated military service verification questions: (a) "What is the acronym for the locations where final physicals are taken prior to shipping off for basic training? (four letters)" and (b) "What is the acronym for the generic term the military uses for various job fields? (three letters)." These questions have been shown to reliably differentiate between individuals with and without true military service history who were recruited from web-based survey panels such as TurkPrime (Lynn & Morgan, 2016). Only participants who correctly answered both questions were included in analyses. Third, two items from the Conscientious Responders Scale (Marjanovic, Struthers, Cribbie, & Greenglass, 2014) were embedded within the survey battery as a validity check: (a) "To answer this question, please choose option number four, 'neither agree nor disagree'" and (b) "Choose the first option—'strongly disagree'—in answering this question." Participants who correctly answered both validity check items were included in analyses. Fourth, as part of the structured demographic survey, participants who self-reported active duty status—as opposed to veteran status—were retained for analyses, given the objective to include active duty military only.

Measures

Demographic and medical history overview. A structured demographics overview questionnaire was administered to characterize the sample. Information collected included age, race/ethnicity, sex, gender identity, sexual orientation, marital status, and military-specific demographic variables (e.g., branch, years of service, deployment history, combat exposure).

Autism Spectrum Quotient. The Autism Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) is a 50-item self-report measure that assesses multiple facets of high-functioning ASD, including social skills, attention switching, attention to detail, communication, and imagination. For the purposes of this study, we conceptualized the AQ as characterizing SCI difficulties, given many items reflect facets related to reciprocal social interaction and effective communication. Respondents indicate whether they *definitely agree, slightly agree, slightly disagree,* or *definitely disagree* for each item. Responses are coded such that 25 of the items receive 1 point for a *definitely agree* or *slightly agree* response, and 25 of the items receive 1 point for a *definitely disagree* or *slightly disagree* response; higher scores indicate more severe ASD-related traits (range: 0–50). A cutoff score of $\geq$ 32 has been proposed as a positive screen for ASD in a general population (Baron-Cohen et al., 2001), yet to further characterize the sample, we also evaluated a less stringent cutoff score of $\geq$ 26, which has been proposed for clinical samples to reduce the false-negative rate (Woodbury-Smith, Robinson, Wheelwright, & Baron-Cohen, 2005). The AQ had acceptable internal consistency within this sample (α = .78).[1]

[1] We elected to utilize the AQ to assess for SCI difficulties because the AQ appears to have adequate psychometric properties (Baron-Cohen et al., 2001; Ruzich et al., 2015; Woodbury-Smith et al., 2005) and because past research examining ASD-related traits and suicide-related outcomes has utilized the AQ (e.g., Pelton & Cassidy, 2017). However, we are mindful that emerging research—at least utilizing a Swedish version of the AQ—has questioned the utility of the AQ in assessing a unitary latent construct of ASD-related traits (Lundqvist & Lindner, 2017).

Repetitive Behaviours Questionnaire–2 for Adults. The Repetitive Behaviours Questionnaire–2 for Adults (RBQ-2A; Barrett et al., 2015) is a 20-item assessment of RRBs associated with ASD. Items are rated based on the frequency (e.g., "Do you like to arrange items in rows or patterns?" [1 = *never or rarely,* 2 = *1 or more times daily,* 3 = *15 or more times daily,* 4 = *30 or more times daily*]) or severity ("Do you have a special interest in the feel of different surfaces?" [1 = *never or rarely,* 2 = *mild or occasional,* 3 = *marked or notable*]) with which they occur. Items rated on a 4-point scale are converted to a 3-point scale such that responses of "4" are collapsed with the responses of "3." Item scores are averaged to calculate a total score, with higher ratings representing greater impairment (range: 1–3). The RBQ-2A is based on the child version, the RBQ-2 (Leekam et al., 2007), which has demonstrated strong psychometric properties (Leekam et al., 2007). Although evidence for the reliability and validity of the RBQ-2A is still emerging (Barrett et al., 2015), and a cutoff score has not yet been empirically derived, the RBQ-2A was utilized in the present study given the dearth of self-report measures assessing RRBs. The RBQ-2A had good internal consistency within this sample (α = .89).

Interpersonal Needs Questionnaire. The Interpersonal Needs Questionnaire (INQ; Van Orden, Cukrowicz, Witte, & Joiner, 2012) is a 15-item self-report measure of perceived burdensomeness (INQ-PB; 6 items; e.g., "These days, the people in my life would be happier without me") and thwarted belongingness (INQ-TB; 9 items; e.g., "These days, I feel disconnected from other people"). Participants rate the degree to which each item has been true for them recently (1 = *not at all true for me* to 7 = *very true for me*). Items are reverse-coded as appropriate and summed for the perceived burdensomeness (range: 6–42) and thwarted belongingness (range: 9–63) subscales. The INQ has strong psychometric properties (Van Orden et al., 2012) and had excellent internal consistency within this sample (INQ-PB: α = .96; INQ-TB: α = .90).

Self-Injurious Thoughts and Behaviors Interview–Short Form. The Self-Injurious Thoughts and Behaviors Interview–Short Form (SITBI-SF; Nock, Holmberg, Photos, & Michel, 2007) is a comprehensive assessment of suicidal thoughts and behaviors. The SITBI-SF was designed as an interview-based measure (Nock et al., 2007), and it has been widely used as a self-report measure in online surveys (e.g., Stanley, Hom, Hagan, & Joiner, 2015). The SITBI-SF was used to characterize the prevalence (yes/no) of suicidal ideation, plans, attempts, and nonsuicidal self-injury (NSSI) across two timeframes: (a) premilitary and (b) since joining the military (i.e., perimilitary). Accordingly, the SITBI-SF was modified to specify "Before joining the military, . . ." and "Since joining the military, . . ." Previous research has modified the SITBI-SF in this fashion to specify career-related timeframes (Stanley et al., 2015). The SITBI-SF has strong psychometric properties (Nock et al., 2007). Individual items were used for analyses; thus, internal consistency estimates are not derivable.

Emotion Regulation Questionnaire. The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) is a 10-item self-report scale of two facets of emotion regulation/dysregulation: cognitive reappraisal (6 items; e.g., "I control my emotions by changing the way I think about the situation I'm in.") and emotional suppression (4 items; e.g., "I control my emotions by not expressing them."). Responses are rated on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale, with higher scores representing higher levels of each facet. For the present study, the cognitive reappraisal subscale was utilized as a rival mediator in analyses due to evidence that cognitive reappraisal difficulties, specifically, might increase suicide risk (Kudinova et al., 2016); thus, this serves as a stringent test of a rival mediator. The ERQ has good psychometric properties (Gross & John, 2003), and the cognitive reappraisal subscale had excellent internal consistency within this sample (α = .90).

Data-Analytic Strategy

Variables were initially screened for violations of normality and were within acceptable ranges for skewness (± 2) and kurtosis (± 7; Curran, West, & Finch, 1996). Next, descriptive statistics were utilized to characterize the sample in terms of (a) ASD-related traits as indexed by the AQ and RBQ-2A and (b) SITBI-SF premilitary and perimilitary lifetime suicidal ideation, plans, and attempts. Analyses of covariance were used to examine differences in AQ SCI difficulties and RBQ-2A RRBs as a function of the presence versus absence of (a) SITBI-SF premilitary suicidal symptoms and (b) SITBI-SF perimilitary suicidal symptoms. Years of military service was entered as a covariate given the specified bifurcation of pre- versus perimilitary suicidal symptoms. Next, logistic regression analyses were utilized to examine the association of AQ SCI difficulties, RBQ-2A RRBs, SITBI-SF premilitary suicidal symptoms, and years of military service with respect to SITBI-SF perimilitary suicidal symptoms; premilitary suicidal symptoms were entered as a covariate because they are associated with perimilitary suicidal symptoms (Nock et al., 2014). Finally, consistent with the approach outlined in Hayes (2013), bias-corrected bootstrap mediation analyses (5,000 resamples) were used to examine perceived burdensomeness and thwarted belongingness as parallel mediators of the association between (a) AQ SCI difficulties and perimilitary suicidal ideation and (b) RBQ-2A RRBs and perimilitary suicidal ideation.[2] Pairwise contrasts were conducted to determine if the indirect effects of perceived burdensomeness and thwarted belongingness were significantly different from each other. Two separate models were also constructed to examine emotion dysregulation as a rival mediator. Statistical significance was determined by a 95% confidence interval that did not cross zero. Missing data at baseline were minimal ($< 1\%$) and addressed using listwise deletion.

We conducted a post hoc power analysis. According to Fritz and Mackinnon (2007), a sample size of 148 is required to have sufficient power ($1 - \beta \geq 0.80$) to detect small-to-moderate effect sizes for the α path (independent variable to mediator) and the β path (mediator to dependent variable) using the bias-corrected mediation approach. Thus, with a sample size of 292, we were adequately powered for the proposed analyses.

[2] *Perimilitary suicidal ideation* was selected as the criterion variable for two reasons. First, compared to premilitary suicidal symptoms, perimilitary suicidal symptoms are more contemporaneous to levels of perceived burdensomeness and thwarted belongingness. Second, suicidal ideation was of interest, given that the interpersonal theory of suicide hypothesizes indirect effects of perceived burdensomeness and thwarted belongingness specific to suicidal ideation (and not plans, NSSI, or attempts).

Results

Clinical Characteristics

See Table 1 for descriptive statistics and intercorrelations. Regarding ASD-related traits, the mean AQ SCI score was 20.30 (SD = 6.74); overall, 4.1% (n = 12) exceeded the AQ cutoff of ≥ 32 and 23.6% (n = 69) exceeded the AQ cutoff of ≥ 26. The mean RBQ-2A score was 1.63 (SD = 0.40). Regarding SITBI-SF premilitary suicidal symptoms, 23.6% (n = 69) reported suicidal ideation, 7.5% (n = 22) suicide plans, 14.8% (n = 43) NSSI, and 2.4% (n = 7) suicide attempts. Regarding SITBI-SF perimilitary suicidal symptoms, 32.2% (n = 94) reported suicidal ideation, 10.6% (n = 31) suicide plans, 10.3% (n = 30) NSSI, and 4.1% (n = 12) suicide attempts.

Autism-Related Traits and Premilitary Suicidal Symptoms

See Table 2 for descriptive differences in AQ SCI difficulties and RBQ-2A RRBs as a function of the presence/absence of premilitary suicidal symptoms, controlling for the number of years of military service. AQ SCI difficulties were significantly elevated in participants who reported premilitary suicidal ideation, $F(1, 284) = 4.762$, $p = .030$, $\eta_p^2 = .016$, and NSSI, $F(1, 284) = 3.910$, $p = .049$, $\eta_p^2 = .014$, compared to participants who denied premilitary suicidal ideation and NSSI, respectively. There were no significant differences in AQ scores as a function of premilitary suicide plans, $F(1, 284) = 3.238$, $p = .073$, $\eta_p^2 = .011$, or suicide attempts, $F(1, 284) = 2.418$, $p = .121$, $\eta_p^2 = .008$. RBQ-2A RRBs were also significantly elevated in participants who reported premilitary suicidal ideation, $F(1, 285) = 4.221$, $p = .041$, $\eta_p^2 = .015$, and NSSI, $F(1, 283) = 8.221$, $p = .004$, $\eta_p^2 = .028$, compared to participants who denied premilitary suicidal ideation and NSSI, respectively. There were no significant differences in RBQ-2A scores based on premilitary suicide plans, $F(1, 285) = 0.094$, $p = .759$, $\eta_p^2 < .001$, or suicide attempts, $F(1, 285) = 0.002$, $p = .967$, $\eta_p^2 < .001$.

Autism-Related Traits and Perimilitary Suicidal Symptoms

See Table 2 for differences in AQ SCI difficulties and RBQ-2A RRBs as a function of the presence/absence of perimilitary suicidal symptoms, controlling for the number of years of military service. AQ SCI difficulties were significantly elevated in participants who reported perimilitary suicidal ideation, $F(1, 284) = 32.654$, $p < .001$, $\eta_p^2 = .103$; suicide plans, $F(1, 284) = 18.410$, $p < .001$, $\eta_p^2 = .061$; and NSSI, $F(1, 283) = 16.692$, $p < .001$, $\eta_p^2 = .056$, compared to participants who denied perimilitary suicidal ideation, plans, and NSSI, respectively. RBQ-2A RRBs were significantly elevated in participants who reported perimilitary suicidal ideation, $F(1, 285) = 17.415$, $p < .001$, $\eta_p^2 = .058$; suicide plans, $F(1, 285) = 5.956$, $p = .015$, $\eta_p^2 = .020$; NSSI, $F(1, 284) = 16.236$, $p < .001$, $\eta_p^2 = .054$; and suicide attempts, $F(1, 285) = 6.390$, $p = .012$, $\eta_p^2 = .022$, compared to participants who denied those perimilitary suicidal symptoms.

See Table 3 for logistic regression analyses examining the simultaneous effects of AQ SCI difficulties and RBQ-2A RRBs on perimilitary suicidal ideation, suicide plans, NSSI, and suicide attempts, controlling for years of military service and premilitary suicidal symptoms. In these models, AQ SCI difficulties (OR = 1.102, 95% CI [1.052, 1.155], $p < .001$) and RBQ-2A RRBs (OR = 2.410, 95% CI [1.161, 5.004], $p = .018$) were independently associated with unique variance in perimilitary suicidal ideation, accounting for a large effect size (Nagelkerke R^2 = 26.3%, $f^2 = .357$); AQ SCI difficulties were associated with perimilitary suicide plans (OR = 1.119, 95% CI [1.046, 1.198], $p < .001$), indicating a medium-to-large effect (Nagelkerke R^2 = 18.4%, $f^2 = .225$); AQ SCI difficulties (OR = 1.096, 95% CI [1.022, 1.174], $p = .010$) and RBQ-2A RRBs (OR = 3.417, 95% CI [1.261, 9.263], $p = .016$) were associated with perimilitary NSSI, indicating a medium-to-large effect (Nagelkerke R^2 = 20.2%, $f^2 = .253$); and RBQ-2A RRBs were associated with perimilitary suicide attempts (OR = 6.397, 95% CI [1.551, 26.392], $p = .010$), indicating a medium effect (Nagelkerke R^2 = 14.3%, $f^2 = .167$).

Purported Mechanism: Interpersonal Theory of Suicide

The mediation model examining the effect of AQ SCI difficulties on perimilitary suicidal ideation, controlling for years of military service and premilitary suicidal ideation, was significant ($p < .001$, Nagelkerke R^2 = 35.4%, $f^2 = .548$). The indirect effect of AQ SCI difficulties on perimilitary suicidal ideation through INQ-PB perceived burdensomeness (B = 0.025, SE = 0.010, bootstrap 95% CI [0.012, 0.049]), but not through INQ-TB thwarted belongingness (B = 0.014, SE = 0.015, bootstrap 95% CI [−0.016, 0.044]), was significant. The mediation model examining the effect of RBQ-2A RRBs on perimilitary suicidal ideation, controlling for years of military service and premilitary suicidal ideation, was also significant ($p < .001$; Nagelkerke R^2 = 34.9%, $f^2 = .536$). The indirect effect of RBQ-2A RRBs on perimilitary suicidal ideation through INQ-PB perceived burdensomeness (B = 0.255, SE = 0.183, bootstrap 95% CI [0.009, 0.723]) and INQ-TB thwarted belongingness (B = 0.171, SE = 0.096, bootstrap 95% CI [0.033, 0.428]) were each significant; a comparison of indirect effects suggests no significant differences between INQ-PB and INQ-TB as parallel mediators (B = 0.084, SE = 0.203, bootstrap 95% CI [−0.223, 0.575]). See Figure 1 for complete path coefficients.

We examined ERQ emotion dysregulation as a rival mediator of the association between AQ SCI difficulties and RBQ-2A RRBs and perimilitary suicidal ideation. ERQ emotional dysregulation was not a significant mediator in either model (AQ SCI difficulties: B = −0.006, SE = 0.006, bootstrap 95% CI [−0.019, 0.004]; RBQ-2A RRBs: B = 0.008, SE = 0.030, bootstrap 95% CI [−0.027, 0.116]). Furthermore, in mediation models that controlled for the effects of ERQ emotion dysregulation, the indirect effect of AQ SCI difficulties on perimilitary suicidal ideation through INQ-PB perceived burdensomeness (B = 0.023, SE = 0.009, bootstrap 95% CI [0.010, 0.047]), but not INQ-TB thwarted belongingness (B = 0.017, SE = 0.013, bootstrap 95% CI [−0.009, 0.044]), was significant. Moreover, controlling for ERQ emotion dysregulation, the indirect effects of RBQ-2A RRBs on perimilitary suicidal ideation through INQ-PB perceived burdensomeness (B = 0.254, SE = 0.178, bootstrap 95% CI [0.025,

Table 1
Means, Standard Deviations, Ranges, Normality Statistics, and Intercorrelations Between Measures (N = 292)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. AQ autism-related traits (SCI)	—											
2. RBQ-2A autism-related traits (RRBs)	.326**	—										
3. SITBI-SF suicidal ideation (premilitary)	.129*	.119*	—									
4. SITBI-SF suicide plans (premilitary)	.105	−.017	.422**	—								
5. SITBI-SF NSSI (premilitary)	.169**	.127*	.434**	.320**	—							
6. SITBI-SF suicide attempts (premilitary)	.093	.000	.282**	.379**	.144*	—						
7. SITBI-SF suicidal ideation (perimilitary)	.321**	.236**	.255**	.137*	.230**	.132*	—					
8. SITBI-SF suicide plans (perimilitary)	.248**	.135*	.018	.112	.139*	.091	.500**	—				
9. SITBI-SF NSSI (perimilitary)	.235**	.232**	.077	.074	.209**	.021	.442**	.579**	—			
10. SITBI-SF suicide attempts (perimilitary)	.080	.142*	.007	.006	.011	.080	.300**	.545**	.384**	—		
11. INQ-PB perceived burdensomeness	.252**	.165**	.051	.028	.079	.062	.371**	.416**	.473**	.467**	—	
12. INQ-TB thwarted belongingness	.514**	.184**	.100	.073	.143*	.054	.324**	.277**	.353**	.206**	.487**	—
n	289	290	292	292	292	292	292	292	292	292	292	290
% Yes	—	—	23.6	7.5	14.8	2.4	32.2	10.6	10.3	4.1	—	—
M	20.30	1.63	—	—	—	—	—	—	—	—	9.25	25.86
SD	6.74	0.40	—	—	—	—	—	—	—	—	6.59	12.91
Minimum	6	1	0	0	0	0	0	0	0	0	6	9
Maximum	40	2.90	1	1	1	1	1	1	1	1	36	61
Skewness	0.05	0.75	—	—	—	—	—	—	—	—	2.41	0.42
Kurtosis	−0.57	0.22	—	—	—	—	—	—	—	—	5.20	−.78
α	.78	.89	—	—	—	—	—	—	—	—	.96	.90

Note. Premilitary refers to suicidal symptoms experienced prior to joining the military. Perimilitary refers to suicidal symptoms experienced since joining the military. AQ = Autism Spectrum Quotient; RBQ-2A = Repetitive Behaviours Questionnaire–2 for Adults; INQ-PB = Interpersonal Needs Questionnaire–Perceived Burdensomeness; INQ-TB = Interpersonal Needs Questionnaire–Thwarted Belongingness; NSSI = nonsuicidal self-injury; RRBs = restricted and repetitive behaviors; SCI = social communication/interaction; SITBI-SF = Self-Injurious Thoughts and Behaviors Interview–Short Form.
* $p < .05$. ** $p < .01$.

Table 2
Differences in Autism-Related Traits as a Function of the Presence Versus Absence of Pre- and Perimilitary Suicidal Ideation, Plans, Nonsuicidal Self-Injury, and Attempts (N = 292)

Variable	Suicidal ideation			Suicide plans			Nonsuicidal self-injury			Suicide attempts		
	Yes	No	Group differences[a]	Yes	No	Group differences[a]	Yes	No	Group differences[a]	Yes	No	Group differences[a]
Suicidal symptoms prior to joining the military												
AQ autism-related traits (SCI), *M* (*SD*)	21.86 (6.03)	19.82 (6.91)	$p = .030^{*}$, $\eta_p^2 = .016$	22.77 (4.97)	20.11 (6.85)	$p = .073$, $\eta_p^2 = .011$	23.05 (5.87)	19.85 (6.81)	$p = .004^{**}$, $\eta_p^2 = .028$	24.29 (5.99)	20.21 (6.76)	$p = .121$, $\eta_p^2 = .008$
RBQ-2A autism-related traits (RRBs), *M* (*SD*)	1.71 (0.42)	1.60 (0.39)	$p = .041^{*}$, $\eta_p^2 = .015$	1.60 (0.34)	1.63 (0.40)	$p = .759$, $\eta_p^2 < .001$	1.74 (0.40)	1.61 (0.40)	$p = .049^{*}$, $\eta_p^2 = .014$	1.63 (0.34)	1.63 (0.40)	$p = .967$, $\eta_p^2 < .001$
Suicidal symptoms since joining the military												
AQ autism-related traits (SCI), *M* (*SD*)	23.46 (6.67)	18.83 (6.29)	$p < .001^{**}$, $\eta_p^2 = .103$	25.20 (6.00)	19.74 (6.62)	$p < .001^{**}$, $\eta_p^2 = .061$	24.93 (5.74)	19.76 (6.68)	$p < .001^{**}$, $\eta_p^2 = .056$	23.00 (6.96)	20.20 (6.74)	$p = .191$, $\eta_p^2 = .006$
RBQ-2A autism-related traits (RRBs), *M* (*SD*)	1.76 (0.37)	1.56 (0.40)	$p < .001^{**}$, $\eta_p^2 = .058$	1.78 (0.44)	1.61 (0.39)	$p = .015^{*}$, $\eta_p^2 = .020$	1.90 (0.40)	1.60 (0.39)	$p < .001^{**}$, $\eta_p^2 = .054$	1.90 (0.46)	1.62 (0.39)	$p = .012^{*}$, $\eta_p^2 = .022$

Note. Premilitary refers to suicidal symptoms experienced prior to joining the military. Perimilitary refers to suicidal symptoms experienced since joining the military. AQ = Autism Spectrum Quotient; RBQ-2A = Repetitive Behaviours Questionnaire–2 for Adults; RRBs = restricted and repetitive behaviors; SCI = social communication/interaction.
[a] Analyses controlled for the number of years of military service.
* $p < .05$. ** $p < .01$.

0.701]) and INQ-TB thwarted belongingness ($B = 0.188$, $SE = 0.100$, bootstrap 95% CI [0.048, 0.457]) were each significant; a comparison of indirect effects suggests no significant differences between INQ-PB and INQ-TB as parallel mediators ($B = 0.066$, $SE = 0.201$, bootstrap 95% CI [−0.257, 0.542]). Finally, when INQ-PB perceived burdensomeness, INQ-TB thwarted belongingness, and ERQ emotion dysregulation were considered as parallel mediators in the same model, ERQ emotion dysregulation as a mediator was statistically inferior (i.e., the 95% CI of the comparison of the indirect effects did not cross zero) to (a) INQ-PB perceived burdensomeness ($B = 0.039$, $SE = 0.012$, bootstrap 95% CI [0.020, 0.067]) in the model examining AQ SCI difficulties and (b) INQ-PB perceived burdensomeness ($B = 0.308$, $SE = 0.198$, bootstrap 95% CI [0.048, 0.802]) and INQ-TB thwarted belongingness ($B = 0.257$, $SE = 0.127$, bootstrap 95% CI [0.071, 0.598]) in the model examining RBQ-2A RRBs.

Discussion

The present study characterized ASD-related traits and suicidal thoughts and behaviors in a large sample of active duty U.S. military service members. Because social disconnectedness is a theorized factor contributing to suicidal ideation in military personnel (Chu et al., 2017; Nock et al., 2013) and also underlies ASD (Carpenter, 2015), this study examined whether perceptions of social disconnectedness (i.e., perceived burdensomeness and thwarted belongingness) account for the link between ASD-related traits and suicidal ideation. Findings revealed that elevated ASD-related traits were associated with an increased likelihood of reporting suicidal thoughts and behaviors occurring prior to and since joining the military; nuanced findings are reported below. Consistent with the propositions of the interpersonal theory of suicide (Van Orden et al., 2010), perceptions of social disconnectedness statistically explained the link between ASD-related traits and perimilitary suicidal ideation. To our knowledge, this is the first study to examine the intersection of ASD-related traits and suicide risk in military service members. Findings have numerous implications for science and practice.

We found that elevated ASD-related traits were associated with an increased odds of reporting suicidal thoughts and NSSI prior to joining the military as well as suicidal thoughts, suicide plans, NSSI, and suicide attempts since joining the military. To capture the nuances of ASD, we included two measures of ASD-related traits—the AQ, which predominantly assesses social and communication difficulties, and the RBQ-2A, which is one of the only measures to assess RRBs via self-report. Our findings indicated that, despite modest shared variance between SCI and RRB traits, $r = .326$, $p < .01$, these domains were independently associated with perimilitary suicidal symptoms. When considered simultaneously, both SCI difficulties and RRBs were significantly associated with suicidal ideation and NSSI; by contrast, SCI difficulties were uniquely associated with suicide plans, and RRBs were uniquely associated with suicide attempts during active duty military status. These findings are robust because we controlled for premilitary suicidal symptoms as well as years of military service, thereby isolating the variance related to the effects during military tenure without the confound of duration of enlistment.

Our findings align with past research demonstrating that ASD is associated with increased risk for suicide. As noted, individuals

Table 3
Logistic Regression Analyses Examining the Association of Autism-Related Traits and Perimilitary Suicidal Ideation, Plans, Nonsuicidal Self-Injury, and Attempts (N = 292)

Suicide-related outcomes	*OR*	95% CI	*p*
SITBI-SF suicidal ideation (perimilitary)			
Nagelkerke $R^2 = 26.3\%$, $f^2 = .357$			
AQ autism-related traits (SCI)	1.102	[1.052, 1.155]	$<.001^{**}$
RBQ-2A autism-related traits (RRBs)	2.410	[1.161, 5.004]	$.018^{*}$
SITBI-SF suicidal ideation (premilitary)	3.130	[1.694, 5.782]	$<.001^{**}$
Years of military service	1.065	[1.024, 1.109]	$.002^{**}$
SITBI-SF suicide plans (perimilitary)			
Nagelkerke $R^2 = 18.4\%$, $f^2 = .225$			
AQ autism-related traits (SCI)	1.119	[1.046, 1.198]	$.001^{**}$
RBQ-2A autism-related traits (RRBs)	1.957	[0.728, 5.261]	.183
SITBI-SF suicide plans (premilitary)	2.698	[0.838, 8.687]	.096
Years of military service	1.066	[1.010, 1.124]	$.020^{*}$
SITBI-SF NSSI (perimilitary)			
Nagelkerke $R^2 = 20.2\%$, $f^2 = .253$			
AQ autism-related traits (SCI)	1.096	[1.022, 1.174]	$.010^{*}$
RBQ-2A autism-related traits (RRBs)	3.417	[1.261, 9.263]	$.016^{*}$
SITBI-SF NSSI (premilitary)	3.050	[1.256, 7.410]	$.014^{*}$
Years of military service	0.971	[0.905, 1.042]	.415
SITBI-SF suicide attempts (perimilitary)			
Nagelkerke $R^2 = 14.3\%$, $f^2 = .167$			
AQ autism-related traits (SCI)	1.015	[0.922, 1.116]	.768
RBQ-2A autism-related traits (RRBs)	6.397	[1.551, 26.392]	$.010^{*}$
SITBI-SF suicide attempts (premilitary)	3.891	[0.347, 43.583]	.270
Years of Military Service	1.076	[0.994, 1.165]	.071

Note. Premilitary refers to suicidal symptoms experienced prior to joining the military. Perimilitary refers to suicidal symptoms experienced since joining the military. AQ = Autism Spectrum Quotient; RBQ-2A = Repetitive Behaviours Questionnaire–2 for Adults; NSSI = nonsuicidal self-injury; RRBs = restricted and repetitive behaviors; SCI = social communication/interaction; SITBI-SF = Self-Injurious Thoughts and Behaviors Interview–Short Form.
$^{*} p < .05$. $^{**} p < .01$.

with ASD die by suicide at a higher rate than those without ASD, making suicide one of the leading causes of death among those with ASD (Hirvikoski et al., 2016; Kirby et al., 2019). Our findings also extend past work relating social problem-solving abilities and suicidal ideation. Across five independent samples, including a military sample, Chu et al. (2018) found that deficits in social problem-solving abilities (cf. SCI difficulties; e.g., being passive in social situations, feeling frustrated when facing socially focused problems) were significantly associated with suicidal ideation. Underdeveloped problem-solving skills have been documented in individuals with ASD (Pugliese & White, 2014), further impeding the development and maintenance of meaningful relationships. Likewise, previous research has demonstrated that transitioning to college is particularly stressful for young adults with ASD, in part because of the need to foster new social relationships (Glennon, 2001). Enlisting in the military may present similar stressful challenges regarding social transitions, and these stressors may be amplified for individuals with elevated ASD-related traits. Military service members with impaired social skills (cf. elevated ASD-related traits) likely have challenges establishing a social network, thereby exacerbating their perceptions of social disconnectedness and, in turn, risk for suicidal thoughts and behaviors.

When SCI difficulties and RRBs were considered simultaneously in the association of suicidal symptoms, only RRBs were significantly associated with perimilitary suicide attempts. One potential explanation is that RRBs manifest, to a degree, similar to symptoms of obsessive–compulsive disorder (OCD; Jiujias, Kelley, & Hall, 2017), a disorder commonly comorbid with ASD (Cath, Ran, Smit, van Balkom, & Comijs, 2008). A separate line of research has identified OCD to be a risk factor for suicide attempts (Angelakis, Gooding, Tarrier, & Panagioti, 2015). Although the mechanisms underlying this association are unknown, this finding suggests that disorders characterized by engaging in repetitive behaviors (i.e., compulsions in OCD or RRBs in ASD) are associated with enhanced risk of engaging in suicidal behavior. It might also be the case that some RRBs contribute to the capability for suicide through repeated exposure and habituation to painful and provocative events as well as hyporeactivity to sensory input (cf. elevated physical pain tolerance); the capability for suicide is proposed by the interpersonal theory of suicide to uniquely contribute to suicidal behaviors (Van Orden et al., 2010).

To elucidate potential mechanisms linking ASD-related traits and suicide risk, we evaluated two constructs proposed by the interpersonal theory of suicide to be etiologically related to suicidal ideation: perceived burdensomeness and thwarted belongingness. Regarding the association between SCI deficits and perimilitary suicidal ideation, perceived burdensomeness (but not thwarted belongingness) statistically accounted for this relationship. Interestingly, Chu et al. (2018) documented that perceived burdensomeness, relative to thwarted belongingness, more robustly accounted for the relationship between deficits in social problem-solving and suicidal ideation among active duty military personnel.

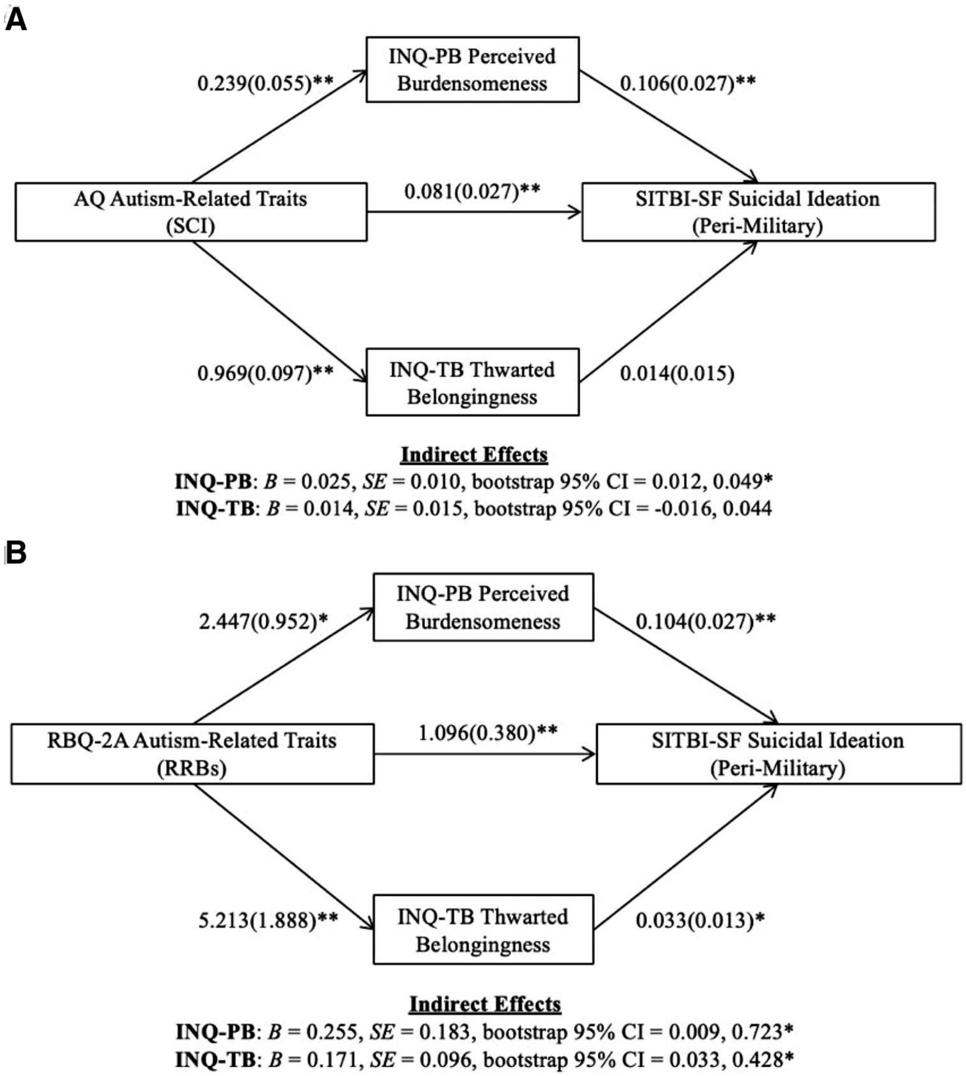

Figure 1. Interpersonal theory of suicide constructs mediating the association between autism-related traits and perimilitary suicidal ideation. Premilitary refers to suicidal symptoms experienced prior to joining the military. Perimilitary refers to suicidal symptoms experienced since joining the military. AQ = Autism Spectrum Quotient; RBQ-2A = Repetitive Behaviours Questionnaire–2 for Adults; INQ-PB = Interpersonal Needs Questionnaire–Perceived Burdensomeness; INQ-TB = Interpersonal Needs Questionnaire–Thwarted Belongingness; RRBs = restricted and repetitive behaviors; SITBI-SF = Self-Injurious Thoughts and Behaviors Interview–Short Form. * $p < .05$. ** $p < .01$.

This finding dovetails with meta-analytic and conceptual evidence that perceived burdensomeness might be more proximally related to suicidal ideation than thwarted belongingness (Chu et al., 2017). Of note, one component of perceived burdensomeness is self-hate (Van Orden et al., 2010), which might also have relevance to the phenomenology of ASD. Indeed, individuals with high-functioning ASD, including perhaps active duty military service members, often have the social desire for relationships but feel frustrated at their inability to establish meaningful social connections (Locke, Ishijima, Kasari, & London, 2010). This frustration might, in turn, lead to feelings of self-hate, thereby contributing to increased suicide risk (Van Orden et al., 2010). Functioning as part of a team in which every member is responsible for the safety of the unit is an essential aspect of military culture. Service members with ASD-related traits might have elevated concerns about being a burden on their unit as a function of limited social connections with the members of their unit. Future research would benefit from disentangling this hypothesized chain relationship utilizing longitudinal data.

Regarding the association of RRBs and perimilitary suicidal ideation, both perceived burdensomeness and thwarted belongingness were significant mediators. While the reasons for these discrepant findings are unclear, conceptually, RRBs often interfere with appropriate social interaction (American Psychiatric Association, 2013). For example, an individual with an excessive interest may recurrently initiate conversations about their topic of interest and subsequently have difficulty transitioning away from that topic of conversation or may provide facts about the topic rather than establishing a reciprocal conversation. Finally, it is worth noting that we examined emotion dysregulation, which underlies ASD (Mazefsky et al., 2013) and suicide risk (Kudinova et al., 2016), as a rival mediator of the association between ASD-related traits and perimilitary suicidal ideation; emotion dysregulation was not a significant mediator, supporting the specificity of social disconnectedness as an explanatory link between ASD-related traits and suicidal ideation.

Clinical Implications

Findings also point to several potential clinical implications. For instance, social skills training, a gold-standard treatment for ASD, promotes increasing the capacity for social problem-solving skills (e.g., how to initiate a conversation, how to handle bullying) as a means for making and keeping relationships (Flynn & Healy, 2012). Relatedly, problem-solving therapy, which might augment perceptions of connectedness (Chu et al., 2018), shows promise in individuals with ASD (Wood et al., 2009) and in non-ASD populations regarding suicide risk reduction (Gustavson et al., 2016). To reduce suicide risk, social skills training protocols for ASD might benefit from the inclusion of modules specifically targeting perceptions of burdensomeness and thwarted belongingness. Guidance for therapeutically targeting perceived burdensomeness and thwarted belongingness is presented in Joiner et al. (2009), and guidance for working with individuals with ASD experiencing a suicidal crisis is reported in Morgan (2018).

ASD-related traits among military service members might present both advantages and disadvantages. On the one hand, the deficits in social functioning inherent in ASD may, for instance, disrupt unit cohesion. More specifically, military service members with elevated ASD-related traits may be less likely to integrate into a close-knit unit, thereby augmenting feelings of thwarted belongingness and perceived burdensomeness and, in turn, suicide risk (Van Orden et al., 2010). On the other hand, because the military provides a structured, routinized environment, individuals with ASD—who often prefer routine (American Psychiatric Association, 2013)—may experience protective effects of military service. Similarly, RRBs, for instance, might present adaptive functions for military service members because individuals with elevated levels of these traits may represent the "go-to" person for specific military tasks (e.g., expertise with firearms, satellite imagery). Incidentally, for this very reason, the Israel Defense Forces specifically recruit individuals with ASD as part of a program entitled, "Watching the Horizon" (Israel Defense Forces, 2016).

Limitations

Our study was not without limitations. First, our study utilized cross-sectional data, and causal or directional conclusions cannot be made. Second, although self-reported ASD-related traits and ASD diagnoses independently predict suicide risk (Cassidy, Bradley, Shaw, & Baron-Cohen, 2018), our assessment of ASD-related traits was limited to the use of two self-report questionnaires that, to our knowledge, have not yet been validated for use in military populations. We did not conduct a thorough evaluation of ASD symptoms, and it is possible that the traits assessed by the AQ and/or the RBQ-2A are not specific to the *DSM–5* ASD diagnosis. Third, one of the self-report questionnaires utilized—the AQ—might be suboptimal in assessing a unitary latent construct of ASD-related traits (Lundqvist & Lindner, 2017). Fourth, and similarly, we relied on the self-report of suicidal thoughts and behaviors; past research suggests that suicide attempts, in particular, may be misclassified (i.e., overreported) when relying on self-report in the absence of follow-up interviews (Hom, Joiner, & Bernert, 2016). Fifth, we did not assess the degree to which participants were bothered by their SCI difficulties and/or RRBs, which would have implications for suicide risk conceptualization. Sixth, the interpersonal theory of suicide posits that perceptions of social disconnectedness will lead to serious suicidal ideation when the social disconnectedness is perceived as intractable (Van Orden et al., 2010); however, we did not assess for the tractability of social disconnectedness, an important next step to test the theory (Chu et al., 2017). Seventh, although we recruited a large sample that spans across various military branches/ranks, our sample is neither a representative nor a clinical sample, hampering generalizability to the U.S. Armed Forces broadly.

Conclusions

Using a large sample of active duty U.S. military service members, this study found that elevated ASD-related traits are associated with an increased risk for reporting suicidal thoughts and behaviors prior to and during one's military tenure. Moreover, findings suggest that elevated levels of perceived burdensomeness and thwarted belongingness—two constructs derived from the interpersonal theory of suicide—may serve as explanations for the link between ASD-related traits and suicidal thoughts occurring during one's military service. Findings highlight several novel potential pathways to suicide prevention among U.S. military service members.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Angelakis, I., Gooding, P., Tarrier, N., & Panagioti, M. (2015). Suicidality in obsessive compulsive disorder (OCD): A systematic review and meta-analysis. *Clinical Psychology Review, 39,* 1–15. http://dx.doi.org/10.1016/j.cpr.2015.03.002

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The autism-spectrum quotient (AQ): Evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *Journal of Autism and Developmental Disorders, 31,* 5–17. http://dx.doi.org/10.1023/A:1005653411471

Barrett, S. L., Uljarević, M., Baker, E. K., Richdale, A. L., Jones, C. R. G., & Leekam, S. R. (2015). The Adult Repetitive Behaviours Questionnaire–2 (RBQ-2A): A self-report measure of restricted and repetitive behaviours. *Journal of Autism and Developmental Disorders, 45,* 3680–3692. http://dx.doi.org/10.1007/s10803-015-2514-6

Carpenter, S. (2015). Disconnected: Adults with autism are left alone to navigate a jarring world. *Science News, 187,* 16–20. http://dx.doi.org/10.1002/scin.2015.187004017

Cassidy, S., Bradley, L., Shaw, R., & Baron-Cohen, S. (2018). Risk markers for suicidality in autistic adults. *Molecular Autism, 9,* 42. http://dx.doi.org/10.1186/s13229-018-0226-4

Cassidy, S., & Rodgers, J. (2017). Understanding and prevention of suicide in autism. *The Lancet Psychiatry, 4,* e11. http://dx.doi.org/10.1016/S2215-0366(17)30162-1

Cath, D. C., Ran, N., Smit, J. H., van Balkom, A. J. L. M., & Comijs, H. C. (2008). Symptom overlap between autism spectrum disorder, generalized social anxiety disorder and obsessive-compulsive disorder in adults: A preliminary case-controlled study. *Psychopathology, 41,* 101–110. http://dx.doi.org/10.1159/000111555

Chu, C., Buchman-Schmitt, J. M., Stanley, I. H., Hom, M. A., Tucker, R. P., Hagan, C. R., . . . Joiner, T. E. (2017). The interpersonal theory of suicide: A systematic review and meta-analysis of a decade of cross-national research. *Psychological Bulletin, 143,* 1313–1345. http://dx.doi.org/10.1037/bul0000123

Chu, C., Walker, K. L., Stanley, I. H., Hirsch, J. K., Greenberg, J. H., Rudd, M. D., & Joiner, T. E. (2018). Perceived problem-solving deficits and suicidal ideation: Evidence for the explanatory roles of thwarted belongingness and perceived burdensomeness in five samples. *Journal of Personality and Social Psychology, 115,* 137–160. http://dx.doi.org/10.1037/pspp0000152

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods, 1,* 16–29. http://dx.doi.org/10.1037/1082-989X.1.1.16

Department of Defense. (2016). *2016 Profile of the military community*. Retrieved from http://download.militaryonesource.mil/12038/MOS/Reports/2016-Demographics-Report.pdf

Flynn, L., & Healy, O. (2012). A review of treatments for deficits in social skills and self-help skills in autism spectrum disorder. *Research in Autism Spectrum Disorders, 6,* 431–441. http://dx.doi.org/10.1016/j.rasd.2011.06.016

Fritz, M. S., & Mackinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science, 18,* 233–239. http://dx.doi.org/10.1111/j.1467-9280.2007.01882.x

Glennon, T. J. (2001). The stress of the university experience for students with Asperger syndrome. *Work: Journal of Prevention, Assessment & Rehabilitation, 17,* 183–190.

Google. (2018). *reCAPTCHA*. Retrieved September 16, 2018, from https://www.google.com/recaptcha/

Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology, 85,* 348–362. http://dx.doi.org/10.1037/0022-3514.85.2.348

Gustavson, K. A., Alexopoulos, G. S., Niu, G. C., McCulloch, C., Meade, T., & Areán, P. A. (2016). Problem-solving therapy reduces suicidal ideation in depressed older adults with executive dysfunction. *American Journal of Geriatric Psychiatry, 24,* 11–17. http://dx.doi.org/10.1016/j.jagp.2015.07.010

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford.

Hirvikoski, T., Mittendorfer-Rutz, E., Boman, M., Larsson, H., Lichtenstein, P., & Bölte, S. (2016). Premature mortality in autism spectrum disorder. *British Journal of Psychiatry, 208,* 232–238. http://dx.doi.org/10.1192/bjp.bp.114.160192

Hom, M. A., Joiner, T. E., & Bernert, R. A. (2016). Limitations of a single-item assessment of suicide attempt history: Implications for standardized suicide risk assessment. *Psychological Assessment, 28,* 1026–1030. http://dx.doi.org/10.1037/pas0000241

Horowitz, L. M., Thurm, A., Farmer, C., Mazefsky, C., Lanzillo, E., Bridge, J. A., . . . the Autism and Developmental Disorders Inpatient Research Collaborative (ADDIRC). (2018). Talking about death or suicide: Prevalence and clinical correlates in youth with autism spectrum disorder in the psychiatric inpatient setting. *Journal of Autism and Developmental Disorders, 48,* 3702–3710. http://dx.doi.org/10.1007/s10803-017-3180-7

Israel Defense Forces. (2016). *Beyond the spectrum*. Retrieved October 29, 2018, from https://www.idf.il/en/minisites/soldiers-of-the-idf/beyond-the-spectrum/

Jiujias, M., Kelley, E., & Hall, L. (2017). Restricted, repetitive behaviors in autism spectrum disorder and obsessive–compulsive disorder: A comparative review. *Child Psychiatry and Human Development, 48,* 944–959. http://dx.doi.org/10.1007/s10578-017-0717-0

Jobe, L. E., & Williams White, S. (2007). Loneliness, social relationships, and a broader autism phenotype in college students. *Personality and Individual Differences, 42,* 1479–1489. http://dx.doi.org/10.1016/j.paid.2006.10.021

Joiner, T. E., Van Orden, K. A., Witte, T. K., & Rudd, M. D. (2009). *The interpersonal theory of suicide: Guidance for working with suicidal clients*. Washington, DC: American Psychological Association. http://dx.doi.org/10.1037/11869-000

Kirby, A. V., Bakian, A. V., Zhang, Y., Bilder, D. A., Keeshin, B. R., & Coon, H. (2019). A 20-year study of suicide death in a statewide autism population. *Autism Research, 12,* 658–666. http://dx.doi.org/10.1002/aur.2076

Kudinova, A. Y., Owens, M., Burkhouse, K. L., Barretto, K. M., Bonanno, G. A., & Gibb, B. E. (2016). Differences in emotion modulation using cognitive reappraisal in individuals with and without suicidal ideation: An ERP study. *Cognition and Emotion, 30,* 999–1007. http://dx.doi.org/10.1080/02699931.2015.1036841

Leekam, S. R., Prior, M. R., & Uljarevic, M. (2011). Restricted and repetitive behaviors in autism spectrum disorders: A review of research in the last decade. *Psychological Bulletin, 137,* 562–593. http://dx.doi.org/10.1037/a0023341

Leekam, S., Tandos, J., McConachie, H., Meins, E., Parkinson, K., Wright, C., . . . Le Couteur, A. (2007). Repetitive behaviours in typically developing 2-year-olds. *Journal of Child Psychology and Psychiatry, 48,* 1131–1138. http://dx.doi.org/10.1111/j.1469-7610.2007.01778.x

Litman, L., Robinson, J., & Abberbock, T. (2017). TurkPrime.com: A versatile crowdsourcing data acquisition platform for the behavioral sciences. *Behavior Research Methods, 49,* 433–442. http://dx.doi.org/10.3758/s13428-016-0727-z

Locke, J., Ishijima, E. H., Kasari, C., & London, N. (2010). Loneliness, friendship quality and the social networks of adolescents with high-functioning autism in an inclusive school setting. *Journal of Research in Special Educational Needs, 10,* 74–81. http://dx.doi.org/10.1111/j.1471-3802.2010.01148.x

Lundqvist, L.-O., & Lindner, H. (2017). Is the autism-spectrum quotient a valid measure of traits associated with the autism spectrum? A Rasch validation in adults with and without autism spectrum disorders. *Journal of Autism and Developmental Disorders, 47,* 2080–2091. http://dx.doi.org/10.1007/s10803-017-3128-y

Lynn, B. M. D., & Morgan, J. K. (2016). Using Amazon's Mechanical Turk (MTurk) to recruit military veterans: Issues and suggestions. *The Military Psychologist, 31,* 10–14.

Marjanovic, Z., Struthers, C. W., Cribbie, R., & Greenglass, E. R. (2014). The Conscientious Responders Scale: A new tool for discriminating between conscientious and random responders. *SAGE Open, 4,* 1–10. http://dx.doi.org/10.1177/2158244014545964

Mazefsky, C. A., Herrington, J., Siegel, M., Scarpa, A., Maddox, B. B., Scahill, L., & White, S. W. (2013). The role of emotion regulation in autism spectrum disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 52,* 679–688. http://dx.doi.org/10.1016/j.jaac.2013.05.006

Morgan, L. (2018). *Crisis supports for the autism community*. Retrieved March 5, 2019, from https://www.sprc.org/sites/default/files/resource-program/Autism%20Crisis%20Supports.pdf

Nock, M. K., Deming, C. A., Fullerton, C. S., Gilman, S. E., Goldenberg, M., Kessler, R. C., . . . Ursano, R. J. (2013). Suicide among soldiers: A review of psychosocial risk and protective factors. *Psychiatry: Interper-*

sonal and Biological Processes, 76, 97–125. http://dx.doi.org/10.1521/psyc.2013.76.2.97

Nock, M. K., Holmberg, E. B., Photos, V. I., & Michel, B. D. (2007). Self-Injurious Thoughts and Behaviors Interview: Development, reliability, and validity in an adolescent sample. *Psychological Assessment, 19,* 309–317. http://dx.doi.org/10.1037/1040-3590.19.3.309

Nock, M. K., Stein, M. B., Heeringa, S. G., Ursano, R. J., Colpe, L. J., Fullerton, C. S., . . . the Army STARRS Collaborators. (2014). Prevalence and correlates of suicidal behavior among soldiers: Results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Journal of the American Medical Association Psychiatry, 71,* 514–522. http://dx.doi.org/10.1001/jamapsychiatry.2014.30

Pelton, M. K., & Cassidy, S. A. (2017). Are autistic traits associated with suicidality? A test of the interpersonal-psychological theory of suicide in a non-clinical young adult sample. *Autism Research, 10,* 1891–1904. http://dx.doi.org/10.1002/aur.1828

Pugliese, C. E., & White, S. W. (2014). Brief report: Problem solving therapy in college students with autism spectrum disorders: Feasibility and preliminary efficacy. *Journal of Autism and Developmental Disorders, 44,* 719–729. http://dx.doi.org/10.1007/s10803-013-1914-8

Richa, S., Fahed, M., Khoury, E., & Mishara, B. (2014). Suicide in autism spectrum disorders. *Archives of Suicide Research, 18,* 327–339. http://dx.doi.org/10.1080/13811118.2013.824834

Ruzich, E., Allison, C., Smith, P., Watson, P., Auyeung, B., Ring, H., & Baron-Cohen, S. (2015). Measuring autistic traits in the general population: A systematic review of the Autism-Spectrum Quotient (AQ) in a nonclinical population sample of 6,900 typical adult males and females. *Molecular Autism, 6,* 2. http://dx.doi.org/10.1186/2040-2392-6-2

Smith, J. A., Doidge, M., Hanoa, R., & Frueh, B. C. (2019). A historical examination of military records of U.S. Army suicide, 1819 to 2017. *Journal of the American Medical Association Network Open, 2,* e1917448. http://dx.doi.org/10.1001/jamanetworkopen.2019.17448

Stanley, I. H., Hom, M. A., Hagan, C. R., & Joiner, T. E. (2015). Career prevalence and correlates of suicidal thoughts and behaviors among firefighters. *Journal of Affective Disorders, 187,* 163–171. http://dx.doi.org/10.1016/j.jad.2015.08.007

Van Orden, K. A., Cukrowicz, K. C., Witte, T. K., & Joiner, T. E. (2012). Thwarted belongingness and perceived burdensomeness: Construct validity and psychometric properties of the Interpersonal Needs Questionnaire. *Psychological Assessment, 24,* 197–215. http://dx.doi.org/10.1037/a0025358

Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., & Joiner, T. E., Jr. (2010). The interpersonal theory of suicide. *Psychological Review, 117,* 575–600. http://dx.doi.org/10.1037/a0018697

Wood, J. J., Drahota, A., Sze, K., Har, K., Chiu, A., & Langer, D. A. (2009). Cognitive behavioral therapy for anxiety in children with autism spectrum disorders: A randomized, controlled trial. *Journal of Child Psychology and Psychiatry, 50,* 224–234. http://dx.doi.org/10.1111/j.1469-7610.2008.01948.x

Woodbury-Smith, M. R., Robinson, J., Wheelwright, S., & Baron-Cohen, S. (2005). Screening adults for Asperger Syndrome using the AQ: A preliminary study of its diagnostic validity in clinical practice. *Journal of Autism and Developmental Disorders, 35,* 331–335. http://dx.doi.org/10.1007/s10803-005-3300-7

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Military Suicide Research Consortium Common Data Elements: Bifactor Analysis and Longitudinal Predictive Ability of Suicidal Ideation and Suicide Attempts Within a Clinical Sample

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To enhance and standardize the assessment of suicidal self-directed violence (SDV) in military populations, the Military Suicide Research Consortium developed the Common Data Elements (CDEs). Previous research supported the CDEs as assessing a higher-order factor of suicidal SDV in military populations. The present study had two aims: 1) confirm the bifactor structure of the CDEs in a high-risk sample, and 2) assess the ability of the factorially derived suicidal SDV factor to predict suicide attempts and return to care for suicidal ideation over 3-month follow-up. Utilizing a sample of service members referred for a psychiatric evaluation ($N = 1{,}044$), the CDE structure was assessed with confirmatory bifactor modeling. Logistic regressions and receiver operating characteristic (ROC) analyses were used to assess the suicidal SDV risk factor's prediction of suicide attempts and return to care for suicidal ideation during follow-up ($n = 758$). Bifactor modeling suggested adequate fit for the overarching suicidal SDV risk factor. Logistic regressions supported the overarching suicidal SDV risk factor as a predictor of suicide attempts (OR = 4.07, $p < .001$) and return to care for suicidal ideation (OR = 2.81, $p < .001$) over follow-up. However, ROC analyses suggested that the model including the suicidal SDV risk factor was only significantly better at classifying suicide attempts over follow-up (not return to care for suicidal ideation) than the model that did not include it (AUC difference = 0.15, $p < .001$). Findings suggest that the shared variance assessed across CDEs better predicts future suicide attempts beyond any individual suicide-related constructs.

Public Significance Statement
This study suggests that the Military Suicide Research Consortium Common Data Elements assess an overarching factor of suicidal self-directed violence that accurately differentiates U.S. active duty service members at high and low risk for suicide attempts over a 3-month follow-up period. As such,

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these findings propose that the shared variance captured via assessment of numerous factors related to suicidal self-directed violence is useful in accurately predicting service members at increased risk for attempting suicide, over and above the information gleaned from assessment and interpretation of any one risk factor in isolation.

Keywords: Military Suicide Research Consortium, common data elements, suicidal ideation, suicide attempt, military

AQ: 4

The suicide rate in the U.S. military has been steadily increasing (Department of Defense [DoD] Task Force on the Prevention of Suicide by Members of the Armed Forces, 2010), with rates estimated at 20.2 deaths per 100,000 among active duty service members (Pruitt, Smolenski, Bush, & Skopp, 2018). Additionally, U.S. service members demonstrate elevations in risk factors for death by suicide, including suicidal ideation and nonfatal suicidal attempts (Nock et al., 2014; Ursano et al., 2015). Indeed, history of suicidal ideation and history of suicide attempts have been identified as two of the top three predictors of suicide death in a recent meta-analysis (Franklin et al., 2017). Thus, identification of factors increasing risk for suicidal ideation and suicide attempts is of the utmost importance in the effort to significantly reduce death by suicide in the military.

Initial efforts to reduce suicide in military populations have highlighted the need for clinical assessment tools that can reliably distinguish between military service members at "high- and low-risk for suicidal self-directed violence" (SDV; Haney et al., 2012, p. 1).[1] To this point, numerous factors have been identified as conferring risk for future suicidal SDV in military populations, including previous attempts (Kessler et al., 2015), anxiety sensitivity (Stanley et al., 2018), posttraumatic stress disorder symptoms (Ramchand, Rudavsky, Grant, Tanielian, & Jaycox, 2015), and thwarted belongingness (Anestis, Khazem, Mohn, & Green, 2015). Additionally, there are numerous empirically supported measures assessing current suicidal symptoms and associated risk factors (Batterham et al., 2015). Efforts to accurately assess risk of suicidal SDV efficiently are hampered by the vast number of available assessment options and lack of a coherent protocol regarding risk assessment in military populations. Furthermore, variability in use of such measures hinders our ability to make meaningful comparisons across studies.

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The Military Suicide Research Consortium (MSRC; see www.msrc.fsu.edu), an effort funded by the U.S. Department of Defense, sought to address these issues via the design of the MSRC Common Data Elements (CDEs). The overarching objective of the MSRC is to implement and guide empirical studies aimed at improving suicide risk assessment, prevention, and treatment approaches in the U.S. military. Integral to this aim, the MSRC developed the CDEs to improve data quality across studies, reduce participant and investigator burden, and expedite the dissemination of study findings (Ringer et al., 2018). The CDEs combine items derived from empirically validated measures designed to assess suicidal SDV and associated risk factors to include measurement of the following constructs: problematic alcohol use, cognitive anxiety sensitivity, recent suicidal ideation, insomnia symptoms, thwarted belongingness, PTSD symptoms, history of suicidal ideation and behaviors, and history of suicidal intent. Permission was obtained from all copyright holders to utilize items from the parent measures. Initial research supports the psychometric properties of the CDEs. For instance, the CDEs demonstrated adequate correlations with their full-length parent measures, and exploratory factor analysis (EFA) provided initial support for a nine-factor solution (Ringer et al., 2018): A Current Suicidality factor, a Suicide Attempt Intent and Lethality factor, and the seven remaining factors represented distinct scales (i.e., PTSD Checklist, Anxiety Sensitivity, Traumatic Brain Injury, Thwarted Belongingness, Insomnia Severity, Alcohol Use, and Beck Hopelessness).

Moreover, support for a higher-order suicidal SDV risk factor derived from lower-order CDE factors was recently provided in current service members and veteran populations (Stanley, Buchman-Schmitt et al., 2019). Specifically, Stanley, Buchman-Schmitt et al. (2019) established strong factorial invariance with an adequately fitting model in three populations: current service members, younger veterans, and older veterans. The model providing adequate fit consisted of first-order CDE scales (i.e., anxiety sensitivity, alcohol use, suicidal ideation, thwarted belongingness, insomnia, PTSD symptoms, suicidal behavior, and suicidal intent) and a second-order factor of overarching suicide risk. The factor structure confirmed by Stanley, Buchman-Schmitt et al. (2019) was largely consistent with the structure identified by Ringer et al. (2018) via EFA, as it confirmed the scale-specific factors identified by Ringer and colleagues (2018) that were included in the CFA. The Stanley, Buchman-Schmitt et al. (2019) findings provided preliminary support for the construct validity of the CDEs, suggesting that they do, indeed, assess overarching suicide risk, as designed, in addition to their scale-specific constructs (e.g., thwarted belongingness). Additionally, Stanley, Buchman-Schmitt et al. (2019) demonstrated that the first- and second-order factor structure of the CDEs was largely consistent across military populations (current service members, younger veterans, and older veterans).

However, replication of this overarching factor in a high-risk clinical sample is required to further validate the CDEs' structure. Moreover, no studies have assessed the ability of this overarching risk factor to predict future suicidal ideation and SDV. Thus, the predictive validity of the CDEs remains to be tested. It is para-

[1] As suicidality is conceptualized to occur along a continuum to include both ideations and behaviors, the use of standardized nomenclature within the present manuscript is worth mentioning. In line with established nomenclature (c.f. Brenner et al., 2011), we use the term suicidal self-directed violence (SDV) to refer to the broad category of suicide-related behaviors, which includes suicidal preparatory behavior and suicide attempts, with and without injury, and interrupted (or not) by self or others. When appropriate, we use specific examples of suicidal SDV to clarify findings (e.g., the term suicide attempt).

mount that the ability of the CDEs to accurately distinguish between service members at low and high risk for future suicidal ideation and SDV be determined. As the CDEs were established to provide broad coverage of factors associated with increased risk for suicidal ideation and SDV outcomes, it would be of benefit to determine if specific factors independently identify service members at increased risk for future SDV more so than others; conversely, it might hold that the shared variance among risk factors may more accurately identify those at increased risk for future suicidal ideation and SDV outcomes than any specific risk factor in isolation. Such findings would clarify assessment approaches via the identification of specific factors that may be of benefit to assess explicitly, or by confirming a need to assess suicidal SDV risk factors in a more comprehensive manner.

Utilizing a large sample of U.S. military service members referred for psychiatric evaluation due to suicidal SDV concerns, the present study sought to address this gap with the following two aims: 1) confirm the bifactor structure of the CDEs to determine if they converge to assess overarching risk for suicidal SDV, and 2) assess the ability of the overarching suicidal SDV risk factor to identify those at increased risk of attempting suicide and returning to care for suicidal ideation over a three-month follow-up period, above and beyond the scale-specific constructs and history of suicide attempts. Given the inherent difficulties with utilizing death by suicide as an outcome (Sher, 2004), we elected to use suicide attempts and return to care for suicidal ideation over follow-up as our main outcomes. We identified return to care for suicidal ideation as a main outcome due to the observed increase in cumulative risk for suicide in individuals with outpatient and/or inpatient clinical contact for mental health concerns (Nordentoft, Mortensen, & Pedersen, 2011), and the particular elevation in risk associated with clinical presentations to emergency departments for suicidal ideation and/or behavior (Crandall, Fullerton-Gleason, Aguero, & LaValley, 2006). Our other main outcome, suicide attempts during follow-up, was chosen as it represents one of the strongest risk factors for future death by suicide (Franklin et al., 2017), and it is associated with a host of negative outcomes including increased hospitalizations and associated medical costs (Centers for Disease Control and Prevention, 2019). Thus, research in this domain will shed light on the clinical utility of the CDEs as a predictor of future SDV within military populations in addition to providing further support for their use in research.

Of note, the sample utilized in the present study is distinct from that used to originally assess the factor structure of the CDEs in the Ringer et al. (2018) and Stanley, Buchman-Schmitt et al. (2019) studies described above. However, a number of findings derived from the present sample (via use of either the entire sample or a subset) are worth noting. Specifically, Gutierrez and colleagues (2019) utilized this sample to compare the following suicide risk assessment measures: The Beck Scale for Suicidal Ideation (BSS), the Columbia-Suicide Severity Rating Scale (C-SSRS), the Suicidal Behaviors Questionnaire—Revised (SBQ-R), and the Self-Harm Behavior Questionnaire (SHBQ). They established that scores derived from these measures were reliable and that interpretation of derived scores had established convergent validity with associated suicide risk factors assessed via the CDEs (e.g., AQ: 5 thwarted belongingness, hopelessness). Hom, Stanley et al. (2019) then examined patterns of reporting suicide attempt history across the BSS, C-SSRS, SBQ-R, SHBQ, and a single item assessing number of previous suicide attempts. They demonstrated that 35.4% of service members were inconsistent in their report of suicide attempts across assessment measures; a point we return to in our limitations section.

Another study by Hom, Duffy et al. (2019) utilized a subset of AQ: 6 the present sample to identify potential mediators of the association between severity of past suicidality (as measured by the SHBQ) and severity of suicidal ideation at three-month follow-up (as measured via the Adult Suicidal Ideation Questionnaire; ASIQ). They found that hopelessness and the total effect of CDE-derived mediators (anxiety sensitivity, alcohol use, depressive symptoms, insomnia, thwarted belongingness, suicidal ideation, and PTSD symptoms) significantly explained the relationship between severity of historical suicidality (SHBQ total scores) and severity of suicidal ideation (i.e., ASIQ total scores) at follow-up. Finally, Stanley, Rogers, Hanson, Gutierrez, and Joiner (2019) utilized this sample to examine potential differences among PTSD symptom clusters in their ability to predict suicide attempts at three-month follow-up in combat-exposed and noncombat-exposed service members. Their findings suggested that, among PTSD symptom clusters, hyperarousal symptoms were the only significant predictor of suicide attempts at follow-up in combat-exposed service members.

Thus, the present study adds to the growing CDE literature through its examination of the shared variance assessed across the CDE measures and the ability of that overarching risk factor to predict future suicidal ideation and SDV in a high-risk, clinical population. As mentioned previously, the CDEs were designed to provide broad coverage of risk factors for suicidal SDV while reducing participant and investigator burden. However, it remains to be tested whether prediction of future suicidal SDV is enhanced with broad assessment techniques, or if military service members can be accurately identified as being at increased risk for future suicidal SDV via use of scale-specific constructs (e.g., through use of a single suicidal ideation measure or PTSD symptom assessment).

Method

Procedure

Data used in the present study were from a clinical assessment study. Participants included U.S. military service members referred to or seeking care from a military emergency department, outpatient behavioral health clinic, or inpatient psychiatry unit for suicidality. Participants were determined to be at elevated suicide risk by military treatment facility (MTF) clinicians utilizing standard practices in each setting. These risk elevations were determined prior to contact between study staff and potential participants. Study staff then approached individuals to determine interest in participating in the study; contact information was obtained for patients who were not immediately available so that their interest could be determined at a more convenient time. Inclusion criteria included (1) active duty member of the U.S. military; and (2) stationed within the continental U.S. for ≥3 months from study enrollment. Exclusion criteria included (1) nonactive duty members of the National Guard or Reserves; and (2) active duty service members deploying outside of the continental U.S. in <3 months from study enrollment.

Participants were initially determined to be at elevated suicide risk by on-site clinicians using standard assessment procedures in the referring clinics. Given that referrals came from inpatient psychiatric units, emergency departments, and outpatient behavioral health clinics, the nature of the assessments varied and were not controlled by study staff. We considered an MTF provider's determination that a service member was at risk of suicide as meeting the study inclusion criteria. During the baseline visit, participants were informed of the study. Service members agreeing to participation were consented and provided their phone number, e-mail address, and the contact information of four other individuals who were likely to be aware of the participants' location to facilitate contact at follow-up. Additionally, baseline measures (described below) were administered in person. Participants then scheduled their follow-up appointments at the end of the baseline assessment. Follow-up data (see follow-up measures below) were obtained via the phone or an in-person visit, depending on the participant's preference. Order of measure administration, both at baseline and follow-up, were randomized across participants. Participants provided written informed consent. This study was approved by relevant university and military institutional review boards and the DoD Human Research Protection Office.

Participants

Overall, 1,044 participants (83.0% of those eligible) completed baseline assessments, with 758 (72.6% of baseline sample) completing assessments at three-month follow-up. At baseline, mean (standard deviation [*SD*]) age was 24.95 (6.02) years with a range of 18 to 55 years. Most ($n = 775$; 74.2%) participants identified as male, 243 (23.3%) as female, and 9 (0.9%) as transgender. Racial/Ethnic breakdown was as follows: 614 (58.8%) identified as Caucasian/White, 221 (21.2%) as Black/African American, 40 (3.8%) as Asian/Pacific Islander, 8 (0.8%) as Native American/Alaskan Native, and 146 (14.0%) as other. Additionally, 159 (15.2%) identified as non-European Hispanic or Latino. Regarding U.S. military branch, 563 (53.9%) reported serving in the Navy, Active Duty, 374 (35.8%) as Army, Active Duty, 40 (3.8%) as Marine Corps, Active Duty, 31 (3.0%) as Air Force, Active Duty, and 14 (1.3%) as Coast Guard, Active Duty, with the 5 remaining participants (0.5%) identifying a different branch of service. Mean (*SD*) years served was 4.42 (4.89). Regarding military experiences, 497 (47.6%) participants reported previous deployment (*Mean* [*SD*] = 2.1 [2.34] deployments). Finally, 260 (24.9%) participants reported a history of combat experience (*Mean* [*SD*] = 1.48 [1.44] combat tours served).

Measures

Baseline measures.

Alcohol Use Disorders Identification Test (AUDIT-C; Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998). The AUDIT-C is a 3-item self-report measure of problematic alcohol use. Items assess the frequency and quantity of alcohol intake. AUDIT-C test scores and their interpretation have demonstrated strong psychometric properties (Bradley et al., 2007). The MSRC CDEs utilize all three AUDIT-C items. In this study, AUDIT-C items demonstrated good internal consistency ($\alpha = .85$).

Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007). The ASI-3 is an 18-item self-report measure of cognitive, physical, and social anxiety sensitivity concerns. The MSRC CDEs utilized five ASI-3 items that assess cognitive anxiety sensitivity concerns because of the relevance of this subfactor to suicidal thoughts and behaviors (see Stanley et al., 2018, for meta-analysis); in a separate study, scores from this abbreviated measure were highly correlated with the full parent measure, $r = .99$, $p < .001$ and were shown to have excellent internal consistency ($\alpha = .90$; Ringer et al., 2018). In this sample, the abbreviated ASI-3 item scores demonstrated good internal consistency ($\alpha = .87$).

Depressive Symptom Index-Suicidality Subscale (DSI-SS; Joiner, Pfaff, & Acres, 2002). The DSI-SS is a 4-item self-report measure of the presence and severity of suicidal thoughts, plans, and urges over the prior two weeks. DSI-SS scores and their interpretation have demonstrated strong psychometric properties (Batterham et al., 2015; Joiner et al., 2002). The MSRC CDEs utilized all four DSI-SS items. In this sample, the DSI-SS items demonstrated excellent internal consistency ($\alpha = .90$).

Insomnia Severity Index (ISI; Bastien, Vallières, & Morin, 2001). The ISI is a 7-item self-report measure that assesses the severity and impact of insomnia symptoms over the previous week. The MSRC CDEs utilized five ISI items; scores derived from this abbreviated measure were shown to have good internal consistency in a previous study ($\alpha = .87$; Ringer et al., 2018). In this sample, the ISI items demonstrated good internal consistency ($\alpha = .81$).

Interpersonal Needs Questionnaire (INQ; Van Orden, Cukrowicz, Witte, & Joiner, 2012). The INQ is a 15-item self-report measure of thwarted belongingness and perceived burdensomeness, constructs posited by the interpersonal theory of suicide to be implicated in suicidal desire (Chu et al., 2017; Van Orden et al., 2010). The MSRC CDEs utilize five items specifically assessing thwarted belongingness (INQ-TB); this subset of items was significantly correlated with the parent measure, $r = .64$, $p < .001$, and scores derived from the abbreviated CDE version demonstrated excellent internal consistency in a separate sample ($\alpha = .90$; Ringer et al., 2018). In this sample, the abbreviated INQ-TB items demonstrated excellent internal consistency ($\alpha = .90$).

PTSD Checklist-Military Version (PCL-M; Weathers, Huska, & Keane, 1991). The PCL-M is a 17-item self-report measure of military-related PTSD symptoms. The MSRC CDEs utilized eight PCL-M items: four assessing reexperiencing symptoms (criterion B in *DSM–5*), two assessing avoidance (criterion C), and two assessing hyperarousal (criterion E); this abbreviated measure was highly correlated with the full parent measure, $r = .83$, $p < .001$, and scores demonstrated excellent internal consistency in a separate study ($\alpha = .94$; Ringer et al., 2018). In this sample, the CDE PCL-M items demonstrated excellent internal consistency ($\alpha = .92$).

Suicidal Behaviors Questionnaire-Revised (SBQ-R; Osman et al., 2001). The SBQ-R is a 4-item self-report measure of the frequency of past year suicidal ideation, one's perceived future likelihood of making a suicide attempt, and past suicide plans and attempts. SBQ-R test scores and their interpretation have been found to have strong psychometric properties (Batterham et al., 2015; Osman et al., 2001). All four SBQ-R items were included in the MSRC CDEs. In this sample, the SBQ-R items demonstrated acceptable internal consistency ($\alpha = .72$).

Suicide Intent Scale (SIS; Beck, Schuyler, & Herman, 1974). The SIS is a 15-item assessment of behaviors and cognitions that occurred prior to and during the most recent suicide attempt. The SIS was developed for administration by a trained interviewer; yet, research has shown that scores from the self-report version correlate strongly with the original (Strosahl, Chiles, & Linehan, 1992). The MSRC CDEs utilized four SIS items; Ringer et al. (2018) found scores derived from the abbreviated CDE version to have good internal consistency in a separate sample (α = .89). In this sample, the abbreviated SIS was only administered to those participants who had recently survived a suicide attempt. The MSRC CDE SIS items demonstrated good internal consistency in the present sample (α = .82).

Suicide attempt history. A single item from the MSRC CDEs assessed suicide attempt history: "How many times in your lifetime have you made an attempt to kill yourself during which you had at least some intent to die?" The item wording is consistent with standardized nomenclature of what constitutes a suicide attempt (Crosby, Ortega, & Melanson, 2011). This item was continuous, assessed at baseline, and included as a covariate. Of the participants that responded to this item, 491 (49.30%) reported a history of one or more suicide attempts (range = 0 – 22 previous attempts). This is not surprising given that our sample was derived from a high-risk population that was seeking or referred to services for suicidality.

Follow-up measures.

Suicide Attempt Self-Injury Interview (SASII; Linehan, Comtois, Brown, Heard, & Wagner, 2006). The SASII is an interview-based measure of SDV. The presence/absence of suicidal behavior from baseline to 3-month follow-up was initially assessed via the following item: "How many times have you deliberately harmed or injured yourself or attempted suicide since last assessment?" Detailed follow-up questions were asked of every positive response to the intentional self-harm question to determine the exact nature and intent of the behavior. In the present study, only responses classified as suicide attempts were coded as positive. Thus, the presence or absence of suicide attempts over follow-up served as one of the main outcome variables for the present study.

Treatment History Interview-Short Form (THI-SF; Linehan & Heard, 1987). The THI is an interview-based measure that assesses treatment sought from a range of providers. Treatment for a new episode of suicide risk (i.e., any suicidal ideation short of an attempt) obtained between baseline to three-month follow-up and provided by an emergency department, inpatient medical and psychiatric unit, crisis center, and related setting served as another outcome variable for this study. The THI-SF has been used in a previous study of individuals at elevated suicide risk and evinced high levels of agreement between patient self-report and medical records (Comtois et al., 2011).

Data Analytic Strategy

We examined all variables for outliers, skewness, kurtosis, normality, and linearity. Outliers were determined by examining the interquartile range, with any data points greater than 1.5 interquartile ranges below or above the first or third quartiles, respectively, identified as outliers. As for skewness and kurtosis, values between −2 and 2 were considered acceptable. Little's MCAR test was used to assess missingness. In the full sample, results of Little's MCAR test revealed that data were not missing completely at random (MCAR, p = .001). Full information maximum likelihood (FIML) was used to handle missing data in Mplus (Muthén & Muthén, 2012) under the assumption that data were missing at random (MAR), instead of MCAR. We then used bifactor modeling to assess the factor structure of the following CDE measures: ASI-3 (anxiety sensitivity), AUDIT-C (alcohol misuse), DSI-SS (current suicidal ideation), INQ-TB (thwarted belongingness), ISI (insomnia symptoms), PCL-M (PTSD symptoms), SBQ-R (suicidal ideation and behaviors), the SIS (suicidal intent), and the loadings of the individual items on a factor assessing overarching suicidal SDV risk. MPlus 7.0 was used to determine the bifactor solution. Bifactor modeling allows us to assess simultaneously the loading of each individual CDE item onto two factors: 1) the scale-specific factor for each item, and 2) the loading of all CDE items onto one general factor comprising the shared variance among all items (Chen, West, & Sousa, 2006). In the present study, the general factor being assessed should capture the shared variance among all potential suicide risk variables; thus, we conceptualized this general factor as an overarching construct of suicidal SDV risk.

The following fit indices were evaluated to determine fit with the following cut-off criteria: Root Mean Square Error of Approximation (RMSEA) <.06 for good fit, Comparative Fit Index (CFI) and Tucker-Lewis fit index (TLI) >.95 for good fit and >.90 for adequate fit, and the Standard Root Mean Square Residual (SRMR) <.08 for good fit (Schreiber, Nora, Stage, Barlow, & King, 2006). Given our large sample size, we determined that the maximum likelihood chi-square statistic did not provide meaningful information regarding fit (Cheung & Rensvold, 2002; Meade, Johnson, & Braddy, 2008); thus, it was not examined in the present study.

Relationships between our variables of interest were assessed with Pearson's correlations, t tests, and χ^2 difference tests. We then used receiver operating characteristic (ROC) analyses to assess the diagnostic accuracy of our overarching suicidal SDV risk factor with respect to suicide attempts and return to care for suicidal ideation over follow-up. Thus, the ROC curve was used to assess the discriminatory capacity of the suicidal SDV risk factor. We obtained ROC curves by plotting the true positive rate (or sensitivity) against the false positive rate (1-specificity). We assessed the area under the curve (AUC) as our accuracy index; AUC values closer to 1 suggest that the measure accurately distinguishes between service members who did and did not return to care for suicidal ideation and those who did and did not attempt suicide over follow-up, whereas AUC values near 0.5 suggest that the predictive ability of the classifier is at chance. The following AUC cut-offs were used: <0.7 is low diagnostic accuracy, 0.7–0.9 is moderate accuracy, and > 0.9 indicates high accuracy (Swets, 2012). AQ: 7

As we were interested in assessing the discriminatory ability of the overarching suicidal SDV risk factor (factorially defined) above and beyond the scale-specific factors obtained via the bifactor modeling described above, we utilized an approach that allowed us to control for covariates in AUC analyses. In line with Janes, Longton, and Pepe (2009), we tested the incremental validity of the overarching suicidal SDV risk factor by conducting two logistic regressions: one consisting of our scale-specific factors (derived from bifactor modeling described above) and suicide attempt history, and the second including the overarching suicidal

SDV risk factor in addition to the scale-specific factors (again derived from bifactor modeling described above) and baseline previous attempts. Baseline suicide attempts were added as a covariate due to the observed risk associated with history of suicide attempts (Franklin et al., 2017). We then compared the AUC derived from the predicted probability of the aforementioned logistic regressions to assess the incremental validity of the overarching suicidal SDV risk factor in SPSS Version 22. Comparisons between the two ROC curves were statistically analyzed via the DeLong test with Medcalc (DeLong, DeLong, & Clarke-Pearson, 1988).

Results

Suicidal Self-Directed Violence Risk Factor (Factorially Defined)

All CDE variables were assessed for non-normality. Interquartile range was used to assess for outliers with data points >1.5 interquartile ranges below/above the first/third quartiles identified as such. Outliers were identified for the following variables: DSI-SS item 2 (suicide planning; 86 outliers), DSI-SS item 4 (suicide impulses; 8 outliers), AUDIT-C item 2 (daily number of alcoholic beverages; 86 outliers), and AUDIT-C item 3 (frequency of 6+ alcoholic beverages; 54 outliers). The identified outliers were adjusted to the lowest or highest number within the normal range for all analyses. For example, a data point of 4 on AUDIT-C item 3 would be adjusted to a score of 3 as this was the highest score in the identified normal range. AUDIT-C item 2 also demonstrated non-normality regarding kurtosis; however, this was fully addressed by reining in the identified outliers (via the method described above). All other variables were deemed acceptable with regard to skewness, kurtosis, normality, and linearity. See Table 1 for descriptive information for our study variables. T1

We assessed the factor structure of the MSRC CDEs using structural equation modeling. The results of the bifactor analysis indicated adequate fit between the predicted model and the observed data: RMSEA = .049 (90% CI [0.046, 0.051]), CFI = 0.931, TLI = 0.922, SRMR = 0.064. Thus, the results support the bifactor structure of the scale-level CDE measures and the overarching suicidal SDV risk model. Furthermore, all indicators made significant contributions to their respective latent variables (see Table 2). T2

Bivariate Relationships

After establishing the structure of the overarching suicidal SDV risk factor factorially defined as described above, we assessed zero-order relationships between demographic variables and the following suicide-related variables: factorially defined suicidal SDV risk factor, suicide attempt history (continuous), return to care for suicidal ideation during follow-up (dichotomous), and suicide attempts during follow-up (dichotomous). With respect to our outcome variables, 49 (6.46%) participants reported a suicide attempt, and 63 (8.31%) participants returned to care for suicidal ideation over the 3-month follow-up period.

First, we examined associations between demographic variables and our main variables of interest as being older, White, and male have all been associated with suicidal SDV (Martin, Ghahramanlou-Holloway, Lou, & Tucciarone, 2009). Age, r = .07, p = .026, race (Caucasian/White vs. all other racial groups: $t(1,020) = 2.09$, p = .037; Black/African American vs. all other racial groups: $t(1,019) = -2.54$, p = .012) and years of military service, r = .08, p = .015, were significantly associated with the suicidal SDV risk factor (factorially defined as described above). Specifically, participants identifying as older, Caucasian, and with more years of military service exhibited higher scores on the suicidal SDV risk factor, whereas those identifying as Black/

Table 1
Descriptive Information for Study Variables

Variable	*N* Factor score	*M* (*SD*) Factor score	Factor score range	*N* (%) Missing
AUDIT-C	1032	0.00 (1.08)	−1.28–2.39	0 (0.0%)
ASI-3	1032	0.00 (0.71)	−1.82–2.12	0 (0.0%)
DSI-SS	1032	0.00 (0.35)	−0.89–0.95	0 (0.0%)
ISI	1032	0.00 (0.73)	−2.60–1.75	0 (0.0%)
INQ-TB	1032	0.00 (1.11)	−2.84–3.47	0 (0.0%)
PCL-M	1032	−0.00 (1.14)	−2.32–2.94	0 (0.0%)
SBQ-R	1032	−0.00 (0.60)	−1.56–1.85	0 (0.0%)
SIS	1032	−0.00 (0.44)	−1.30–1.08	0 (0.0%)
Suicidal SDV factor	1032	0.00 (0.62)	−1.25–1.78	0 (0.0%)
Variable	***N* Total score**	***M* (*SD*) Total score**	**Total score range**	***N* (%) Missing**
Lifetime attempts	996	1.02 (1.85)	0.00–22.00	48 (4.6%)
FU attempts	757	0.07 (0.25)	0.00–1.00	287 (27.5%)
FU suicidal ideation care	758	0.08 (0.28)	0.00–1.00	286 (27.4%)

Note. ASI-3 = Anxiety Sensitivity Index-3; AUDIT-C = Alcohol Use Disorders Identification Test; DSI-SS = Depressive Symptom Index-Suicidality subscale; FU = three-month follow-up; INQ-TB = Interpersonal Needs Questionnaire-Thwarted Belongingness subscale; ISI = Insomnia Severity Index; PCL-M = PTSD Checklist-Military Version; SBQ-R = Suicidal Behaviors Questionnaire-Revised; SIS = Suicide Intent Scale; Suicidal SDV factor = CDE suicidal self-directed violence risk factor. Full information maximum likelihood (FIML) was used to handle missing data for presented factors. Thus, all computed factor scores resulted in total sample of 1,032 with no missing data points for these variables.

Table 2
Unstandardized and Standardized Factor Loadings of the MSRC CDEs

CDE factor	Variable	Unstandardized loading (*SE*)	Standardized loading (*SE*)
ASI-3 factor	ASI item 1	1.00 (0.00)	0.54*** (0.03)
	ASI item 2	0.94*** (0.07)	0.54*** (0.03)
	ASI item 3	1.05*** (0.07)	0.63*** (0.02)
	ASI item 4	1.18*** (0.07)	0.66*** (0.02)
	ASI item 5	1.28*** (0.07)	0.72*** (0.02)
AUDIT-C factor	AUDIT item 1	1.00 (0.00)	0.82*** (0.01)
	AUDIT item 2	0.50*** (0.02)	0.73*** (0.02)
	AUDIT item 3	0.92*** (0.03)	0.95*** (0.01)
DSI-SS factor	DSI-SS item 1	1.00 (0.00)	0.52*** (0.03)
	DSI-SS item 2	1.39*** (0.07)	0.68*** (0.02)
	DSI-SS item 3	1.58*** (0.08)	0.66*** (0.02)
	DSI-SS item 4	0.74*** (0.05)	0.49*** (0.03)
INQ-TB factor	INQ item 1	1.00 (0.00)	0.70*** (0.02)
	INQ item 2	0.84*** (0.05)	0.52*** (0.02)
	INQ item 3	1.13*** (0.05)	0.73*** (0.02)
	INQ item 4	1.13*** (0.05)	0.70*** (0.02)
	INQ item 5	1.21*** (0.05)	0.70*** (0.02)
ISI factor	ISI item 1	1.00 (0.00)	0.64*** (0.02)
	ISI item 2	1.06*** (0.06)	0.66*** (0.02)
	ISI item 3	0.38*** (0.06)	0.23*** (0.03)
	ISI item 4	0.93*** (0.05)	0.67*** (0.02)
	ISI item 5	0.90*** (0.05)	0.59*** (0.02)
PCL-M factor	PCL-M item 1	1.00 (0.00)	0.80*** (0.02)
	PCL-M item 2	0.85*** (0.03)	0.74*** (0.02)
	PCL-M item 3	0.85*** (0.03)	0.77*** (0.02)
	PCL-M item 4	0.99*** (0.03)	0.79*** (0.02)
	PCL-M item 5	0.96*** (0.03)	0.73*** (0.02)
	PCL-M item 6	0.96*** (0.03)	0.76*** (0.02)
	PCL-M item 7	0.62*** (0.04)	0.49*** (0.03)
	PCL-M item 8	0.57*** (0.04)	0.45*** (0.03)
SBQ-R factor	SBQ-R item 1	1.00 (0.00)	0.51*** (0.05)
	SBQ-R item 2	0.68*** (0.10)	0.43*** (0.04)
	SBQ-R item 3	0.61*** (0.09)	0.42*** (0.04)
	SBQ-R item 4	0.189** (0.07)	0.11*** (0.04)
SIS factor	SIS item 1	1.00 (0.00)	0.78*** (0.03)
	SIS item 2	0.99*** (0.05)	0.80*** (0.03)
	SIS item 3	0.59*** (0.04)	0.52*** (0.03)
	SIS item 4	0.65*** (0.04)	0.53*** (0.03)
Suicidal SDV risk factor	ASI item 1	1.00 (0.00)	0.46*** (0.03)
	ASI item 2	0.82*** (0.07)	0.39*** (0.03)
	ASI item 3	0.82*** (0.07)	0.41*** (0.03)
	ASI item 4	1.12*** (0.07)	0.52*** (0.03)
	ASI item 5	0.95*** (0.07)	0.45*** (0.03)
	AUDIT item 1	0.13 (0.07)	0.06 (0.03)
	AUDIT item 2	0.09* (0.04)	0.08* (0.03)
	AUDIT item 3	0.17** (0.06)	0.10** (0.03)
	DSI-SS item 1	0.74*** (0.06)	0.64*** (0.02)
	DSI-SS item 2	0.71*** (0.06)	0.58*** (0.03)
	DSI-SS item 3	0.88*** (0.07)	0.62*** (0.02)
	DSI-SS item 4	0.54*** (0.05)	0.59*** (0.02)
	INQ item 1	0.92*** (0.11)	0.36*** (0.03)
	INQ item 2	1.73*** (0.14)	0.59*** (0.02)
	INQ item 3	1.18*** (0.12)	0.42*** (0.03)
	INQ item 4	1.44*** (0.13)	0.50*** (0.03)
	INQ item 5	1.28*** (0.13)	0.41*** (0.03)
	ISI item 1	0.78*** (0.08)	0.40*** (0.03)
	ISI item 2	0.79*** (0.08)	0.40*** (0.03)
	ISI item 3	0.61*** (0.08)	0.29*** (0.03)
	ISI item 4	0.82*** (0.08)	0.47*** (0.03)
	ISI item 5	0.89*** (0.08)	0.47*** (0.03)
	PCL-M item 1	0.74*** (0.09)	0.33*** (0.03)
	PCL-M item 2	0.69*** (0.08)	0.33*** (0.03)
	PCL-M item 3	0.54*** (0.08)	0.27*** (0.03)
	PCL-M item 4	0.78*** (0.09)	0.34*** (0.03)
	PCL-M item 5	0.80*** (0.09)	0.34*** (0.03)
	PCL-M item 6	0.78*** (0.09)	0.35*** (0.03)
	PCL-M item 7	0.78*** (0.09)	0.35*** (0.03)
	PCL-M item 8	0.92*** (0.10)	0.41*** (0.03)
	SBQ-R item 1	1.01*** (0.11)	0.40*** (0.03)
	SBQ-R item 2	1.32*** (0.11)	0.65*** (0.02)
	SBQ-R item 3	0.57*** (0.07)	0.31*** (0.03)
	SBQ-R item 4	1.69*** (0.13)	0.75*** (0.02)
	SIS item 1	0.42*** (0.06)	0.36*** (0.04)
	SIS item 2	0.36*** (0.05)	0.32*** (0.04)
	SIS item 3	0.49*** (0.05)	0.48*** (0.03)
	SIS item 4	0.42*** (0.05)	0.38*** (0.04)

Note. MSRC = Military Suicide Research Consortium; CDEs = Common Data Elements; ASI-3 = Anxiety Sensitivity Index-3; AUDIT-C = Alcohol Use Disorders Identification Test; DSI-SS = Depressive Symptom Index-Suicidality subscale; INQ-TB = Interpersonal Needs Questionnaire-Thwarted Belongingness subscale; ISI = Insomnia Severity Index; PCL-M = PTSD Checklist-Military Version; SBQ-R = Suicidal Behaviors Questionnaire-Revised; SIS = Suicide Intent Scale; Suicidal SDV risk factor = CDE Suicidal self-directed violence risk factor.
* $p < .05$. ** $p \le .01$. *** $p \le .001$.

T3, 4, AQ:8

African American demonstrated lower scores on the suicidal SDV risk factor (factorially defined as described above) in comparison to all other racial groups. No demographic variables were significantly associated with suicide attempts or return to care for suicidal ideation during follow-up (Tables 3 and 4). Suicide attempt history was significantly associated with the suicidal SDV risk factor (factorially defined as described above; $r = .27$, $p < .001$), and suicide attempts during follow-up, $t(730) = 2.25$, $p = .025$, but was nonsignificant with return to care for suicidal ideation during follow-up, $t(730) = 1.91$, $p = .057$. As such, number of previous attempts was included as a covariate in analyses. Finally, the suicidal SDV risk factor (factorially defined as described above) was significantly associated with suicide attempts, $t(752) = 5.05$, $p < .001$, and return to care for suicidal ideation, $t[80.35] = 5.31$, $p < .001$, during follow-up. Participants who reported a suicide attempt during follow-up or returned to care for suicidal ideation exhibited higher mean scores on the suicidal SDV risk factor compared to those who did not report the aforementioned outcomes.

Return to Care for Suicidal Ideation at Follow-Up

First, we tested the relationship between the overarching factorially derived suicidal SDV risk factor on return to care for suicidal ideation during the 3-month follow-up by conducting logistic regressions for our two models: 1) the model including baseline suicide attempts and the scale-specific factors (derived from bifactor analysis) as predictors, and 2) our model including baseline suicide attempts, scale-specific factors, and our suicidal SDV risk factor (factorially defined as described above). The first model that was tested, which did not include the factorially derived suicidal SDV risk factor, was not significant: $\chi^2(9, N = 732) = 12.63$, $p = .180$. In contrast, the second model, which included the factorially derived suicidal SDV risk factor, was significant: $\chi^2(10, N = 732) = 27.62$, $p = .002$, correctly identifying 91.4% of cases and

Table 3
Bivariate Relationships Among Study Variables (Pearson's Correlations and t-Tests)

Pearson's correlations	1	2	3	4	5
1. Age	—				
2. Years served	0.85***	—			
3. Previous attempts	−0.10	−0.004	—		
4. Suicidal SDV factor	0.07*	0.08*	0.27***	—	
5. Deployments	0.48***	0.58***	−0.02	−0.02	—
t-tests					
6. Gender	3.27***	3.29***	−1.32	−0.46	4.22***
7. Race	0.10	0.35	1.19	2.09*	1.03
8. Ethnicity	−0.12	−0.10	−1.55	−1.33	1.16
9. Combat exposure	−13.80***	−13.63***	−0.26	1.78	−2.94**
10. FU suicide ideation care	−0.82	−0.19	−1.91	−5.31***	0.68
11. FU suicide attempt	0.73	0.05	−2.25*	−5.05***	1.18

Note. Age (in years); previous attempts (number); deployments (number); gender (0 = male, 1 = other); race (0 = other, 1 = white); ethnicity (0 = not Hispanic, 1 = Hispanic); combat exposure (0 = no exposure, 1 = exposure); FU Suicide Ideation Care (0 = did not report return to care for suicidal ideation during follow-up, 1 = reported return to care for suicidal ideation during follow-up); FU suicide attempt (0 = did not report suicide attempt during follow-up, 1 = reported suicide attempt during follow-up); Suicidal SDV factor = suicidal self-directed violence risk factor derived from bifactor modeling of CDEs.
* $p < .05$. ** $p \leq .01$. *** $p \leq .001$.

explaining between 3.7% (Cox and Snell R Square) and 8.3% (Nagelkerke R Square) of the variance in return to care for suicidal ideation at follow-up. The suicidal SDV risk factor (factorially defined as described above) significantly predicted return to care for suicidal ideation at 3-month follow-up ($OR = 2.81$, $p < .001$), above and beyond previous attempts and the aforementioned scale-specific factors. Specifically, only the AUDIT-C factor ($OR = 1.30$, $p = .021$) and the factorially derived suicidal SDV risk factor were significant in the final model (see Table 5). T5, AQ: 9

Next, we conducted ROC analyses with the predicted probability for each of the aforementioned logistic regressions as classifiers of return to care for suicidal ideation at follow-up: Model 1 (scale-specific factors and previous attempts): AUC = 0.65 ($SE = .04$, 95% CI [.58, .72]) and Model 2 (scale-specific factors, previous attempts, and factorially derived suicidal SDV risk factor): AUC = 0.69 ($SE = .03$, 95% CI [.63, .76]). Thus, both models fell in the low range. Pairwise comparisons of the ROC curves revealed no significant difference in AUC between our two models with regard to their ability to accurately classify presence of return to care for suicidal ideation over follow-up (AUC difference = 0.05, $SE = .03$, 95% CI [−.01, .10], Z = 1.62, $p = .100$; Figure 1). F1

Report of a Suicide Attempt at Follow-Up

Consistent with our statistical approach for models classifying return to care for suicidal ideation, we also evaluated two logistic regression models predicting suicide attempts during follow-up. The first model including only scale-specific factors and previous suicide attempts was again not significant: $\chi^2(9, N = 731) = 9.68$, $p = .377$. The second model including the suicidal SDV risk factor (factorially defined as described above) was significant: $\chi^2(10, N = 731) = 30.95$, $p < .001$, correctly identifying 93.6% of cases and accounting for 4.1% (Cox and Snell R Square) to 10.9% (Nagelkerke R Square) of the variance in suicide attempts during follow-up. The factorially derived suicidal SDV risk factor significantly predicted follow-up suicide attempts (OR = 4.07, $p < .001$), above and beyond previous suicide attempts and the scale-

Table 4
Bivariate Relationships Among Study Variables (Chi-Square Difference Tests)

Variables	6	7	8	9	10	11
6. Gender	—					
7. Race	34.23***	—				
8. Ethnicity	0.03	20.32***	—			
9. Combat exposure	24.13***	4.07*	3.13	—		
10. FU suicide ideation care	3.77	0.59	0.52	2.14	—	
11. FU suicide attempt	0.002	0.06	0.46	1.02	22.77***	—

Note. Gender (0 = male, 1 = other); Race (0 = other, 1 = White); Ethnicity (0 = not Hispanic, 1 = Hispanic); Combat exposure (0 = no exposure, 1 = exposure); FU Suicide Ideation Care (0 = did not report return to care for suicidal ideation during follow-up, 1 = reported return to care for suicidal ideation during follow-up); FU suicide attempt (0 = did not report suicide attempt during follow-up, 1 = reported suicide attempt during follow-up).
* $p < .05$. *** $p \leq .001$.

Table 5
Logistic Regression Examining Effect of Previous Attempts, CDE Factors, and Factorially Derived Suicidal Self-Directed Violence Risk Factor on Return to Care for Suicidal Ideation and Report of Suicide Attempts During Follow-Up

Variables	β	*SE*	Wald	*p*	*OR*
Suicidal ideation					
Previous attempts	0.03	0.06	0.18	0.670	1.03
ASI-3 factor	−0.20	0.20	0.97	0.324	0.82
AUDIT-C factor	0.26	0.11	5.30	0.021	1.30
DSI-SS factor	−0.22	0.44	0.24	0.622	0.80
INQ-TB factor	0.02	0.13	0.02	0.901	1.02
ISI factor	0.17	0.22	0.62	0.429	1.19
PCL-M factor	−0.09	0.12	0.52	0.473	0.92
SBQ-R factor	0.07	0.27	0.07	0.797	1.07
SIS factor	0.003	0.34	0.00	0.993	1.00
Suicidal SDV factor	1.03	0.27	14.61	.001	2.81
Suicide attempts					
Previous attempts	0.03	0.06	0.25	0.614	1.03
ASI-3 factor	−0.27	0.23	1.41	0.235	0.76
AUDIT-C factor	−0.10	0.15	0.41	0.521	0.91
DSI-SS factor	−1.21	0.52	5.49	0.019	0.30
INQ-TB factor	−0.20	0.15	1.77	0.183	0.82
ISI factor	−0.08	0.25	0.11	0.737	0.92
PCL-M factor	−0.12	0.14	0.73	0.394	0.89
SBQ-R factor	−0.11	0.31	0.12	0.730	0.90
SIS factor	−0.99	0.37	7.06	0.008	0.37
Suicidal SDV factor	1.41	0.31	20.11	<.001	4.07

Note. β = standardized regression coefficient; *SE* = Standard Error; *OR* = odds ratio; *p* = p-value; ASI-3 = Anxiety Sensitivity Index-3; AUDIT-C = Alcohol Use Disorders Identification Test; DSI-SS = Depressive Symptom Index-Suicidality Subscale; INQ-TB = Interpersonal Needs Questionnaire-Thwarted Belongingness subscale; ISI = Insomnia Severity Index; PCL-M = PTSD Checklist-Military Version; SBQ-R = Suicidal Behaviors Questionnaire-Revised; CDE = common data elements; SIS = Suicide Intent Scale; Suicidal SDV Factor = factorially derived Suicidal Self-Directed Violence CDE risk factor.

specific factors (see Table 5). Additionally, the SIS factor ($OR = 0.37$, $p = .008$) and DSI-SS factor ($OR = 0.30$, $p = .019$) remained significant predictors of suicide attempts at follow-up in the final model.

Finally, we conducted ROC analyses with the predicted probability for each of the aforementioned logistic regressions as predictors of suicide attempts during follow-up: Model 1 (scale-specific factors and previous attempts): AUC = 0.58 ($SE = .037$, 95% CI [.55, .62]); and Model 2 (scale-specific factors, previous attempts, and factorially derived suicidal SDV risk factor): AUC = 0.73 ($SE = .04$, 95% CI [.70, .76]). Thus, Model 1 fell in the low range and Model 2 fell in the modest range. Pairwise comparisons of the ROC curves revealed that Model 2, which included the suicidal SDV risk factor (factorially defined as described above), was significantly better at classifying the suicide attempt outcome than the model that did not include the factorially derived suicidal SDV risk factor (AUC difference = 0.15, $SE = .03$, 95% CI [.08, .21], Z = 4.36, $p < .001$; Figure 2). F2

Discussion

This study aimed to assess the bifactor structure of the MSRC CDEs, and to evaluate the ability of the factorially derived suicidal SDV risk factor to accurately classify services members at risk for returning to care for suicidal ideation and those at risk for suicide attempts over a three-month follow-up period. Our results provided additional support for the factor structure of the CDEs and confirmed that the CDEs significantly load on an overarching factor of suicidal SDV risk. Additionally, this study was the first to provide evidence for the predictive validity of the suicidal SDV risk factor (factorially defined as described above) derived from the CDEs. Specifically, we found that the factorially derived suicidal SDV risk factor more accurately classified military service members who did and did not report a suicide attempt over the three-month follow-up period, above and beyond previous suicide attempts and scale-specific constructs. However, we found no significant differences in the ability of our models to accurately classify return to care for suicidal ideation at follow-up. Thus, these findings suggest that the factorially derived suicidal SDV risk factor more accurately identifies and classifies military service AQ: 10 members at risk for future engagement in suicide attempts, rather than those who may experience suicidal ideation alone. Given that past behaviors are robust predictors of future behaviors, identifying service members at elevated risk of future suicide attempts seems at least as clinically important as identifying those likely to have thoughts about suicide (cf. Jobes & Joiner, 2019).

As noted, the MSRC developed the CDEs to facilitate data acquisition and analysis across studies aimed at assessing suicidality and related risk factors. Ringer et al. (2018) demonstrated that the CDEs exhibit strong psychometric properties that are comparable to their parent measures, and Stanley, Buchman-Schmitt et al. (2019) found evidence for an overarching factor of suicidal SDV risk derived from the CDEs in current service members and veterans. The present study replicates and extends these findings by confirming that the CDEs load onto their individual factors, in addition to a suicidal SDV risk factor (factorially defined as described above), in a high-risk—and, importantly, distinct—clinical sample of active duty service members. Beyond the findings of Ringer et al. (2018) and Stanley, Buchman-Schmitt et al. (2019), the present study was the first to demonstrate that the factorially derived suicidal SDV risk factor correctly classifies suicide attempts over a three-month follow-up period. Indeed, the present findings suggest that the shared variance captured across CDE items resulted in significantly improved prediction in comparison to scale-specific constructs.

The suicidal SDV risk factor (factorially defined as described above) in the present study represents the common suicide risk assessed by all scale-specific CDE constructs. Of note, the SIS and DSI-SS factors remained significant predictors of suicide attempts over follow-up in the hierarchical logistic regression. However, examination of the ORs for these factors suggested that lower scores on these factors significantly predicted suicide attempts over follow-up, contrary to hypotheses. Scale-specific factor scores generated by bifactor modeling represent item response variance that is not accounted for by the general factor of suicidal SDV risk. Thus, the present findings suggest that the variance captured in the SIS and DSI-SS factors, which is not accounted for by the overarching suicidal SDV risk, may be associated with reduced risk in future suicide attempts. However, additional research is needed to confirm and expand these findings.

The present findings also add to the growing literature examining predictors of suicidal ideation and SDV in military service members. Stanley, Rogers et al. (2019) demonstrated that the

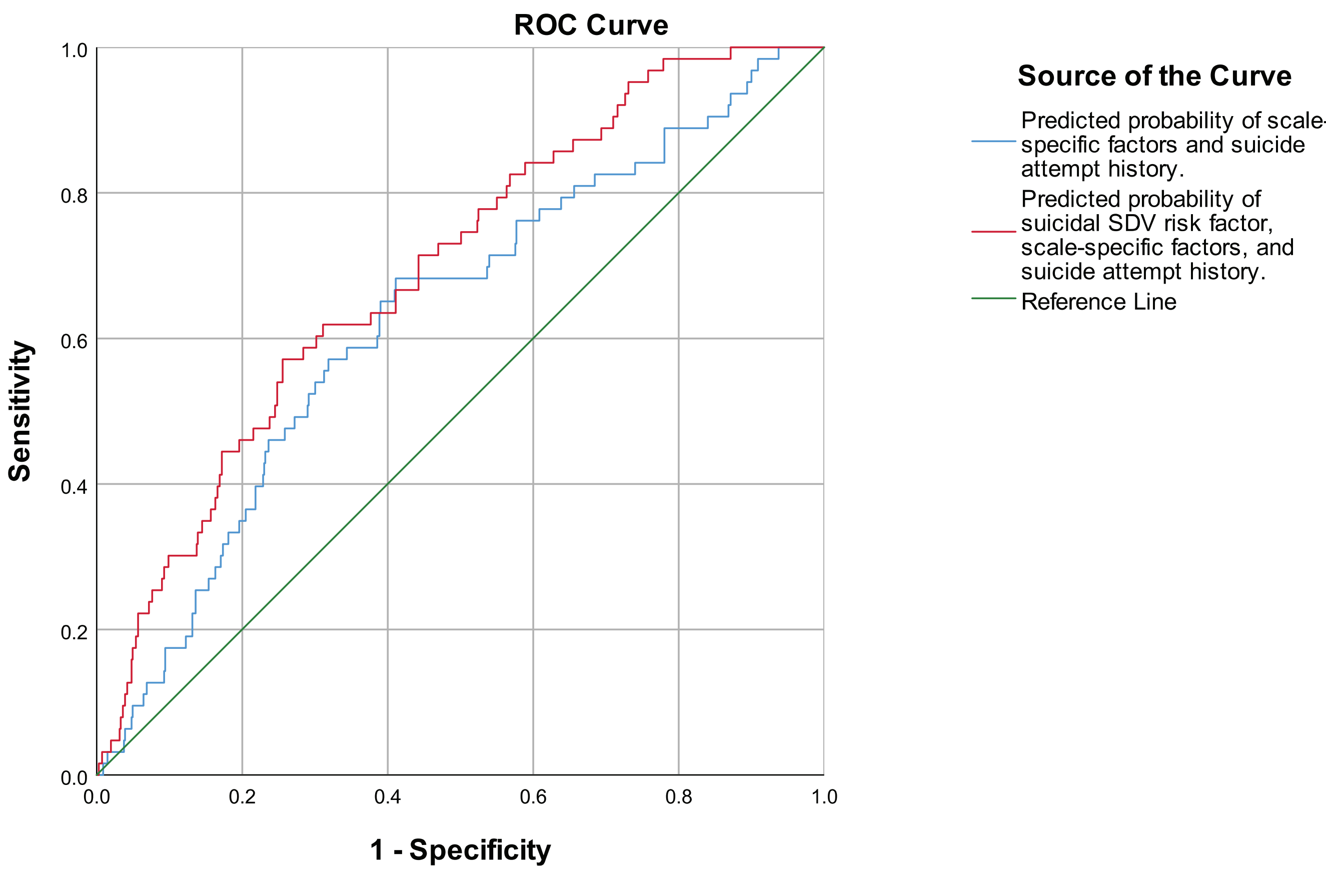

Figure 1. SDV = self-directed violence. Receiver operating characteristic (ROC) curve comparing predictive probability of logistic models with and without the factorially derived suicidal SDV risk factor classifying return to care for suicidal ideation over the three-month follow-up. See the online article for the color version of this figure.

PTSD hyperarousal symptom cluster predicted suicide attempts at follow-up in combat-exposed service members. The present findings suggest that the shared variance assessed via the CDEs results in increased identification of service members at high risk for future suicide attempts in both combat-exposed and non-combat-exposed service members. The present findings also expand the results of Hom, Duffy et al. (2019) by demonstrating that the CDEs not only account for shared variance between historical suicidal symptoms and future suicidal ideation, but the shared variance captured across their scale-specific constructs actually results in significantly more accurate identification of service members at increased risk for future suicide attempts. Additionally, although the effect sizes observed in the present study are small to medium, they are consistent with the top established risk factors for future suicidal ideation and suicide attempts identified within the larger literature (Franklin et al., 2017). For example, history of nonsuicidal self-injury was identified by Franklin et al. (2017) as the top predictor of future suicide attempts in their recent meta-analysis with a weighted OR of 4.15; in the present study, the OR identified for our suicidal SDV risk factor was 4.07.

Overall, our findings provided additional support for the use of the CDEs in studies of suicide risk within military samples. The CDEs offer the advantages of being psychometrically sound, allowing assessment of numerous risk factors, while also requiring less time for administration than would be required via administration of all parent measures, thus minimizing participant burden while allowing for a comprehensive assessment of numerous risk factors for suicidal ideation and SDV. Increased use of CDEs will also assist efforts to compare results across different studies, enabling stakeholders to generalize findings and evaluate the utility of numerous risk factors within different samples.

Limitations and Future Directions

This investigation has notable strengths, including the use of a prospective study design, a large sample size, and a clinically severe sample at increased risk for suicide that is of interest to military leaders, military clinicians, military stakeholders, and others. Nevertheless, the limitations of this study should be considered. First, only self-report data were utilized. Given that military culture creates some barriers to disclosing suicidal symptoms (Anestis & Green, 2015), the inclusion of implicit measures of suicidality (e.g., Nock et al., 2010) in future studies might be a promising approach to circumvent inaccurate reporting. Our assessment of suicidal ideation over follow-up was also limited to those participants that returned to care for suicidal ideation. Thus, we likely did not capture participants that experienced suicidal ideation but did not seek care for it. Future research utilizing an

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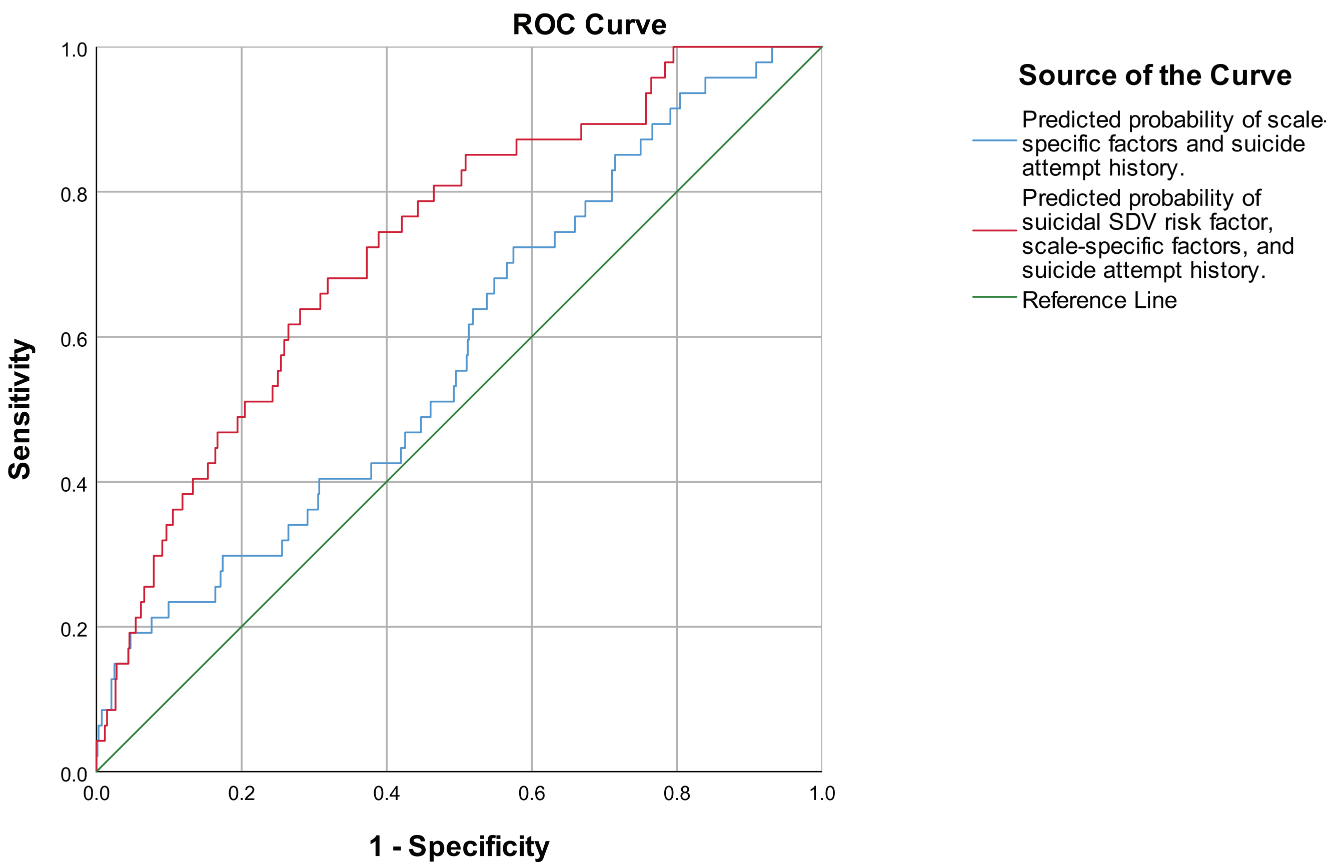

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Figure 2. SDV = self-directed violence. Receiver operating characteristic (ROC) curve comparing predictive probability of logistic models with and without the factorially derived suicidal SDV risk factor classifying suicide attempts over the three-month follow-up. See the online article for the color version of this figure.

ecological momentary data approach would be of benefit to help assess the temporal relationship between suicidal ideation, return to care for suicidal ideation, and suicidal SDV and improve our ability to capture variance in suicidal ideation and SDV more accurately.

The use of a single item to assess suicide attempt history is another limitation given research suggesting this assessment approach may misclassify suicidal behaviors (Hom, Joiner, & Bernert, 2016; Millner, Lee, & Nock, 2015), and the observation that participants may respond differently to varying assessment AQ: 12 approaches of suicide attempt history (Hom, Stanley et al. (2019)). As such, future research is needed to evaluate the most accurate method of obtaining information pertaining to past suicidal behavior, particularly history of suicide attempts. Relatedly, abbreviated self-report measures were used in several cases, possibly diminishing our ability to detect significant effects.

As many, but not all, of our participants were recruited from inpatient units, the generalizability of our findings in addition to our failure to control for referral source represents another limitation of the current study. Similarly, data regarding why eligible participants did and did not participate were not collected. Thus, the present findings may be influenced by selection bias. Additionally, although the present study adds to the field by providing support for the predictive validity of the CDEs in a high-risk sample, the predictive validity of the suicidal SDV risk factor derived from the CDEs remains to be tested in other clinical samples. Research suggests that most civilians who die by suicide are seen by a medical provider in the months to year prior to their death (Appleby et al., 1999; Vastag, 2001), and yet a significant percentage of individuals with suicidal symptoms do not disclose these symptoms to their provider (Silverman & Berman, 2014). As such, research is needed to determine if the CDEs can accurately identify service members at increased risk for future suicide attempts in a sample that may be less likely to disclose their suicidality (e.g., military service members seeking medical care in primary care settings as opposed to specialty mental health clinics). To this point, the CDEs may represent a unique opportunity to improve our prediction of suicidal SDV in populations less likely to disclose suicide-specific symptoms, as the CDEs do not solely rely on report of past and current suicidal symptoms in their risk assessment.

While our sample included a relatively large age range (18 to 55 years), the average age of participants was 24.95 years. As such, our findings may not generalize to older service members and veterans. As older individuals are at particularly high risk for death by suicide (Hedegaard, Curtin, & Warner, 2018), future research investigating the accuracy of the CDEs in classifying older individuals at risk for future suicidal SDV is warranted. Additional work is also needed to replicate study findings in other military-relevant populations, including non-active-duty service members and veterans. The outcome variables used in the present study, suicide attempts and return to care for suicidal ideation over follow-up, represent an additional limitation worth noting. Although both of our outcomes represent prominent risk factors for future death by suicide (Franklin et al., 2017), we did not assess death by suicide in the present study. As prediction of death by suicide is the ultimate goal of suicide prevention work, evaluation of the CDEs' predictive validity with respect to death by suicide is needed to further validate their clinical utility.

Conclusions

The DoD has identified the prevention of suicide and related behaviors as one of the main identified goals within the four outlined strategic directions and specifically identified "the assessment and treatment of individuals with high suicide risk" as a priority within the domain of treatment and support services (Franklin, 2015, p. 24). To attend to this clinical priority and facilitate suicide research in military populations, the MSRC developed the CDEs. Our findings provide additional support for the sound psychometric properties of the CDEs and suggest that they load onto an overarching factor of suicidal SDV risk, which correctly identified services members at increased risk for suicide attempts over a three-month follow-up, even after controlling for scale-specific constructs. Thus, the CDEs represent one tool to address the challenge of accurately assessing and mitigating suicide risk in U.S. military populations.

References

Anestis, M. D., & Green, B. A. (2015). The impact of varying levels of confidentiality on disclosure of suicidal thoughts in a sample of United States national guard personnel. *Journal of Clinical Psychology, 71,* 1023–1030. http://dx.doi.org/10.1002/jclp.22198

Anestis, M. D., Khazem, L. R., Mohn, R. S., & Green, B. A. (2015). Testing the main hypotheses of the interpersonal–psychological theory of suicidal behavior in a large diverse sample of United States military personnel. *Comprehensive Psychiatry, 60,* 78–85. http://dx.doi.org/10.1016/j.comppsych.2015.03.006

Appleby, L., Shaw, J., Amos, T., McDonnell, R., Harris, C., McCann, K., . . . Parsons, R. (1999). Suicide within 12 months of contact with mental health services: National clinical survey. *British Medical Journal, 318,* 1235–1239. http://dx.doi.org/10.1136/bmj.318.7193.1235

Bastien, C. H., Vallières, A., & Morin, C. M. (2001). Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Medicine, 2,* 297–307. http://dx.doi.org/10.1016/S1389-9457(00)00065-4

Batterham, P. J., Ftanou, M., Pirkis, J., Brewer, J. L., Mackinnon, A. J., Beautrais, A., . . . Christensen, H. (2015). A systematic review and evaluation of measures for suicidal ideation and behaviors in population-based research. *Psychological Assessment, 27,* 501–512. http://dx.doi.org/10.1037/pas0000053

Beck, A. T., Schuyler, D., & Herman, I. (1974). Development of Suicidal Intent Scales. In A. T. Beck, H. L. Resnik, & D. J. Lettieri (Eds.), *The prediction of suicide* (pp. 45–56). Oxford, England: Charles Press.

Bradley, K. A., DeBenedetti, A. F., Volk, R. J., Williams, E. C., Frank, D., & Kivlahan, D. R. (2007). AUDIT-C as a brief screen for alcohol misuse in primary care. *Alcoholism: Clinical and Experimental Research, 31,* 1208–1217. http://dx.doi.org/10.1111/j.1530-0277.2007.00403.x

Brenner, L. A., Breshears, R. E., Betthauser, L. M., Bellon, K. K., Holman, E., Harwood, J. E., . . . Nagamoto, H. T. (2011). Implementation of a suicide nomenclature within two VA healthcare settings. *Journal of Clinical Psychology in Medical Settings, 18,* 116–128. http://dx.doi.org/10.1007/s10880-011-9240-9

Bush, K., Kivlahan, D. R., McDonell, M. B., Fihn, S. D., & Bradley, K. A. (1998). The AUDIT alcohol consumption questions (AUDIT-C): An effective brief screening test for problem drinking. *Archives of Internal Medicine, 158,* 1789–1795. http://dx.doi.org/10.1001/archinte.158.16.1789

Centers for Disease Control and Prevention. (2019). *Preventing suicide*. Atlanta, GA: Author. Retrieved from https://www.cdc.gov/violenceprevention/suicide/fastfact.html

Chen, F. F., West, S. G., & Sousa, K. H. (2006). A comparison of bifactor and second-order models of quality of life. *Multivariate Behavioral Research, 41,* 189–225. http://dx.doi.org/10.1207/s15327906mbr4102_5

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9,* 233–255. http://dx.doi.org/10.1207/S15328007SEM0902_5

Chu, C., Buchman-Schmitt, J. M., Stanley, I. H., Hom, M. A., Tucker, R. P., Hagan, C. R., . . . Joiner, T. E. (2017). The interpersonal theory of suicide: A systematic review and meta-analysis of a decade of cross-national research. *Psychological Bulletin, 143,* 1313–1345. http://dx.doi.org/10.1037/bul0000123

Comtois, K. A., Jobes, D. A., O'Connor, S. S., Atkins, D. C., Janis, K., Chessen, C. E., . . . Yuodelis-Flores, C. (2011). Collaborative assessment and management of suicidality (CAMS): Feasibility trial for next-day appointment services. *Depression and Anxiety, 28,* 963–972. http://dx.doi.org/10.1002/da.20895

Crandall, C., Fullerton-Gleason, L., Aguero, R., & LaValley, J. (2006). Subsequent suicide mortality among emergency department patients seen for suicidal behavior. *Academic Emergency Medicine, 13,* 435–442. http://dx.doi.org/10.1197/j.aem.2005.11.072

Crosby, A. E., Ortega, L., & Melanson, C. (2011). *Self-directed violence surveillance: Uniform definitions and recommended data elements*. Atlanta, GA: National Center for Injury Prevention and Control, Division of Violence Prevention.

DeLong, E. R., DeLong, D. M., & Clarke-Pearson, D. L. (1988). Comparing the areas under two or more correlated receiver operating characteristic curves: A nonparametric approach. *Biometrics, 44,* 837–845. http://dx.doi.org/10.2307/2531595

Department of Defense Task Force on the Prevention of Suicide by Members of the Armed Forces. (2010). *The challenge and the promise: Strengthening the force, preventing suicide, and saving lives*. Washington, DC: Department of Defense.

Franklin, J. C., Ribeiro, J. D., Fox, K. R., Bentley, K. H., Kleiman, E. M., Huang, X., . . . Nock, M. K. (2017). Risk factors for suicidal thoughts and behaviors: A meta-analysis of 50 years of research. *Psychological Bulletin, 143,* 187–232. http://dx.doi.org/10.1037/bul0000084

Franklin, K. (2015). *The Department of Defense strategy for suicide prevention*. Washington, DC: Department of Defense.

Gutierrez, P. M., Joiner, T., Hanson, J., Stanley, I. H., Silva, C., & Rogers, M. L. (2019). Psychometric properties of four commonly used suicide risk assessment measures: Applicability to military treatment settings. *Military Behavioral Health, 7,* 177–184. http://dx.doi.org/10.1080/21635781.2018.1562390

Haney, E. M., O'Neil, M. E., Carson, S., Low, A., Peterson, K., Denneson, L. M., . . . Kansagara, D. (2012). *Suicide risk factors and risk assessment tools: A systematic review* (VA-ESP Project #05–225). Washington, DC: Department of Veterans Affairs.

Hedegaard, H., Curtin, S. C., & Warner, M. (2018). *Suicide mortality in the United States, 1999–2017* (NCHS Data Brief, no. 330). Hyattsville, MD: National Center for Health Statistics. Retrieved from https://www.cdc.gov/nchs/products/databriefs/db330.htm

Hom, M. A., Duffy, M. E., Rogers, M. L., Hanson, J. E., Gutierrez, P. M., & Joiner, T. E. (2019). Examining the link between prior suicidality and subsequent suicidal ideation among high-risk U.S. military service members. *Psychological Medicine, 49,* 2237–2246. http://dx.doi.org/10.1017/S0033291718003124

AQ: 13

Hom, M. A., Joiner, T. E., Jr., & Bernert, R. A. (2016). Limitations of a single-item assessment of suicide attempt history: Implications for standardized suicide risk assessment. *Psychological Assessment, 28,* 1026–1030. http://dx.doi.org/10.1037/pas0000241

Hom, M. A., Stanley, I. H., Duffy, M. E., Rogers, M. L., Hanson, J. E., Gutierrez, P. M., & Joiner, T. E. (2019). Investigating the reliability of suicide attempt history reporting across five measures: A study of U.S. military service members at risk of suicide. *Journal of Clinical Psychology, 75,* 1332–1349. http://dx.doi.org/10.1002/jclp.22776

AQ: 14

Janes, H., Longton, G., & Pepe, M. S. (2009). Accommodating covariates in receiver operating characteristic analysis. *The Stata Journal, 9,* 17–39. http://dx.doi.org/10.1177/1536867X0900900102

Jobes, D. A., & Joiner, T. E. (2019). Reflections on suicidal ideation. *Crisis, 40,* 227–230. http://dx.doi.org/10.1027/0227-5910/a000615

Joiner, T. E., Jr., Pfaff, J. J., & Acres, J. G. (2002). A brief screening tool for suicidal symptoms in adolescents and young adults in general health settings: Reliability and validity data from the Australian National General Practice Youth Suicide Prevention Project. *Behaviour Research and Therapy, 40,* 471–481. http://dx.doi.org/10.1016/S0005-7967(01)00017-1

Kessler, R. C., Warner, C. H., Ivany, C., Petukhova, M. V., Rose, S., Bromet, E. J., . . . Ursano, R. J. (2015). Predicting suicides after psychiatric hospitalization in U.S. Army soldiers: The Army Study To Assess Risk and rEsilience in Servicemembers (Army STARRS). *Journal of the American Medical Association Psychiatry, 72,* 49–57. http://dx.doi.org/10.1001/jamapsychiatry.2014.1754

Linehan, M. M., Comtois, K. A., Brown, M. Z., Heard, H. L., & Wagner, A. (2006). Suicide Attempt Self-Injury Interview (SASII): Development, reliability, and validity of a scale to assess suicide attempts and intentional self-injury. *Psychological Assessment, 18,* 303–312. http://dx.doi.org/10.1037/1040-3590.18.3.303

Linehan, M. M., & Heard, H. L. (1987). *Treatment history interview (THI)*. Seattle, Washington: University of Washington.

Martin, J., Ghahramanlou-Holloway, M., Lou, K., & Tucciarone, P. (2009). A comparative review of U.S. military and civilian suicide behavior: Implications for OEF/OIF suicide prevention efforts. *Journal of Mental Health Counseling, 31,* 101–118. http://dx.doi.org/10.17744/mehc.31.2.a6338384r2770383

Meade, A. W., Johnson, E. C., & Braddy, P. W. (2008). Power and sensitivity of alternative fit indices in tests of measurement invariance. *Journal of Applied Psychology, 93,* 568–592. http://dx.doi.org/10.1037/0021-9010.93.3.568

Millner, A. J., Lee, M. D., & Nock, M. K. (2015). Single-item measurement of suicidal behaviors: Validity and consequences of misclassification. *PLoS ONE, 10,* e0141606. http://dx.doi.org/10.1371/journal.pone.0141606

Muthén, L. K., & Muthén, B. O. (2012). *Mplus statistical modeling software: Release 7.0*. Los Angeles, CA: Author.

Nock, M. K., Park, J. M., Finn, C. T., Deliberto, T. L., Dour, H. J., & Banaji, M. R. (2010). Measuring the suicidal mind: Implicit cognition predicts suicidal behavior. *Psychological Science, 21,* 511–517. http://dx.doi.org/10.1177/0956797610364762

Nock, M. K., Stein, M. B., Heeringa, S. G., Ursano, R. J., Colpe, L. J., Fullerton, C. S., . . . Kessler, R. C. (2014). Prevalence and correlates of suicidal behavior among soldiers: Results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Journal of the American Medical Association Psychiatry, 71,* 514–522. http://dx.doi.org/10.1001/jamapsychiatry.2014.30

Nordentoft, M., Mortensen, P. B., & Pedersen, C. B. (2011). Absolute risk of suicide after first hospital contact in mental disorder. *Archives of General Psychiatry, 68,* 1058–1064. http://dx.doi.org/10.1001/archgenpsychiatry.2011.113

Osman, A., Bagge, C. L., Gutierrez, P. M., Konick, L. C., Kopper, B. A., & Barrios, F. X. (2001). The Suicidal Behaviors Questionnaire-Revised (SBQ-R): Validation with clinical and nonclinical samples. *Assessment, 8,* 443–454. http://dx.doi.org/10.1177/107319110100800409

Pruitt, L. D., Smolenski, D. J., Bush, N., & Skopp, N. (2018). *CY 2016 Department of Defense Suicide Event Report*. http://dx.doi.org/10.13140/RG.2.2.36668.13445

Ramchand, R., Rudavsky, R., Grant, S., Tanielian, T., & Jaycox, L. (2015). Prevalence of, risk factors for, and consequences of posttraumatic stress disorder and other mental health problems in military populations deployed to Iraq and Afghanistan. *Current Psychiatry Reports, 17,* 37. http://dx.doi.org/10.1007/s11920-015-0575-z

Ringer, F. B., Soberay, K. A., Rogers, M. L., Hagan, C. R., Chu, C., Schneider, M., . . . Joiner, T. E. (2018). Initial validation of brief measures of suicide risk factors: Common data elements used by the Military Suicide Research Consortium. *Psychological Assessment, 30,* 767–778. http://dx.doi.org/10.1037/pas0000519

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting structural equation modeling and confirmatory factor analysis results: A review. *The Journal of Educational Research, 99,* 323–338. http://dx.doi.org/10.3200/JOER.99.6.323-338

Sher, L. (2004). Preventing suicide. *QJM: An International Journal of Medicine, 97,* 677–680. http://dx.doi.org/10.1093/qjmed/hch106

Silverman, M. M., & Berman, A. L. (2014). Suicide risk assessment and risk formulation part I: A focus on suicide ideation in assessing suicide risk. *Suicide and Life-Threatening Behavior, 44,* 420–431. http://dx.doi.org/10.1111/sltb.12065

Stanley, I. H., Boffa, J. W., Rogers, M. L., Hom, M. A., Albanese, B. J., Chu, C., . . . Joiner, T. E. (2018). Anxiety sensitivity and suicidal ideation/suicide risk: A meta-analysis. *Journal of Consulting and Clinical Psychology, 86,* 946–960. http://dx.doi.org/10.1037/ccp0000342

Stanley, I. H., Buchman-Schmitt, J. M., Chu, C., Rogers, M. L., Gai, A. R., Wagner, R. K., . . . Joiner, T. E. (2019). The Military Suicide Research Consortium common data elements: An examination of measurement invariance across current service members and veterans. *Assessment, 26,* 963–975.

Stanley, I. H., Rogers, M. L., Hanson, J. E., Gutierrez, P. M., & Joiner, T. E. (2019). PTSD symptom clusters and suicide attempts among high-risk military service members: A three-month prospective investigation. *Journal of Consulting and Clinical Psychology, 87,* 67–78. http://dx.doi.org/10.1037/ccp0000350

Strosahl, K., Chiles, J. A., & Linehan, M. (1992). Prediction of suicide intent in hospitalized parasuicides: Reasons for living, hopelessness, and depression. *Comprehensive Psychiatry, 33,* 366–373. http://dx.doi.org/10.1016/0010-440X(92)90057-W

Swets, J. (2012). *Evaluation of diagnostic systems*. Orlando, FL: Academic Press.

Taylor, S., Zvolensky, M. J., Cox, B. J., Deacon, B., Heimberg, R. G., Ledley, D. R., . . . Cardenas, S. J. (2007). Robust dimensions of anxiety sensitivity: Development and initial validation of the Anxiety Sensitivity Index-3. *Psychological Assessment, 19,* 176–188. http://dx.doi.org/10.1037/1040-3590.19.2.176

Ursano, R. J., Kessler, R. C., Stein, M. B., Naifeh, J. A., Aliaga, P. A., Fullerton, C. S., . . . Heeringa, S. G. (2015). Suicide attempts in the U.S. Army during the wars in Afghanistan and Iraq, 2004 to 2009. *Journal of the American Medical Association Psychiatry, 72,* 917–926. http://dx.doi.org/10.1001/jamapsychiatry.2015.0987

Van Orden, K. A., Cukrowicz, K. C., Witte, T. K., & Joiner, T. E., Jr. (2012). Thwarted belongingness and perceived burdensomeness: Construct validity and psychometric properties of the Interpersonal Needs

Questionnaire. *Psychological Assessment, 24,* 197–215. http://dx.doi.org/10.1037/a0025358

Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., & Joiner, T. E., Jr. (2010). The interpersonal theory of suicide. *Psychological Review, 117,* 575–600. http://dx.doi.org/10.1037/a0018697

Vastag, B. (2001). Suicide prevention plan calls for physicians' help. *Journal of the American Medical Association, 285,* 2701–2703. http://dx.doi.org/10.1001/jama.285.21.2701

Weathers, F., Huska, J., & Keane, T. (1991). *The PTSD checklist—Military version (PCL-M)*. Boston, MA: National Center for PTSD. AQ: 17

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AQ10—Author: "identifies and classifies" OK? (to match singular subject, "risk factor")

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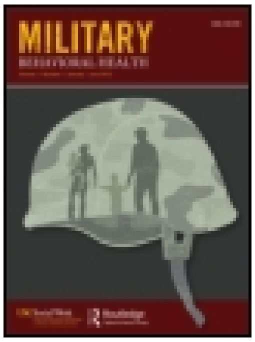

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Suicidal Ideation Severity in Transgender and Cisgender Elevated-Risk Military Service Members at Baseline and Three-Month Follow-Up

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ABSTRACT

There is a dearth of research on mental health in transgender military service members, despite 21.4% of eligible transgender United States citizens having served in the military. The aim of this study was to examine differences in suicide risk and ideation based on gender identity in elevated risk service members over a 3-month period. Participants included 1,041 military service members identified as at risk of suicide by military treatment providers. Of these participants, 1,027 provided baseline data and 726 provided follow-up data. Baseline suicide risk was measured using the Suicidal Behaviors Questionnaire—Revised, and baseline suicidal ideation was derived from the Self Harm Behaviors Questionnaire. Follow-up data on suicidal ideation were collected using the Adult Suicidal Ideation Questionnaire. At baseline, differences in suicide risk and ideation between transgender and cisgender military members were not significant. However, at the 3-month follow-up, transgender service members had significantly higher levels of suicidal ideation than cisgender service members. In our sample, at-risk transgender service members do not differ from their at-risk cisgender counterparts in severity of suicidal risk or ideation. These findings have implications for future research to inform military policy and mental health services.

KEYWORDS

Suicide; military; suicidal ideation; service member; identity; gender; transgender

Rates of death by suicide in active duty United States military service members have nearly doubled between 2005 and 2011 (Anglemyer et al., 2016). Given this increase, it is important to address suicide risk in this population through a cultural lens (Bryan et al., 2012). There is some evidence to suggest that service members who are in a minority subgroup might be at an elevated risk for suicide; for example, new soldiers who were in a minority gender, race, or religious subgroup had higher odds of suicidal plans and attempts (Ursano et al., 2015).

Transgender service members are a significant minority subgroup within the military. In fact, the military is the largest employer of transgender individuals, with 21.4% of transgender individuals in the United States having served in the military (Gates & Herman, 2014; Zugelder & Champagne, 2018). In 2016, there were an estimated 1,320–6,630 transgender individuals actively serving in the military (Schaefer et al., 2016). However, research on transgender military service members' mental health is limited, in part because of the short duration of legislation allowing transgender military members to openly serve, lasting from 2016 to 2019 (Jane Doe v. Shanahan, 2019; Zugelder & Champagne, 2018). This political history has contributed to other factors limiting research on transgender service members, including the dilemma transgender service members face of whether or not to disclose their gender identity, the lack of systematic data collection on assigned sex at birth and gender identity in military personnel systems, and the conflation of Gender Identity Disorder diagnoses with transgender identification (Blosnich et al., 2013; Downing et al., 2018).

Research on suicide risk in transgender service members is especially important given higher rates of suicidal ideation and attempts in the transgender civilian population (Haas et al., 2010, 2014). The Gender Minority Stress Model provides a theoretical basis consistent with finding, positing that transgender individuals might be at risk for suicidal ideation and attempts because they experience unique stressors

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related to their identity, such as discrimination, which can precipitate the development and maintenance of suicidal ideation (Testa et al., 2017). In addition, the Cultural Model of Suicide illustrates how cultural experiences unique to particular minority groups, such as the transgender population, influences the development and expression of suicidal tendencies. Therefore, treatments that do not account for these cultural experiences can fail to adequately assess or address suicidal tendencies in transgender individuals (Chu et al., 2010). The disparities in suicide rates between transgender and cisgender civilians could be augmented by the lack of adapted empirically-supported interventions to address stressors unique to the transgender community, along with a lack of transgender affirming training among mental health professionals (Haas et al., 2010; Mizock & Lundquist, 2016).

Research on gender identity and suicide disparities in the military has either utilized samples solely consisting of veterans or samples that do not distinguish between veterans and current service members (Matarazzo et al., 2014). National online surveys indicate that more than 65% of transgender veterans have experienced lifetime suicide-related ideation, and more than 30% have experienced a history of at least one suicide attempt (Lehavot et al., 2016; Tucker et al., 2019). Further evidence shows that transgender veterans are at a 4–5 times greater risk of reporting either suicidal ideation or a suicide attempt (Brown & Jones, 2016). In line with the Gender Minority Stress Model, experiencing stigma-related minority stressors during and after military service may increase the risk for suicidal thoughts and behaviors in transgender veterans (Tucker et al., 2019). However, extant findings should not be generalized to active duty service members, as there are differences in mental health outcomes between transgender veterans and transgender active duty service members (Hill et al., 2016). At this time, there is a lack of literature examining suicide risk in transgender service members.

Ultimately, these findings underscore the need to further our understanding of the experiences of transgender service members. Further, it is important to look at differences in clinical outcomes in transgender and cisgender service members. The purpose of this study was to determine whether (1) suicide risk upon being brought to the attention of mental health providers, and (2) suicidal ideation at 3-month follow-up, differed between transgender and cisgender service members who had been referred to psychiatric services for suicide-related concerns. Importantly, all participants in the current study were included with elevated levels of suicide risk at baseline, as indicated by clinician assessment, bolstering the clinical relevance of findings.

Methods

Participants/Procedures

The current study uses data from a larger investigation of mental health and suicide risk in U.S. military service members (Gutierrez et al., 2019; Stanley et al., 2019). Participants included active duty service members ($n = 1,041$) who were referred to/seeking care for a suicide-related concern from a military emergency department, outpatient behavioral health clinic, or inpatient psychiatric unit at two large military installations in the southeastern and southern U.S. All eligible participants were determined to be at an elevated level of suicide risk at baseline based on clinician assessment at each military installation utilizing their standard suicide screening protocols. As eligibility was solely determined by military clinician assessment of baseline risk, participants were not rescreened for eligibility at follow-up. Upon providing written informed consent, participants completed a baseline battery of self-report measures related to suicide and mental health (those utilized in the current analyses are described below in the Measures section). Three months after the baseline assessment, study staff contacted participants via phone or scheduled an in-person visit to administer follow-up measures. The study received ethics approval from all relevant university and military institutional review boards (IRBs) as well as the Department of Defense Human Research Protection Office (HRPO). Data were collected from January 2014 to July 2017, including time periods when the transgender military service ban was in place (January 2014–June 2016) and was repealed (June 2016–July 2017).

Out of the 1,041 active duty members who provided data for the larger study, 14 participants did not report gender identity and were excluded from these analyses. At baseline, data from 1,027 service members with non-zero levels of suicide risk were included. The mean Suicidal Behaviors Questionnaire-Revised (SBQ-R) suicide risk score was 9.44 ($SD = 3.50$) at baseline, exceeding the cutoff for clinical significance in both the general adult population (i.e., >7) and inpatient psychiatric population (i.e., > 8; Osman et al., 2001), as expected given study inclusion criteria. Follow-up data were provided by 73.1% ($n = 751$) of the sample. Study completers and study non-completers did not differ by gender identity ($p = 0.28$), nor did they differ in severity of suicide risk, as measured by the SBQ-R total score ($p = 0.08$), severity of lifetime suicidal ideation, as measured by the Self-Harm Behaviors Questionnaire (SHBQ) Ideation subscore ($p = 0.17$), or severity of lifetime suicide attempts, as measured by the SHBQ Attempts subscore ($p = 0.09$).

Measures

Demographics

A self-report questionnaire developed for the primary study was administered to participants to assess sociodemographic characteristics (e.g., age, gender, race/ethnicity). Gender identity was reported as cisgender (male/female) or transgender.

Suicidal Behaviors Questionnaire— Revised (SBQ-R)

The SBQ-R is a 4-item self-report index of current suicide risk potential, including the frequency of past-year suicidal ideation, one's perceived future likelihood of making a suicide attempt (cf. suicidal intent), and past suicide plans and attempts. The SBQ-R has strong psychometric properties (Osman et al., 2001) and has been identified by a systematic review as a paragon measure of suicide risk in population-based studies (Batterham et al., 2015). In the current sample, the SBQ-R demonstrated acceptable internal consistency ($\alpha = 0.72$). The SBQ-R was assessed at baseline.

Self-Harm Behavior Questionnaire (SHBQ)

The SHBQ was assessed at baseline. The SHBQ is a 4-section structured interview that asks about lifetime experiences of non-suicidal self-harm, suicide attempts, suicide threats, and suicide ideation (Gutierrez et al., 2001). To operationalize baseline suicidal ideation, we used scores from the ideation section (Section D) of the SHBQ. A higher score indicates a greater severity of suicide ideation. The SHBQ Ideation section had high internal consistency ($\alpha = 0.89$) in the current sample.

Adult Suicidal Ideation Questionnaire (ASIQ)

The ASIQ is a 25-item, self-report questionnaire that assesses the frequency and severity of suicidal ideation over the past month. The ASIQ has demonstrated strong psychometric qualities, including high internal consistency and test-retest reliability (Reynolds, 1991). In this sample, the ASIQ demonstrated excellent internal consistency ($\alpha = 0.96$). The cutoff score for clinical significance (indicating that further evaluation is necessary) has been established as 31 (Gutierrez et al., 2016; Reynolds, 1991). The ASIQ was administered at the 3-month follow-up. It should be noted that the purpose of the parent study was to evaluate predictive validity and other characteristics of four suicide-specific assessment tools. Therefore, it was necessary to assess suicide ideation at follow-up with a different measure than used at baseline in order to prevent testing the ability of a measure to predict scores on itself.

Data analytic strategy

Descriptive statistics were used to describe the sample's demographics and prevalence of suicidal ideation and risk. Study variables were screened for violations of normality; all predictor variables were within acceptable ranges (i.e., ± 2 for skewness and kurtosis). The interrelatedness between study variables was then examined. Two one-way analysis of covariance (ANCOVA) models were utilized to assess for differences between transgender and cisgender service members in (1) baseline suicide risk (SBQ-R score) and (2) baseline suicidal ideation (SHBQ Ideation score) while controlling for race. Next, an analysis of covariance (ANCOVA) model assessed differences between transgender and cisgender service members in suicidal ideation at the 3-month follow-up (ASIQ total score), controlling for race, baseline suicide risk and baseline suicidal ideation.

As unequal group sizes may violate the assumption of homogeneity of variance required for ANCOVAs, especially given that there were far fewer transgender than cisgender service members in our sample, we tested for homogeneity of variance utilizing Levene's test (Levene, 1960).A non-significant Levene's test suggests that the assumption of homogeneity of variance is met and ANCOVA findings are interpretable, even in the context of unequal between-group sample sizes.

Results

Table 1 displays the demographic characteristics of cisgender and transgender military service members. The average age of participants was approximately 25 years old ($M = 24.92$, $SD = 5.99$). Participants predominantly identified as cisgender ($n = 1018$; 99.1%), of whom 76.1% identified as male ($n = 775$) and 23.9% identified as female ($n = 243$). Our sample consisted of 9 participants who identified as transgender ($n = 9$; 0.9%). Of the full sample, 59.4% of participants identified as White/Caucasian ($n = 610$), 21.5% of participants identified as Black/African-American ($n = 221$), and 19.1%

Table 1. Participant sociodemographic and military experience characteristics.

Characteristic	Baseline				3-month follow-up			
	Cisgender (*N* = 1018)		Transgender (*N* = 9)		Cisgender (*N* = 719)		Transgender (*N* = 7)	
Age in years (*M* ± *SD*)	24.93 ± 5.98		24.00 ± 7.35		25.22 ± 4.65		22.29 ± 4.82	
Years of military service (*M* ± *SD*)	4.4 ± 4.9		4.0 ± 4.9		4.7 ± 5.0		3.4 ± 4.9	
Number of deployments (*M* ± *SD*)	2.1 ± 2.3		1.3 ± 0.5		2.3 ± 2.4		1.3 ± 0.5	
Hours of combat experience (*M* ± *SD*)	1.8 ± 0.4		1.6 ± 0.5		1.7 ± 0.5		1.6 ± 0.5	
	N	%	N	%	N	%	N	%
Race*								
White/Caucasian	605	*59.6*	5	*55.6*	442	*61.6*	3	*42.9*
Black/African American	219	*21.5*	2	*22.2*	141	*19.6*	2	*28.6*
Native American/Alaska Native	7	*0.7*	1	*11.1*	5	*0.7*	1	*14.3*
Asian/Pacific Islander	40	*3.9*	0	–	30	*4.2*	0	–
Other	144	*14.2*	1	*11.1*	100	*13.9*	1	*14.3*
Missing	3	–	0	–	1	–	0	–
Ethnicity								
Hispanic or Latinx	157	*17.8*	1	*11.1*	126	*18.7*	1	*14.3*
Not Hispanic or Latinx	660	*74.8*	8	*88.9*	521	*77.3*	6	*85.7*
Other	65	*7.4*	0	–	27	*4.0*	0	–
Missing	136	–	0	–	45	–	0	–
Education								
Did not complete high school	7	*0.7*	0	–	3	*0.4*	0	–
High school graduate/GED	520	*51.1*	8	*88.9*	352	*49.0*	6	*85.7*
Some college, no degree	363	*35.7*	1	*11.1*	268	*37.3*	1	*14.3*
College graduate, Associate's	56	*5.5*	0	–	41	*5.7*	0	–
College graduate, Bachelor's	57	*5.6*	0	–	44	*6.1*	0	–
Graduate degree	15	*1.5*	0	–	11	*1.5*	0	–
Missing	0	–	0	–	0	–	0	–
Relationship status								
Married	380	*37.3*	3	*33.3*	278	*38.7*	2	*28.6*
Single	517	*50.8*	5	*55.6*	345	*48.0*	4	*57.1*
Separated	74	*7.3*	1	*11.1*	54	*7.5*	1	*14.3*
Divorced	47	*4.6*	0	–	42	*5.8*	0	–
Missing	0	–	0	–	0	–	0	–
Military branch								
Army	372	*36.7*	3	*33.3*	312	*43.6*	3	*42.9*
Air Force	32	*3.2*	0	–	19	*2.7*	0	–
Navy	556	*54.9*	6	*66.7*	351	*49.0*	4	*57.1*
Marine Corps	40	*3.9*	0	–	26	*3.6*	0	–
Coast Guard	13	*1.3*	0	–	8	*1.1*	0	–
Missing	5	–	0	–	3	–	0	–

*indicates significant difference in group (row) distributions at baseline between transgender and cisgender service members (χ^2 = 12.842, $p = 0.012$).

of participants identified as another race ($n = 196$). Transgender and cisgender military service members did not significantly differ in age, military branch served, years served, education, relationship status or deployment status (see Table 1). There were significant differences in the racial distributions between transgender and cisgender military service members (χ^2 = 12.842, $p = 0.012$). However, a follow-up analysis indicated these differences could be due to the lack of representation of transgender military service members in certain racial groups. The distribution of those who identified as Caucasian vs. non-Caucasian did not significantly differ based on gender identity (χ^2 = 0.601, $p = 0.805$). Nonetheless, race was included as a covariate in our analyses.

Table 2 presents suicide measure characteristics by gender identity. There were no significant differences in percentages of individuals who reported a history of suicide attempts at baseline ($\chi^2[1]$ = .070, p = .792) or follow-up ($\chi^2[1] = 1.021$, p = .312) as a function of gender identity, based on the first question in the Attempts section from the Self-Harm Behaviors Questionnaire, which assessed whether participants had ever attempted suicide in their lifetime.

Study variable means, standard deviations, normality statistics, and bivariate correlations are presented in Table 3. Table 4 presents the ANCOVA statistics for each of the below models.

Model 1: Suicide risk

Levene's test indicated that the assumption of the homogeneity of variance was met ($p = 0.244$). After controlling for race, there were no significant differences between transgender and cisgender military members in SBQ-R scores, indicating no significant differences in suicide risk at the baseline measurement point ($F(1, 987)$ = 0.016; $p = 0.901$). There were significant differences in SBQ-R scores based on race, ($F(4, 987)$ = 3.05; $p = 0.012$). Post-hoc analyses using

Table 2. Suicide measure characteristics by gender identity.

Suicide measures (baseline)	Cisgender ($N = 1018$)		Transgender ($N = 9$)		p-value*
	M ± *SD*	*M* ± *SD*	*M* ± *SD*		
SBQ-R Item 1: Lifetime severity	2.80 ± 1.02		2.78 ± 1.20		0.955
SBQ-R Item 2: 12-month suicidal ideation frequency	3.27 ± 1.36		3.44 ± 1.51		0.708
SBQ-R Item 3: Threat of suicide attempt (intent)	1.71 ± 0.69		1.56 ± 0.88		0.514
SBQ-R Item 4: Likelihood of future suicidal ideation	1.61 ± 1.52		1.89 ± 1.61		0.585
BSS Total Score	6.21 ± 8.23		9.33 ± 9.33		0.259
C-SSRS severity of ideation	3.37 ± 1.55		4.14 ± 1.78		0.188
C-SSRS severity of behavior	1.26 ± 1.26		1.21 ± 1.09		0.218
	N	%	N	%	
Lifetime severity subgroups (SBQ-R Item 1):					
Non-suicidal	150	*14.9*	2	*22.2*	0.542
Suicide risk ideation	202	*20.1*	1	*11.1*	0.502
Suicide plan	355	*35.3*	3	*33.3*	0.901
Suicide attempt	298	*29.7*	3	*33.3*	0.810
Suicidal ideation in past 12 months (SBQ-R Item 2)	885	*88.0*	8	*88.9*	0.941
SBQ-R above clinical cutoff	689	*70.3*	6	*66.7*	0.812
Suicide measures (follow-up)	**Cisgender ($N = 719$)**		**Transgender ($N = 7$)**		
	N	%	N	%	
ASIQ above clinical cutoff	120	*16.7*	3	*33.3*	0.066

*$p < 0.05$. *p*-values calculated through chi-squared tests/independent groups t-tests. SBQ-R = Suicidal Behaviors Questionnaire—Revised; BSS = Beck Scale for Suicide Ideation; C-SSRS = Columbia-Suicide Severity Rating Scale; ASIQ = Adult Suicidal Ideation Questionnaire.

Table 3. Study variable means, standard deviations, and intercorrelations.

Variable *Gender identity*	R^2			*N* *Cis*	*N* *Trans*	*M (SD)* *Cis*	*M (SD)* *Trans*	*p*-value	Skewness	Kurtosis
1. SBQ-R suicide risk (T1)	–			980	9	9.4 (3.5)	9.7 (4.3)	0.821	−0.03 (0.08)	−0.63 (0.16)
2. SHBQ suicidal ideation (T1)	.417**	–		992	9	6.9 (3.3)	7.2 (4.0)	0.159	−0.48 (0.08)	−0.50 (0.15)
3. ASIQ suicidal ideation (T2)	.278**	.244**	–	719	7	17.6 (20.8)	31.4 (1.7)	0.033*	1.99 (0.09)	4.27 (0.18)

*$p < 0.05$. **$p < 0.01$. *p*-values calculated through Pearson's correlations/independent groups t-test. SBQ-R = Suicidal Behaviors Questionnaire—Revised; SHBQ = Self Harm Behavior Questionnaire; ASIQ = Adult Suicidal Ideation Questionnaire; T1 = time point one (baseline); T2 = time point two (3-month follow-up).

Table 4. ANCOVA models examining gender identity as a predictor of baseline and follow-up suicide risk/ideation.

Predictors	*df*	*MS*	*F*	*p-value*	*np2*
Model 1: SBQ-R[a] (baseline risk)					
Gender identity	1	0.19	0.02	0.901	<0.001
Race	4	36.67	3.05	0.016*	0.012
Model 2: SHBQ[b] (baseline ideation)					
Gender identity	1	0.49	0.11	0.742	<0.001
Race	4	19.65	1.85	0.117	0.007
Model 3: ASIQ[c] (follow-up ideation)					
Overall model	8	32160.49	78.99	<0.001*	0.479
Gender identity	1	1718.28	4.22	0.040*	0.006
Baseline suicide risk (SBQ-R)[a]	1	11797.48	28.98	<0.001*	0.041
Baseline suicidal ideation (SHBQ)[b]	1	6610.61	16.24	<0.001*	0.023
Race	4	155.14	0.38	0.822	0.002

*$p < 0.05$.
[a]SBQ-R = Suicidal Behaviors Questionnaire—Revised; [b]SHBQ = Self Harm Behavior Questionnaire—Ideation; [c]ASIQ = Adult Suicidal Ideation Questionnaire.

Tukey's HSD test revealed that White/Caucasian military service members ($M = 9.67$, $SD = 3.43$) had higher baseline suicide risk scores compared to Black/African American military service members ($M = 8.81$, $SD = 3.69$; $p = 0.023$).

Model 2: Baseline suicidal ideation

Levene's test was non-significant, indicating that the assumption of the homogeneity of variance was met ($p = 0.321$). After controlling for race, there were no significant differences between transgender and cisgender military members in SHBQ Ideation scores, indicating no significant differences in baseline suicidal ideation ($F[1, 999] = 0.046$; $p = 0.830$).

Model 3: Follow-up suicidal ideation

A non-significant Levene's test indicated that the assumption of the homogeneity of variance was met

($p = 0.684$). While controlling for race, baseline suicide risk (SBQ-R) and baseline suicidal ideation (SHBQ), there were significant differences between transgender service members and cisgender service members in suicidal ideation at three-month follow-up ($F[1, 691] = 4.139$; $p = 0.042$; $np^2 = 0.006$). Transgender service members ($M = 34.57$, $SD = 31.42$) had significantly higher levels of suicidal ideation at three-month follow-up than cisgender service members ($M = 17.64$, $SD = 20.81$). The overall model significantly predicted the variation in ASIQ scores ($F[3, 691] = 26.867$; $p < 0.01$, $R^2 = 0.101$). Both baseline suicide risk (SBQ-R score; $F[1, 686] = 16.236$; $p < 0.01$; $np^2 = 0.041$) and severity of baseline suicidal ideation (SHBQ Ideation score; $F([1, 686] = 28.975$; $p < 0.01$; $np^2 = 0.023$) were significant predictors of follow-up suicidal ideation.

Discussion

This study sought to examine differences in severity of suicide-related variables between transgender and cisgender service members with non-zero suicide risk levels at two time points: baseline and 3-month follow-up. The results of the current study demonstrated no significant differences in overall baseline suicide risk or baseline suicidal ideation between transgender and cisgender service members; however, at the 3-month follow-up, transgender service members experienced a higher level of suicidal ideation compared to cisgender service members. In fact, the transgender service members' average ASIQ score was above the clinical cutoff on that measure whereas the cisgender service members' was well below it. While more work in this area is needed to replicate findings, particularly because of the small transgender sample size, this study has important implications for the mental health treatment of gender minorities in the military.

First, the finding that, in our sample, transgender military service members did not differ in severity of suicide risk or ideation at baseline compared to cisgender service members is notable. That is, in this sample, transgender service members referred to or seeking care for suicide-related concerns were not at higher risk for suicide than their cisgender service member counterparts. While our small sample size limits the ability to draw generalizations, this finding prompts the need for greater research on suicide risk differences between transgender and cisgender service members as a result of military service, especially given assertions about transgender mental health and military efficacy. In particular, mental health disparities between transgender and cisgender individuals have been used as a justification to restrict transgender individuals from enlisting in the military (Winer, 2018), despite a lack of research substantiating these claims. Even though the findings from the current study might be an artifact of the low number of transgender members in our sample, it is important to note that the proportion of transgender service members in our sample (0.1%) roughly mirrors the unadjusted population percentage (0.16%; Schaefer et al., 2016). We did not statistically test whether these percentages are different. Nonetheless, the comparison between our sample proportion and the population proportion might indicate that at these military installations, transgender service members are not disproportionately referred to or seeking mental health care compared to cisgender service members. While conclusions are limited from this particular analysis, this finding illustrates the need for greater research on the claim that gender identity confers elevated risk for suicide among active service members.

In contrast to baseline findings, transgender military service members reported higher suicidal ideation than their cisgender counterparts at 3-month follow up, controlling for baseline suicide risk. Since the 3-month follow-up period followed access to mental health services specifically directed at suicide-related concerns, our results might indicate that the care received may have differentially addressed suicidal ideation in transgender and cisgender service members. However, this interpretation is tempered by the fact that no data were collected on the specific nature of services received (e.g., frequency, modality), nor data on treatment engagement or the frequency of mental health service utilization over the 3-month period. Many other factors likely contributed to the differences noted, and additional research is needed to identify the most important ones to target with policy and practice changes.

Previous literature has documented the need for psychological treatments to adopt a culturally competent approach for transgender individuals (Borden, 2015). As mentioned earlier, the Gender Minority Stress Model posits that transgender individuals face unique stressors that confer a differential risk for developing suicidal ideation and behaviors compared to cisgender individuals (Testa et al., 2017; Tucker et al., 2019). Existing treatment models were designed to address risk in cisgender individuals. It may be that specific factors underlying risk for suicidal thoughts and behaviors in transgender individuals are not addressed by current military treatment protocols. Implementing simple adaptations to evidence-based therapies, such as Transgender Affirmative Cognitive Behavioral Therapy (TA-CBT), which provides frameworks for addressing minority stressors, the effect of discrimination on mental health, and transphobic negative self-beliefs, could increase the efficacy of military mental health treatment for transgender service members (Austin & Craig, 2015). More work is needed to determine whether mental health treatment in military environments needs to be tailored to better address suicidal ideation in transgender service members. We also note that no information was gathered on subjective or objective quality of mental healthcare received during the follow-up period, so we are unable to comment on the extent to which it did or did not meet the cultural needs of the transgender participants.

Results of this study should be interpreted in the context of several limitations. First, the overall sample included a small number of transgender individuals. Levene's test justified the statistical validity of our data analytic approach. However, due to the small sample size, we may have been underpowered to detect significant findings at baseline. Unfortunately, the small sample size is to be expected given the specificity of the subsample (i.e., transgender identity and referred to treatment/seeking treatment for elevated suicide risk, both of which appear at low base rates in the population). Future studies in military clinical settings that oversample for transgender service members are needed, although this will be difficult given current political restrictions. Though this is a logistically difficult research area, studies exploring transgender military mental health are extremely important, especially given the military's history of employing transgender individuals and the political implications mentioned earlier.

Second, interpretations are limited by the use of different methods to collect and measure suicide risk and ideation at baseline and follow-up. At follow-up, participants either answered questions about suicidal ideation over the phone or in person, which could have affected disclosure. Unfortunately, we did not collect data on follow-up methodology, and therefore could not control for it in the current analyses. Further, as explained in the methods section, the use of different measures was necessary in the parent study that provided data for these secondary analyses. As such, we do not have a direct comparison measure to explore quantitative differences in suicide-related variables over time. This information would be useful in order to assess the change in suicidal ideation over time between cisgender and transgender participants. However, the use of different suicide measures at baseline and follow-up is also a study strength. Doing so reduces common-method variance, which can artificially inflate statistical relationships by creating covarying measurement error (Sharma et al., 2009). For example, using different measures to assess suicidal ideation reduces the likelihood that our findings are an artifact of participant response biases, such as illusory correlations and desirability effects (Buckner et al., 2012). Some may suggest the different findings at baseline and follow-up could be explained by sensitivity and specificity differences in the instruments. This argument would be compelling if the mean ASIQ scores in the two groups only differed by a few points, but the transgender participants' mean score was above the clinical cutoff and the cisgender participants' mean score was well below it. Therefore, it is unlikely that these findings are driven by differences in sensitivity/specificity of the instruments.

Third, we do not know specifics for the treatments administered to participants, which limits our ability to propose treatment changes. For example, we do not know how many sessions they attended or what treatment modality they received. However, since these data were drawn from an assessment study and not a clinical trial, it is reasonable to assume that all service members received typical care in the respective clinical settings from which they were recruited.

Fourth, a two-step method of gender identity was not used in the parent study. As this was a secondary data analysis, we cannot speak to the role of assigned gender at birth or current gender identity. Also, we do not know if respondents disclosed their transgender status to their healthcare providers. Disclosure may affect healthcare efficacy in many ways—such as healthcare provider biases, failure to address the unique stressors of the patient, a lack of therapeutic relationship between patient/provider, or various other concerns. Future research studies should examine how gender identity disclosure directly impacts experience of mental health treatment for transgender military service members.

Despite these limitations, this study is the first, to our knowledge, to explore how suicidal ideation differs between transgender and cisgender active duty service members at two time points. Our findings indicate no differences in suicide risk or ideation severity between elevated-risk transgender and cisgender service members entering treatment in this sample, which indicates the need for further research addressing the validity of the assertion that transgender service members are prone to developing mental health issues as a result of military service. Rather, our results indicate that in this sample, suicidal ideation is significantly higher in transgender compared to cisgender service members three months after being referred to or seeking services for suicide risk, even though baseline risk and ideation levels do not differ. The current findings should be interpreted with caution due to the small sample size of transgender military service members. However, these findings support the need for future research oversampling for transgender military service members, and the implementation of culturally competent treatment for transgender service members, such as the Cultural Assessment of Risk for Suicide and Transgender Affirmitive Cognitive Behavioral Therapy (Austin & Craig, 2015; Chu et al., 2013). These findings have important implications for military policy and treatment protocols. More research oversampling for transgender service members is needed, as these results will be highly important to address if they hold up in larger samples.

Data availability

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

Anglemyer, A., Miller, M. L., Buttrey, S., & Whitaker, L. (2016). Suicide rates and methods in active duty military personnel, 2005 to 2011: A cohort study. *Annals of Internal Medicine*, *165*(3), 167–174. doi:10.7326/M15-2785

Austin, A., & Craig, S. L. (2015). Transgender affirmative cognitive behavioral therapy: Clinical considerations and applications. *Professional Psychology: Research and Practice*, *46*(1), 21–29. doi:10.1037/a0038642

Batterham, P. J., Ftanou, M., Pirkis, J., Brewer, J. L., Mackinnon, A. J., Beautrais, A., Fairweather-Schmidt, A. K., & Christensen, H. (2015). A systematic review and evaluation of measures for suicidal ideation and behaviors in population-based research. *Psychological Assessment*, *27*(2), 501–512. doi:10.1037/pas0000053

Blosnich, J. R., Brown, G. R., Shipherd, J. C., Kauth, M., Piegari, R. I., Bossarte, R. M., & Bossarte, R. M. (2013). Prevalence of gender identity disorder and suicide risk among transgender veterans utilizing veterans health administration care. *American Journal of Public Health*, *103*(10), e27–32. doi:10.2105/AJPH.2013.301507

Borden, K. A. (2015). Introduction to the special section transgender and gender noncomforming individuals: Issues for professional psychologists. *Professional Psychology: Research and Practice*, *46*(1), 1–2. doi:10.1037/a0038847

Brown, G. R., & Jones, K. T. (2016). Mental health and medical health disparities in 5135 transgender veterans receiving healthcare in the Veterans Health Administration: A case–control study. *LGBT Health*, *3*(2), 122–131. doi:10.1089/lgbt.2015.0058

Bryan, C. J., Jennings, K. W., Jobes, D. A., & Bradley, J. C. (2012). Understanding and preventing military suicide. *Archives of Suicide Research*, *16*(2), 95–110. doi:10.1080/13811118.2012.667321

Buckner, J. D., Joiner, T. E., Schmidt, N. B., & Zvolensky, M. J. (2012). Daily marijuana use and suicidality: The unique impact of social anxiety. *Addictive Behaviors*, *37*(4), 387–392. doi:10.1016/j.addbeh.2011.11.019

Chu, J., Floyd, R., Diep, H., Pardo, S., Goldblum, P., & Bongar, B. (2013). A tool for the culturally competent assessment of suicide: The Cultural Assessment of Risk for Suicide (CARS) measure. *Psychological Assessment*, *25*(2), 424–434. doi:10.1037/a0031264

Chu, J., Goldblum, P., Floyd, R., & Bongar, B. (2010). The cultural theory and model of suicide. *Applied and Preventive Psychology*, *14*(1–4), 25–40. doi:10.1016/j.appsy.2011.11.001

Downing, J., Conron, K., Herman, J. L., & Blosnich, J. R. (2018). Transgender and cisgender US veterans have few health differences. *Health Affairs*, *37*(7), 1160–1168. doi:10.1377/hlthaff.2018.0027

Gates, G. J., Herman, J. L. (2014). *Transgender military service in the United States*. https://escholarship.org/uc/item/1t24j53h.

Gutierrez, P. M., Joiner, T., Hanson, J., Stanley, I. H., Silva, C., & Rogers, M. L. (2019). Psychometric properties of four commonly used suicide risk assessment measures: Applicability to military treatment settings. *Military Behavioral Health*, *7*(2), 177–184. doi:10.1080/21635781.2018.1562390

Gutierrez, P. M., Davidson, C. L., Friese, A. H., & Forster, J. E. (2016). Physical activity, suicide risk factors, and suicidal ideation in a veteran sample. *Suicide and Life-Threatening Behavior*, *46*(3), 284–292. doi:10.1111/sltb.12190

Gutierrez, P. M., Osman, A., Barrios, F. X., & Kopper, B. A. (2001). Development and initial validation of the self-harm behavior questionnaire. *Journal of Personality Assessment*, *77*(3), 475–490. doi:10.1207/S15327752JPA7703_08

Haas, A. P., Eliason, M., Mays, V. M., Mathy, R. M., Cochran, S. D., D'Augelli, A. R., Silverman, M. M., Fisher, P. W., Hughes, T., Rosario, M., Russell, S. T., Malley, E., Reed, J., Litts, D. A., Haller, E., Sell, R. L., Remafedi, G., Bradford, J., Beautrais, A. L., … Clayton, P. J. (2010). Suicide and suicide risk in lesbian, gay, bisexual, and transgender populations: Review and recommendations. *Journal of Homosexuality*, *58*(1), 10–51. doi:10.1080/00918369.2011.534038

Haas, A. P., Rodgers, P. L., Herman, J. L. (2014). *Suicide attempts among transgender and gender non-conforming adults. Findings of the National Transgender Discrimination Survey*. https://williamsinstitute.law.ucla.edu/wp-content/uploads/AFSP-Williams-Suicide-Report-Final.pdf.

Hill, B. J., Bouris, A., Barnett, J. T., & Walker, D. (2016). Fit to serve? Exploring mental and physical health and well-being among transgender active-duty service members and veterans in the US military. *Transgender Health*, *1*(1), 4–11. doi:10.1089/trgh.2015.0002

Jane Doe v. Shanahan. (2019). Court of Appeals, Dist. of Columbia Circuit.

Lehavot, K., Simpson, T. L., & Shipherd, J. C. (2016). Factors associated with suicidality among a national sample of transgender veterans. *Suicide and Life-Threatening Behavior*, *46*(5), 507–524. doi:10.1111/sltb.12233

Levene, H. (1960). Robust tests for equality of variances. In I. Olkin, S.G. Ghurye, W.Hoeffding, W.G.Madow, & H.B.Mann (Eds.), Contributions to probability and statistics: Essays in honor of Harold Hotelling (pp. 278–292), Stanford University Press.

Matarazzo, B. B., Barnes, S. M., Pease, J. L., Russell, L. M., Hanson, J. E., Soberay, K. A., & Gutierrez, P. M. (2014). Suicide risk among lesbian, gay, bisexual, and transgender military personnel and veterans: What does the literature tell us? *Suicide and Life-Threatening Behavior*, *44*(2), 200–217. doi:10.1111/sltb.12073

Mizock, L., & Lundquist, C. (2016). Missteps in psychotherapy with transgender clients: Promoting gender sensitivity in counseling and psychological practice. *Psychology of Sexual Orientation and Gender Diversity*, *3*(2), 148–155. 10.1037/sgd0000177

Osman, A., Bagge, C. L., Gutierrez, P. M., Konick, L. C., Kopper, B. A., & Barrios, F. X. (2001). The suicidal behaviors questionnaire-revised (SBQ-R): Validation with clinical and nonclinical samples. *Assessment*, *8*(4), 443–454. doi:10.1177/107319110100800409

Reynolds, W. (1991). *ASIQ, adult suicidal ideation questionnaire: professional manual.* Psychological Assessment Resources, Incorporated.

Schaefer, A., Iyengar, R., Kadiyala, S., Kavanagh, J., Engel, C., Williams, K., & Kress, A. (2016). *Assessing the implications of allowing transgender personnel to serve openly*. RAND Corporation. doi:10.7249/RR1530

Sharma, R., Yetton, P., & Crawford, J. (2009). Estimating the effect of common method variance: The method–method pair technique with an illustration from TAM Research. *Mis Quarterly*, *33*(3), 473–490. doi:10.2307/20650305

Stanley, I. H., Rogers, M. L., Hanson, J. E., Gutierrez, P. M., & Joiner, T. E. (2019). PTSD symptom clusters and suicide attempts among high-risk military service members: A three-month prospective investigation. *Journal of Consulting and Clinical Psychology*, *87*(1), 67–78. doi:10.1037/ccp0000350

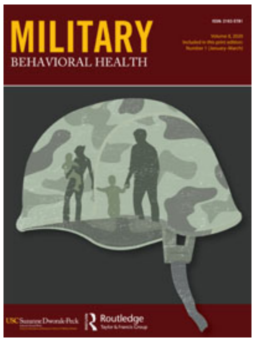
Testa, R. J., Michaels, M. S., Bliss, W., Rogers, M. L., Balsam, K. F., & Joiner, T. (2017). Suicidal ideation in transgender people: Gender minority stress and interpersonal theory factors. *Journal of Abnormal Psychology*, *126*(1), 125–136. doi:10.1037/abn0000234

Tucker, R. P., Testa, R. J., Reger, M. A., Simpson, T. L., Shipherd, J. C., & Lehavot, K. (2019). Current and military-specific gender minority stress factors and their relationship with suicide ideation in transgender veterans. *Suicide and Life-Threatening Behavior*, *49*(1), 155–166. doi:10.1111/sltb.12432

Ursano, R. J., Heeringa, S. G., Stein, M. B., Jain, S., Raman, R., Sun, X., Chiu, W. T., Colpe, L. J., Fullerton, C. S., Gilman, S. E., Hwang, I., Naifeh, J. A., Nock, M. K., Rosellini, A. J., Sampson, N. A., Schoenbaum, M., Zaslavsky, A. M., & Kessler, R. C. (2015). Prevalence and correlates of suicidal behavior among new soldiers in the U.S. army: Results from the army study to assess risk and resilience in service members (Army STARRS). *Depression and Anxiety*, *32*(1), 3–12. doi:10.1002/da.22317

Winer, A. S. (2018). Action and reaction: The Trump executive orders and their reception by the federal courts. *Mitchell Hamline Law Review*, *44*(3), 4.

Zugelder, M. T., & Champagne, P. J. (2018). A management approach to LGBT employment: Diversity, inclusion and respect. *Journal of Business Diversity*, *18*(1), 1–11.



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Exploring the Content of Suicidality among Military Personnel and Veterans

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ABSTRACT

Previous research and theorizing have long sought to describe reliable typologies of suicide risk, particularly regarding soldier and veteran military samples. In the present study, we examined suicidal content from two samples of outpatient suicidal military personnel—one a sample of active-duty infantry soldiers ($n = 89$) and the other a sample of veterans ($n = 62$), using the first page of the Suicide Status Form (SSF; Jobes, 2016). Descriptive statistics examined both the qualitative and quantitative SSF-based responses between these cohorts. Preliminary findings showed different psychological content profiles between these samples: active-duty soldiers reported being more "self-focused" and "escape-oriented" in responses related to suicide, whereas veterans reported being more "other-focused" in responses related to suicide. This study suggests that despite similarities resulting from military experience, active-duty soldiers and veterans likely experience suicide risk differently. The main goal of this study was to differentiate clinically relevant suicidal responses on the exact same stimulus tool, which can be useful in generating hypotheses to be tested in future research about similarities and differences in suicide risk presentations between active-duty soldiers and veterans.

KEYWORDS

Suicide; depression; military; veterans; soldier; servicemember

Nationally, suicide is the 10th leading cause of death in the United States, with 41,419 suicides, yielding an annual rate of about 12.6 per 100,000 people (Center for Disease Control and Prevention, 2015). In recent years, the U.S. Military has struggled with increased rates of suicide, as it has become the second leading cause of death within this population (Bryan, Hernandez, Allison, & Clemans, 2013). In particular, the U.S Army suicide rate reached its historically highest point in 2012, with 27.9 suicides per 100,000 service members (Colpe et al., 2015). Military suicide attempts have increased since 2005, coinciding with the beginning of combat operations in Iraq and Afghanistan (Bryan et al., 2013). These data defy the tendency for suicide rates to decrease during times of war (Cassimatis & Rothberg, 1997; Rothberg, Holloway, & Ursano, 1987). There have also been concerns about increases in veterans dying by suicide with a rate of 35.3 per 100,000 in 2014, which has remained relatively consistent in recent years (U.S. Department of Veterans Affairs, 2016). Major theories regarding risk and protective factors have been proposed to understand suicide and suicidal ideation for many populations, including the U.S. military (e.g., Bryan et al., 2013; Colpe et al., 2015). This work includes at least one study comparing suicide-related behaviors in Soldiers and Veterans (Villatte et al., 2015). They found that service members and veterans differed in their attempt characteristics. For example, soldiers had a higher rate of pre-enlistment suicide attempts. However, we are aware of no studies that examine the content of suicidal thoughts between current service members and veterans. Given national concerns about increases in active-duty and veteran suicide, understanding more about this topic in these high-risk groups is compelling.

There are still many barriers that pose challenges to treating suicidal patients effectively. These challenges include insufficient clinical assessment and understanding of suicide risk and lack of clinicians

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using evidence-based interventions (Jobes, 2016). One therapeutic assessment that aims to mitigate these challenges is the Collaborative Assessment and Management of Suicidality (CAMS; Jobes, 2016), featuring the use of the Suicide Status Form (SSF). The CAMS SSF is a multipurpose assessment, treatment planning, tracking, and clinical outcome tool that helps reveal the content of a patient's suicidal thoughts. Through the collaborative use of the SSF various qualitative and quantitative data, themes of the patient's suicidality emerge (Jobes, 2016). For example, two main content themes that are frequently seen within CAMS/SSF assessments focus on relationships/social factors and the need for escape (Jobes, 2016). These themes are both commonly seen in suicidal individuals and seem particularly prevalent in suicidal military personnel (Jobes, 1995; Baumeister, 1990). Therefore, theories that emphasize certain social forces and the idea of escape or entrapment may be worth investigating to better understand the psychology of military and veteran suicide.

Psycho-social theories

Theories that emphasize social forces may be especially pertinent for understanding suicide risk in soldiers and veterans because there is so much emphasis on being a part of a unit and larger organization. Joiner's interpersonal theory of suicide emphasizes perceived burdensomeness, thwarted belongingness, and acquired capability as variables that would increase someone's desire and ability to die by suicide (Joiner, 2005). Perceived burdensomeness (thinking one is a burden on others) can be extremely important within military psychology. Unit cohesion is vital in a combat environment where depending on others is literally a life and death situation (Griffith, 1988; Griffith, 2007). However, if an individual is unable to function effectively in the unit, it may result in being ostracized and feeling like a burden (Nademin et al., 2008). Furthermore, strains placed on relationships at home during deployment and feeling unable to readjust to civilian life after being discharged can lead to a lack of belongingness (Nademin et al., 2008; Selby et al., 2010). The last variable is acquired capability, involving the individual's ability to use lethal means to die by suicide (Joiner, 2005). Those with more exposure to military training or violence (i.e., killing others, seeing others killed, IED explosions) may be more desensitized to violence, thus increasing their acquired capability for suicide (Selby et al., 2010).

Another important social theory involves the importance of relationships in regard to suicidal thinking. Jobes (1995) has proposed two suicidal typologies worth considering: intrapsychic (or self-oriented) and interpsychic (or relationally-oriented). Intrapsychic people have a suicidal preoccupation that centers largely on a private, internal psychological struggle. These people report high levels of depression or dysphoria and are often self-focused (Jobes, 1995). In contrast, interpsychic people have a suicidal preoccupation that centers on public, interpersonal struggles. They are preoccupied with relational-conflicts and for them suicide may be intended to effect change in their interpersonal world (Jobes, 1995). There are of course exceptions to the pure versions of these typologies, as many suicidal people struggle both internally and relationally as well (Jobes, 2016). However, understanding service members' and veterans' typical orientations may help inform treatment.

Entrapment and escape

Military personnel have often committed many years of their lives to service and may embark on multiple deployments. Furthermore, enlisted service members are required to serve out the terms of their contract with few exceptions, or risk possible court martial and imprisonment. These realities could lead to feeling trapped by their commitments, particularly if they are experiencing work-related stressors which lead to a desire to terminate military service prematurely. It is also possible for veterans who have returned home to feel they are trapped in a world that does not understand them and their experiences. Thus, Williams' (2001) *Cry of Pain* model and Baumeister's (1990) explanation of suicide as a function of *escaping the self* may be especially relevant to military populations. Williams posited that suicide is a response to stressful situations involving three components: the presence of defeat, the perception of no escape, and the perception of no rescue. It follows that when escape is unachievable, the person feels powerless and hopeless, which may lead to suicide as a means of psychological escape.

Current study

The present study aimed to consider some of these psychological constructs as they pertain to samples of suicidal active-duty personnel and veterans. This is an exploratory investigation of possible differences between these related but different groups, with a goal of generating ideas for future research. Of note, this study used samples of convenience with two groups with dissimilar inclusion criteria, preventing direct between-group statistical comparisons. To avoid confounds, only descriptive statistics and frequency counts were used.

In the present study qualitative written responses on the SSF were studied. CAMS is a suicide-specific evidence-based therapeutic framework that uses a unique set of assessments and treatment planning processes designed to enhance the therapeutic alliance and increase patient motivation (Jobes, 2016). The validity and reliability of the quantitative aspects of the SSF are well established and replicated (Conrad et al., 2009; Jobes et al., 1997). In addition, a meta-analysis found that using the SSF within CAMS guided care with suicidal Air Force personnel functioned as a "therapeutic assessment" experience (Poston & Hanson, 2010).

The current study was guided by two broad a priori exploratory research questions. Do active-duty suicidal soldiers and suicidal veterans report more self or relationally oriented written content responses related to suicide? Are suicidal soldiers and suicidal veterans similarly focused on psychological escape on their SSF qualitative responses? Different psychological profiles might be relevant to active-duty personnel and veterans because they are at different points of their military careers. In particular, suicidal active-duty soldiers might be more focused on relationships, report more perceived burdensomeness and thwarted belongingness, and present with a desire to escape the military, whereas veterans might be more preoccupied with self-identity, and who they are outside of the military. Thus, we hypothesized that soldiers would be more interpsychic and escape-oriented in their responses when generally compared to suicide-related responses of veterans.

Method

Participants

Data from two samples of treatment-seeking suicidal patients with military backgrounds were used in this investigation. The first sample included suicidal active-duty U.S. Army soldiers from a large infantry installation in the Southeastern United States, who were recruited as part of a larger randomized controlled trial funded by the Department of Defense comparing the use of CAMS versus enhanced care as usual (Jobes et al., 2017; Huh et al., 2018). In the present study, we used a subset of data from the CAMS-arm participants of the randomized controlled trial ($n = 89$) who expressed significant suicidal ideation prior to engaging in treatment (Scale for Suicidal Ideation-Current score > 13). Participant ages ranged from 18 to 48 years ($M = 26.8$, $SD = 5.90$). Exclusion criteria included an inability to understand, consent, or benefit from study procedures due to significant psychosis, paranoia, cognitive impairment, or where psychosocial therapeutic care was otherwise contraindicated; a judicial order to treatment; separation, change of station, or deployment expected in the next 12 weeks; and patients who were in the Warriors in Transition Unit; and pregnant patients (as per Institutional Review Board requirement).

The second sample included suicidal veterans who were recruited to participate in a suicide-specific group therapy assessment study at a Veterans Affairs Medical Center in the Southern Midwest (Johnson, O'Connor, Kaminer, Jobes & Gutierrez, 2014). All veterans who had been psychiatrically hospitalized due to high suicide risk (either a recent attempt or concern that they would not be able to resist acting on suicidal thoughts) were eligible to participate. Many of these veterans had been struggling with suicide over many years of mental health treatment. Only veterans deemed by the study team to be inappropriate clinically for group participation (e.g. actively responding to auditory hallucinations to the extent that they could not engage in group discussions) were excluded. Participants age ranged from 27 to 71 years ($M = 47.98$, $SD = 11.06$).

As noted, the inclusion and exclusion criteria for these two samples were different. Although the soldier sample required a minimum Scale for Suicidal Ideation-Current score of 13 or higher and no comorbid psychosis, paranoia, or cognitive impairments, etc. (noted above), veterans were enrolled immediately after inpatient hospitalization, and psychosis was not an exclusion criterion (Johnson et al., 2014). All sample demographic characteristics are shown in Table 1. Critically, different inclusion/exclusion criteria precluded any direct statistical between-group comparisons; we thus focused our attention on the written content responses to the SSF from both groups. These two samples were samples of convenience chosen because data existed for both populations using the first page of the CAMS SSF. Although analyses were exploratory and qualitative, information is still potentially useful for other researchers wishing to generate hypotheses about similarities and differences in suicide risk presentations between veterans and active-duty soldiers.

Table 1. Baseline sociodemographic and clinical characteristics: Active-duty and veteran samples.

Characteristic	Active-duty ($n = 89$)		Veterans ($n = 62$)	
	n	%	*n*	%
Gender				
Male	67	75	54	87
Female	22	25	8	13
Ethnicity				
White/Caucasian	46	51	50	81
Black/African American	21	24	11	18
Other	22	25	1	1
Marital status				
Single, never married	23	26	15	24
Married	46	52	17	28
Separated or divorced	20	22	30	48
Education				
Some high school	1	1	0	0
High school graduate or GED	36	40	21	34
Some college, AA, or technical training	42	48	33	53
Bachelor's or graduate degree	8	9	8	13
Number of combat deployments				
0	33	37	—	—
1	23	26	—	—
2	20	22	—	—
3 or more	12	14	—	—
Lifetime psychiatric history				
Depressive disorder	69	78	42	68
Bipolar disorder	4	5	15	24
Alcohol or drug abuse/dependence	15	17	9	15
Anxiety disorder (not posttraumatic stress disorder)	51	57	17	27
Posttraumatic stress disorder	53	60	27	44
Borderline personality disorder	19	21	4	6

Measures

SSF

The SSF is a multipurpose suicide-specific-risk assessment, treatment-planning, tracking, and clinical outcome tool that functions as the "road map" for the CAMS framework (Jobes, 2016). The SSF is a seven-page assessment tool, including three initial pages which assess suicide risk (including current overall risk), plan treatment, and track a patient's suicidal status (Jobes, 2016). In this study, only the first page of the initial session SSF was used, which includes various quantitative and qualitative assessments.

Quantitative data. SSF quantitative responses included 1 to 5 ratings for the SSF Core Assessment: Psychological Pain, Stress, Agitation, Hopelessness, Self-Hate, and Overall Risk of Suicide (Jobes, 2016). Also included are ratings of 1 to 5 measuring how much the patient would relate their suicidal thoughts and feelings to self or others (Jobes, 2016). Finally, on a scale from 0 to 8, the patient rates their respective wish to live and their wish to die (Jobes, 2016). Descriptive statistics (mean and standard deviation) were calculated for each group.

Qualitative data. The first page of the SSF contains three types of qualitative assessments (Jobes, 2006; 2016). Thoughts and feelings regarding suicide are found by using coding methodologies, which analyzes each qualitative response separately (Jobes, 2006, 2016).

The first coded qualitative assessment involves the SSF Core Assessment and is based on Rotter's Incomplete Sentence Blank (Rotter & Rafferty, 1950). After each quantitative assessment, the patient writes in their own words responses to various incomplete sentence prompts, so the clinician was able to see first-hand how the suicidal patient thinks and feels (Jobes, 2006, 2016). Twelve different responses for coding the SSF Core Assessment were identified and are shown in Table 3. These responses are as follows: self, relational, role responsibility, global/general, helpless, unpleasant internal states, unsure/unable to articulate, situation-specific, compelled to act, future, internal descriptors, and external descriptors (Jobes et al., 2004). Further explanations and examples of coding categories for all qualitative sections can be found in the supplemental tables (Refer to Supp. 1 A-D).

The second qualitative assessment of the initial SSF is called reasons for living (RFL) versus reasons for dying (RFD) Assessment (Jobes, 2006, 2016). In this part, the suicidal patient can list up to five RFLs and RFDs in the spaces provided. Common reliable responses have been identified to organize these responses, consisting of nine RFL responses and nine

RFD responses (Jobes & Mann, 1999). The nine RFL responses are family, friends, responsibility to others, burdening others, plans and goals, hopefulness for the future, enjoyable things, beliefs, and self. The nine RFD responses are relationships, unburdening others, loneliness, hopelessness, general descriptors of self, escape in general, escape the past, escape the pain, and escape responsibilities (Jobes & Mann, 1999). The RFL and RFD responses can be seen in Tables 4 and 5.

The final qualitative assessment is referred to as the *SSF one-thing response* (i.e., what one thing would make me no longer be suicidal?). The coding methodology for this response includes organizing responses into self vs. relational responses (Jobes, 2006, 2016).

Procedure

Data were extracted and entered into SPSS Version 24.0 (IBM Corp, 2016) and Excel files. The means and standard deviations are reported for the following quantitative variables: psychological pain, stress, agitation, hopelessness, self-hate, self vs. other ratings, and wish to live vs. wish to die ratings.

Regarding qualitative responses, separate coding teams of two to three undergraduate and graduate students were created to reliably code the written responses into thematic categories. Training involved having one or more practice rounds with data from a different population using SSF coding manuals (Jobes, 2016). The goal of this qualitative manual was to thematically code the qualitative portions of the SSF to better understand their written descriptions of a person's suicidal psyche (Jobes, 2004). As cited in Jobes (2004), the qualitative coding manual was derived using a four-step process: First, each of the five SSF constructs were considered separately by five research team members. Second, the research team met to review each team member's content category sorting. Third, each of the five members was given one of the five SSF constructs and studied all of the relevant theoretical and empirical literature on that construct to further reduce, refine, and understand these coding categories. Finally, the coding manual was written to include detailed descriptions of the categories as well as decision rules about coding conflicts. Occasionally, qualitative responses contained more than one answer fitting into two potential categories. When this occurred, only the first written response was coded. The results were then assessed for interrater reliability (Kappa $\geq$ 0.8). The first team was trained in coding the Core SSF Assessment. The second team was trained in coding the RFL and RFD sections. Finally, the third team was trained in coding the one-thing responses. Interrater reliability had to be $K \geq 0.8$ for these teams, or those variables would have to be re-coded and then reanalyzed. Kappa coefficients for all coded SSF variables were greater than 0.8 and significant at $p < .0001$. The two suicidal samples were compared using frequency counts to observe the top responses.

Results

Quantitative results

Means and standard deviations for the quantitative variables are reported in Table 2. Although between-group statistical analyses were not conducted in this qualitatively oriented study, certain observations regarding means and standard deviations can be highlighted. First, there seem to be differences in how the two samples rated their amount of self-hate: Veterans ($M = 2.72$, $SD = 1.37$) rated higher self-hate than the active-duty soldier sample ($M = 3.40$, $SD = 1.38$). Second, there seems to be a difference in the two groups' quantitative self vs. others ratings with the veteran sample ($M = 3.92$, $SD = 1.20$) relating suicidal thoughts more to self than the soldier sample ($M = 3.20$, $SD = 1.46$). Finally, soldiers ($M = 3.03$, $SD = 1.33$) seemed to relate their suicidal thoughts more to others than the veteran sample ($M = 2.27$, $SD = 1.34$).

Table 2. Descriptive statistics (mean and standard deviation) of quantitative Suicide Status Form (SSF) responses.

SSF construct	Active-duty ($n = 89$) M (SD)	Veterans ($n = 62$) M (SD)
Pain	3.27 (1.2)	3.05 (1.1)
Stress	3.61 (1.7)	3.61 (1.1)
Agitation	3.10 (1.4)	2.88 (1.3)
Hopelessness	3.19 (1.3)	3.08 (1.4)
Self-hate	2.72 (1.4)	3.40 (1.4)
Overall risk	1.84 (0.9)	1.72 (1.0)
Self	3.20 (1.5)	3.92 (1.2)
Others	3.03 (1.3)	2.27 (1.3)
Wish to live	5.75 (2.0)	5.63 (2.2)
Wish to die	3.13 (2.4)	2.66 (2.5)

Table 3. Frequency and percent's for qualitative core Suicide Status Form (SSF) responses.

Coding responses	Active-duty ($n = 89$) n, %	Veterans ($n = 62$) n, %
A. Core SSF Q. 1: Psychological Pain		
Self	8, 9.5%	14, 24.1%
Relational	46, 54.8%	12, 20.7%
Role/responsibilities	9, 10.7%	4, 6.9%
Global/general	5, 6.0%	10, 17.2%
Helpless	5, 6.0%	2, 3.4%
Unpleasant internal states	9, 10.7%	16, 27.6%
Unsure	2, 2.4%	0, 0.0%
B. Core SSF Q. 2: Stress		
Relational	14, 16.3%	8, 13.8%
Self	3, 3.5%	4,, 6.9%
Role/responsibilities	49, 57.0%	6 10.3%
Unpleasant internal states	2, 2.3%	10, 17.2%
Global/general	13, 15.1%	10, 17.2%
Situation-specific	3, 3.5%	12, 20.7%
Helpless	2, 2.3%	5, 8.6%
Unsure	0, 0.0%	3, 5.2%
C. Core SSF Q. 3: Agitation		
Compelled to act	5, 6.3%	3, 5.2%
Global/general	6, 7.6%	2, 3.2%
Helpless	5, 6.3%	4, 6.9%
Unsure	2,, 2.5%	10, 17.2%
Situation-specific	4 5.1%	7, 12.1%
Unpleasant internal states	8, 10.1%	9, 15.5%
Self	5, 6.3%	9, 15.5%
Relational	27, 34.2%	9, 15.5%
Role/responsibilities	17, 21.5%	5, 8.6%
D. Core SSF Q. 4: Helplessness		
Global/general	18, 21.4%	12, 20.7%
Future	9, 10.7%	21, 36.2%
Relational	19, 22.6%	2, 3.4%
Role/responsibilities	25, 30.0%	7, 12.1%
Self	13, 15.5%	6, 10.3%
Unpleasant internal states	0, 0.0%	6, 10.3%
Unsure	0, 0.0%	4, 6.9%
E. Core SSF Q. 5: Self Hate		
Helpless	9, 11.1%	11, 19.3%
Internal descriptors	41, 50.6%	11, 19.3%
External descriptors	10, 12.3%	17, 29.8%
Relational	10, 12.3%	4, 7.0%
Global	2, 2.5%	6, 10.5%
Role/responsibilities	7, 8.6%	2, 3.5%
Unsure	2, 2.5%	6, 10.5%

Qualitative results

All frequency counts and percentages for each of the SSF Core Assessment variables are shown in Table 3 (sections A-E). As shown in Table 3A, there were seven reliable coding responses under the psychological pain construct. As shown in Table 3B, there were eight responses under the stress construct. As shown in Table 3C, there were nine responses for the agitation construct. As shown in Table 3D, there were seven responses which fit into the hopelessness construct. Table 3E shows seven responses which fit into the self-hate construct. In all, 445 responses were given for all five variables in the active-duty sample, 116 were coded as relational issues (26%). Also, 107 (24%) of all responses were coded as role/responsibilities. For the veteran sample, the answers given for all five core variables were less consistent, but the two most common coded themes were unpleasant internal states and self-related responses. Out of the 310 responses given for all five variables, 41 responses were coded as unpleasant internal states (13%) and 33 responses were coded as self-related responses (11%).

Table 4. Frequency and percent's for reasons for living Suicide Status Form (SSF) responses.

Coding responses	Active-duty ($n = 249$ combined) n, %	Veterans ($n = 181$ combined) n, %
Family	109, 43.8%	73, 40,3%
Friends	19, 7.6%	10, 5.5%
Responsibility to others	10, 4.0%	5, 2.8%
Burdening others	12, 4.8%	6, 3.3%
Plans and goals	27, 10.8%	25, 13.8%
Hopefulness for the future	31, 12.5%	18, 9.9%
Enjoyable things	10, 4.0%	12, 6.6%
Beliefs	16, 6.4%	15, 8.3%
Self	15, 6.0%	17, 9.4%

For RFL and RFD, all five RFLs or RFDs were grouped together and run as one analysis. As shown in Table 4, there were nine responses which fit into the RFL category. For the soldier sample, the most common theme for the RFL prompt pertained to family (43.8%), followed by hopefulness for the future (12.5) and plans and goals (10.8%). For the veteran sample, the most common theme for the RFL prompt pertained to family (40.3%), followed by plans and goals (13.8%) and hopefulness for the future (9.9%).

As shown in Table 5, there were nine responses which fit into the RFD construct. For the Soldier sample, the most common qualitative written response for the RFD prompt pertained to escape in general (30.0%), followed by general descriptors of self (14.9%) and escape the pain (14.9%). For the veteran sample, the most common qualitative written response for the RFD prompt pertained to hopelessness (20.0%) and general descriptors of self (20.0%), followed by escape the pain (14.6%).

Regarding one-thing coded qualitative responses, both samples reported being self-oriented. These observations addressed our initial research questions and have potentially important clinical implications.

Discussion

The objective of this study was to describe ways two related but different suicidal samples, a younger soldier sample and an older veteran sample, think about suicide. This study suggests that despite similarities resulting from military experience, active-duty soldiers and veterans likely experience suicide risk differently. In the present study, potential differences will be inferred from an examination of written content

Table 5. Frequency and percent's for Reasons for Dying Suicide Status Form (SSF) responses.

Coding responses	Active-duty (*n* = 225 combined)	Veterans (*n* = 171 combined)
	n, %	*n*, %
Others (relationships)	34, 13.3%	14, 8.2%
Unburdening others	27, 10.6%	15, 8.8%
Loneliness	9, 3.5%	9, 5.3%
Hopelessness	24, 9.4%	34, 20.0%
General descriptors of self	40, 15.7%	34, 20.0%
Escape-in general	56, 30.0%	24, 14.0%
Escape-the past	8, 3.1%	8, 4.7%
Escape-the pain	38, 14.9%	25, 14.6%
Escape-responsibilities	19, 7.5%	8, 4.7%
All Escape variables	#(6–9) 55.5%	#(6–9) 37.0%

responses to the SSF revealing various aspects of the suicidal considerations of these samples.

Quantitative descriptive statistics show that the means were similar for psychological pain, stress, agitation, hopelessness, overall risk, and wish to live and wish to die. This finding is striking, considering current theories, such as Joiner's interpersonal theory of suicide (2005), would suggest soldiers might have a higher capability for suicide, suggesting a higher overall risk and/or wish to die, especially given risk factors associated with soldiers (i.e., multiple combat deployments, firearm access; Nademin et al., 2008). However, given observations of the means and standard deviations, the veteran sample seemed to rate self-hate higher, suggesting that they possibly possess more negative feelings about the self. Importantly, these samples also seem to differ in how they relate their suicidal thoughts to self and to others. Soldiers related their suicidal thoughts more to others and veterans related their suicidal thoughts more to self. This finding has possible "instrumental" implications in that soldiers may be more relationally oriented in their thinking and feeling about suicide as opposed to veterans who are more internally focused. Clinicians armed with such knowledge about their patients would be better equipped to make decisions about where to focus treatment as well as the types of interventions to consider with their military/veteran patients at risk of suicide. Because data were drawn from two existing data sets, based on studies with very different methodologies, it was deemed inappropriate to perform inferential statistics; thus, more research is necessary before direct comparisons can be made related to these two groups. However, we believe the observations made here can serve as a starting point for generating hypotheses to be tested in studies designed to compare active duty military and veteran reasons for experiencing thoughts and feelings about suicide.

Regarding coded qualitative data, the two samples appeared to differ on all five SSF Core Assessment variables, which warrants further review. Following the methodology from Jobes and colleagues (Jobes et al., 2004), all the SSF Core variables were collapsed and then analyzed. For soldiers, the two most common responses for the SSF Core were coded as relational and role/responsibility responses, which may demonstrate how vital relationships and specific roles and responsibilities are in the military relative to suicide risk. Many challenges cited in the soldier's SSFs were about command and relational struggles specific to military life (e.g., authority, struggles with family during combat deployment). Again, clinicians possessing this level of detail regarding why their patients are considering suicide can intervene on issues most relevant to the patient's suicidal risk.

For veterans, the answers given for all five core variables were less consistent, but the two most common coded responses were unpleasant internal states and self-related responses. For example, many veterans cited specific problems with themselves, such as problems with their depression or feeling hopeless. As noted by Jobes and colleagues (Jobes et al., 2004), the importance of focusing on unpleasant internal states may be a result of being in the psychiatric system for decades, so recovery from suicidality and psychopathology might feel hopeless. Thus, those initially relationally oriented suicidal soldiers may become more self-oriented and focused on unpleasant internal states as they grow older and are engaged in the psychiatric care system for more time. Of course, the cross-sectional nature of our data precludes drawing such temporal inferences. An alternative explanation is that this veteran sample had more serious psychopathology, leading to a greater degree of suffering.

Regarding coded data for RFLs, the top three responses for both samples were family, hopefulness for the future, and plans and goals. For both groups, having good social support, looking positively toward the future, and having positive plans and goals have the biggest influence regarding choosing life over death. An important note is that the veterans' highest response was family, although in other responses they seem to be more self-oriented. This might suggest a shared value system of people in military life and may aid in helping with treatment. Specifically, this information is important in considering how to address protective factors in treatment which increases a patient's RFL while at the same time other aspects of treatment target the previously discussed reasons which increase risk (Jobes, 2016).

Regarding coded qualitative data for RFDs, soldiers' response pertained mostly to escape variables, general descriptors regarding the self, and responses regarding relationships. It is interesting that soldier's responses for RFD focused mostly on escape in general as well as escaping the pain. A majority of the responses found on these SSF assessments involve challenges related to living and working in the military, often attributed to relational issues and command structure. As discussed earlier, many soldiers feel they have no control over their lives or feel unable to connect to the civilian world after deployment experiences, thus their desire to escape may be significantly heightened (Jobes et al., 2004; Gutierrez et al., 2013). For veterans, the most common responses pertained to hopelessness and general descriptors of self. These categories imply that many veterans may feel more hopeless about their lives than soldiers as well as focusing more on negative feelings about themselves. These observations addressed our initial research questions and have potentially important clinical implications.

We tested two exploratory research questions based on conceptual constructs in the extant literature. Regarding the first question, it seems suicidal soldiers and veterans are psychologically oriented differently to suicide, with the soldier sample relating suicidal thoughts more to others and the veteran sample focused more on self in both types of assessments. This difference also suggests that these younger soldiers may feel more perceived burdensomeness (Joiner, 2005), because they seem more focused on external factors such as family and friends.

A second research question focused on the notion of psychological escape. For our suicidal soldier sample, escape responses accounted for over 50% of the Soldier's RFD qualitative responses, and many were explicit about their desire to leave the military. In contrast, escape was not as salient the veterans' RFD responses. As said above, the idea of escape may be especially prevalent in a soldier population, where discharge and quitting is difficult. It is also possible soldiers feel more thwarted belongingness (perhaps for reasons explained above), which may intensify this desire to escape.

What emerges are an intriguing possible narrative about suicidal risk among those who are serving or have served in the military. It appears that the relational aspects of suicidality may be more salient for the younger soldier sample, perhaps reflecting an instrumental means of escaping military life and may be more at risk for attempting suicide. In contrast, the older veteran sample seems to be much more internally-focused and more miserable and may be more at risk for eventually dying by suicide (based on previous theorizing proposed by Jobes, 1995). This seems to correlate with the demographic data, where a significantly higher percentage of soldiers were married (52% vs. 28%), whereas more veterans were divorced/separated (48% vs. 22%), and these differences, as well as the differences in age, could be a possible explanation for the observed patterns. Interestingly, Joiner (2005), might argue that active-duty soldiers would have more acquired capability for suicide and would be more likely to complete suicide. However, to truly test that assertion, more detail is needed regarding the nature of military experience, particularly related to combat. In any case, some intriguing psychological differences are of note, which can aid in generating hypotheses for future studies.

Limitations of this study include its preliminary/exploratory nature; this was an unplanned descriptive investigation of two samples of convenience and thus could be prone to potential confounds. It is quite possible that a variety of factors not captured in the current data affected the apparent differences in thoughts about suicide in these two samples. All of the active-duty participants were soldiers in infantry units whereas members of other services and unit types were represented in the veteran sample. In addition, the veterans served across multiple eras, some of which did not involve combat operations. However, it is unknown how representative the samples actually are of actual active-duty soldiers and veterans. Future sample-comparison research would ideally have planned between-group comparisons using inferential statistics, controlling for demographic differences and comparable inclusion and exclusion criteria for increasing internal validity and improved generalizability of the findings. A major limitation is the use of small sample sizes, different exclusion criteria, and research methods used in the two studies from which data were drawn. These differences prevented the use of inferential statistics and raise questions about the generalizability of these findings. Although it is true that these were samples of convenience, this does not trivialize the value of having access to both veteran and active-duty SSF data. These data provide valuable insight to the suicidal considerations of the participants in the two samples. As stated above, the main goal was to differentiate clinically relevant responses on the exact same stimulus tool, which can be very useful for other researchers wishing to generate hypotheses about similarities and differences in suicide risk presentations between veterans and active-duty soldiers. As described by Jobes and colleagues (Jobes et al., 2004), the constructs of the SSF have limitations and additional psychological constructs could be used to describe suicidal thoughts and behaviors. SSF qualitative coding categories tend to be broad but in this sense, perhaps not very specific which limits what exactly is meant by a "relational" response. Finally, as a cross-sectional study, we cannot really know about the potential evolution of a younger suicidal military sample's suicidality as they grow older and become veterans. Longitudinal research following the same sample over time to understand the natural evolution of the psychology of suicide would be interesting.

Despite these limitations, to our knowledge, this is the first descriptive investigation comparing suicidal military personnel and veterans using the same quantitative and qualitative measures. There may be several implications for clinical practice within our data. It would seem that potential instrumental and relational suicidality observed in the soldier sample may need to be addressed by command (for those seeking to leave military life) or alternatively in couples or family therapy (for relationally-oriented suicidality). Military providers could thus use such information to work more effectively with their patients to help them problem solve about how to address the aspects of military life contributing to their wish to die. When treating suicidal veterans, psychotherapy may need to focus on more internal issues of self-esteem and psychological misery. Given the high rates of suicide among these two at-risk samples, there is a great need for additional hypothesis-driven research to better understand and ultimately treat the psychological nature of suicide risk that is the same, and different, among those who serve their nation in uniform, both actively and beyond military life.

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References

Baumeister, R. F. (1990). Suicide as escape from self. *Psychological Review*, *97*(1), 90–113. doi:10.1037/0033-295X.97.1.90

Bryan, C. J., Hernandez, A. M., Allison, S., & Clemans, T. (2013). Combat exposure and suicide risk in two samples of military personnel. *Journal of Clinical Psychology*, *69*(1), 64–77. doi:10.1002/jclp.21932

Cassimatis, E. G., & Rothberg, J. M. (1997). Suicide in the U.S. military. In A. J. Botsis, C. R. Soldatos, & C. N. Stefanis (Eds.), *Suicide: Biopsychosocial approaches* (pp. 23–32). Amsterdam, The Netherlands: Elsevier Science.

Center for Disease Control and Prevention. (2015). Suicide at a glance. [Data file]. Retrieved from https://www.cdc.gov/violenceprevention/pdf/suicide-datasheet-a.pdf.

Colpe, L. J., Naifeh, J. A., Aliaga, P. A., Sampson, N. A., Heeringa, S. G., Stein, M. B., … Kessler, R. C. (2015). Mental health treatment among soldiers with current mental disorders in the army study to assess risk and resilience in service members (Army STARRS). *Military Medicine*, *180*(10), 1041–1051. doi:10.7205/MILMED-D-14-00686

Conrad, A. K., Jacoby, A. M., Jobes, D. A., Lineberry, T. W., Shea, C. E., Arnold Ewing, T. D., … Kung, S. (2009). A psychometric investigation of the suicide status form with suicidal inpatients. *Suicide and Life-Threatening Behavior*, *39*(3), 307–320. doi:10.1521/suli.2009.39.3.307

Griffith, J. (1988). Measurement of group cohesion in U.S. Army units. *Basic and Applied Social Psychology*, *9*(2), 149–171. doi:10.1207/s15324834basp0902_6

Griffith, J. (2007). Further considerations concerning the cohesion-performance relation in military settings. *Armed Forces & Society*, *34*(1), 138–147. doi:10.1177/0095327X06294620

Gutierrez, P. M., Brenner, L. A., Rings, J. A., Devore, M. D., Kelly, P. J., Staves, P. J., … Kaplan, M. S. (2013). A qualitative description of female veterans' deployment-related experiences and potential suicide risk factors: Female veterans. *Journal of Clinical Psychology*, *69*(9), 923–935. doi:10.1002/jclp.21997

Huh, D., Jobes, D. A., Comtois, K. A., Kerbrat, A. H., Chalker, S. A., Gutierrez, P. M., & Jennings, K. W. (2018). The Collaborative Assessment and Management of Suicidality (CAMS) versus Enhanced Care as Usual (E-CAU) with suicidal soldiers: Moderator analyses from a randomized controlled trial. *Military Psychology*, *80*(4), 339–356. doi:10.1080/08995605.2018.1503001

IBM Corp. (2016). *IBM SPSS statistics for windows, Version 24.0*. Armonk, NY: IBM Corp.

Jobes, D. A. (1995). The challenge and the promise of clinical suicidology. *Suicide and Life-Threatening Behavior*, *25*, 437–449. doi:10.1111/j.1943-278X.1995.tb00237.x

Jobes, D. A. (2006). *Managing suicidal risk: A collaborative approach*. New York: The Guilford Press.

Jobes, D. A. (2016). *Managing suicidal risk: A collaborative approach 2nd Ed*. New York: The Guilford Press.

Jobes, D. A., Jacoby, A. M., Cimbolic, P., & Hustead, L. A. T. (1997). The assessment and treatment of suicidal clients in a university counseling center. *Journal of Counseling Psychology*, *44*(4), 368–377.

Jobes, D. A., & Mann, R. E. (1999). Reasons for living versus reasons for dying: Examining the internal debate of suicide. *Suicide and Life-Threatening Behavior*, *29*, 97–104. doi:10.1111/j.1943-278X.1999.tb01048.x

Jobes, D. A., Nelson, K. N., Peterson, E. M., Pentiuc, D., Downing, V., Francini, K., & Kiernan, A. (2004). Describing suicidality: An investigation of qualitative SSF responses. *Suicide and Life-Threatening Behavior*, *34*(2), 99–112. doi:10.1521/suli.34.2.99.32788

Jobes, D. A., Comtois, K. A., Gutierrez, P. M., Brenner, L. A., Huh, D., Chalker, S. A., … Crow, B. (2017). A randomized controlled trial of the collaborative assessment and management of suicidality versus enhanced care as usual with suicidal soldiers. *Psychiatry: Interpersonal and Biological Processes*, *80*(4), 339–356. doi:10.1080/00332747.2017.1354607

Johnson, L. L., O'Connor, S. S., Kaminer, B., Jobes, D. A., & Gutierrez, P. M. (2014). Suicide-focused group therapy for veterans. *Military Behavioral Health*, *2*(4), 327–336. doi:10.1080/21635781.2014.963762

Joiner, T. (2005). *Why people die by suicide*. Cambridge, MA: Harvard University Press.

Nademin, E., Jobes, D. A., Pflanz, S. E., Jacoby, A. M., Ghahramanlou-Holloway, M., Campise, R., … Johnson, L. (2008). An investigation of interpersonal-psychological variables in air force suicides: A controlled-comparison study. *Archives of Suicide Research*, *12*(4), 309–326. doi:10.1080/13811110802324847

Poston, J. M., & Hanson, W. E. (2010). Meta-analysis of psychological assessment as a therapeutic intervention. *Psychological Assessment*, *22*(2), 203–212. doi:10.1037/a0018679

Rothberg, J. M., Holloway, H. C., & Ursano, R. J. (1987). Suicide in the United States military. *Psychiatric Annals*, *17*(8), 545–548. doi:10.3928/0048-5713-19870801-10

Rotter, J. B., & Rafferty, J. E. (1950). *Manual for the rotter incomplete sentence blank, college form*. New York: Psychological Corporation.

Selby, E. A., Anestis, M. D., Bender, T. W., Ribeiro, J. D., Nock, M. K., Rudd, M. D., … Joiner, T. E. (2010). Overcoming the fear of lethal injury: Evaluating suicidal behavior in the military through the lens of the Interpersonal–Psychological theory of suicide. *Clinical Psychology Review*, *30*(3), 298–307. doi:10.1016/j.cpr.2009.12.004

U.S. Department of Veterans Affairs. (2016). Suicide among Veterans and other Americans 2001-2014 [Data file]. Retrieved from http://www.mentalhealth.va.gov/docs/2016suicidedatareport.pdf.

Villatte, J. L., O'Connor, S. S., Leitner, R., Kerbrat, A. H., Johnson, L. L., & Gutierrez, P. M. (2015). Suicide attempt characteristics among Veterans and active duty service-members: A pooled data analysis. *Military Behavioral Health*, *3*(4), 316–327. doi:10.1080/21635781.2015.1093981

Williams, J. M. G. (2001). *The cry of pain*. London: Penguin.

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Pre-deployment predictors of suicide attempt during and after combat deployment: Results from the Army Study to Assess Risk and Resilience in Servicemembers

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A R T I C L E I N F O

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A B S T R A C T

Background: Deployment-related experiences might be risk factors for soldier suicides, in which case identification of vulnerable soldiers before deployment could inform preventive efforts. We investigated this possibility by using pre-deployment survey and administrative data in a sample of US Army soldiers to develop a risk model for suicide attempt (SA) during and shortly after deployment.

Methods: Data came from the Army Study to Assess Risk and Resilience in Servicemembers Pre-Post Deployment Survey (PPDS). Soldiers completed a baseline survey shortly before deploying to Afghanistan in 2011–2012. Survey measures were used to predict SAs, defined using administrative and subsequent survey data, through 30 months after deployment. Models were built using penalized regression and ensemble machine learning methods.

Results: Significant pre-deployment risk factors were history of traumatic brain injury, 9 + mental health treatment visits in the 12 months before deployment, young age, female, previously married, and low relationship quality. Cross-validated AUC of the best penalized and ensemble models were .75–.77. 21.3–40.4% of

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SAs occurred among the 5–10% of soldiers with highest predicted risk and positive predictive value (PPV) among these high-risk soldiers was 4.4–5.7%.

Conclusions: SA can be predicted significantly from pre-deployment data, but intervention planning needs to take PPV into consideration.

1. Introduction

Suicide prevention is a high priority of the US Department of Defense (Office of the Under Secretary of Defense for Personnel and Readiness, 2017). Given that an increase in fatal and non-fatal suicide attempts (SAs) has occurred during sustained operations in Iraq and Afghanistan, there has been particular focus on the effects of deployment on suicide (Reger et al., 2018). Evidence for an association between deployment and suicide has been mixed, with some studies finding a substantially elevated suicide rate among ever-deployed soldiers compared to never-deployed soldiers (Schoenbaum et al., 2014) and others finding a weak association (see Bryan et al., 2015 for meta-analytic review) or no association (e.g., LeardMann et al., 2013; Reger et al., 2015). It has been suggested that this inconsistency might be due to heterogeneity in the experiences associated with deployment and in vulnerability to these experiences (Reger et al., 2018). If so, it would be ideal to identify the most vulnerable soldiers *prior* to deployment to inform Army decisions.

Up to now, research on deployment-related predictors of suicidality has focused mostly on deployment-related experiences (e.g., combat experiences such as killing or exposure to death; Bryan et al., 2015) or on other well-known risk factors (e.g., psychiatric disorders) that may or may not have been present pre-deployment. Only limited research exists on other potentially important pre-deployment predictors of deployment-related suicidal-behaviors (Ursano et al., 2016; Shen et al., 2016). The significant predictors in the latter studies include Army occupation (Kessler et al., 2015a; Ursano et al., 2017), length of time in service prior to first deployment (Ursano et al., 2018), and socio-demographics (Gilman et al., 2014; Street et al., 2015), but other potentially important predictors exist that have not been examined. One way to do this would be to combine data collected in self-report surveys obtained shortly before deployment with administrative records to develop a prediction model. This approach has been used to predict other negative outcomes during deployment, including mental disorders and interpersonal violence (Rosellini et al., 2018). We present the results of this approach in the current report. The analysis used baseline data from the Army Study to Assess Risk and Resilience in Servicemembers (STARRS) Pre-Post Deployment Survey (PPDS) and administrative data available for those soldiers at the time of survey to predict subsequent suicide attempts during and after deployment to Afghanistan.

2. Materials and methods

2.1. Participants

The PPDS was a four-wave panel survey of soldiers from three Brigade Combat Teams (BCTs). Baseline assessments (T0) were conducted 1–2 months prior to unit deployment to Afghanistan (October 2011–February 2012). Upon return from deployment, follow-up surveys were collected within one month of return (T1; September 2012–February 2013), two months after return (T2; October 2012–March 2013), and 9–12 months after return (T3; June 2013–May 2014). Self-administered questionnaires were administered at each wave to assess socio-demographic characteristics, lifetime and current mental disorders, history of suicidal behavior, and a multitude of other risk and resilience factors. We focus in the current report only on survey data from T0 as predictors of subsequent SAs. We used data from later surveys to identify self-reported SAs (see *The Outcome* below) that occurred either during or after deployment. All participants provided written informed consent prior to participation. All study procedures were approved by the human subjects boards of all involved organizations.

Baseline PPDS participants were drawn from the soldiers present for duty in three BCTs about to deploy to Afghanistan. Of the 9949 soldiers in these BCTs at baseline, 9488 (95.3%) consented to participate in the survey. Most (n = 8558; 86.0%) provided complete T0 survey responses and consented to linking their responses to administrative records. Only T0 soldiers who subsequently deployed to Afghanistan (n = 7742; 90.5%) were included in T1-T3. However, 65 of the latter were excluded from analysis either because they had no administrative record (n = 1), were currently deployed at T0 (n = 1), were in the National Guard or Army Reserve (n = 2), or had more than one deployment between T0 and T3 (n = 65), leaving n = 7677 in the analysis. The remaining n = 4645 (60.0%) provided complete data at all post-deployment assessments. Analyses were weighted to adjust for baseline differences between soldiers who completed the T0 survey versus non-completers, agreed versus did not agree to have their administrative data linked to their survey data, and completed versus did not complete the full set of T1-T3 post-deployment surveys. Additional details on the PPDS design and sampling procedures are reported elsewhere (Kessler et al., 2013a, 2013b).

2.2. The outcome

Suicide attempts (SAs). SAs following T0 were determined using data from both self-report PPDS data and Army administrative data up to 30 months after baseline. Self-reported SAs were assessed in the T2-T3 surveys with a question adapted from the Columbia-Suicide Severity Rating Scale (*Did you ever make a suicide attempt; that is, purposefully hurt yourself with at least some intention to die?* Posner et al., 2011). At T2, soldiers were asked separately to report any SAs that occurred during their recent deployment and since returning from deployment. At T3, soldiers who completed T2 were asked to report additional SAs that had occurred since T2, whereas soldiers who did not participate in T2 were asked to report SAs occurring during or following their most recent deployment.

Administrative records of SAs came from the Army STARRS Historical Administrative Data Study (HADS; Kessler et al., 2013a). The HADS includes records from 38 Army/DoD administrative data systems. Records on SAs were obtained from four of these data systems: the Department of Defense Suicide Event Report (DoDSER), the Military Health System Data Repository (MDR), the Theater Medical Data Store (TMDS), and the TRANSCOM (Transportation Command) Regulating and Command and Control Evacuating System (TRAC^{2}ES). These data systems together provide healthcare encounter information from military and civilian treatment facilities, combat operations, and aeromedical evacuations. One of these systems, DoDSER, is a DoD-wide surveillance system that aggregates information on suicidal behaviors (ideation, attempts, deaths) via a standardized form completed by medical providers at DoD treatment facilities. Our definition of SA included either DoDSER records or an ICD-9-CM diagnostic code (E950-E958) in one or more of the other healthcare encounter systems listed above. The decision to combine these was based on prior work showing that these outcomes have very similar correlates (Ursano et al., 2015). Self-reported and administratively-reported SAs were combined into a single person-level outcome measure for whether each soldier made one or more suicide attempts subsequent to deployment.

2.3. Pre-deployment predictors

Pre-deployment survey variables. T0 variables were grouped broadly into 11 categories: lifetime mental disorders, lifetime self-injurious thoughts and behaviors, personality, childhood adversities, lifetime traumatic events, recent and chronic stress, social support, recent health problems, traumatic brain injury, recent mental health treatment, and sociodemographic and Army career characteristics. Detailed information about items used to assess constructs within these categories can be found in Supplemental Materials.

Pre-deployment administrative variables. STARRS analyses reported elsewhere extracted a set of 1399 administrative variables that we conceptualized as potential predictors of suicidal behaviors and other negative outcomes (Kessler et al., 2015b). Previous reports used these variables to predict other outcomes in the entire Army, such as sexual assault (Rosellini et al., 2017; Street et al., 2016) and violent crime (Rosellini et al., 2016; Bernecker et al., 2018). We used similar procedures to predict suicide in the total Army with a 12-month time horizon. The final model included 27 administrative variables (see Supplemental Materials for descriptions of all administrative predictors). These significant predictors were in three broad categories: recent mental health treatment (e.g., inpatient and outpatient treatment use, psychotropic medication use), criminal history (i.e., perpetrator of any crime in past 24 months), and socio-demographics/Army career characteristics (e.g., gender, age, time in service). Given the large number of administrative predictors in this model in relation to the number of SAs in our PPDS sample, we created a composite predicted risk score based on the model and assigned this as a single variable to each PPDS respondent as of T0 rather than include the 27 administrative predictors as separate predictors in the PPDS model. Scores on this composite risk score were standardized to a mean of 0 and a standard deviation of 1 in the total PPDS sample.

2.4. Analysis methods

We used a three-step process to build a model for survey predictors. In the first step, we focused separately on the potential predictors within each of the 11 categories listed above and examined bivariate associations. In the second step, we used penalized regression to estimate within-category multivariate models that included all significant bivariate predictors. Detailed results of these first two model-building steps are presented in Supplemental Tables 1–12. In the third step, we estimated an overall multivariate model that included all significant predictors in all within-category multivariate models, using elastic net penalized regression to select the optimal final subset of these predictors (Friedman et al., 2010). This final model was then re-estimated with conventional weighted logistic regression to obtain odds-ratios and design-based 95% confidence intervals based on the Taylor series linearization method (Wolter, 2007) to adjust for the weighting of the PPDS data.

After this three-step process was complete and the final multivariate model obtained, we estimated a model that included these same survey predictors along with the HADS administrative composite risk score to determine whether the survey variables remained significant after controlling for administrative predictors. Finally, in order to make a head-to-head comparison of prediction strength of survey and administrative variables, we created a survey composite risk score that, like the administrative composite risk score, was standardized to have a mean of 0 and variance of 1 and estimated a model that contained only the two composite risk scores as predictors.

The above model-building approach did not allow for the possibility of interactions either within or between administrative and survey predictors. This is a limitation, as some theories of suicide hypothesize the existence of interactions among predictors (O'Connor and Nock, 2014). To address this limitation partially we used the Super Learner ensemble machine learning algorithm (van der Laan et al., 2007) to investigate whether stable interactions existed either among the survey predictors or between the survey predictors and the composite HADS risk score. Four classifiers that capture interactions were included in the ensemble: multivariate adaptive regression splines (Friedman, 1991), random forest (Breiman, 2001), gradient boosting (Chen and Guestrin, 2016), and Bayesian additive regression trees (Chipman et al., 2010). Rather than require us to choose among these different classifiers, Super Learner allowed us to combine results across all four in addition to conventional additive models by developing an optimal weighted average across the individual-level predicted probabilities based on each classifier that is guaranteed to perform at least as well as the best individual model (i.e., when the weight for that model is 1.0 and the weights for the other models are all 0) and generally performs considerably better than the best individual model.

We used a number of different hyper-parameter tunings for each component classifier in our Super Learner library (Supplemental Table 12). For both the final logistic model and the final Super Learner model, we adjusted for over-fitting in estimating out-of-sample performance by using 5-fold cross-validation (5F-CV; James et al., 2013) to generate a pooled receiver operating characteristic (ROC) curve (Smith et al., 2014). Area under the ROC curve (AUC) was calculated to evaluate cross-validated model fit. Sensitivity (SN; the proportion of observed true cases found among soldiers above a given threshold on the predicted outcome scale) and positive predictive value (PPV; the prevalence of SAs among soldiers above a given threshold on the same outcome scale) were computed from cross-validated outcome scores. Statistical significance was evaluated using 2-sided 0.05-level tests. Missing data were imputed using multiple imputation (MI) (Little and Rubin, 2002) with SAS *proc MI* (SAS Institute Inc, 2010).

3. Results

3.1. Distribution of prospective SAs among deployed soldiers

A suicide attempt subsequent to T0 was either self-reported in the T2-T3 surveys or recorded in the administrative records for 103 (1.3%, SE = 0.1) of the 7677 soldiers in the analysis sample (Table 1). The plurality of these SAs were reported only in the surveys (n = 48), fewer only in the administrative data (n = 33), and fewest in both the surveys and administrative data (n = 22).

3.2. Risk factors associated with SAs among deployed soldiers

Many T0 survey predictors had significant bivariate associations with subsequent SAs (Supplemental Tables 1–12). After trimming within-category multivariate models and using elastic net penalized regression to select the optimal final subset of predictors, a multivariate survey model was developed that had 24 predictors (Table 2). The predictors in this model included indicators of childhood adversities (parental maltreatment; parent impaired due to physical illness/disability), lifetime traumatic events (interpersonal violence; other events), personality traits (negative affect; fearlessness), lifetime mental

Table 1
Distribution of self-reported and administratively-recorded suicide attempts during and after deployment among deployed soldiers who completed T0 PPDS (n = 7677).

	Distribution		Percentage of all attempts		(n)
	%	(SE)	%	(SE)	
Suicide attempts					
Survey only	0.6	(0.1)	48.0	(5.7)	(48)
Administrative only	0.4	(0.1)	31.7	(5.8)	(33)
Both	0.3	(0.1)	20.3	(4.1)	(22)
Total	1.3	(0.1)	100.0	–	(103)

Table 2
Best-fitting logistic regression models for pre-deployment risk factors predicting suicide attempt 30 months following baseline among deployed soldiers who completed T0 PPDS (n = 7677).

Risk factor	Distribution		Univariate associations		Model 1 Best multivariate survey predictors[a]		Model 2 Best multivariate survey predictors plus administrative composite[a]		Model 3 Significant predictors from Model 2[a]	
	Estimate	SE	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Childhood adversities										
Frequent emotional and physical maltreatment (%)	2.8	(0.2)	2.8*	(1.2-6.8)	1.7	(0.5-5.9)	1.7	(0.5-5.8)	–	–
Frequent emotional, physical, and sexual maltreatment (%)	0.4	(0.1)	5.4*	(1.1-25.0)	3.3	(0.4-27.5)	3.3	(0.4-27.0)	–	–
Overall maltreatment frequency (mean of a summary scale coded 0–4)	0.2	(0.0)	1.5*	(1.2-1.9)	1.0	(0.6-1.6)	1.0	(0.6-1.6)	–	–
Parent impaired due to physical illness/disability (%)	6.8	(0.3)	2.4*	(1.3-4.3)	1.5	(0.8-3.0)	1.5	(0.8-3.0)	–	–
χ^2_4					5.7	p = .22	5.7	p = .23		
Lifetime traumatic events										
Exposed to traumatic interpersonal violence (%)	36.5	(0.7)	2.1*	(1.4-3.3)	1.1	(0.7-2.0)	1.1	(0.7-2.0)	–	–
Other[b] (%)	65.2	(0.7)	2.0*	(1.3-3.1)	1.3	(0.8-2.1)	1.3	(0.8-2.1)	–	–
χ^2_2					1.5	p = .48	1.1	p = .57		
Personality										
Negative affectivity (mean of deciles coded 1–10)	5.6	(0.1)	1.1*	(1.0-1.3)	1.0	(0.9-1.2)	1.0	(0.9-1.2)	–	–
Negative affectivity (% in top two deciles)	20.1	(0.6)	2.3*	(1.3-4.1)	1.3	(0.6-2.9)	1.3	(0.6-2.9)	–	–
Fearlessness (mean of standardized 0 [1] scale)[c]	0.0	(0.0)	1.3*	(1.1-1.6)	1.0	(0.8-1.3)	1.0	(0.8-1.3)	–	–
χ^2_3					1.5	p = .69	1.5	p = .69		
Lifetime mental disorders										
Any lifetime mental disorder (%)	42.8	(0.8)	2.9*	(2.0-4.3)	1.2	(0.7-2.1)	1.2	(0.7-2.1)	–	–
PTSD months in the past year (mean number of months coded 0–12)	0.5	(0.0)	1.2*	(1.1-1.2)	1.1	(1.0-1.2)	1.1	(1.0-1.2)	–	–
χ^2_2					3.3	p = .19	3.3	p = .19		
Lifetime suicidality										
Worst week suicide ideation (% more than a few seconds/minutes)	74.5	(1.5)	7.6*	(1.1-51.2)	1.6	(0.8-2.9)	1.6	(0.9-2.9)	–	–
Social support										
Social burden (mean of standardized 0 [1] scale)[c]	0.0	(0.0)	1.2*	(1.1-1.4)	1.1	(0.9-1.3)	1.1	(0.9-1.3)	–	–
Relationship quality (mean of standardized 0 [1] scale)[c]	0.0	(0.0)	0.7*	(0.5-0.8)	0.8*	(0.6-0.9)	0.8*	(0.6-0.9)	0.7*	(0.5-0.8)
χ^2_2					7.1*	p = .03	7.1*	p = .03		
Recent health problems										
Health interfered with life (mean of standardized 0[1] scale)[c]	0.0	(0.0)	1.5*	(1.2-1.7)	1.1	(0.8-1.4)	1.1	(0.8-1.4)	–	–
Traumatic brain injury										
Worst severity was very mild (%)	23.6	(0.5)	0.4*	(0.2-0.7)	0.4*	(0.3-0.7)	0.4*	(0.3-0.7)	0.4*	(0.2-0.7)
Risk factor										
Post-concussive symptoms (mean of standardized 0[1] scale)[c]	0.0	(1.0)	1.6*	(1.3-2.0)	1.1	(0.8-1.5)	1.1	(0.8-1.5)	–	-
χ^2_2					10.7	p = .005	10.7	p = 0.005		
Mental health treatment (Past 12 months)										
1–8 visits for any mental health treatment (%)	12.2	(0.5)	1.9*	(1.1-3.3)	1.2	(0.7-2.0)	1.2	(0.7-2.0)	–	–
9 + visits for any mental health treatment (%)	3.8	(0.2)	7.3*	(4.7-11.6)	3.6*	(2.0-6.5)	3.5*	(2.0-6.3)	6.1*	(3.9-9.5)
χ^2_2			84.6*	p < .001	19.1*	p < .001	19.6*	p < .001		
Army career characteristics										
Unit cohesion (mean of standardized 0[1] scale)[c]	0.0	(0.0)	0.8*	(0.7-1.0)	1.2	(1.0-1.5)	1.2	(1.0-1.5)	–	–
Composite Risk Score Variables										
Survey composite risk score	0.0	(0.0)	2.2*	(2.0-2.4)	–	–	–	–	–	–
Administrative composite risk score	0.0	(0.0)	1.3*	(1.1-1.6)	–	–	1.0	(0.8-1.2)	–	–
Sociodemographics										
Age at T0 (mean in years)	25.0	(8.3)	0.9*	(0.9-1.0)	0.9*	(0.9-1.0)	0.9*	(0.9-1.0)	0.9*	(0.9-1.0)

(*continued on next page*)

Table 2 (*continued*)

Risk factor	Distribution		Univariate associations		Model 1 Best multivariate survey predictors[a]		Model 2 Best multivariate survey predictors plus administrative composite[a]		Model 3 Significant predictors from Model 2[a]	
	Estimate	SE	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Male (%)	94.9	(0.5)	0.4*	(0.2-0.8)	0.5*	(0.3-1.0)	0.5*	(0.3-1.0)	0.5*	(0.3-1.0)
High school education or less (%)	80.6	(1.1)	4.1*	(1.2-13.8)	2.0	(0.7-5.6)	2.0	(0.7-5.5)	–	–
Previously married (%)	5.6	(0.4)	3.2*	(1.6-6.6)	2.7*	(1.3-5.6)	2.7*	(1.3-5.6)	3.2*	(1.6-6.5)
χ^2_4					31.5*	$p < .001$	31.8*	$p < .001$		
$\chi^2_{24/25/6}$					638.0*	$p < .001$	659.7*	$p < .001$	117.1*	$p < .001$
Cross-validated AUC					0.75		0.75		0.73	

*Significant at the .05 level, two-sided test.

[a] Controlling for months in administrative data and dummy variables for completing T2-only, T3-only, and both. The omitted category is made up of respondents who completed neither follow-up survey. Information about SA for the latter respondents came exclusively from administrative data.

[b] Other lifetime traumatic events include: Murder of close friend/relative; suicide of close friend/relative; suicide attempt of close friend/relative; discovered dead body; assault of close friend/relative; and any other event that created risk of death for a close friend/relative.

[c] The variable was standardized to have a mean of 0 and a variance of 1.0 in this sample.

disorders (any lifetime mental disorder; PTSD months in the past year), lifetime suicidality (duration of suicidal ideation during worst week), social support (feelings of being a burden; relationship quality), recent health problems (health interfered with life), traumatic brain injury (lifetime experience; worst severity; post-concussive symptoms), recent (past year) treatment of mental health problems (number of visits, 1–8 vs. 9+; no treatment but needed it vs. didn't need it), and several socio-demographic and Army career characteristics (age at baseline; gender; education; marital status; any prior deployment; unit cohesion).

All survey variables had significant univariate associations with the outcome. However, only 6 of these 24 remained significant in the best-fitting multivariate model: relationship quality (OR = 0.77), worst TBI was very mild (OR = 0.44), having 9 + mental health treatment visits (OR = 3.58), age (OR = 0.91), male gender (OR = 0.51), and previously married (either dating or not dating currently) (OR = 2.72) (Model 1; Table 2). After adding in the administrative composite variable (Model 2; Table 2), these 6 predictors all remained significant and their ORs were largely unchanged, whereas the administrative composite variable was not a significant predictor of SA. Consistent with the fact that all 24 variables in Model 1 were selected as important in the penalized regression analysis, though, the cross-validated AUC of the Model containing all 24 predictors (Model 1; AUC = 0.75) was higher than that of the model containing only the 6 individually significant predictors (Model 3; AUC = 0.73).

3.3. *Development and performance of machine learning models*

All the dozens of significant variables from the bivariate models within each risk factor category (Supplemental Tables 1–12) were included in a Super Learner ensemble model. The cross-validated AUC of that model was 0.77 (Fig. 1), which is not much higher than the 0.75 AUC of Model 1. We also estimated several elastic net models on this larger set of risk factors. Cross-validated AUCs from these models were 0.75–0.76 depending on the value specified for the mixing parameter (Fig. 1). As shown in Fig. 1 and Table 3, 21.3–22.7% of all subsequent SAs occurred among the 5% of soldiers at highest predicted SA risk and that 34.4–40.4% of all subsequent suicide attempts occurred among the 10% of soldiers at highest predicted risk in the various models. PPV was in the range 5.3–5.7% in these models among the 5% and 4.4–5.1% among the 10% of soldiers at highest predicted risk.

4. Discussion

We sought to determine if risk models using pre-deployment survey data would have sufficient strength for practical use predicting SAs during and after deployment. Three key findings emerged. First, we identified an optimal subset of 24 predictors from a much larger number of survey variables originally considered, and only 6 of these 24 remained significant in our final multivariate logistic model. A composite administrative predictor was non-significant. Second, an ensemble machine learning model allowing for interactions had only a marginally higher AUC than the final logistic model. Third, PPV was quite low despite the relatively good model AUC due to the rarity of SAs. We expand on each of these findings below.

The final significant predictors were largely consistent with prior military and general population research (e.g., Franklin et al., 2017; Nock et al., 2013; Ursano et al., 2016): history of minor TBI, frequent recent mental health treatment visits, young age, female, and indicators of relationship difficulties (low relationship quality, previously married, not dating). We also considered several distal risk factors that have received less attention in military populations (e.g., childhood adversities), but none entered the final model.

Although overall model accuracy, as indicated by AUC, was good, some other studies predicting SAs had higher AUCs (see the recent review by Belsher et al., 2019). However, the latter studies all predicted over considerably shorter follow-up periods than the 30-month time

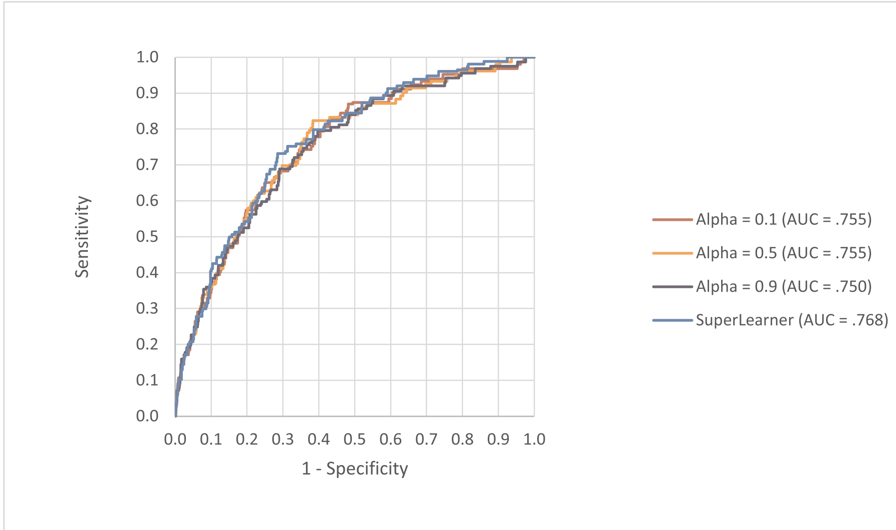

Fig. 1. Cross-validated ROC curves for elastic nets vs Super Learner in predicting prospective suicide attempts among deployed soldiers who completed the T0 PPDS (n = 7,677).

Table 3
Associations of risk strata with subsequent suicide attempts.

Model	Sensitivity		Positive Predictive Value	
	%	(SE)	%	(SE)
I. Five percent of soldiers with highest predicted risk				
Elastic net (.1 mixing parameter)	22.7	(4.5)	5.7	(1.3)
Elastic net (.5 mixing parameter)	21.7	(4.4)	5.4	(1.2)
Elastic net (.9 mixing parameter)	22.7	(4.6)	5.7	(1.3)
Super Learner	21.4	(4.4)	5.3	(1.2)
II. Ten percent of soldiers with highest predicted risk				
Elastic net (.1 mixing parameter)	34.4	(5.1)	4.4	(0.8)
Elastic net (.5 mixing parameter)	35.9	(5.1)	4.5	(0.8)
Elastic net (.9 mixing parameter)	37.4	(5.1)	4.7	(0.8)
Super Learner	40.4	(5.2)	5.1	(0.8)

horizon in our study. AUC would be expected to increase as the time horizon decreases to the extent that predictors change.

Despite relatively good AUC, especially given the long time horizon, PPV was low due to the rarity of SAs. Moreover, PPV would be expected to decrease if the time horizon was shortened. Recent commentators have argued that low PPV undercuts the value of prediction models for suicidal behaviors (Belsher et al., 2019). However, this is not necessarily the case so long as intervention costs are low enough relative to anticipated benefits (Kessler, 2019; Simon et al., 2019). For example, soldiers with comparatively high predicted SA risk might cost-effectively be assigned to inexpensive low-risk interventions (Greden et al., 2010; Torous and Walker, 2019) or model results might be used to target a subset of soldiers for additional assessments to determine next steps (Matarazzo et al., 2019; Zuromski et al., 2019).

One noteworthy limitation of our study is that classification accuracy might have been affected by our small sample size, as we had to use a composite administrative risk score rather than consider the many individual administrative variables available for each soldier for inclusion in the model. A larger sample in future replications would allow more nuanced analyses of administrative predictors. A larger sample would also make it possible to develop models over shorter time horizons, which might have greater practical value to decision-makers. It would also be of interest to expand the variety of predictors considered in future expansions of our work. For example, suggestions exist that experiences from prior deployments (e.g., combat) and time-related variables related to time since prior deployment might be significant predictors of suicidal behaviors during subsequent deployments. (Bryan et al., 2015; Ursano et al., 2018). Information obtained from various biomarkers (Niculescu et al., 2017; Stein et al., 2017) and other data sources (e.g., social media posts; Bryan et al., 2018) might also be of value.

Another potentially important limitation is that we combined information about self-reported and administratively-recorded SAs. Although the prevalence of SAs in our sample was higher than estimated for the general US population (Olfson et al., 2017), the relative rarity of SAs made it impossible to carry out separate analyses of self-reported and administratively-recorded SAs. Furthermore, we excluded the small number of PPDS respondents who died by suicide because of the extreme rarity of this outcome. It might well be that predictors are different for self-reported SA, administratively-recorded SA, and suicide death. A final important limitation is that PPDS respondents were given assurances that their survey responses would be confidential, which may have encouraged more open responding than if a similar survey without this guarantee of confidentiality was carried out in the future for the purpose of targeting soldiers for preventive interventions.

The latter limitation means that any attempt to use the current results to build a SA risk model would need to replicate our study using a survey in which respondents were aware that their responses are identified, possibly supplementing the questions we found to be significant predictors with other measures designed to be less subject to response bias in identified surveys (Nock et al., 2010; Bryan et al., 2014). Iterative refinement would doubtlessly be needed prior to such a model being used for practical decision-making (Fusar-Poli et al., 2018).

Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2019.12.003.

References

Belsher, B.E., Smolenski, D.J., Pruitt, L.D., Bush, N.E., Beech, E.H., Workman, D.E., Skopp, N.A., 2019. Prediction models for suicide attempts and deaths: a systematic review and simulation. JAMA Psychiatr. 76, 642–651. https://doi.org/10.1001/jamapsychiatry.2019.0174.

Bernecker, S.L., Rosellini, A.J., Nock, M.K., Chiu, W.T., Gutierrez, P.M., Hwang, I., Kessler, R.C., 2018. Improving risk prediction accuracy for new soldiers in the US Army by adding self-report survey data to administrative data. BMC Psychiatry 18, 87. https://doi.org/10.1186/s12888-018-1656-4.

Breiman, L., 2001. Random forests. Mach. Learn. 45, 5–32. https://doi.org/10.1023/A:1010933404324.

Bryan, C.J., Butner, J.E., Sinclair, S., Bryan, A.B.O., Hesse, C.M., Rose, A.E., 2018. Predictors of emerging suicide death among military personnel on social media networks. Suicide Life-Threatening Behav. 48, 413–430. https://doi.org/10.1111/sltb.12370.

Bryan, C.J., Griffith, J.E., Pace, B.T., Hinkson, K., Bryan, A.O., Clemans, T.A., Imel, Z.E., 2015. Combat exposure and risk for suicidal thoughts and behaviors among military personnel and veterans: a systematic review and meta-analysis. Suicide Life-Threatening Behav. 45, 633–649. https://doi.org/10.1111/sltb.12163.

Bryan, C.J., Rudd, M.D., Wertenberger, E., Etienne, N., Ray-Sannerud, B.N., Morrow, C.E., Peterson, A.L., Young-McCaughon, S., 2014. Improving the detection and prediction of suicidal behavior among military personnel by measuring suicidal beliefs: an evaluation of the Suicide Cognitions Scale. J. Affect. Disord. 159, 15–22. https://doi.org/10.1037/e522252014-179.

Chen, T., Guestrin, C., 2016. XGBoost: a scalable tree boosting system. In: Proceedings of the 22nd Acm Sigkdd International Conference on Knowledge Discovery and Data Mining, pp. 785–794. https://doi.org/10.1145/2939672.2939785.

Chipman, H.A., George, E.I., McCulloch, R.E., 2010. BART: Bayesian additive regression trees. Ann. Appl. Stat. 4, 266–298. https://doi.org/10.1214/09-aoas285.

Franklin, J.C., Ribeiro, J.D., Fox, K.R., Bentley, K.H., Kleiman, E.M., Huang, X., Musacchio, K.M., Jaroszewski, A.C., Chang, B.P., Nock, M.K., 2017. Risk factors for suicidal thoughts and behaviors: a meta-analysis of 50 years of research. Psychol. Bull. 143, 187–232. https://doi.org/10.1037/bul0000084.

Friedman, J., 1991. Multivariate adaptive regression splines. Ann. Stat. 19, 1–67. https://doi.org/10.1214/aos/1176347963.

Friedman, J., Hastie, T., Tibshirani, R., 2010. Regularization paths for generalized linear models via coordinate descent. J. Stat. Softw. 33. https://doi.org/10.18637/jss.v033.i01.

Fusar-Poli, P., Hijazi, Z., Stahl, D., Steyerberg, E.W., 2018. The science of prognosis in psychiatry: a review. JAMA Psychiatr. 75, 1289–1297. https://doi.org/10.1001/jamapsychiatry.2018.2530.

Gilman, S.E., Bromet, E.J., Cox, K.L., Colpe, L.J., Fullerton, C.S., Gruber, M.J., Kessler, R.C., 2014. Sociodemographic and career history predictors of suicide mortality in the United States Army 2004–2009. Psychol. Med. 44, 2579–2592. https://doi.org/10.1017/S003329171400018X.

Greden, J.F., Valenstein, M., Spinner, J., Blow, A., Gorman, L.A., Dalack, G.W., Marcus, S., Kees, M., 2010. Buddy-to-Buddy, a citizen soldier peer support program to counteract stigma, PTSD, depression, and suicide. Ann. N. Y. Acad. Sci. 1208, 90–97. https://doi.org/10.1111/j.1749-6632.2010.05719.x.

James, G., Witten, D., Hastie, T., Tibshirani, R., 2013. An Introduction to Statistical Learning: with Applications in R. Springer, New York.

Kessler, R.C., 2019. Clinical epidemiological research on suicide-related behaviors—-where we are and where we need to go. JAMA Psychiatr. https://doi.org/10.1001/jamapsychiatry.2019.1238. [Epub ahead of print].

Kessler, R.C., Colpe, L.J., Fullerton, C.S., Gebler, N., Naifeh, J.A., Nock, M.K., Ursano, R.J., 2013a. Design of the Army study to assess risk and resilience in Servicemembers (Army STARRS). Int. J. Methods Psychiatr. Res. 22, 267–275. https://doi.org/10.1002/mpr.1401.

Kessler, R.C., Heeringa, S.G., Colpe, L.J., Fullerton, C.S., Gebler, N., Hwang, I., Naifeh, J.A., Nock, M.K., Sampson, N.A., Schoenbaum, M., Zaslavsky, A.M., Stein, M.B., Ursano, R.J., 2013b. Response bias, weighting adjustments, and design effects in the Army study to assess risk and resilience in Servicemembers (Army STARRS). Int. J. Methods Psychiatr. Res. 22, 288–302. https://doi.org/10.1002/mpr.1399.

Kessler, R.C., Stein, M.B., Bliese, P.D., Bromet, E.J., Chiu, W.T., Cox, K.L., Ursano, R.J., 2015a. Occupational differences in U.S. Army suicide rates. Psychol. Med. 45, 3293–3304. https://doi.org/10.1017/S0033291715001294.

Kessler, R.C., Warner, C.H., Ivany, C., Petukhova, M.V., Rose, S., Bromet, E.J., Ursano, R.J., 2015b. Predicting suicides after psychiatric hospitalization in US Army soldiers. JAMA Psychiatr. 72, 49–57. https://doi.org/10.1001/jamapsychiatry.2014.1754.

LeardMann, C.A., Powell, T.M., Smith, T.C., Bell, M.R., Smith, B., Boyko, E.J., Hoge, C.W., 2013. Risk factors associated with suicide in current and former US military personnel. J. Am. Med. Assoc. 310, 496–506. https://doi.org/10.1001/jama.2013.65164.

Little, R., Rubin, D., 2002. Statistical Analysis with Missing Data, second ed. John Wiley & Sons, New York.

Matarazzo, B.B., Brenner, L.A., Reger, M.A., 2019. Positive predictive values and potential success of suicide prediction models. JAMA Psychiatr. https://doi.org/10.1001/jamapsychiatry.2019.1519. [Epub ahead of print].

Niculescu, A.B., Le-Niculescu, H., Levey, D.F., Phalen, P.L., Dainton, H.L., Roseberry, K., Salomon, D.R., 2017. Precision medicine for suicidality: from universality to subtypes and personalization. Mol. Psychiatry 22, 1250–1273. https://doi.org/10.1038/mp.2017.128.

Nock, M.K., Deming, C.A., Fullerton, C.S., Gilman, S.E., Goldenberg, M., Kessler, R.C., McCarroll, J.E., McLaughlin, K.A., Peterson, C., Schoenbaum, M., Stanley, B., Ursano, R.J., 2013. Suicide among soldiers: a review of psychosocial risk and protective factors. Psychiatry 76, 97–125. https://doi.org/10.1521/psyc.2013.76.2.97.

Nock, M.K., Park, J.M., Finn, C.T., Deliberto, T.L., Dour, H.J., Banaji, M.R., 2010. Measuring the suicidal mind: implicit cognition predicts suicidal behavior. Psychol. Sci. 21, 511–517. https://doi.org/10.1177/0956797610364762.

O'Connor, R.C., Nock, M.K., 2014. The psychology of suicidal behaviour. The Lancet 1, 73–85.

Olfson, M., Blanco, C., Wall, M., Liu, S.M., Saha, T.D., Pickering, R.P., Grant, B.F., 2017. National trends in suicide attempts among adults in the United States. JAMA Psychiatr. 74, 1095–1103. https://doi.org/10.1001/jamapsychiatry.2017.2582.

Office of the Under Secretary of Defense for Personnel and Readiness, 2017. Defense suicide prevention program, DoD instruction 6460.16. Retrieved from. https://www.dspo.mil/Portals/113/Documents/649016_dodi_2017.pdf?ver=2018-04-13-170143-593.

Posner, K., Brown, G.K., Stanley, B., Brent, D.A., Yershova, K.V., Oquendo, M.A., Currier, G.W., Melvin, G.A., Greenhill, L., Shen, S., Mann, J.J., 2011. The Columbia-Suicide Severity Rating Scale: initial validity and internal consistency findings from three multisite studies with adolescents and adults. Am. J. Psychiatry 168, 1266–1277. https://doi.org/10.1176/appi.ajp.2011.10111704.

Reger, M.A., Smolenski, D.J., Skopp, N.A., Metzger-Abamukang, M.J., Kang, H.K., Bullman, T.A., Gahm, G.A., 2015. Risk of suicide among US military service members following Operation Enduring Freedom or Operation Iraqi Freedom deployment and separation from the US military. JAMA Psychiatr. 72, 561–569. https://doi.org/10.1001/jamapsychiatry.2014.3195.

Reger, M.A., Tucker, R.P., Carter, S.P., Ammerman, B.A., 2018. Military deployments and suicide: a critical examination. Perspect. Psychol. Sci. 13, 688–699. https://doi.org/10.1177/1745691618785366.

Rosellini, A.J., Monahan, J., Street, A.E., Heeringa, S.G., Hill, E.D., Petukhova, M., Stein, M.B., 2016. Predicting non-familial major physical violent crime perpetration in the US Army from administrative data. Psychol. Med. 46, 303–316. https://doi.org/10.1017/s0033291715001774.

Rosellini, A.J., Monahan, J., Street, A.E., Petukhova, M.V., Sampson, N.A., Benedek, D.M., Kessler, R.C., 2017. Predicting sexual assault perpetration in the U.S. Army using administrative data. Am. J. Prev. Med. 53, 661–669. https://doi.org/10.1016/j.amepre.2017.06.022.

Rosellini, A.J., Stein, M.B., Benedek, D.M., Bliese, P.D., Chiu, W.T., Hwang, I., Kessler, R.C., 2018. Predeployment predictors of psychiatric disorder-symptoms and interpersonal violence during combat deployment. Depress. Anxiety 35, 1073–1080. https://doi.org/10.1002/da.22807.

SAS Institute Inc, 2010. SAS/STATR Software. SAS Institute Inc, Cary, NC.

Schoenbaum, M., Kessler, R.C., Gilman, S.E., Colpe, L.J., Heeringa, S.G., Stein, M.B., Ursano, R.J., Cox, K.L., 2014. Predictors of suicide and accident death in the Army study to assess risk and resilience in Servicemembers (Army STARRS): results from the Army study to assess risk and resilience in Servicemembers (Army STARRS). JAMA Psychiatr. 71, 493–503. https://doi.org/10.1001/jamapsychiatry.2013.4417.

Shen, Y.C., Cunha, J.M., Williams, T.V., 2016. Time-varying associations of suicide with deployments, mental health conditions, and stressful life events among current and former US military personnel: a retrospective multivariate analysis. Lancet Psychiatr. 3, 1039–1048. https://doi.org/10.1016/S2215-0366(16)30304-2.

Simon, G., Shortreed, S., Coley, Y., 2019. Positive predictive values and potential success of suicide prediction models. JAMA Psychiatr. https://doi.org/10.1001/jamapsychiatry.2019.1516. [Epub ahead of print].

Smith, G.C., Seaman, S.R., Wood, A.M., Royston, P., White, I.R., 2014. Correcting for optimistic prediction in small data sets. Am. J. Epidemiol. 180, 318–324. https://doi.org/10.1093/aje/kwu140.

Stein, M.B., Ware, E.B., Mitchell, C., Chen, C.Y., Borja, S., Cai, T., Dempsey, C.L., Fullerton, C.S., Gelernter, J., Heeringa, S.G., Jain, S., Kessler, R.C., Naifeh, J.A., Nock, M.K., Ripke, S., Sun, X., Beckham, J.C., Kimbrel, N.A., Ursano, R.J., Smoller, J.W., Jain, S., 2017. Genomewide association studies of suicide attempts in US soldiers. Am. J. Med. Genet. B Neuropsychiatr. Genet. 174, 786–797. https://doi.org/10.1002/ajmg.b.32594.

Street, A.E., Gilman, S.E., Rosellini, A.J., Stein, M.B., Bromet, E.J., Cox, K.L., Colpe, L.J., Fullerton, C.S., Gruber, M.J., Heeringa, S.G., Lewandowski-Romps, L., Little, R.J., Naifeh, J.A., Nock, M.K., Sampson, N.A., Schoenbaum, M., Ursano, R.J., Zaslavsky, A.M., Kessler, R.C., 2015. Understanding the elevated suicide risk of female soldiers during deployments. Psychol. Med. 45, 717–726. https://doi.org/10.1017/s003329171400258x.

Street, A.E., Rosellini, A.J., Ursano, R.J., Heeringa, S.G., Hill, E.D., Monahan, J., Bliese, P.D., 2016. Developing a risk model to target high-risk preventive interventions for sexual assault victimization among female US Army soldiers. Clin. Psychol. Sci. 4, 939–956. https://doi.org/10.1177/2167702616639532.

Torous, J., Walker, R., 2019. Leveraging digital health and machine learning toward reducing suicide— from panacea to practical tool. JAMA Psychiatr. https://doi.org/10.1001/jamapsychiatry.2019.1231. [Epub ahead of print].

Ursano, R.J., Kessler, R.C., Heeringa, S.G., Cox, K.L., Naifeh, J.A., Fullerton, C.S., Sampson, N.A., Tzu-Cheg, K., Aliaga, P.A., Vegella, P., Herberman Mash, H., Buckley, C., Colpe, L.J., Schoenbaum, M., Stein, M.B., on behalf of the Army STARRS collaborators, 2015. Nonfatal suicidal behaviors in US Army administrative records, 2004–2009: results from the Army study to assess risk and resilience in Servicemembers (Army STARRS). Psychiatry 78, 1–21. https://doi.org/10.1080/00332747.2015.1006512.

Ursano, R.J., Kessler, R.C., Naifeh, J.A., Mash, H.H., Fullerton, C.S., Aliaga, P.A., Stein, M.B., 2018. Associations of time-related deployment variables with risk of suicide attempt among soldiers: results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). JAMA Psychiatr. 75, 596–604. https://doi.org/10.1001/jamapsychiatry.2018.0296.

Ursano, R.J., Kessler, R.C., Naifeh, J.A., Mash, H.H., Fullerton, C.S., Ng, T.H.H., Stein, M.B., 2017. Suicide attempts in U.S. Army combat arms, special forces and combat medics. BMC Psychiatry 17, 194. https://doi.org/10.1186/s12888-017-1350-y.

Ursano, R.J., Kessler, R.C., Stein, M.B., Naifeh, J.A., Aliaga, P.A., Fullerton, C.S., Wryter, C.L., 2016. Risk factors, methods, and timing of suicide attempts among US Army soldiers. JAMA Psychiatr. 73, 741–749. https://doi.org/10.1001/jamapsychiatry.2016.0600.

van der Laan, M., Polley, E., Hubbard, A., 2007. Super learner. Stat. Appl. Genet. Mol. Biol. 6, 1–21. https://doi.org/10.2202/1544-6115.1309.

Wolter, K., 2007. Introduction to Variance Estimation, second ed. Springer, New York, New York.

Zuromski, K.L., Bernecker, S.L., Gutierrez, P.M., Joiner, T.E., King, A.J., Liu, H., Naifeh, J.A., Nock, M.K., Sampson, N.A., Zaslavsky, A.M., Stein, M.B., Ursano, R.J., Kessler, R.C., 2019. Assessment of a risk index for suicide attempts among US Army soldiers with suicidal ideation: analysis of data from the Army study to assess risk and resilience in Servicemembers (Army STARRS). JAMA Netw. Open 2, e190766. https://doi.org/10.1001/jamanetworkopen.2019.0766.

JAMA Psychiatry | Original Investigation

Economic Evaluation of Brief Cognitive Behavioral Therapy vs Treatment as Usual for Suicidal US Army Soldiers

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IMPORTANCE Brief cognitive behavioral therapy (BCBT) is a clinically effective intervention for reducing risk of suicide attempts among suicidal US Army soldiers. However, because specialized treatments can be resource intensive, more information is needed on costs and benefits of BCBT compared with existing treatments.

OBJECTIVE To evaluate the cost-effectiveness of BCBT compared with treatment as usual for suicidal soldiers in the US Army.

DESIGN, SETTING, AND PARTICIPANTS A decision analytic model compared effects and costs of BCBT vs treatment as usual from a US Department of Defense (DoD) perspective. Model input data were drawn from epidemiologic data sets and a clinical trial among suicidal soldiers conducted from January 31, 2011, to April 3, 2014. Data were analyzed from July 3, 2018, to March 25, 2019.

INTERVENTIONS The strategies compared were treatment as usual alone vs treatment as usual plus 12 individual BCBT sessions. Treatment as usual could include a range of pharmacologic and psychological treatment options.

MAIN OUTCOMES AND MEASURES Costs in 2017 US dollars, suicide attempts averted (self-directed behavior with intent to die, but with nonfatal outcome), suicide deaths averted, and incremental cost-effectiveness ratios, assuming a 2-year time horizon for treatment differences but including lifetime costs.

RESULTS In the base-case analysis, BCBT was expected to avert approximately 23 to 25 more suicide attempts and 1 to 3 more suicide deaths per 100 patients treated than treatment as usual. Sensitivity analyses assuming a range of treatment effects showed BCBT to be cost saving in most scenarios. Using the federal discount rate, the DoD was estimated to save from $15 000 to $16 630 per patient with BCBT vs treatment as usual. In a worst-case scenario (ie, assuming the weakest plausible BCBT effect sizes), BCBT cost an additional $1910 to $2250 per patient compared with treatment as usual.

CONCLUSIONS AND RELEVANCE Results suggest BCBT may be a cost-saving intervention for suicidal active-duty soldiers. The costs of ensuring treatment fidelity would also need to be considered when assessing the implications of disseminating BCBT across the entire DoD.

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Supplemental content

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In response to increasing suicides in the US military,[1,2] the US Department of Defense (DoD) has prioritized suicide prevention,[3] implementing many different preventive interventions. The cost-effectiveness of these interventions has not been systematically assessed; in most cases, the comparative efficacy of the interventions used in military service members remains unknown.

Cognitive behavioral therapy (CBT) is currently the psychological treatment with the most consistent meta-analytic evidence for reducing suicide attempts.[4,5] Cognitive behavioral therapy is most effective when it targets suicidal thoughts or behaviors directly as opposed to targeting mental disorders or other risk factors.[6] Brief CBT (BCBT) is one such suicide-focused CBT, and its brevity and flexibility enable it to accommodate the unpredictable demands of military service. Over 12 sessions, the clinician and patient analyze precipitants of the crisis, create and practice a crisis response plan, practice emotion regulation skills, and reduce cognitions associated with suicidal behavior (eg, hopelessness). A trial that randomized 152 Army soldiers presenting with recent suicidal crises (attempt or ideation with intent to die) to receive treatment as usual or BCBT plus treatment as usual found that adding BCBT significantly reduced soldiers' likelihood of future suicide attempts,[7] which was an effect not attributable to receiving a higher psychotherapy dose.[8]

Despite this evidence, it remains unclear whether BCBT should be considered a standard treatment for service members after a suicidal crisis, because the most effective treatment might not be the most cost-effective treatment. New treatments typically cost more than the current standard of care, including new psychological treatments, which can be resource intensive to disseminate because of training and quality-control monitoring costs.[9] Cost-effectiveness analysis assesses whether such treatments produce enough health gains to justify their costs or whether implementing the intervention could draw resources away from other treatments that produce more health per dollar spent. Cost-effectiveness modeling can also incorporate sensitivity analysis to address uncertainty in estimates of effect sizes. The magnitude of BCBT's effect among service members remains unclear because, to our knowledge, only 1 trial among soldiers has been published, although suicide-focused CBT has consistently shown benefits among civilians[4,5]; sensitivity analysis can reveal whether BCBT would remain cost-effective at different effect sizes.

To assist DoD decision makers, we estimated the cost-effectiveness from the DoD perspective of providing BCBT to US Army soldiers with a recent suicidal crisis. To be clear, the aim of cost-effectiveness analysis is not to save money at the expense of lives, but rather to identify treatment strategies that optimally allocate resources to maximize health gains.

Key Points

Question Is brief cognitive behavioral therapy cost-effective vs treatment as usual for preventing suicidal behaviors among at-risk US Army soldiers?

Findings In this economic evaluation, data from a published clinical trial and multiple epidemiologic data sets were used to estimate that brief cognitive behavioral therapy may be cost saving compared with treatment as usual. Brief cognitive behavioral therapy remained cost-effective in sensitivity analyses that explored alternative scenarios.

Meaning Brief cognitive behavioral therapy appears to be a cost-effective intervention for at-risk soldiers and should be considered for widespread implementation.

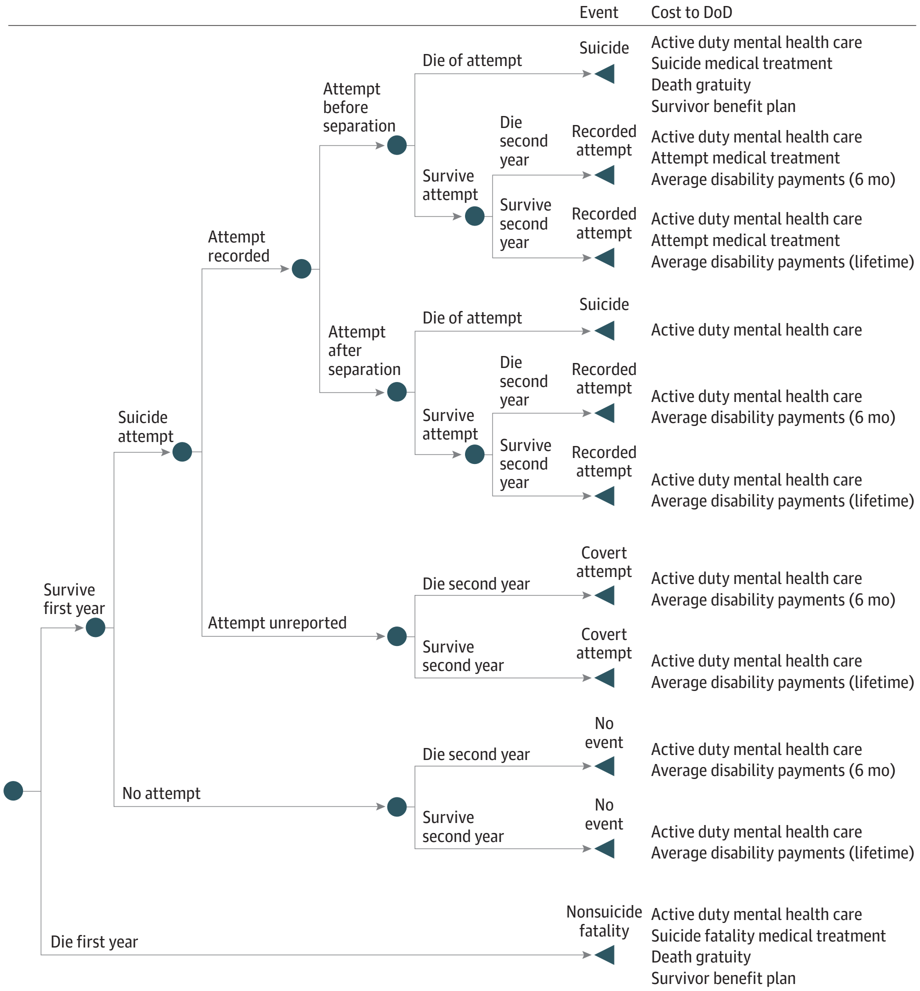
Methods

Model Overview and Inputs

We developed a decision-analytic model (**Figure 1**) to compare costs, suicide attempts, and suicide deaths among patients treated with BCBT vs treatment as usual for the target population of Army soldiers presenting with a recent suicidal crisis. In this model, the probability of each event was multiplied by the event's cost to compute total costs for each of the 2 treatments. The model assumes that all treatment effects end after 2 years. Because this duration corresponds to the follow-up length of the trial providing data, the effects of psychological treatment beyond 2 years remain understudied,[10] and treatment differences typically decay.[11]

We included direct costs from the DoD perspective in 2017 US dollars: medical costs and compensation provided to disabled retirees and decedents' next of kin. Consistent with the DoD perspective, we only included health care costs accrued before separation from duty, and we included lifetime costs of disability and next-of-kin benefits. However, the DoD may have a goal of reducing suicide attempts and deaths regardless of when they occur despite the lack of direct consequences on the DoD budget. To capture the investment required from the DoD to avert these negative events for the benefit of society, we also present the incremental cost to the DoD per event averted, regardless of event timing. In other words, this cost includes what the DoD would need to pay to prevent a suicide attempt or death before or after a soldier separates from service. Input values for the base case and sensitivity analyses[7,12-22] appear in **Table 1**. Model input data were drawn from epidemiologic data sets and a clinical trial among suicidal soldiers conducted from January 31, 2011, to April 3, 2014. Data were analyzed from July 3, 2018, to March 25, 2019. This study followed the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) reporting guideline.[23] Deidentified data were provided to 2 of us (S.L.B. and K.L.Z.) via a data-sharing agreement between the National Center for Veterans Studies at the University of Utah and Harvard University. The original trial's procedures were reviewed and approved by the institutional review board of the Madigan Army Medical Center. The need for further study approval was waived by the institutional review boards of the University of Utah and Harvard University.

Figure 1. Decision Tree Structure for Each Strategy



Terminal nodes are labeled with the event and with costs that would be paid by the Department of Defense (DoD).

Demographic Data and Background Mortality

Demographic data on the target population (ie, soldiers with recent suicidal crises) were drawn from 2 sources: the BCBT trial that randomized 152 Army soldiers[7] and the Army Study to Assess Risk and Resilience in Service members (STARRS), a multicomponent, epidemiologic-neurobiologic study of US Army soldiers.[24] Two STARRS components contributed data: the All-Army Survey, a large representative survey of Army soldiers, and the Historical Administrative Data System, a compilation of administrative records. Suicide attempter demographic information from the All-Army Survey corresponded well to BCBT trial participant demographics, suggesting that trial participants were reasonably representative of soldiers at risk for suicide attempt.

To account for background mortality, we estimated mortality probability in the first or second year after receiving treatment for a cohort of soldiers with the same age distribution as the target population. For deaths in year 1, we used active-duty mortality rates[15] because the median time to separation was the end of the first year, and for deaths in year 2, we used a weighted combination of veteran[16] and disabled retiree mortality rates.[15]

Treatment Effects

Data on treatment effects were drawn from the BCBT trial that randomized active-duty soldiers with past-month suicide attempt or past-week ideation with intent to die to treatment as usual or treatment as usual plus 12 individual outpatient BCBT sessions.[7] Treatment as usual could include medication; individual or group psychotherapy; and intensive outpatient, partial hospitalization, and/or inpatient treatment. Data were collected for 2 years on suicide attempts, use of mental health care services, and separation from the Army. We had access to raw trial data and therefore report results not presented in the original publication. Based on trial results, our model assumed the existence of advantages of BCBT over treatment as usual alone on the probability of suicide attempts, probability of disability retirement, and mental health care visit counts, including the BCBT visits in the intervention. Because of the uncertainty conferred by relying on 1 trial, we tested alternative effect sizes in sensitivity analyses.

Other Probabilities and Event Times

We also used trial data to estimate values that were assumed to be the same regardless of assignment based on finding no

Table 1. Model Input Data

Parameter	Base Case	Sensitivity Analysis Value or Distribution[a]	Source
General input			
Annual discount rate, %	Federal rate	3%	Sanders et al[12]; US Office of Management and Budget[13]
Time horizon	Lifetime for costs/benefits, 2 y for treatment effects	NA	NA
Event probabilities			
Suicide attempt probability, %			Rudd et al[7]
Treatment as usual	39.5	37.1 For weaker and lower-bound scenarios	
BCBT	13.5	22.5 For weaker and 31.8 for lower-bound scenarios	
Attempt medical/administrative record probability, %	64.5	β (α = 40, β = 21)	Rudd et al[7]
Death probability/recorded attempt, %			Army STARRS,[b] CDC WISQARS[14]
Higher lethality (Army)	17.2	β (α = 279, β = 1340)	
Lower lethality (civilian)	7.1	β (α = 44 000, β = 575 000)	
Attempt before separation probability/attempt, %	61.1	β (α = 11, β = 7)	Rudd et al[7]
Disability evaluation probability, %			Rudd et al[7]
Treatment as usual	57.6	β (α = 38, β = 28)	
BCBT	39.4	Treatment as usual probability $\times\ e^{\text{normal, mean (SD): 0.378 (0.181)}}$	
Disability rating probability/disability evaluation, %	90.0	β (α = 45, β = 5)	Rudd et al[7]
Background mortality probability, %			DoD OACT[15]; NCVAS[16]
Year 1 treatment as usual and BCBT	0.069	NA	
Year 2 treatment as usual	0.185	Varied based on proportion disabled	
BCBT	0.168	Varied based on proportion disabled	
Event timing			
Time to attempt, d			Rudd et al[7]
Treatment as usual	279	245 For weaker and lower-bound scenarios	
BCBT	152	295 For weaker and 245 for lower-bound scenario	
Time to, d			
Separation	348	NA	Rudd et al[7]
Death from other causes			NA
Year 1	183	NA	
Year 2	548	NA	
Surviving spouse life expectancy, y			Arias et al[17]
Male patients' wives	57	NA	
Female patients' husbands	50.7	NA	
Child coverage expectancy, y	17.5	NA	DoD OACT[15]
Disabled retiree life expectancy, y	48	NA	DoD OACT[15]
Treatment costs			
Mental health care total costs, 2017 US $			Rudd et al[7]; MHS M2[b]
Treatment as usual	20 244	Normal, mean (SD): 20 244 (2780)	
BCBT	15 832	Treatment as usual cost + normal, mean (SD): −4413 (3894)	
Suicide medical cost, 2017 US $[c]			
Suicide death	5031	NA	CDC WISQARS[14]
Suicide attempt	3043	NA	MHS M2[b]
Other death	30 000	NA	eAppendix in the Supplement

(continued)

Table 1. Model Input Data (continued)

Parameter	Base Case	Sensitivity Analysis Value or Distribution[a]	Source
Benefit costs			
Annual retired disability pay, 2017 US $	1282	Normal, mean (SD): 1284 (353)	Defense Finance and Accounting Service[18]
Annual survivor benefit annuity, 2017 US $			
Spouse beneficiary	3720	NA	10 USC §§ 1447-1460B[19]; 38 USC §§ 1301-1322[20]; 38 CFR §§ 3[21]
Child beneficiary	12 322	NA	10 USC §§ 1447-1460B[19]; 38 USC §§ 1301-1322[20]; 38 CFR §§ 3[21]
Death gratuity	100 000	NA	20 CFR § 10, Subpart J[22]

Abbreviations: Army STARRS, Army Study to Assess Risk and Resilience in Servicemembers; BCBT, Brief Cognitive Behavioral Therapy; CDC WISQARS, US Centers for Disease Control and Prevention Web-Based Injury Statistics Query and Reporting System; CFR, Code of Federal Regulations; DoD OACT, Department of Defense Office of the Actuary; MHS M2, Military Health System Management Analysis and Reporting Tool data sets; NA, not applicable; NCVAS, National Center for Veterans Analysis and Statistics; USC, United States Code.

[a] Where appropriate, SEs of continuous values estimated from the data appear in this column as the SDs used to generate normally distributed values for probabilistic sensitivity analyses.

[b] Original analysis of unpublished data.

[c] Medical cost refers to medical care other than mental health care.

significant or appreciable differences in the trial: probability of suicide attempt being administratively recorded vs only self-reported, time to Army separation, and proportion of suicide attempts before vs after separating.

Probability of Dying by Suicide

The trial was powered to detect differences in likelihood of suicide attempt, but not death, owing to the lower base rate of the latter. Therefore, to simulate treatment effects on suicide deaths, we assumed that a proportion of medically and/or administratively recorded[2] suicide attempts would result in death—in other words, that they would actually be suicides. We applied a probability of death only to medically and/or administratively recorded suicide attempts in the model because the ratios available in the literature represent the proportion of medically and/or administratively recorded suicide attempts that are fatal and omit covert/unreported suicide attempts in the denominator. More than one-third of attempts during follow-up were reported only in clinical interviews and not medically or administratively recorded. Historical Administrative Data System 2004-2014 data suggested that approximately 17% of administratively recorded Army soldier suicide attempts ended in death. Based on this percentage, we assumed that for every 100 suicidal acts averted, 17 would be suicide deaths and the remaining 83 would be attempts. This proportion is higher than the proportions reported in civilian studies,[25] implying either that a higher proportion of Army than civilian suicide attempts are underreported or that soldiers' suicidal behaviors are more lethal than those of civilians. Because both explanations seemed plausible, we computed results with 2 lethality rates: the Historical Administrative Data System lethality rate and a rate drawn from US Centers for Disease Control and Prevention Web-Based Injury Statistics Query and Reporting System[14] 2010-2016 data on civilian suicides and self-harm hospital visits.

Costs

Mortality Costs

For suicide and nonsuicide deaths, we added costs of death gratuity, survivor benefit plan, and medical (ie, non-mental health) treatment. The death gratuity is a $100 000 lump sum paid to next-of-kin after any active-duty service member's death.[26] The survivor benefit plan consists of an annuity paid to spouse or children for certain active-duty deaths. The determination of beneficiary and annuity amount is complex and depends on the soldier's pay, whether the death was in the line of duty, next-of-kin demographics, and whether the soldier was retirement eligible.[19-21] We computed the expected lifetime annuity per decedent separately for suicide and other deaths because line-of-duty determination and next-of-kin demographics were assumed to differ.

The mean medical treatment cost for Army soldiers who die by suicide was not available, so we used the cost for civilian men aged 18 to 45 years from the Centers for Disease Control and Prevention Web-based Injury Statistics Query and Reporting System database (2010 data), likely an underestimate because health care costs are higher in the DoD than in civilian health care systems,[27] resulting in a more conservative analysis (ie, less favorable to BCBT). We estimated nonsuicide death medical treatment costs by obtaining costs from the civilian literature for the most common causes of death in the Army and weighting them by the percentage of deaths in each category,[28] ignoring combat deaths because suicidal soldiers would likely be considered nondeployable. We expected costs of nonsuicide deaths to have little association with the results owing to their infrequency over the time horizon.

Suicide Attempt Cost

For nonfatal suicide attempts, the only cost applied was the medical treatment cost (excluding mental health because this was included separately in the model) for the proportion of suicide attempts before separation that were medically and/or administratively recorded. Cost data from 2017 were obtained for all active-duty Army soldiers in the continental United States from the Military Health System Management Analysis and Reporting Tool (M2) data sets.

Mental Health Treatment Costs

Trial data (patient report supplemented with administrative records) were used to estimate quantities of individual psychotherapy sessions, group psychotherapy sessions (including partial hospitalization or intensive outpatient), psychiatric inpatient days, and intake evaluations for patients assigned to both treatment arms. The number of BCBT sessions is included in individual psychotherapy sessions. Unit costs were drawn from the 2017 M2 data sets.

The total mental health treatment cost for each trial patient was computed by multiplying units by costs per unit. We then conducted a regression analysis, with multiple imputation to address missingness, computing the pooled mean and SE for each treatment and estimated difference between the 2 treatments and the multiple imputation–based SEs of these estimated treatment effects.

Retired Disability Pay Costs

Calculating the DoD's portion of retired disability pay requires information on base pay, military and Department of Veterans Affairs disability percentages, and demographics. Information was not formally gathered in the trial on military and Department of Veterans Affairs disability percentages, but nevertheless, both were recorded for approximately 80% of during-trial disability retirements. We calculated disability pay for individuals using publicly available online calculators,[18,29] then used multiple imputation to account for missing data when estimating the mean and SE. Lifetime disability pay for each condition was computed by multiplying the probability that a soldier would retire owing to disability by annual disability pay by disabled veteran life expectancy.

Discounting and Inflation

The US government mandates use of its own discount rates in cost-effectiveness analyses[13] based on interest rates and inflation forecasts. The current rates begin at −0.8% and increase over time. Per the recommendations of the Second Panel on Cost-Effectiveness in Health and Medicine,[12] and for comparability with other health care cost-effectiveness analyses,[30] we also present results using a 3% discount rate. Health care costs from pre-2017 sources were inflated to 2017 dollars using the consumer price index[25] medical care component, the standard index for inflating medical costs in DoD cost analyses.[31]

Statistical Analysis

All analyses were conducted using R statistical software, version 3.5 (R Foundation). We conducted analyses under 3 scenarios representing different possible effect sizes of BCBT on suicide attempts and, through attempts, on suicide deaths: (1) the base case, generated from trial data survival analysis; (2) a scenario assuming a weaker treatment effect by attenuating the hazard ratio by 1 SE; and (3) a scenario assuming a lower-bound treatment effect by attenuating the hazard ratio by 1.96 SEs (ie, the lower bound of the 95% CI). We also created a worst-case scenario in which we fixed BCBT's effects on mental health care costs and the likelihood of receiving disability pay to the most unfavorable end of each 95% CI. We ran all analyses separately using the high-lethality (Army) and lower-lethality (civilian) probabilities of dying from a suicide attempt. Under the high-lethality scenario, a larger proportion of the suicidal behaviors averted are counted as suicides rather than attempts.

In addition, we conducted probabilistic sensitivity analysis that varied multiple uncertain parameters simultaneously. Table 1 lists parameter distributions for the probabilistic sensitivity analysis, which were for the most part derived directly from available data. For each of 10 000 simulations, each parameter's value was randomly drawn from its distribution. When a parameter differed between treatments, we allowed the value to vary for treatment as usual and drew from a distribution of the difference between treatment as usual and BCBT to calculate the parameter for BCBT.

Results

Estimates of BCBT's cost per patient treated, number of suicide attempts and deaths averted per patient treated, and costs per outcome under each scenario are reported in **Table 2**. All values are incremental relative to treatment as usual. In all but the worst-case scenario, BCBT was projected to be cost saving relative to treatment as usual. Estimated savings were greater when using the federal discount rate ($15 000-$16 630) because future costs averted (ie, disability and survivor benefit plan payments) were discounted less. In the worst-case scenario, BCBT cost the DoD an additional $1910 to $2250 per patient than treatment as usual. In the base case, we estimated that BCBT would avert approximately 23 more attempts and 3 more suicide deaths than treatment as usual per 100 patients treated in the high-attempt lethality scenario compared with 25 attempts and 1 suicide death in the lower-lethality scenario.

Probabilistic sensitivity analysis results for the federal discount rate appear in **Figure 2** and **Figure 3**. Each point represents the results of 1 of the 10 000 simulations for each scenario, with the incremental cost of BCBT plotted against the number of events averted per patient treated. Probabilistic sensitivity analysis results for the 3% discount rate appear in eFigure 1 and eFigure 2 in the Supplement. To our knowledge, no official cost-effectiveness threshold exists for this perspective and these outcomes, so we plot lines for various thresholds. Brief cognitive behavioral therapy remained cost saving in most simulations.

Discussion

We found BCBT to be cost saving and to be associated with reduced adverse outcomes compared with treatment as usual in nearly all scenarios, including in sensitivity analyses that assumed BCBT to be less clinically effective. Even under our

Table 2. Estimated Costs and Effect Sizes of BCBT vs Treatment as Usual[a]

Scenario	Incremental Cost of BCBT vs Treatment as Usual: Federal Discount Rate	3% Discount Rate	Attempts Averted	Suicides Averted	ICER, $/Suicide Attempt Averted: Federal Discount Rate	3% Discount Rate	ICER, $/Suicide Death Averted: Federal Discount Rate	3% Discount Rate
Base Case								
High lethality[b]	−16 630	−11 920	0.231	0.029	−72 110	−51 680	−576 500	−413 190
Low lethality[c]	−15 000	−10 480	0.248	0.012	−60 570	−42 340	−1 260 110	−880 990
Weaker Effect Size								
High lethality	−15 120	−10 630	0.129	0.016	−116 900	−82 190	−934 570	−657 080
Low lethality	−14 290	−9870	0.139	0.007	−102 930	−71 100	−2 141 530	−1 479 210
Lower-Bound Effect Size								
High lethality	−13 870	−9570	0.047	0.006	−294 880	−203 480	−2 357 370	−1 626 730
Low lethality	−13 710	−9370	0.051	0.002	−271 500	−185 530	−5 648 760	−3 860 110
Worst-Case Scenario								
High lethality	1910	2310	0.047	0.006	40 650	49 010	325 000	391 820
Low lethality	2250	2600	0.051	0.002	44 530	51 480	926 470	1 071 170

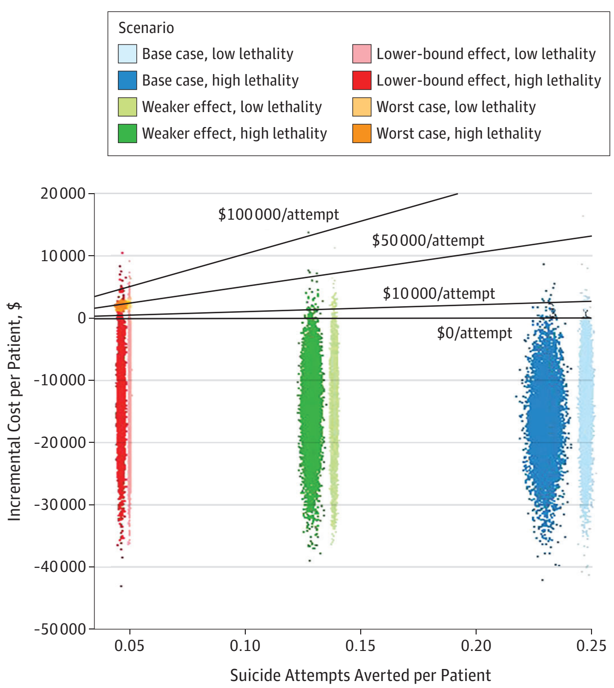
Abbreviations: BCBT, Brief Cognitive Behavioral Therapy; ICER, incremental cost-effectiveness ratio.

[a] All costs and effects are per patient treated.

[b] Costs and effect sizes assuming higher lethality of suicide attempts based on Army data.

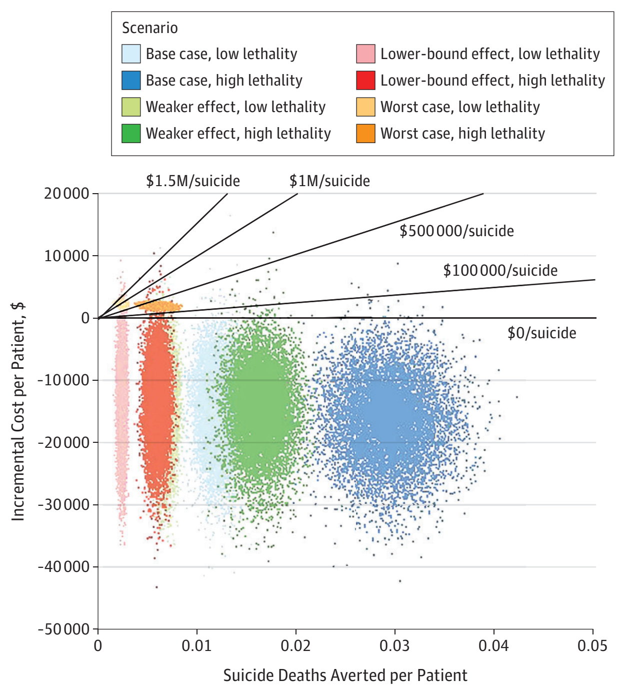
[c] Costs and effect sizes assuming lower lethality of suicide attempts based on civilian data.

Figure 2. Probabilistic Sensitivity Analysis Results for Suicide Attempt Averted



Incremental cost of brief cognitive behavioral therapy relative to treatment as usual per suicide attempt averted, federal discount rate.

Figure 3. Probabilistic Sensitivity Analysis Results for Suicide Death Averted



Incremental cost of brief cognitive behavioral therapy relative to treatment as usual per suicide death averted, federal discount rate.

worst-case scenario, BCBT's incremental cost per suicide attempt and death averted falls well below reasonable thresholds (eg, the value of a statistical life, approximately $9 million).[32] We suggest that BCBT is a cost-effective intervention for active-duty soldiers with recent suicidal crises. Only a small proportion of suicides in the Army are attributable to the narrow subset of soldiers who present in crisis. There is no indication that BCBT would be cost-effective for all service members reporting suicidal ideation. Disseminating BCBT throughout the DoD would incur additional costs of training and quality-control monitoring,[33] but even high training costs may be outweighed by the cost savings in many scenarios, leaving BCBT cost saving overall. For example, a $2000 course and 40 hours of consultation at $100/h per clinician would amount to $6000. If the clinician treated as few as 3 patients with BCBT, the per-patient cost would fall to $2000, which would be more than offset by the base-case cost savings.

These results are notable because most interventions incur increased costs to achieve health gains. However, evidence suggests that mental health care is a particularly good investment. Several reviews have found positive returns for some psychological treatments when accounting for factors such as medical cost offset and increased labor productivity.[34-37] Our analysis joins other recent work[38] in highlighting the utility of economic evaluations when considering expanding suicide-focused interventions. Given that few suicide prevention randomized clinical trials exist,[5] including economic evaluations alongside trial results might accelerate dissemination and implementation efforts.

Limitations

Our findings must be interpreted in light of several limitations. There was uncertainty in parameter estimates: only 1 clinical trial served as the basis for most treatment effect estimates; we did not have adequate information to model associations between most parameters, requiring us to assume independence; and considerable uncertainty remains regarding the probability of death from a suicide attempt. We generally made conservative analytic choices to address these uncertainties, such as assuming that BCBT's effects would not endure beyond 2 years. As another conservative choice, we limited our analysis to direct costs. However, providing BCBT would also reduce indirect costs through productivity changes. For example, service members' productivity may increase; in addition, suicides require numerous investigations, and averting deaths would free the individuals conducting investigations for other productive work. Consequently, this analysis represents a lower bound estimate of BCBT's benefit to the DoD. We also lacked information on use of psychiatric medications. Our DoD perspective and focus on the Army limits our findings' generalizability. We took a DoD perspective to inform DoD decision makers and consequently did not consider costs and benefits to the Department of Veterans Affairs or society. We also used treatment effect estimates, costs, policies, and demographics from the Army, and these parameters may differ slightly for other military branches. In addition, some costs included in this analysis would not apply in nonmilitary settings. Given BCBT's possibly positive effects on suicidal behavior and use of mental health care, further studies should investigate whether BCBT would be a cost-effective treatment for civilians.

Conclusions

Brief cognitive behavioral therapy is likely cost saving relative to treatment as usual in addition to being more effective, and therefore represents an opportunity for the DoD to invest in human capital. If the DoD disseminates BCBT for service members with recent suicidal crises, it will be critical to work with dissemination and implementation experts to ensure treatment fidelity through effective and efficient training. To bolster confidence in BCBT's effectiveness, the DoD can await results of an ongoing trial,[39] but sensitivity analyses suggest that BCBT will remain cost saving even if its effects are weaker than predicted.

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REFERENCES

1. Pruitt LD, Smolenski DJ, Reger MA, Bush NE, Skopp NA, Campise RL; National Center for Telehealth and Technology (T2). Department of Defense Suicide Event Report (DoDSER) Calendar Year 2016. https://www.dspo.mil/Portals/113/Documents/DoDSER%20CY%202016%20Annual%20Report_For%20Public%20Release.pdf?ver=2018-07-02-104254-717. Published June 2017. Accessed March 1, 2019.

2. US Dept of Veterans Affairs Office of Mental Health and Suicide Prevention. Veteran suicide data report, 2005-2016. https://www.mentalhealth.va.gov/docs/data-sheets/OMHSP_National_Suicide_Data_Report_2005-2016_508.pdf. Published September 2018. Accessed March 1, 2019.

3. US Department of Defense. Department of Defense Strategy for Suicide Prevention. https://www.dspo.mil/Portals/113/Documents/TAB%20B%20-%20DSSP_FINAL%20USD%20PR%20SIGNED.PDF. Published December 2015. Accessed March 1, 2019.

4. Gøtzsche PC, Gøtzsche PK. Cognitive behavioural therapy halves the risk of repeated suicide attempts: systematic review. *J R Soc Med*. 2017;110(10):404-410. doi:10.1177/0141076817731904

5. Hawton K, Witt KG, Taylor Salisbury TL, et al. Psychosocial interventions for self-harm in adults. *Cochrane Database Syst Rev*. 2016;(5):CD012189.

6. Meerwijk EL, Parekh A, Oquendo MA, Allen IE, Franck LS, Lee KA. Direct versus indirect psychosocial and behavioural interventions to prevent suicide and suicide attempts: a systematic review and meta-analysis. *Lancet Psychiatry*. 2016;3(6):544-554. doi:10.1016/S2215-0366(16)00064-X

7. Rudd MD, Bryan CJ, Wertenberger EG, et al. Brief cognitive-behavioral therapy effects on post-treatment suicide attempts in a military sample: results of a randomized clinical trial with 2-year follow-up. *Am J Psychiatry*. 2015;172(5):441-449. doi:10.1176/appi.ajp.2014.14070843

8. Bryan CJ, Rudd MD. Response to Stankiewicz et al. *Am J Psychiatry*. 2015;172(10):1022-1023. doi:10.1176/appi.ajp.2015.15060774r

9. Martino S, Paris M Jr, Añez L, et al. The effectiveness and cost of clinical supervision for motivational interviewing: a randomized controlled trial. *J Subst Abuse Treat*. 2016;68:11-23. doi:10.1016/j.jsat.2016.04.005

10. Steinert C, Hofmann M, Kruse J, Leichsenring F. Relapse rates after psychotherapy for depression—stable long-term effects? a meta-analysis. *J Affect Disord*. 2014;168:107-118. doi:10.1016/j.jad.2014.06.043

11. Conradi HJ, Bos EH, Kamphuis JH, de Jonge P. The ten-year course of depression in primary care and long-term effects of psychoeducation, psychiatric consultation and cognitive behavioral therapy. *J Affect Disord*. 2017;217:174-182. doi:10.1016/j.jad.2017.03.064

12. Sanders GD, Neumann PJ, Basu A, et al. Recommendations for conduct, methodological practices, and reporting of cost-effectiveness analyses: second panel on cost-effectiveness in health and medicine. *JAMA*. 2016;316(10):1093-1103. doi:10.1001/jama.2016.12195

13. United States Office of Management and Budget. *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs (Circular A-94)*. Washington, DC: US Dept of Transportation; 1992.

14. National Center for Injury Prevention and Control, Centers for Disease Control and Prevention. Web-based Injury Statistics Query and Reporting System (WISQARS). https://www.cdc.gov/injury/wisqars. Published February 19, 2017. Accessed October 16, 2018.

15. Defense Human Resources Activity Office of the Actuary. *Valuation of the Military Retirement System September 30, 2016*. Alexandria, VA: Dept of Defense; 2018.

16. National Center for Veterans Analysis and Statistics. *Mortality Rates and Life Expectancy of Veterans from 1980 to 2014, and by Education and Income*. Washington, DC: Dept of Veterans Affairs; 2017.

17. Arias E, Heron M, Xu J. *United States Life Tables, 2014*. Hyattsville, MD: National Center for Health Statistics; 2017.

18. Retirement Disability Pay Estimator. https://www.dfas.mil/militarymembers/woundedwarrior/disabledretireest.html. Accessed April 8, 2019.

19. Survivor Benefit Plan. 10 USC §§1447-1460B (2011).

20. Dependency and Indemnity Compensation. 38 USC §§1301-1322 (2011).

21. Adjudication. 38 CFR §§3 (2003).

22. US Department of Labor. Claims for compensation under the federal employees' compensation act, as amended: death gratuity. 20 CFR § 10, Subpart J.

23. Husereau D, Drummond M, Petrou S, et al; ISPOR Health Economic Evaluation Publication Guidelines-CHEERS Good Reporting Practices Task Force. Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—explanation and elaboration: a report of the ISPOR Health Economic Evaluation Publication Guidelines Good Reporting Practices Task Force. *Value Health*. 2013;16(2):231-250. doi:10.1016/j.jval.2013.02.002

24. Ursano RJ, Colpe LJ, Heeringa SG, Kessler RC, Schoenbaum M, Stein MB; Army STARRS Collaborators. The Army study to assess risk and resilience in servicemembers (Army STARRS). *Psychiatry*. 2014;77(2):107-119. doi:10.1521/psyc.2014.77.2.107

25. U.S. Bureau of Labor Statistics. Consumer Price Index for All Urban Consumers: Medical Care [CPIMEDSL]. https://fred.stlouisfed.org/series/CPIMEDSL. Accessed February 16, 2019.

26. House Committee on Armed Services. Death benefits. 10 USC § 1475.

27. Lurie P. *Comparing the costs of Military Treatment Facilities With Private Sector Care*. Alexandria, VA: Institute for Defense Analyses; 2016.

28. Mancha B, Abdur-Rahman I, Mitchell T, et al. *Mortality Surveillance in the US Army 2005-2014*. Aberdeen Proving Ground, MD: Army Public Health Center; 2016:0034370-14.

29. Regular Military Compensation (RMC) Calculator. https://militarypay.defense.gov/calculators/rmc-calculator/. Accessed April 8, 2019.

30. Cangelosi MJ. Health economic implications and consumer preference distortions of negative interest rate policy. Paper presented at: 22nd annual meeting of ISPOR, The Professional Society for Health Economics and Outcomes Research; May 2017; Boston, MA.

31. Wise G, Lochbryn C, Oprisu D. *Department of Defense Inflation Handbook*. 2nd ed. McLean, VA: MCR Federal, LLC, for Office of the Secretary of Defense, Cost Analysis and Program Evaluation; 2011.

32. Robinson LA, Hammitt JK. Research synthesis and the value per statistical life. *Risk Anal*. 2015;35(6):1086-1100. doi:10.1111/risa.12366

33. Herschell AD, Kolko DJ, Baumann BL, Davis AC. The role of therapist training in the implementation of psychosocial treatments: a review and critique with recommendations. *Clin Psychol Rev*. 2010;30(4):448-466. doi:10.1016/j.cpr.2010.02.005

34. Chiles JA, Lambert MJ, Hatch AL. *The Impact of Psychological Interventions on Medical Cost Offset: A Meta-analytic Review*. Vol 6. Oxford, UK: Blackwell Publishing Ltd; 1999:204-220.

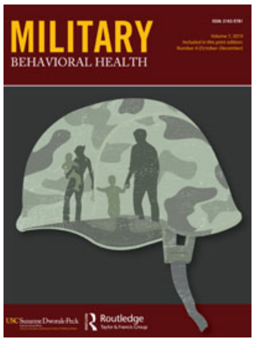
35. Stuhldreher N, Konnopka A, Wild B, et al. Cost-of-illness studies and cost-effectiveness analyses in eating disorders: a systematic review. *Int J Eat Disord*. 2012;45(4):476-491. doi:10.1002/eat.20977

36. Konnopka A, Leichsenring F, Leibing E, König HH. Cost-of-illness studies and cost-effectiveness analyses in anxiety disorders: a systematic review. *J Affect Disord*. 2009;114(1-3):14-31. doi:10.1016/j.jad.2008.07.014

37. Chisholm D, Sweeny K, Sheehan P, et al. Scaling-up treatment of depression and anxiety: a global return on investment analysis. *Lancet Psychiatry*. 2016;3(5):415-424. doi:10.1016/S2215-0366(16)30024-4

38. Park AL, Gysin-Maillart A, Müller TJ, Exadaktylos A, Michel K. Cost-effectiveness of a brief structured intervention program aimed at preventing repeat suicide attempts among those who previously attempted suicide: a secondary analysis of the ASSIP randomized clinical trial. *JAMA Netw Open*. 2018;1(6):e183680. doi:10.1001/jamanetworkopen.2018.3680

39. Bryan C. Brief cognitive behavioral therapy replication trial. 2018; https://clinicaltrials.gov/ct2/show/NCT03769259?recrs=abdf&outc=suicide+attempt&draw=2. Accessed November 6, 2019.



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Improving Military Readiness and Reducing Suicide Risk: The Role Between Positive TBI Screens, Severe Insomnia, and Suicidal Outcomes

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Improving Military Readiness and Reducing Suicide Risk: The Role Between Positive TBI Screens, Severe Insomnia, and Suicidal Outcomes

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ABSTRACT
This study examined how insomnia severity and a positive traumatic brain injury (TBI) screen relate to suicidal outcomes across military branches. Data were compiled from 1,635 participants across seven studies. A series of analyses were conducted by military branch to identify which significantly differed on the variables of interest. A series of multiple regression analyses were conducted to explore whether insomnia severity and a positive TBI screen predicted suicidal outcomes and whether the effect varied as a function of military branch. Insomnia severity and a positive TBI screen each had independent relationships with the suicide risk outcomes. The relationship between insomnia and suicide risk varied by military branch. However, a positive TBI screen had a significant effect on suicidal behavior and thoughts and the effect was similar across the four groups. Efforts to identify and intervene on insomnia and TBI sequelae may improve quality of care for service members at risk of suicide. Insomnia and post-TBI symptoms are important targets of intervention as they are often less stigmatized and can be easily assessed by brief self-report measures.

KEYWORDS
Suicide; insomnia; traumatic brain injury; military; screening

Maintaining readiness is essential to the operational mission of the military. There are several factors that can inhibit military readiness, including the psychological health of a service member (Kennedy & Zillmer, 2012). One psychological health-related issue that is a major concern for the Armed Forces is suicide, with military suicide rates increasing over the past decade. Suicide is the second leading cause of death among military personnel (Armed Forces Health Surveillance Center, 2014; Hoge & Castro, 2012; Ramchand, Acosta, Burns, Jaycox, & Pernin, 2011). Within the services, individual branches experience varying suicide rates. In 2009, the Army and Marine suicide rates surpassed the civilian rate (Department of the Army, 2010). According to the most recent Department of Defense Suicide Event Report, the suicide rates within the Active Component for the Army (26.7 per 100,000), Marine Corps (20.1 per 100,000), and Navy (15.3 per 100,000) had no evidence of change since 2011; whereas, the Active Component Air Force suicide rate (19.4 per 100,000) increased incrementally (Pruitt et al., 2018). In addition, the National Guard Component reported suicide rate (27.3 per 100,000) and the Active Component Army suicide rate were significantly higher than expected compared to the general population, after adjusting for sex and age. In contrast, the Active Component Navy suicide mortality rate was significantly lower than expected given the age restrictions (Pruitt et al., 2018).

There are several known risk factors for suicide among military personnel, including symptoms of insomnia and a history of a traumatic brain injury (TBI; Bryan & Clemans, 2013; Hoge et al., 2008). This is notable as sleep disturbances are among the most commonly reported psychological complaints in the U.S. military (e.g., Luxton et al., 2011; Troxel et al., 2015) and TBIs have been labeled one of the signature wounds of the current conflicts (Hoge et al., 2008; Tanielian et al., 2008).

The diagnostic rates of insomnia disorder have increased 19-fold in recent years for active duty service members (Armed Forces Health Surveillance Center, 2010). These numbers are also likely an underestimate of the actual rate of insomnia disorder in the military, which may be in part due to the inconsistent use of insomnia screenings in military treatment facilities (Troxel et al., 2015). Furthermore,

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the occurrence of insomnia has steadily increased during the same timeframe as the increase in suicide risk in military populations (Armed Forces Health Surveillance Center, 2010; McCarthy et al., 2009), although this does not necessarily indicate causality. However, research has consistently demonstrated that insomnia severity is associated with suicidal ideation and self-directed violence, establishing insomnia severity as a suicide risk factor (Bernert & Joiner, 2008; Bernert, Kim, Iwata, & Perlis, 2015; McCall & Black, 2013; Pigeon, Pinquart, & Conner, 2012).

There has been extensive research into insomnia and suicide risk in the military, mostly with active duty soldiers. Luxton and colleagues (Luxton et al., 2011) conducted a cross-sectional study of 3,152 soldiers who had recently returned from combat and found that sleep durations of 6 hours or less were associated with increased suicide risk. In a rigorous examination to determine whether insomnia severity is a robust independent suicide risk factor, Ribeiro and colleagues (Ribeiro et al., 2012) found that insomnia severity was associated with suicidal ideation even after controlling for depression, posttraumatic stress disorder (PTSD), anxiety, substance abuse, and hopelessness. In their sample of active duty soldiers, insomnia symptoms had a direct association with current and future suicide ideation and was a unique predictor of suicide attempt 1 month after baseline, above the effects of baseline depressive and hopelessness symptoms. This was a particularly meaningful finding as the control variables are well-established suicide risk factors. These findings suggest that there is a unique opportunity for identifying insomnia symptoms among active duty military, as it is a modifiable risk factor for suicide that often lacks the magnitude of stigma associated with reporting suicidal thoughts and behaviors.

Furthermore, insomnia symptoms are also core symptoms of traumatic brain injuries, among other psychological disorders, which may contribute to their relationship to suicide risk. Previous research has shown that sleep disturbances affect anywhere from 30% to 70% of individuals post-TBI (Ouellet & Morin, 2006; Viola-Saltzman & Watson, 2012). The significant associations between insomnia severity and TBIs within active duty military (Troxel et al., 2015) also underscores the importance of considering these two suicide risk factors simultaneously.

TBI is also associated with a higher risk of suicide in active duty military personnel (Bryan & Clemans, 2013; Hyman, Ireland, Frost, & Cottrell, 2012). Approximately 15–23% of service members from the current conflicts report a history of a TBI while deployed (Hoge et al., 2008; Terrio et al., 2009). In a cross-sectional study that included the entire U.S. military population (1,981,810 service members for 2007), the authors found elevated odds ratios (*ORs*) for suicide across the services for individuals with a TBI (Hyman, Ireland, Frost, & Cottrell, 2012). Specifically, post-TBI soldiers had a 5.94 *OR* for suicide, Marines had a 13.10 *OR*, Sailors had a 12.00 *OR*, and Airmen had a 22.86 *OR*. Furthermore, a study of U.S. service members referred to a TBI clinic in Iraq reported that the number of TBIs experienced was significantly associated with suicidal thoughts and behaviors, even after controlling for clinical symptom severity (Bryan & Clemans, 2013). The authors noted that participants with a history of mild TBI reported significantly more severe depression, PTSD, insomnia, and suicidal symptoms, compared to those who did not meet criteria for a TBI (Bryan, Clemans, Hernandez, & Rudd, 2013). A more recent systematic review examining suicidality post-TBI reported that postinjury sequelae, such as increased substance use, depression, and presence of any psychiatric history or emotional distress, including insomnia severity, were significant predictors of suicidal ideation and attempts (Bahraini et al., 2013; Simpson & Tate, 2005; Teasdale & Engberg, 2001). Further understanding the factors that contribute to active duty military's increased suicide rates and why that may vary by military branch is essential.

Suicide risk is a multifactorial problem to which the independent and comorbid effects of insomnia severity and TBI may contribute (Bramoweth & Germain, 2013). Although an extensive amount of research has independently examined the link between TBI, insomnia, and suicide-specific outcomes, few studies have explored the relationships of TBI, insomnia severity, and suicidality within a military population. Bryan and colleagues (Bryan et al., 2013) administered a battery of assessments, including the Insomnia Severity Index (ISI) and the Suicidal Behaviors Questionnaire—Revised (SBQ–R), to 158 military personnel referred to an outpatient TBI clinic. Participants with mild TBI (85.4%) reported significantly more severe depression, PTSD, insomnia, and suicidal symptoms compared to those who did not meet criteria for a TBI. However, their study focused on risk factors in totality, with limited attention to insomnia specifically. Soberay and colleagues (Soberay et al., 2018) examined the effects of a positive TBI screen and insomnia severity with a sample of 3,993 active duty military, veteran, and civilian participants.

Table 1. Demographic Information as a function of military branch.

Variable	*n* (%)	Army (*n* = 457)	Navy (*n* = 456)	Marine (*n* = 117)	National Guard/ Reserve (*n* = 605)
Age					
Age, *M* (*SD*)	25.90 (7.05)	27.18 (7.24)	24.41 (5.45)	23.09 (5.20)	26.60 (7.92)
Gender					
Male	1,281 (78.3%)	379 (82.9%)	307 (67.3%)	99 (84.6%)	496 (82.0%)
Female	340 (20.8%)	75 (16.4%)	141 (30.9%)	18 (15.4%)	106 (17.5%)
Transgender	8 (0.5%)	3 (0.7%)	5 (1.1%)		
Missing	6 (0.4%)		3 (0.7%)		3 (0.5%)
Race					
White/Caucasian	1004 (61.4%)	279 (61.1%)	271 (59.4%)	67 (57.3%)	387 (64.0%)
Black/African American	334 (20.4%)	67 (14.7%)	110 (24.1%)	11 (9.4%)	146 (24.1%)
Native American/Alaskan	13 (0.8%)	8 (1.8%)	1 (0.2%)		4 (0.7%)
Asian	46 (2.8%)	11 (2.4%)	17 (3.7%)	4 (3.4%)	14 (2.3%)
Other	228 (13.9%)	89 (19.5%)	56 (12.3%)	31 (26.5%)	52 (8.6%)
Missing	10 (0.6%)	3 (0.7%)	1 (.2%)	4 (3.4%)	2 (0.3%)
Ethnicity					
Hispanic	184 (11.3%)	83 (18.2%)	57 (12.5%)	17 (14.5%)	27 (4.5%)
Non-Hispanic	1,270 (77.7%)	335 (73.3%)	275 (60.3%)	86 (73.5%)	574 (94.9%)
Other	57 (3.5%)	15 (3.3%)	39 (8.6%)	3 (2.6%)	
Missing	124 (7.6%)	24 (5.3%)	85 (18.6%)	11 (9.4%)	4 (0.7%)
Relationship status					
Married	564 (34.5%)	219 (47.9%)	140 (30.7%)	32 (27.4%)	173 (28.6%)
Single	846 (51.7%)	159 (34.8%)	267 (58.6%)	69 (59.0%)	251 (58.0%)
Widowed	1 (0.1%)				1 (0.2%)
Divorced/separated	211 (12.9%)	74 (16.2%)	49 (10.7%)	13 (11.1%)	75 (12.4%)
Missing	13 (0.8%)	5 (1.1%)		3 (2.6%)	5 (0.8%)
Deployment history					
Yes	883 (54.0%)	250 (54.7%)	221 (48.5%)	35 (29.9%)	377 (62.3%)
No	738 (45.1%)	206 (45.1%)	234 (51.3%)	78 (66.7%)	220 (36.4%)
Missing	14 (0.9%)	1 (0.2%)	1 (0.2%)	4 (3.4%)	8 (1.3%)

Note. Percentages were rounded to the first decimal place.

They found that TBI and insomnia each had independent relationships with suicidal outcomes and that veterans, relative to civilian and active duty participants, presented as clinically worse across the outcomes. However, the relationship between insomnia and suicidal responses was stronger for active duty military compared to veterans.

To expand the limited research on insomnia and TBI on suicidal outcomes, the present study examined the effects of insomnia severity and a positive TBI screen on suicidal outcomes across military branches. Although there is likely overlap among the factors contributing to suicide risk across the military branches, there may be important differences that can inform prevention, assessment, and intervention practices (Pruitt et al., 2018). We hypothesized that greater insomnia severity and a positive TBI screening would predict differences across the military branches and suicidal outcomes. However, given the varying suicide rates by military branch, we explored if insomnia severity and a positive TBI screen interacted as a function of military branch to predict suicidal outcomes. It was possible that TBI or insomnia had a stronger influence on suicidal outcomes for certain branches, which could help to account for the branch differences.

Methods

Procedure and participants

Data for the current analyses come from participants in seven studies funded by the Military Suicide Research Consortium (MSRC). Methods, recruitment, study design, and measure administration varied between each study and information regarding study protocols is available (see Ringer et al., 2017). Data from a total of 1,635 active duty service members were included in this study. Participants were primarily Caucasian males, with descriptive statistics for the basic demographics of the sample by military branch in Table 1. The study participants included 37% National Guardsmen/Reservists (including both Army and/or Air Force National Guard), 27.95% active component Army, 27.89% active component Navy, and 7.16% active component Marines. Active Air Force and Coast Guard participants were excluded from this sample because of the small number recruited, 30 and 10, respectively, by the studies chosen for these analyses.

Approval was obtained for all study protocols by the lead organization's institutional review board (IRB) and the Department of Defense's Human Research Protection Office (HRPO). National

Guardsmen and Reservists recruited within this research were activated at the time of enrollment and therefore were included within this study of active duty service members.

Measures

The participants completed brief demographic information that included age, gender, race, ethnicity, and relationship status. Military specific demographic information included branch of service and deployment history (i.e., "Have you ever been deployed?").

All MSRC funded studies include the MSRC Common Data Elements (CDEs; Ringer et al., 2017), which were developed to assess suicide-related behavior and empirically established suicide risk factors. The 57 items within the CDEs were selected by a panel of expert suicidologists, including 47 items from existing validated measures and 10 items created specifically for this item set. Initial evidence supports use of the MSRC CDEs as a psychometrically valid, brief set of suicide risk and related items (Ringer et al., 2017). The following subsets of items within the MSRC CDEs were included for this study.

Traumatic Brain Injury-4. The Traumatic Brain Injury-4 (TBI-4; Brenner et al., 2013) is a four-item screening tool that assesses for possible accidents or injuries that may have resulted in a traumatic brain injury. Research is ongoing to establish the concurrent validity and clinical utility of the TBI-4 questions (Brenner et al., 2013; Olson-Madden et al., 2014; Schneider et al., 2016). Brenner and colleagues (Brenner et al., 2013) reported that the specificity and sensitivity of endorsing any of the four items was 0.56 and 0.74, respectively. Our analyses determined a TBI positive screen to be when a participant responded affirmative that any of the possible accidents or injuries occurred. If a participant responded "no" to all the items, he or she received a negative screen for TBI.

Insomnia Severity Index. The Insomnia Severity Index (ISI; Bastien, Vallières, & Morin, 2001) is a seven-item measure that examines current sleep disturbances (i.e., last 2 weeks) and its effect on functioning. The MSRC CDEs included an abbreviated five-item version of the seven-item ISI, specific to the insomnia severity subscale. Participants rated common insomnia symptoms (e.g., difficulty staying asleep) on a 5-point Likert scale measuring severity, satisfaction, and interference with higher scores indicating greater insomnia. The full ISI exhibits good psychometric properties, including high internal consistency and validity (Bastien, Vallières, & Morin, 2001; Morin, Belleville, Bélanger, & Ivers, 2011). A recent examination of the five-item ISI used within the MSRC CDEs found that internal consistency of the MSRC CDEs version was also good (Cronbach's $\alpha = 0.87$; Ringer et al., 2017). In this study, the ISI severity subscale demonstrated good internal consistency (Cronbach's $\alpha = 0.88$).

SBQ–R. The SBQ–R has four items that assesses lifetime suicide ideation, plans, and attempts; recent frequency of suicidal ideation; communication of suicidal intent; and self-determined likelihood of future suicidal behavior. The four items are measured on Likert scales of varying lengths. Research has demonstrated the SBQ–R to be valid and reliable across a range of populations with good internal consistency (Osman et al., 2001). The full measure of the SBQ–R was included in the CDEs, and it exhibited good internal consistency within this sample (Cronbach's $\alpha = 0.79$). However, in the present study, the individual items (suicidal thoughts, behavior, communication, and likelihood) from the SBQ–R were analyzed separately.

Data analysis

Data were analyzed using SPSS version 22. A series of between-subject four group (military branch: Army vs. Navy vs. Marine vs. Reserve/National Guard) analyses of variance (ANOVAs) were conducted on the TBI-4 screen, insomnia severity, as well as the items from the SBQ–R assessing frequency of current thoughts (coded as suicidal thoughts), lifetime history of suicidal behavior (coded as suicidal behavior), communication of suicidal intent (coded as suicidal communication), and future likelihood (coded as suicidal likelihood). Significant main effects were followed with Tukey tests, to identify which of the military branches significantly differed from each other.

Next, a series of regression analyses were conducted to explore whether screening positive for a TBI and insomnia severity predicted suicidal thoughts, behavior, communication, and likelihood and whether the effect of these factors varied as a function of military branch. Given the relationship often found between a TBI and insomnia symptoms (Ouellet & Morin, 2006; Viola-Saltzman & Watson, 2012), it was not surprising that a positive screen for TBI was correlated with insomnia severity in the present sample ($r = .22$, $p < .001$). However, there is no sufficient means to independently assess the impact of insomnia independent of TBI sequela. Dummy codes were created with the Army participants as the comparison group. Suicidal behavior, thoughts, communication, and likelihood

Table 2. Analysis of variance and descriptive statistics for variables by military branch.

Variable	Military branch F	p	Army ($n = 457$) M	SD	Navy ($n = 456$) M	SD	Marine ($n = 117$) M	SD	National Guard/ Reserve ($n = 605$) M	SD
TBI screen	24.34	<.001	$.60_a$	.49	$.38_b$	.49	$.45_b$	.50	$.35_b$	.48
Insomnia severity	256.41	<.001	2.22_{ab}	.99	2.09_b	1.01	2.39_a	.97	$.85_c$	.85
Suicidal thoughts	463.58	<.001	3.41_a	1.38	3.06_b	1.37	3.78_c	1.25	1.16_d	.60
Suicidal behavior	387.61	<.001	2.93_a	1.01	2.65_b	1.01	3.05_a	.95	1.27_c	.68
Suicidal communication	148.23	<.001	1.68_a	.72	1.70_a	.67	1.81_a	.76	1.08_b	.29
Suicidal likelihood	24.82	<.001	1.57_a	1.36	1.73_b	1.67	1.98_b	1.58	1.17_c	.60

Note. Means between columns without common subscripts differ at $p < .05$ according to a Tukey's post hoc honestly significant difference test. The traumatic brain injury (TBI) screen was scored 0 (negative) or 1 (positive). Insomnia severity was scored on a 0 (none) to 4 (very severe) scale. Suicidal behavior was scored on a 4-point scale, suicidal thoughts on a 5-point scale, suicidal communication on a 3-point scale, and suicidal likelihood on a 7-point scale with higher scores indicating a more intense suicidal response in each case.

were regressed on the TBI screen dichotomous variable, centered insomnia severity scores, the three dummy codes for military branch, and the two-way interactions between the dummy codes and TBI screening, the dummy codes and insomnia severity, and insomnia severity and TBI screening.[1]

Results

As a first step in examining our results, we compared participants across our key measures as a function of in which branch they served (Army, Navy, Marine, National Guard/Reserve). All descriptives and statistics from these ANOVAs can be found in Table 2.

Examination of the insomnia severity scores revealed that Marine and Army participants reported the highest insomnia severity scores followed by the participants from the Navy, who did not significantly differ from the Army sample. The National Guard/ Reserve participants reported the lowest insomnia severity scores. The analysis of the TBI screen revealed that the participants in the Army were significantly more likely to report a positive TBI screen compared to participants from the other branches.

For each of our variables, there was a significant main effect for military branch. For suicidal thoughts, the Marines scored the highest followed by the Army, then Navy participants with the National Guard/ Reserve participants reporting the least suicidal thoughts. Somewhat paralleling the analysis for thoughts, the results for suicidal behavior revealed that the Marine and Army groups scored the highest, followed by the Navy, and National Guard/Reserve sample. The National Guard/Reserves sample reported the least suicidal communication compared to the other branches. Lastly, the Marine and Navy group reported the highest self-determined likelihood to engage in suicidal behavior, with Army group next, and then National Guard/Reserve reporting the least likelihood. At a mean level, the Marine and Army groups are generally scoring the highest for the insomnia severity and suicide risk variables, with the Navy group slightly lower, and the National Guard/ Reserve group often significantly lower.

We next conducted a series of regression analyses to examine whether insomnia severity and a positive TBI screen predicted suicidal thoughts, behavior, communication, and likelihood and whether their effects varied as a function of military branch. The branch comparisons described in the ANOVAs were also included in the regression analyses, particularly contrasting the Army sample to the other samples. However, to avoid redundancy in reporting results, we do not repeat the differences between the branch samples in the regression analyses.

The regression analysis for suicidal thoughts revealed main effects of insomnia severity ($\beta = .32$, $p < .001$) and a positive TBI screen ($\beta = .07$, $p = .047$) indicating that greater insomnia severity and a positive TBI screen were each independently related to more suicidal thoughts. The main effect of insomnia was qualified by an interaction between insomnia severity and Army vs. National Guard/Reserve ($\beta = -.11$, $p < .001$). Simple slopes analyses indicated that insomnia was a predictor for both branch groups, but the effect of insomnia on suicidal thoughts was stronger for the Army sample ($\beta = .32$, $p < .001$) than the National Guard/Reserve sample ($\beta = .12$, $p = .002$). Thus, a positive TBI screen had a similar effect across the groups, whereas insomnia severity had a similar effect across the groups except for the National Guard/Reserve group. Within this group, there was a weaker effect of insomnia severity on suicidal thoughts.

The analyses of suicidal behavior revealed main effects of insomnia severity ($\beta = .23$, $p < .001$) and a positive TBI screen ($\beta = .09$, $p = .008$). The lack of interactions with branch indicated that insomnia severity and a positive TBI screen had a similar and significant effect across the groups associated with greater reported suicidal behavior. The analyses of suicidal communication revealed a main effect of insomnia severity ($\beta = .11$, $p = .03$) but no main effect for the TBI screen ($\beta = .05$, $p = .26$). The significant influence of insomnia severity was equivalent for all groups such that more severe insomnia was associated with more suicidal communication.

For suicidal likelihood, there is a main effect for insomnia severity ($\beta = .34$, $p < .001$) but no main effect of TBI screen ($\beta = .05$, $p = .28$). The main effect of insomnia severity was qualified by an interaction between insomnia severity and Army vs. National Guard/Reserve ($\beta = -.13$, $p = .003$) and an interaction between insomnia severity and the Army vs. Navy comparison ($\beta = .08$, $p = .03$). For these interactions, the effect of insomnia severity was stronger for the Army participants ($\beta = .34$, $p < .001$) than the National Guard/Reserve group ($\beta = .12$, $p = .02$). However, the impact of insomnia severity was a bit stronger for the Navy group ($\beta = .50$, $p < .001$) than the Army group.

Discussion

Our study findings are consistent with the current research, in that greater insomnia severity and a positive TBI screen are positively associated with suicidal outcomes. However, our study broadens the literature by demonstrating both variation in the average severity for these risk factors and suicidal outcomes across military branches and differences in the strength of association between insomnia severity, a positive TBI screen, and suicidal outcomes across military branches. Army and Marine participants generally scored the highest for insomnia severity and suicide risk outcomes, followed by Navy participants, and the National Guard/Reserve group often significantly lower. Similarly, the Army participants were more likely to report a positive TBI screen compared to participants from the other branches. Thus, the Army and Marine participants tended to report both worse suicide outcomes at the time of the study and greater risk factors (although the TBI screen was only higher among the Army participants) indicating a greater risk of suicidal outcomes at the time of data collection among these participants.

There was a significant association between insomnia and all suicide risk outcome variables (suicidal thoughts, behavior, communication of threat, and likelihood), although it was weaker for the National Guard/Reserve group for predicting suicidal thoughts and likelihood as compared to the Army group. In addition, insomnia had a greater effect for suicide likelihood for the Navy group compared to the Army group, although both groups showed a strong impact of insomnia severity. With this exception, the effect of insomnia severity on the outcome variables did not differ between the Army, Navy, or Marine group. In addition, we found that a positive TBI screen had a significant effect on suicidal behavior and thoughts and the effect was similar across the four groups. Given the general lack of variability by military branch on the effect of insomnia severity and a positive TBI screen on the suicidal outcomes, using existing treatment guidelines for managing mild TBIs (mTBI; U.S. Department of Veterans Affairs, 2015) and risk for suicide (U.S. Department of Veterans Affairs, 2013) is supported by this study. These and other Veterans Affairs/Department of Defense (VA/DoD) clinical practice guidelines (e.g., PTSD) address sleep disturbances and its assessment and treatment as it relates to mTBI, suicide risk, and PTSD. Although a VA/DoD clinical practice guideline does not currently exist for insomnia, there are several guidelines for improving sleep among service members (Troxel et al., 2015) that may further supplement providers' practice.

However, it remains important to explore why the National Guard/Reserves group consistently scored the lowest for the insomnia and suicide risk variables within this study, considering the National Guard/Reserves Component has the highest reported suicide rate among service members (Pruitt et al., 2018). Additional examination on why the Army group fared worse and reported a higher rate of positive TBI screens is also needed. Our results may lead us to believe that National Guard/Reserves service members may experience less severe clinical symptoms as compared to their active duty counterparts. Research has varied on National Guardsmen and Reservists' reported mental health concerns compared to that of an active duty component (Kim et al., 2010; Milliken, Auchterlonie, & Hoge, 2007; Thomas et al., 2010; Vogt et al., 2008). Specifically, Kim and colleagues (2010) found that overall risk for mental health problems was higher for active duty soldiers compared to National Guard soldiers; however, the increase in specific diagnoses (e.g., depression, anxiety, PTSD) was greater for National Guard soldiers 12 months postdeployment. Furthermore, Milliken and colleagues (Milliken et al., 2007) indicated that National Guard and Army Reserve soldiers reported significantly higher rates of mental health and general concerns compared to active soldiers. In addition, studies consistently demonstrate that both active duty and National Guard/Reserve service members experience stigma associated with mental health care and apprehensiveness that mental health service utilization will impact their career (e.g., Gorman, Blow, Ames, & Reed, 2011; Kim et al., 2010; Milliken et al., 2007). These findings suggest that the current study may also be influenced by underreporting, which may be in part due to perceived stigma. A recent study demonstrated how confidentiality is presented to service members participating in research may impact their level of comfort in suicide risk disclosure (Anestis & Green, 2015). Variations in reported mental health symptoms and access to care indicate a need to accurately assess for insomnia, TBI history, and suicide risk, while addressing the potential for stigma and barriers in help-seeking.

Regular and accurate assessment of sleep disturbances and TBI history among service members would likely improve identification and treatment of not only insomnia and history of TBI, but also suicide risk. There are several brief screening measures, such as the Patient Health Questionnaire-9 (PHQ-9; Kroenke, Spitzer, & Williams, 2001), that can determine initial risk for insomnia and suicide and are not burdensome to providers. Specifically, Item 3 of the PHQ-9 may be an efficient screening tool to determine the likelihood of a sleep disturbance in a military sample (MacGregor et al., 2012). Furthermore, Item 9 is commonly used among medical and mental health practitioners to screen for recent suicidal ideation and endorsement is associated with an increased risk for suicide attempt and death (Simon et al., 2013). Should an individual screen positively for a sleep disturbance or suicidal ideation on the PHQ-9, providers would benefit from administering the ISI and SBQ–R used in this study to better identify potential routes of intervention and determine overall suicide risk, while also remaining aware of service members' concerns of confidentiality. This study supports the integration of TBI screenings to determine if those scheduled for redeployment with a TBI history, continue to experience post-injury sequelae (Terrio et al., 2009). Furthermore, TBI screenings could also inform providers on service members' increased likelihood for suicide risk and may be valuable to screen service members as they transition to civilian status. Specifically, the TBI-4 is a brief, empirically supported screening measure that can indicate likelihood of a positive TBI history.

As demonstrated in this study, insomnia severity, a positive TBI screening, and suicide risk are easily assessed by brief self-report measures. Thus, identifying insomnia severity and a positive TBI screen may present a useful and nonstigmatizing point of entry for service members to receive care. Furthermore, insomnia has been established to be a robust predictor of suicide risk that outperformed other suicide-related symptoms among service members and has been a useful route through which to engage at-risk service members in mental health treatment (Hom et al., 2016). Service members may be more willing to initially report insomnia severity and history of a TBI than endorse suicide risk and therefore, more likely to engage in mental health services for those problems. The results of this study support efforts to identify, assess, and engage service members in mental health care for insomnia severity and persisting TBI sequalae, across the services.

Variations in reported insomnia severity and suicide risk found in this study may be partially due to the environment in which the data were collected. That Marine, Army, and Navy service members reported greater levels of insomnia severity compared to the National Guard and Reserve participants may be in part due to length of deployment and combat exposure. Although the percentage of service members who had been deployed at any time did not account for the present findings and was in fact highest for the National Guard sample, the length of deployment and combat exposure was not ascertained. Research indicates that service members report significantly more sleep disruptions when deployed and postdeployment (Peterson, Goodie, Satterfield, & Brim, 2008; Seelig et al., 2010). However, a study of service members across the Armed Forces examined if the prevalence of sleep disturbances varied according to deployment history and combat exposure (Troxel et al., 2015). The authors determined there were few statistically significant differences between those endorsing deployment history and sleep disturbances, yet there were significant differences found in those with combat exposure. These results indicate that assessment of insomnia severity predeployment and prior to combat, may help identify service members at an increased risk for mental health problems, including suicide risk.

Similarly, the Army group in this study was significantly more likely to endorse a positive TBI screen than the other branches. This is consistent with findings that the number of lifetime TBIs is significantly associated with greater suicide risk and may be contributing to the Army's sharp increase in suicides in recent years (Bryan & Clemans, 2013; Ramchand et al., 2011); although this finding does not necessarily indicate a causal link between these factors. Continued screening and further assessment of cumulative TBIs provides an opportunity to engage service members in care to attend to post-TBI symptoms and associated suicide risk.

The appropriate identification, assessment, and treatment of insomnia severity and post-TBI symptoms have further implications on military personnel's long-term mental and physical health. Insomnia has been shown to precede other psychological symptoms and disorders, such as depressive episodes and disorders (Ohayon & Roth, 2003). Furthermore, insomnia disorder is significantly associated with TBIs and work-related accidents for active duty military personnel, which may be due to fatigue and diminished concentration (Troxel et al., 2015). Insomnia and post-TBI sequelae are also associated with lower odds of deployment, increased odds of early termination from the services, and impaired combat readiness (Capaldi et al., 2015; Seelig et al., 2016; Terrio et al., 2009). Service members who report increased insomnia severity and a positive TBI screen should be educated on the availability of evidence-based treatment to reduce symptoms. Introducing mental health services as a means to managing insomnia and post-TBI sequalae may be a less-stigmatizing approach to engage service members across branches and components in care, to decrease suicide risk, and ultimately improve military readiness. In addition, targeting insomnia symptoms by behavioral health providers may reduce an overreliance on sleep medications, which has been found to increase an individual's risk for a benzodiazepine and opioid addiction (Capaldi et al., 2015; Hawkins et al., 2015) and its side effects may interfere with operational effectiveness (Troxel et al., 2015). As this study supports, by decreasing insomnia and post-TBI symptoms, the DoD could reduce suicide risk and likely improve military readiness.

Limitations

There are several limitations to consider for this study. The MSRC CDE items used in the current analyses (ISI, TBI-4, SBQ–R) had varying time intervals for the reported symptoms. For example, the ISI measured insomnia severity within the past 2 weeks, whereas the TBI-4 assessed the likelihood of a TBI in the service member's lifetime, and the SBQ–R individual item's timelines vary by the question. Furthermore, the ISI is not defined in clinical terms for insomnia disorder and the TBI-4 screening tool limits the interpretation of a positive TBI screen compared to a confirmed TBI diagnosis (with related information regarding severity) on the suicidal outcomes.

Our study also relied on the use of self-report measures, which subjects the study to reporting bias. The service members may have been concerned about perceived consequences in reporting suicidal thoughts and behaviors for their military careers. However, Soberay and colleagues (Soberay et al., 2018) found that the active duty participants reported higher rates of suicidal thoughts and likelihood of a future attempt compared to civilians. Although the interpretation of the results must factor in situational and contextual factors, the use of self-report measures for suicide research has been shown to be superior to clinician gathered data (Harkavy-Friedman & Asnis, 1989; Kaplan et al., 1994; Kendall, Cantwell, & Kazdin, 1989).

Finally, this study is limited due to the varying inclusion and exclusion criteria for the MSRC funded studies and by each study's aims and hypotheses. In most studies, participants who were experiencing psychological distress were actively recruited. Therefore, this sample may represent individuals with more clinical symptoms than the average service member and may limit generalizability. Generalizability also may be limited due to the distribution among branches. The Air Force active component is not represented in this sample, the Army is slightly overrepresented, whereas the Navy and National Guard/Reserve are significantly overrepresented in this sample.

Conclusion

The prevention and treatment of suicide is a difficult challenge for the DoD. This study provides evidence that insomnia severity and history of a TBI have similar effects across the Armed Forces, suggesting that prevention, assessment, and intervention efforts can be streamlined and coordinated. In addition, insomnia and post-TBI symptoms are important targets of intervention as they are often less stigmatized and symptom improvement will enhance military readiness.

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References

Anestis, M. D., & Green, B. A. (2015). The impact of varying levels of confidentiality on disclosure of suicidal thoughts in a sample of United States National Guard personnel. *Journal of Clinical Psychology*, *71*(10), 1023–1030.

Armed Forces Health Surveillance Center. (2010). Insomnia, active component, U.S. Armed Forces, January 2000-December 2009. *Medical Surveillance Monthly Report*, *17*(5), 12–15.

Armed Forces Health Surveillance Center. (2014). Surveillance snapshot: Manner and cause of death, active component, U.S. Armed Forces, 1998–2013. *Medical Surveillance Monthly Report*, *21*(10), 21.

Bahraini, N. H., Simpson, G. K., Brenner, L. A., Hoffberg, A. S., & Schneider, A. L. (2013). Suicidal ideation and behaviors after traumatic brain injury: A systematic review. *Brain Impairment*, *14*(01), 92–112.

Bastien, C. H., Vallières, A., & Morin, C. M. (2001). Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Medicine*, *2*(4), 297–307.

Bernert, R. A., & Joiner, T. E. (2008). Sleep disturbances and suicide risk: A review of the literature. *Neuropsychiatric Disease and Treatment*, *3*(6), 735–743.

Bernert, R. A., Kim, J. S., Iwata, N. G., & Perlis, M. L. (2015). Sleep disturbances as an evidence-based suicide risk factor. *Current Psychiatry Reports*, *17*(3), 15.

Bramoweth, A. D., & Germain, A. (2013). Deployment-related insomnia in military personnel and veterans. *Current Psychiatry Reports*, *15*(10), 1–8.

Brenner, L. A., Homaifar, B. Y., Olson-Madden, J. H., Nagamoto, H. T., Huggins, J., Schneider, A. L., … Corrigan, J. D. (2013). Prevalence and screening of traumatic brain injury among veterans seeking mental health services. *The Journal of Head Trauma Rehabilitation*, *28*(1), 21–30.

Bryan, C. J., & Clemans, T. A. (2013). Repetitive traumatic brain injury, psychological symptoms, and suicide risk in a clinical sample of deployed military personnel. *JAMA Psychiatry*, *70*(7), 686–691.

Bryan, C. J., Clemans, T. A., Hernandez, A. M., & Rudd, M. D. (2013). Loss of consciousness, depression, posttraumatic stress disorder, and suicide risk among deployed military personnel with mild traumatic brain injury. *The Journal of Head Trauma Rehabilitation*, *28*(1), 13–20.

Capaldi, V. F., Kim, J. R., Grillakis, A. A., Taylor, M. R., & York, C. M. (2015). Insomnia in the military: Application and effectiveness of cognitive and pharmacologic therapies. *Current Psychiatry Reports*, *17*(10), 85.

Department of the Army. (2010). Army health promotion, risk reduction, suicide prevention: Report 2010. Department of the Army.

Gorman, L. A., Blow, A. J., Ames, B. D., & Reed, P. L. (2011). National Guard families after combat: Mental health, use of mental health services, and perceived treatment barriers. *Psychiatric Services*, *62*(1), 28–34.

Harkavy-Friedman, J. M., & Asnis, G. M. (1989). Assessment of suicidal behavior: A new instrument. *Psychiatric Annals*, *19*(7), 382–387.

Hawkins, E. J., Malte, C. A., Grossbard, J. R., & Saxon, A. J. (2015). Prevalence and trends of concurrent opioid analgesic and benzodiazepine use among veterans affairs patients with post-traumatic stress disorder, 2003–2011. *Pain Medicine*, *16*(10), 1943–1954.

Hoge, C. W., & Castro, C. A. (2012). Preventing suicides in US service members and veterans: Concerns after a decade of war. *Journal of the American Medical Association*, *308*(7), 671–672.

Hoge, C. W., McGurk, D., Thomas, J. L., Cox, A. L., Engel, C. C., & Castro, C. A. (2008). Mild traumatic brain injury in US soldiers returning from Iraq. *New England Journal of Medicine*, *358*(5), 453–463.

Hom, M. A., Lim, I. C., Stanley, I. H., Chiurliza, B., Podlogar, M. C., Michaels, M. S., … Joiner, T. E. (2016). Insomnia brings soldiers into mental health treatment, predicts treatment engagement, and outperforms other suicide-related symptoms as a predictor of major depressive episodes. *Journal of Psychiatric Research*, *79*, 108–115.

Hyman, J., Ireland, R., Frost, L., & Cottrell, L. (2012). Suicide incidence and risk factors in an active duty US military population. *American Journal of Public Health*, *102*(S1), S138–S146.

Kaplan, M. L., Asnis, G. M., Sanderson, W. C., Keswani, L., de Lecuona, J. M., & Joseph, S. (1994). Suicide assessment: Clinical interview vs. self-report. *Journal of Clinical Psychology*, *50*(2), 294–298.

Kendall, P. C., Cantwell, D. P., & Kazdin, A. E. (1989). Depression in children and adolescents: Assessment issues and recommendations. *Cognitive Therapy and Research*, *13*(2), 109–146.

Kennedy, C. H., & Zillmer, E. A. (2012). *Military psychology: Clinical and operational applications* (2nd ed.). New York, NY: Guilford Press.

Kim, P. Y., Thomas, J. L., Wilk, J. E., Castro, C. A., & Hoge, C. W. (2010). Stigma, barriers to care, and use of mental health services among active duty and National Guard soldiers after combat. *Psychiatric Services*, *61*(6), 582–588.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, *16*(9), 606–613.

Luxton, D. D., Greenburg, D., Ryan, J., Niven, A., Wheeler, G., & Mysliwiec, V. (2011). Prevalence and impact of short sleep duration in redeployed OIF soldiers. *Sleep*, *34*(9), 1189–1195.

MacGregor, K. L., Funderburk, J. S., Pigeon, W., & Maisto, S. A. (2012). Evaluation of the PHQ-9 Item 3 as a screen for sleep disturbance in primary care. *Journal of General Internal Medicine*, *27*(3), 339–344.

McCall, W. V., & Black, C. G. (2013). The link between suicide and insomnia: Theoretical mechanisms. *Current Psychiatry Reports*, *15*(9), 1–9.

McCarthy, J. F., Valenstein, M., Kim, H. M., Ilgen, M., Zivin, K., & Blow, F. C. (2009). Suicide mortality among patients receiving care in the Veterans Health Administration health system. *American Journal of Epidemiology*, *169*(8), 1033–1038.

Milliken, C. S., Auchterlonie, J. L., & Hoge, C. W. (2007). Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the Iraq war. *JAMA*, *298*(18), 2141–2148.

Morin, C. M., Belleville, G., Bélanger, L., & Ivers, H. (2011). The Insomnia Severity Index: Psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep*, *34*(5), 601–608.

Ohayon, M. M., & Roth, T. (2003). Place of chronic insomnia in the course of depressive and anxiety disorders. *Journal of Psychiatric Research*, *37*(1), 9–15.

Olson-Madden, J. H., Homaifar, B. Y., Hostetter, T. A., Matarazzo, B. B., Huggins, J., Forster, J. E., … Brenner, L. A. (2014). Validating the traumatic brain injury-4 screening measure for veterans seeking mental health treatment with psychiatric inpatient and outpatient service utilization data. *Archives of Physical Medicine and Rehabilitation*, *95*(5), 925–929.

Osman, A., Bagge, C. L., Gutierrez, P. M., Konick, L. C., Kopper, B. A., & Barrios, F. X. (2001). The Suicidal Behaviors Questionnaire—Revised (SBQ–R): Validation with clinical and nonclinical samples. *Assessment*, *8*(4), 443–454.

Ouellet, M. C., & Morin, C. M. (2006). Subjective and objective measures of insomnia in the context of traumatic brain injury: A preliminary study. *Sleep Medicine*, *7*(6), 486–497.

Peterson, A. L., Goodie, J. L., Satterfield, W. A., & Brim, W. L. (2008). Sleep disturbance during military deployment. *Military Medicine*, *173*(3), 230–235.

Pigeon, W. R., Pinquart, M., & Conner, K. (2012). Meta-analysis of sleep disturbance and suicidal thoughts and behavior. *Journal of Clinical Psychiatry*, *73* (09), e1160–e1167.

Pruitt, L. D., Smolenski, D. J., Bush, N. E., Skopp, N. A., Edwards-Stewart, A., & Hoyt, T. V. (2018). Department of Defense Suicide Event Report (DoDSER) Calendar Year 2016 Annual Report. Psychological Health Center of Excellence (PHCoE) Defense Health Agency (DHA) United States.

Ramchand, R., Acosta, J., Burns, R. M., Jaycox, L. H., & Pernin, C. G. (2011). The war within: Preventing suicide in the US military. *Rand Health Quarterly*, *1*(1), 2–13.

Ribeiro, J. D., Pease, J. L., Gutierrez, P. M., Silva, C., Bernert, R. A., Rudd, M. D., & Joiner, T. E. Jr, (2012). Sleep problems outperform depression and hopelessness as cross-sectional and longitudinal predictors of suicidal ideation and behavior in young adults in the military. *Journal of Affective Disorders*, *136*(3), 743–750.

Ringer, F., Soberay, K., Rogers, M., Hagan, C., Chu, C., Schneider, M., … Joiner, T. (2017). Initial validation of brief measures of suicide risk factors: Common Data Elements used by the Military Suicide Research Consortium. Psychological Assessment, *30*(6), 767–778.

Schneider, A. L., Hostetter, T. A., Homaifar, B. Y., Forster, J. E., Olson-Madden, J. H., Matarazzo, B. B., …., Brenner, L. A. (2016). Responses to traumatic brain injury screening questions and suicide attempts among those seeking Veterans Health Administration mental health services. *Frontiers in Psychiatry*, *7*, 59.

Seelig, A. D., Jacobson, I. G., Donoho, C. J., Trone, D. W., Crum-Cianflone, N. F., & Balkin, T. J. (2016). Sleep and health resilience metrics in a large military cohort. *Sleep*, *39*(5), 1111–1120.

Seelig, A. D., Jacobson, I. G., Smith, B., Hooper, T. I., Boyko, E. J., Gackstetter, G. D., … Millennium Cohort Study Team. (2010). Sleep patterns before, during, and after deployment to Iraq and Afghanistan. *Sleep*, *33*(12), 1615–1622.

Simon, G. E., Rutter, C. M., Peterson, D., Oliver, M., Whiteside, U., Operskalski, B., & Ludman, E. J. (2013). Does response on the PHQ-9 Depression Questionnaire predict subsequent suicide attempt or suicide death? *Psychiatric Services*, *64*(12), 1195–1202.

Simpson, G., & Tate, R. (2005). Clinical features of suicide attempts after traumatic brain injury. *The Journal of Nervous and Mental Disease*, *193*(10), 680–685.

Soberay, K. A., Hanson, J. E., Dwyer, M., Plant, E. A., & Gutierrez, P. M. (2018). The relationship between suicidal responses and traumatic brain injury and severe insomnia in active duty, veteran, and civilian populations. *Archives of Suicide Research*, 1–20.

Tanielian, T., Haycox, L. H., Schell, T. L., Marshall, G. N., Burnam, M. A., Eibner, C., … Vaiana, M. E. (2008). *Invisible wounds of war. Summary and recommendations for addressing psychological and cognitive injuries*. Santa Monica, CA: RAND Corp.

Teasdale, T. W., & Engberg, A. W. (2001). Suicide after traumatic brain injury: A population study. *Journal of Neurology, Neurosurgery & Psychiatry*, *71*(4), 436–440.

Terrio, H., Brenner, L. A., Ivins, B. J., Cho, J. M., Helmick, K., Schwab, K., … Warden, D. (2009). Traumatic brain injury screening: Preliminary findings in a US Army Brigade Combat Team. *The Journal of Head Trauma Rehabilitation*, *24*(1), 14–23.

Thomas, J. L., Wilk, J. E., Riviere, L. A., McGurk, D., Castro, C. A., & Hoge, C. W. (2010). Prevalence of mental health problems and functional impairment among active component and National Guard soldiers 3 and 12 months following combat in Iraq. *Archives of General Psychiatry*, *67*(6), 614–623.

Troxel, W. M., Shih, R. A., Pedersen, E. R., Geyer, L., Fisher, M. P., Griffin, B. A., … Steinberg, P. S. (2015). Sleep in the military: Promoting healthy sleep among US service members. *Rand Health Quarterly*, *5*(2), 19.

Viola-Saltzman, M., & Watson, N. F. (2012). Traumatic brain injury and sleep disorders. *Neurologic Clinics*, *30*(4), 1299–1312.

Vogt, D. S., Samper, R. E., King, D. W., King, L. A., & Martin, J. A. (2008). Deployment stressors and posttraumatic stress symptomatology: Comparing active duty and National Guard/Reserve personnel from Gulf War I. *Journal of Traumatic Stress*, *21*(1), 66–74.

U.S. Department of Veterans Affairs. (2013). *VA/DoD Clinical Practice Guideline for assessment and management of patients at risk for suicide*. Retrieved from https://www.healthquality.va.gov/guidelines/MH/srb/VADODCP_SuicideRisk_Full.pdf.

U.S. Department of Veterans Affairs. (2015). *VA/DoD Clinical Practice Guideline for the management of concussion-mild traumatic brain injury*. Retrieved from\https://www.healthquality.va.gov/guidelines/Rehab/mtbi/mTBICPGClinicianSummary50821816.pdf.

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Interoceptive deficits differentiate suicide groups and associate with self-injurious thoughts and behaviors in a military sample

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Objective: Previous research shows that interoceptive deficits are associated with harmful behaviors such as nonsuicidal self-injury (NSSI), eating disorder pathology, and suicide attempts. The present study replicates and extends this area of research by examining the association between interoceptive deficits and suicidality in a military sample.

Method: In Study 1, respondents to an online survey (N = 134) answered self-report questionnaires related to interoceptive deficits. Study 2 consisted of a secondary data analysis of 3,764 military service members who had previously completed questionnaires on interoceptive indicators, NSSI, suicide thoughts and attempts, and other psychopathology.

Results: Study 1 demonstrated that our interoceptive deficits latent variable had adequate psychometric properties. In Study 2, multigroup confirmatory factor analysis showed that scores on the interoceptive deficits latent variable were highest among suicide attempters, lowest among those with no suicide history, and intermediary among participants who had thought about but not attempted suicide. The interoceptive deficits latent variable was more strongly related to NSSI and suicidality than were posttraumatic stress disorder symptoms, hopelessness, gender, and age.

Conclusions: These results confirm—and extend to a military sample—previous research showing that interoceptive deficits can provide important information about suicide risk.

Self-injurious thoughts and behaviors (SITBs), including nonsuicidal self-injury (NSSI) as well as suicide ideation, plans, and attempts, are serious public health problems worldwide (World Health Organization [WHO], 2019). Although suicide occurs among people of all nationalities, genders, races, and ages, some groups have a particularly elevated risk for

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suicide. Veterans are one such group: according to a recent report by the Department of Veteran's Affairs (2018), the suicide rate for Veterans is 1.5 times higher (adjusting for age and sex) than the rate for non-Veteran adults. And although suicides among active duty military personnel have historically been comparable to or lower than civilian suicide rates (Reimann & Mazuchowski, 2018), suicide among active duty service members is a growing concern given sharp increases in the suicide rate for this population in recent years (Armed Forces Health Surveillance Center, 2012; Kuehn, 2009). Thus, the aim of the present study was to better understand suicidal behavior in the military by examining associations between a potential novel risk factor—interoceptive deficits—and suicidality in a large, military sample.

Interoceptive deficits are one promising risk factor for suicidal behavior that may yield greater predictive power than previously studied factors (Franklin et al., 2017; Ribeiro et al., 2016). Interoception is the ability to accurately perceive and interpret the sensations of the physical body, such as touch, temperature, emotions, pain, itch, hunger, fullness, cardiovascular activity, and respiratory activity (Craig, 2003). Interoceptive deficits refer to a disconnection from the physical body which can cause difficulty in truly understanding and knowing one's own body. This disconnection can have wide-reaching negative effects (e.g., Paulus, Feinstein, & Khalsa, 2019). Of most relevance to the present research is theoretical and empirical work suggesting that interoceptive deficits seem to facilitate an increased ability to engage in self-harming behaviors.

Muehlenkamp (2012) theorizes that interoception is an important component of body regard (how one perceives, cares for, and experiences the body). Thus, if someone is disconnected from their body, they may not feel protective and caring toward it which in turn should make it easier to engage in behaviors that harm the body. Furthermore, disconnection from the body may contribute to increased body objectification, and the more a body is seen as an object the easier it should be to harm.

A burgeoning body of research supports these theoretical links. Research shows an association between self-harming behaviors and interoceptive deficits. For instance, people with eating disorders—who by definition chronically engage in behaviors that harm the physical body such as self-starvation or self-induced vomiting—consistently show greater interoceptive deficits than people without eating disorders (Fassino, Pierò, Gramaglia, & Abbate-Daga, 2004; Garner, 2004; Pollatos et al., 2008; Jenkinson, Taylor, & Laws, 2018). Similarly, individuals who engage in NSSI or attempt suicide appear to have greater interoceptive deficits than those without self-harming behaviors. Specifically, Franklin, Aaron, Arthur, Shorkey, and Prinstein (2012) found that young adults who self-injure took longer to perceive pain, perceived pain as less intense once detected, and tolerated higher pain intensities than young adults who do not self-injure. Ross, Heath, and Toste (2009) found that adolescents who self-injure report greater difficulty identifying and describing emotions than adolescents who do not self-injure. More recently, Forrest, Smith, White, and Joiner (2015) compared interoceptive deficits across groups with varying suicidality and found that (1) suicide attempters reported significantly greater interoceptive deficits than suicide ideators and planners, (2) attempters, ideators, and planners reported greater interoceptive deficits than nonsuicidal controls, and (3) recent suicide attempters reported greater interoceptive deficits than those with more distal attempts. Additionally, people with eating disorders who also have a history of suicide attempts show greater interoceptive deficits than those with eating disorders alone (Forcano et al., 2009; Smith, Forrest, & Velkoff, 2018) or co-occurring NSSI (Favaro & Santonastaso, 1998; Muehlenkamp, Peat, Claes, & Smits, 2012; Smith et al., 2018). Taken together, there is clear and consistent evidence of an association between interoceptive deficits and engaging in self-harming behavior.

Research on the direction of the association between interoceptive deficits and self-harming behaviors supports the theorized causality. Prospective research in a nonclinical sample of adolescent girls found that interoceptive deficits predicted disordered eating one year later (Leon, Fulkerson, Perry, & Early-Zald, 1995). Moreover, among patients with anorexia nervosa, interoceptive deficits prospectively predicted greater eating disorder symptom severity 5–10 years later (Bizeul, Sadowsky, & Rigaud, 2001), and in a sample of women with eating disorders who were followed longitudinally for 8 years, interoceptive deficits at baseline were greater among those who went on to attempt suicide during the course of the study versus those who did not (Franko et al., 2004).

Overall, past research demonstrates that interoceptive deficits are associated with SITBs and that greater interoceptive deficits are associated with more methods of self-harm (e.g., eating disorder behavior and NSSI versus eating disorder behavior alone) and more dangerous SITBs (e.g., suicide attempts versus ideation). However, to our knowledge, no studies have examined the relation between interoceptive deficits and SITBs in a military sample. Extending the research on interoceptive deficits and SITBs to a military sample is important because of the elevated risk of death by suicide among those who have served in the military, and because evidence suggests that military populations have elevated rates of symptoms related to interoceptive deficits, such as emotional numbness and pain insensitivity (Guerra & Calhoun, 2011; Nademin et al., 2008; Shelef, Levi-Belz, & Fruchter, 2014). For example, in a sample of Operation Enduring Freedom/Operation Iraqi Freedom veterans (N = 393), emotional numbing (as assessed by the Davidson Trauma Scale–Emotional Numbing subscale) was positively and significantly associated with the likelihood of experiencing current suicidal ideation (Guerra & Calhoun, 2011). Moreover, dissociation, which is conceptually related to interoceptive deficits, is positively associated with suicidal behavior among soldiers (Shelef et al., 2014). That is, Israeli soldiers who have attempted suicide exhibit higher dissociation as compared to soldiers who have not attempted suicide (Shelef et al., 2014). Further, PTSD symptoms (which include symptoms related to interoceptive deficits) are prevalent among treatment seeking service members (Ramchand et al., 2010), and PTSD is related to suicidal behavior (e.g., Boscarino, 2006). Taken together, evidence indicates that service members experience proxies of interoceptive deficits (e.g., pain insensitivity, dissociation, emotional numbing) and that these proxies are associated with suicidality.

Thus, the present study aimed to replicate existing research on the relation between interoception and SITBs while also expanding it to a military sample. Specifically, we tested whether interoceptive deficits differentiate between military suicide groups and tested whether interoceptive deficits associate with SITBs over and above established risk factors. In Study 1, we created an interoceptive deficits latent variable and tested its validity. In Study 2, which was a military sample, we tested whether the interoceptive deficits latent mean differed between those with no suicidality, those with suicide ideation and/or planning, and those who have attempted suicide. We hypothesized that the latent mean would significantly differ across all groups, with suicide attempters having the highest mean, those with no suicidality having the lowest mean, and those with suicide ideation and/or planning falling in between. Furthermore, we hypothesized that interoceptive deficits would be positively associated with SITBs and that this relation would hold controlling for other SITB risk factors.

STUDY 1

Because the main study (see Study 2) was a secondary data analysis, an existing measure of interoceptive deficits was not included. However, the Study 2 data included several items referred to as Common Data Elements (CDE), which are items that all investigators funded by the Military Suicide Research Consortium (MSRC) are asked to collect. Thus, the first and fourth author reviewed all the items included in the CDE assessment battery and independently selected items that were believed to tap the construct of "interoceptive deficits." These items were then reviewed and discussed, which led to the selection of four items that were believed to have the greatest face validity for interoceptive deficits: three items that assessed emotional numbness or disconnect and one item assessing pain tolerance (see item descriptions in Measures section). The purpose of Study 1 was to examine the convergent validity between these items and more established measures of interoceptive deficits in an independent sample.

Participants and Procedures

We collected data from a sample of participants recruited from Amazon's Mechanical Turk (MTurk; N = 134, 50.0% female, 80.6% white, average age = 37; see Table 1) to determine the validity of our proposed interceptive deficits latent variable. MTurk is an online recruitment Web site designed to match paid tasks to participants with the appropriate task characteristics.

Participation for the validation study was limited to individuals who indicated that they were located in the United States. To increase the validity of data collected online, only workers who had an approval rating of 90% or more were eligible to take part in the study. Additionally, two attention checks were included in the survey. One hundred seventy-five participants initiated the study and completed study measures. Participants who failed either attention check (n = 41) were excluded, resulting in a final sample of 134.

Measures

Multidimensional Assessment of Interoceptive Awareness (MAIA). The MAIA (Mehling et al., 2012) is a 32-item instrument that has participants rate how often statements apply to their general daily life on scale from 0 (*never*) to 5 (*always*). A total score and scores

TABLE 1
Demographic characteristics for Study 1 and Study 2 samples

	Study 1 (N = 134) n (%)	Study 2 (N = 3,764) n (%)
Gender		
Male	66 (49.3)	2,998 (79.6)
Female	67 (50.0)	674 (17.9)
Transgender	Not assessed	9 (0.2)
Other	1 (0.7)	1 (0.0)
Not reported	0 (0)	82 (2.2)
Race		
American Indian/ Alaska Native	2 (1.5)	40 (1.1)
Asian	8 (6.0)	94 (2.5)
Black/African American	11 (8.2)	707 (18.8)
Native Hawaiian/ Pacific Islander	1 (0.7)	8 (0.2)
White	108 (80.6)	2,386 (63.4)
Multiracial	1 (0.7)	43 (1.1)
Other	3 (2.2)	376 (10.0)
Not reported	0 (0)	110 (2.9)
Ethnicity		
Hispanic	6 (4.5)	377 (10.0)
Not Hispanic	128 (95.5)	2,999 (79.7)
Other	0 (0)	61 (1.6)
Not reported	0 (0)	327 (8.7)
Military service	Not assessed	
Currently serving	–	2,392 (63.5)
Veteran	–	1,346 (35.8)
Served but status unknown	–	26 (0.7)
Deployment	Not assessed	
No	–	1,341 (35.6)
Yes	–	1,550 (41.2)
Not reported	–	873 (23.2)
Military branch	Not assessed	
Army	–	1,960 (52.1)
Air Force	–	176 (4.7)
Navy	–	471 (19.7)
Marine Corps	–	456 (12.1)
Coast Guard	–	26 (0.7)
Unspecified/Other	–	36 (1.0)
Not reported	–	369 (9.8)
Suicidality		
No suicidality	96 (71.6)	918 (24.4)
Ideation	30 (22.4)	1,488 (39.5)

(continued)

TABLE 1
(continued)

	Study 1 (N = 134) n (%)	Study 2 (N = 3,764) n (%)
Attempt	8 (6.0)	1,078 (28.6)
	M (SD)	M (SD)
Age	37.0 (11.8)	33.3 (14.2)

In Study 1, ideation, planning, and attempting were each assessed. However, in Study 2, an assessment of suicide plans was not available. Thus, for Study 1 participants, the *ideation* category includes participants who reported ideation with no suicide plan and participants who reported ideation with a suicide plan.

for each of the measure's eight scales are calculated by averaging the scores of the individual items. The eight scales are as follows: not distracting, not worrying, attention regulation, emotional awareness, self-regulation, body listening, and trusting. An example of an item is *I notice where in my body I am comfortable*. The total score was used in the current study; internal reliability for the total score was excellent (Cronbach's α = .95).

Eating Disorder Inventory—Interoceptive Deficits Subscale. This ten-item subscale measuring interoceptive deficits has participants rate answers on a scale from 1 (*never*) to 6 (*always*) (Garner, Olmstead, & Polivy, 1983). An example item is *I don't know what is going on inside me*. Subscale scores were computed by summing items after some items were reverse-coded; higher scores indicate more severe deficits in interoceptive abilities. The Interoceptive Deficits subscale demonstrated good internal reliability in this sample (Cronbach's α = .88).

Toronto Alexithymia Scale (TAS). This measure is the most widely used instrument for measuring alexithymia (Bagby, Parker, & Taylor, 1994), which is closely related to interoceptive deficits (Brewer, Cook, & Bird, 2016). It contains 20 items. An example of an item is *It is difficult for me to find the right words for my feelings*. Items are rated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The TAS-20 demonstrated good internal reliability in this study (Cronbach's α = .86).

Proposed Interoceptive Deficits Latent Variable. To create our latent variable, we used three items from the PTSD CheckList (PCL; Weathers, Litz, Huska, & Keane, 1994) and one item from the Acquired Capability for Suicide Scale (ACSS; Ribeiro et al., 2014). The PCL is a standardized self-report measure that evaluates key symptoms related to PTSD. Participants rate how bothered they have been by a symptom over the past month using a 5-point scale ranging from "Not at all" to "Extremely." The following items from this measure were used in analyses: a*void thinking about or talking about a stressful experience from the past or avoid having feelings related to it; feeling distant or cut off from other people;* and *feeling emotionally numb or being unable to have loving feelings for those close to you*. The one Likert-type item from the ACSS assessed subjective pain tolerance and was phrased, *I can tolerate a lot more pain than most people*. Scores could range from 0 to 4, with higher scores indicating greater subjective pain tolerance. Similar self-reported items have been found to load onto a factor indexing discomfort and pain tolerance (Schmidt, Richey, & Fitzpatrick, 2006).

Results

The CDE-defined interoceptive deficits variable had acceptable internal consistency (α = .71). Crucially, the sum of the CDE-defined interoceptive deficits variable exhibited moderate-to-strong correlations with existing measures of interoceptive deficits (r = .51 with Eating Disorders Inventory—Interoceptive Deficits subscale; r = .45 with TAS; r = −.23 with MAIA total score; all ps < .01; see Table S1). These correlations are similar in magnitude to the correlations among these existing measures of interoceptive deficits. Taken together, this initial study demonstrates that the CDE-defined interoceptive deficits variable had adequate reliability and convergent validity with existing interoceptive deficits measures.

STUDY 2

After establishing preliminary construct validity for our proposed interoceptive deficits latent variable, we proceeded to examine its psychometric properties in a large military sample. Provided the items demonstrated reasonable reliability and factor structure in the military sample, we planned to conduct our main analyses of interest, which were to test whether suicide groups differed on the interoceptive deficits latent mean and whether the interoceptive deficits variable associated with SITBs above and beyond other risk factors, which included gender, age, hopelessness, and PTSD symptoms.

Method

Participants and Procedures. This was a secondary data analysis using participants who were previously recruited from 25 independent studies funded by the MSRC and who indicated they had served in the military (see Witte, Holm-Denoma, Zuromski, Gauthier, & Ruscio, 2017 for a more detailed description of recruitment procedures). As noted below, 10% of the data was used for conducting an exploratory factor analysis of the interoceptive deficits latent variable. The remaining 90% of the sample was used for all additional analyses, and thus, we describe the composition of that sample. The sample consisted of 3764 individuals (79.6% males). The sample ranged in age from 18 to 88 (M = 33.34, SD = 14.21) and was predominately non-Hispanic (79.7%) and White (63.4%). The majority of participants (52.1%) reported being associated with the Army, see Table 1. Each primary study site obtained approval from their respective Institutional Review Board (IRB) to collect the initial data, and the authors of the current study received IRB approval to conduct secondary data analyses.

Measures

As noted above, all participants completed the 57-item Common Data Elements (CDE) assessment, which is a selection of items developed by the MSRC to assess suicide relevant constructs. Most items were taken from existing measures that assess constructs like PTSD, hopelessness, alcohol use, insomnia, and suicidality, though some were created by MSRC personnel. Overall, the CDE items demonstrate convergence with the scales they were derived from (Ringer et al., 2018). Our interoceptive deficits latent variable was created from these items. See Appendix S1 for a full list of CDE items.

Interoceptive Deficits Indicators. A single-factor interoceptive deficits latent variable was specified using the same items as described in Study 1. However, as this was a military sample the PCL items were from the military version of the PCL (Weathers et al., 1994).

Current Suicidal Desire and Ideation. Current suicidal desire was assessed using the four-item Depressive Symptom Index—Suicidality Subscale (DSI-SS; Joiner, Pfaff, & Acres, 2002; Metalsky & Joiner, 1997). Participants are asked about suicidal thoughts, suicidal plans, control over suicidal thoughts, and impulses for suicide in the past two weeks. For each question, participants select one of four answer options, scored from 0 to 3. The responses to the four items were summed, creating a total score ranging from 0 to 12 with higher scores indicating greater severity of suicidal desire and ideation. Internal reliability was excellent in the present sample, as indicated by a Cronbach's α of .91.

Lifetime Number of Suicide Attempts. Participants were asked "*How many times in your lifetime have you made an attempt to kill yourself during which you had at least some intent to die?*"

Lifetime Number of NSSI Acts. Participants were asked "*How many times in your lifetime have your purposefully hurt yourself* without *wanting to die?*"

Objective Lethality of Most Serious Suicide Attempt. Participants were asked to write a narrative account of their most lethal suicide attempt (*Thinking about the most lethal attempt, describe the details of the plan and method used.*

Use the space below. If you have never attempted to kill yourself with at least some intent to die, please leave the space below blank.). Participants were also asked about the level of medical attention required for this suicide attempt, on the following scale: *0 = no medical attention; 1 = primary care doctor or nurse visit; 2 = emergency room visit; 3 = hospital admission to a general medical floor;* and *4 = hospital admission to an intensive care unit*. Three doctoral students in clinical psychology used both the narrative description and the medical attention received to rate the lethality of the suicide attempt. The rating scheme was based on the Lethality of Suicide Attempt Rating Scale-II (LSARS-II; Berman, Shepherd, & Silverman, 2003) as modified by Witte et al. (2017), with some additional modifications for the present study. Participants who reported having never attempted suicide, and those for whom information was insufficient or unclear enough to provide an accurate lethality rating, received an LSARS score of 0. Lethality ratings for suicide attempts ranged 1 to 11, with higher scores indicating more lethal attempts (M = 4.84, SD = 2.30, range = 1–11).

One rater coded all participants, and each of the other two raters coded half of the participants, resulting in two rater pairs. If raters disagreed on whether an attempt had occurred or whether there was enough information to accurately rate the lethality, the study's principal investigator—a licensed clinical psychologist with substantial experience treating and researching suicidality—made a determination as to whether the case would be rated. The interrater reliability for LSARS scores for the two pairs of raters was excellent, with both pairs achieving reliability of .90.

Suicide Study Group. For analyses involving group comparisons, participants were assigned to one of three suicidality groups based on participants' self-reported ideation (current and lifetime) and the narrative attempt descriptions. Those with incomplete data on suicidality history and related variables were excluded from these analyses (n = 307). Participants were classified as Attempters (coded as group 2) if their LSARS score was greater than 0 (n = 1,078). Participants were classified as Ideators/Planners (coded as group 1) if their LSARS score was 0, and either their DSI-SS score was greater than 0 or they endorsed lifetime suicidality on a separate CDE item (*Have you ever thought about or attempted to kill yourself?*) (n = 1,488). Lastly, participants were classified as No Suicidality (coded as group 0) if their LSARS score was 0, and their DSI-SS score was 0, and they did not endorse lifetime suicidality on the CDE item *Have you ever thought about or attempted to kill yourself?* (n = 918).

Covariates

Hopelessness. The CDEs included three items from the Beck Hopelessness Scale (BHS; Beck, Weissman, Lester, & Trexler, 1974) that were modified to a true/false answer option (*I happen to be particularly lucky, and I expect to get more of the good things in life than the average person; I don't expect to get what I really want; Things just won't work out the way I want them to)*. For the first item, a response of "true" is scored as 0 and "false" is scored as 1; for the second and third items, a response of "true" is scored as 1 and a response of "false" is scored as 0. Responses to the items are summed to create a total score, ranging 0 to 3. Lower scores indicate greater hopefulness (i.e., higher scores indicate more hopelessness). Internal reliability was acceptable for the present sample (α = .76).

PTSD Symptoms. In addition to the three PCL items used in the creation of the interoceptive deficits latent variable, the CDEs included seven additional items from the PCL-M (*Having physical reactions [e.g., heart pounding, trouble breathing, sweating] when something reminded you of a stressful military experience?; Repeated, disturbing memories, thoughts, or images of a stressful military experience?; Repeated, disturbing dreams of a stressful military experience?; Suddenly acting or feeling as if a stressful military experience were happening again?; Avoiding activities or situations because they reminded you of a stressful military experience?; Being "super alert" or watchful or on guard?;* and *Feeling jumpy or easily startled?*).

We included these additional items as control variables in the structural regression analyses to demonstrate specificity of the effect of our latent variable, over and above other PCL-M items.

Data Analytic Strategy

Analyses were primarily completed in M*plus* version 7.3 (Muthén & Muthén, 1998–2012) using robust estimators (i.e., MLR), given that several outcome variables were nonnormally distributed (e.g., NSSI frequency, suicide attempts). The covariance coverage matrix indicated that the proportion of pairwise present data ranged from .55 to .98 for the No Suicidality group, from .33 to .99 for the Ideator/Planner group, and from .25 to .99 for the Attempter group. Missing data resulted from a variety of factors, but were largely due to differing procedures for data collection across the sites. Missing data were handled using full information maximum likelihood (FIML) which is considered to be the best technique for handling missing data, especially when large amounts of data are missing (Enders, 2010). SPSS was used for descriptives, computing correlations, and computing reliabilities.

Preliminary Analyses: Measurement Model Identification

Before testing any of the structural models, a measurement model (i.e., an exploratory factor analysis [EFA]) was tested on the CDE item-defined interoceptive deficits latent variable using a randomly selected subset (n = 410; 10%) of the full sample. This step was taken in order to identify whether the model fit well in a subsample of the military sample, and if not, to make adjustments before moving onto the confirmatory stage, as it is not recommended to make further model modifications at that stage (Byrne, 2012). Good fit was indicated by chi-square (lower values indicate better fit), comparative fit index (CFI) ≥ .95, root mean square error of approximation (RMSEA) < .08, and standardized root mean square residual (SRMR) ≤ .08 (Hu & Bentler, 1999). The EFA included the estimation of only one factor and used Geomin rotation. The overall fit was adequate, (χ^2 = 8.57, df = 2, p = .01; CFI = .97; RMSEA = .09 [90% CI: .035, .158]; SRMR = .05). All factor loadings were significant (p < .001) and were between .29 and .95. Internal consistency was also adequate (α = .77).

We next proceeded to testing the model via confirmatory factor analysis (CFA) in the remainder of the sample (n = 3,750). The overall fit was excellent, (χ^2 = 5.44, df = 2, p = .07; CFI = 1.00; TLI = .99; RMSEA = .02 [90% CI: .000, .045]; SRMR = .02). Additionally, all factor loadings were statistically significant, p < .01. Internal consistency was also adequate (α = .76).

Multigroup Confirmatory Factor Analysis

We followed the recommended sequence to evaluate CFA equivalence (i.e., invariance) across groups (Brown, 2014; Byrne, 2012): establishing the baseline models, testing the configural model, testing the factor loading model (i.e., constraining loadings to equality), testing the intercepts model (i.e., constraining intercepts to equality), and, finally, testing differences in latent means among the No Suicidality, Ideator/Planner, and Attempter groups. Residual variances were estimated freely between groups at each step in factorial equivalence testing, as constraining these to be equal between groups results in an overly strict equivalence criterion (see Byrne, 2012).

Traditionally, $\Delta\chi^2$ tests have been used to determine whether one model fits significantly worse than the other, where a significant value indicates noninvariance. However, recently researchers have contended that the $\Delta\chi^2$ test has a number of limitations “rendering it an impractical and unrealistic criterion upon which to base evidence of invariance” (Byrne, 2012, p. 256). Therefore, some have argued for using other metrics for invariance, for instance, that the multigroup model demonstrates good fit and that ΔCFI between the nested models is <.05 (Byrne, 2012; Little, 1997). Accordingly, $\Delta\chi^2$ values are reported, but were not used as an indicator of factorial invariance; instead, we prioritized overall model fit and ΔCFI < .05.

Results

Baseline Models. As can be seen in Table 2, the baseline models for all groups had excellent fit and no modification indices (MIs) were above 10.0. Within all groups except the No Suicidality group, all items significantly loaded onto the interoceptive deficits latent variable. Specifically, within the No Suicidality group, the loading for the "pain tolerance" item was nonsignificant (p = .58). However, given the overall good fit and lack of MIs above 10.0, we did not make any changes to the models.

Configural model. We next tested a configural model with no parameter constraints across groups. At this step, the baseline models are simultaneously evaluated. The model fit was excellent, see Table 3.

Factor loading model. In this next step, we constrained all the factor loadings to equivalence across the three groups. This model did not produce good fit (see Table 3), indicating some level of noninvariance. We next examined MIs related to the factor loadings, and per Byrne's (2012) recommendations, we relaxed only one constraint at a time and then reestimated the model after each respecification. MIs indicated that the "emotionally numb" item was noninvariant in the No Suicidality group and the "feeling distant" item was noninvariant in the Ideator group. After relaxing the "emotionally numb" item within the No Suicidality group and the "feeling distant" item within the Ideator group, the model demonstrated adequate fit and ΔCFI between the configural model and the factor loading model was negligible (.01), see Table 3.

Intercepts Model. The next step was to constrain the intercepts to be equal across the three groups, which produced a poor fitting model. Given this, we examined MIs and relaxed the constraints on the intercepts one at a time (Byrne, 2012). We ultimately freed intercepts for the following items in the No Suicidality group: "feeling distant," "emotionally numb," and "avoid thinking about stressful experiences." Thus, the No Suicidality group had its own values for these intercepts, but the intercepts for the other two groups were constrained to equality. After freeing these intercepts in the No Suicidality group, model fit was acceptable and ΔCFI between the factor loading model and the intercepts models was below .05, see Table 3.

Latent Means Model. Given that each group had at least one loading and intercept in common, we were able to proceed to testing differences in latent means for a partially invariant model (Byrne, 2012). The No Suicidality group served as the reference group, and thus, its factor mean was fixed to zero. The latent means model demonstrated good fit, see Table 3. The Ideator factor mean (mean = 1.38) was significantly different from the No Suicidality group (p < .01), as

TABLE 2
Fit indices for the baseline interoceptive deficits latent variable models among Study 2 suicidality groups

Group	χ^2 (*df*)	*p*	MLR scaling correction	CFI	TLI	RMSEA (90% CI)	SRMR
No suicidality	0.27 (2)	.88	1.318	1.000	1.020	.000 (.000, .033)	.004
Ideator/Planner	1.44 (2)	.49	1.050	1.000	1.004	.000 (.000, .047)	.013
Attempter	4.15 (2)	.13	1.018	0.990	0.971	.032 (.000, .075)	.027

Total N = 3,764, No suicidality n = 918, Ideator/Planner n = 1,488, Attempter n = 1,078.
CFI, comparative fit index; MLR, maximum likelihood with robust standard errors; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker–Lewis Index.

TABLE 3

Fit indices for the interoceptive deficits latent variable multigroup confirmatory factor analysis

Model	χ^2 (*df*)	CFI	TLI	RMSEA (90% CI)	SRMR	Model comp	$\Delta\chi^2$ (Δdf)	ΔCFI	ΔTLI	ΔRMSEA	ΔSRMR	Decision
M1: Configural	5.40 (6)	1.000	1.002	.000 (.000, .036)	.018	–	–	–	–	–	–	–
M2: Factor loadings	76.75** (14)	0.930	0.910	.062 (.049, .076)	.140	M1	71.35 (8)	.070	.092	.062	.122	Reject
M2a: Partial factor loadings	26.11* (12)	0.984	0.976	.032 (.015, .049)	.056	M1	20.71 (6)	.016	.026	.032	.038	Accept
M3: Intercepts	690.25** (19)	0.253	0.292	.175 (.164, .186)	.358	M2a	664.14 (7)	.731	.684	.143	.302	Reject
M3a: Partial intercepts	70.15** (17)	0.941	0.937	.052 (.040, .065)	.074	M2a	44.04 (5)	.043	.039	.020	.018	Accept
M4: Latent means	29.06* (13)	0.982	0.975	.033 (.017, .049)	.050	M3a	41.09 (4)	.041	.038	.019	.024	Accept

Total N = 3,764, No suicidality n = 918, Ideation n = 1,488, Attempt n = 1,078.

CFI, comparative fit index; model comp, model comparison; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; TLI, Tucker–Lewis Index.

*$p \le .01$

**$p < .0001$.

was the Attempter factor mean (mean = 1.85, $p < .01$). In order to test whether the No Suicidality group and Attempter group differed from the Ideator group, we next set the Ideator group to serve as the reference group. As predicted, the Attempter factor mean was significantly greater than the Ideator group ($p < .01$), and the No Suicidality group was significantly less than the Ideator group ($p < .01$). In sum, we found that the Attempter group had the greatest elevations on the interoceptive deficits latent mean, with the Ideator group intermediary.

Testing the Association between Interoceptive Deficits and SITBs

To determine whether interoceptive deficits were associated with SITB severity over and above other established SITB risk factors, PTSD symptoms, hopelessness, age, and gender were modeled as covariates (entered as exogenous, observed variables[1]). Results revealed that the interoceptive deficits latent variable was associated with suicidal ideation ($\beta = .40$, $SE = .04$, $p < .001$), NSSI ($\beta = .42$, $SE = .04$, OR = 2.86, $p < .001$), suicide attempts, ($\beta = .17$, $SE = .05$, OR = 1.44, $p < .001$), and attempt lethality ($\beta = .19$, $SE = .04$, $p < .001$) over and above these other covariates, see Tables 4–7.

DISCUSSION

Within a large military sample, our results confirm and extend a growing body of research which finds that interoceptive deficits are most pronounced in those who have attempted suicide. Specifically, among military members we found that people who have attempted suicide had greater interoceptive deficits than those with no suicide history, with people who have thought about or planned an attempt intermediary. Additionally, we found that interoceptive deficits had a stronger relationship (i.e., beta values were larger) with suicidal ideation, NSSI, suicide attempts, and attempt lethality than any of the other risk factors included in the models, including PTSD symptoms, hopelessness, gender, and age.

These findings extend and replicate past work and suggest that interoceptive deficits are a particularly promising construct to study in relation to SITBs among military personnel. As noted earlier, several studies find that proxies of interoceptive deficits (i.e., dissociation, emotional numbing) are related to SITBs in military members (Evren & Can, 2007; Guerra & Calhoun, 2011; Shelef et al., 2014). With respect to pain tolerance, Nademin et al. (2008) identified that suicide decedents who served in the U.S. Air Force were perceived to exhibit higher pain tolerance as compared to Air Force personnel who had not died by suicide. Taken together, our findings add to this literature and suggest that interoceptive deficits are important to consider in relation to SITBs among individuals in the military.

Recent empirically informed theories of suicide highlight the importance of identifying factors that lead from suicide ideation to suicidal behavior (i.e., Joiner, 2005; Klonsky & May, 2015; Van Orden et al., 2010). However, currently there are few known risk factors that reliably differentiate ideators from attempters (May & Klonsky, 2016). Interoceptive deficits may be one such differentiating factor. Specifically, interoceptive deficits may lead to such disconnection from the self that the body comes to be seen as "other" and potentially even "nonhuman." There is a vast body of both scientific and historical work documenting the use of dehumanization as a means to perpetrate lethal injury (Haslam & Loughnan, 2014; Kteily, Bruneau, Waytz, & Cotterill, 2015; Smith, 2011). It is possible

[1]Although age and gender are likely to be measured with very little error, it is likely that hopelessness and the PTSD symptoms included as covariates were measured with some error. We ran models assuming reliabilities of .8 for the hopelessness items and .97 for the PTSD items (based on the reliabilities in our sample) and computed the residual variances as: Residual variance = (1-reliability)*sample variance. Using these residual variance estimates for our observed variables did not change the overall pattern of the results.

TABLE 4
Regression results of interoceptive deficits latent variable positively associating with suicide ideation over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	1.40	.16	.40 (.33, .47)	<.001
Age	−0.01	.00	−.05 (−.08, −.02)	.002
Gender	−0.03	.12	.00 (−.04, .03)	.81
Hopelessness	0.70	.05	.29 (.25, .32)	<.001
PCL Memories	0.04	.07	.02 (−.05, .09)	.56
PCL Dreams	−0.01	.07	.00 (−.07, .07)	.91
PCL Flashback	0.05	.07	.02 (−.04, .08)	.51
PCL Avoid reminders	0.03	.06	.02 (−.04, .08)	.59
PCL On guard	−0.08	.05	−.04 (−.09, .01)	.08
PCL Startled	0.18	.05	.09 (.04, 0.15)	<.001
PCL Physical reactions	−0.15	.07	−.07 (−.13, −.01)	.02

PCL = PTSD Checklist; PCL Memories = Repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = Repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being "super alert" or watchful or on guard; PCL Startled = Feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

TABLE 5
Regression results of interoceptive deficits latent variable associating with nonsuicidal self–injury over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	1.05	.15	.42 (.33, .50)	<.001
Age	−0.03	.00	−.20 (−.25, −.16)	<.001
Gender	0.42	.11	.08 (.04, .12)	<.001
Hopelessness	0.32	.04	.18 (.14, .23)	<.001
PCL Memories	0.01	.06	.01 (−.08, .09)	.87
PCL Dreams	−0.09	.06	−.06 (−.13, .02)	.14
PCL Flashback	0.06	.06	.03 (−.03, .10)	.32
PCL Avoid reminders	−0.11	.05	−.08 (−.14, −.01)	.03
PCL On guard	0.02	.04	.02 (−.04, .08)	.59
PCL Startled	0.13	.04	.09 (.03, .15)	<.01
PCL Physical reactions	0.00	.06	.00 (−.07, .08)	.95

PCL = PTSD Checklist; PCL Memories = Repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = Repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being "super alert" or watchful or on guard; PCL Startled = Feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

that interoceptive deficits allow for a dehumanization of the body which in turn facilitates self-injury.

Our results have several important clinical implications. First, it may be worthwhile to consider assessing for interoceptive

TABLE 6

Regression results of interoceptive deficits latent variable associating with suicide attempts over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	0.36	.10	.17 (.05, .26)	<.001
Age	0.01	.00	.09 (.06, .13)	<.001
Gender	0.22	.09	.04 (.01, .08)	.02
Hopelessness	0.31	.03	.19 (.15, .23)	<.001
PCL Memories	0.02	.05	.02 (−.06, .09)	.66
PCL Dreams	0.02	.05	.02 (−.05, .09)	.66
PCL Flashback	−0.02	.05	−.02 (−.08, .05)	.63
PCL Avoid reminders	−0.02	.04	−.01 (−.08, .05)	.68
PCL On guard	0.03	.04	.03 (−.03, .08)	.39
PCL Startled	0.13	.04	.10 (.05, .16)	<.001
PCL Physical reactions	0.01	.05	.00 (−.06, .07)	.91

PCL = PTSD Checklist; PCL Memories = Repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = Repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being "super alert" or watchful or on guard; PCL Startled = Feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

TABLE 7

Regression results of interoceptive deficits latent variable associating with suicide attempt lethality over and above covariates

	B	*SE*	β (95% CI)	*p*
Interoceptive deficits	0.56	.13	.19 (.11, .28)	<.001
Age	0.01	.00	.04 (.01, .08)	.01
Gender	0.08	.11	.01 (−.02, .04)	.45
Hopelessness	0.23	.04	.11 (.07, .15)	<.001
PCL Memories	−0.05	.06	−.03 (−.10, .4)	.46
PCL Dreams	0.12	.06	.07 (.00, .14)	.06
PCL Flashback	−0.05	.07	−.03 (−.09, .04)	.46
PCL Avoid reminders	−0.10	.05	−.06 (−.12, .00)	.07
PCL On guard	−0.01	.05	−.01 (−.06, .05)	.81
PCL Startled	0.12	.05	.07 (.02, .13)	.01
PCL Physical reactions	0.05	.06	.03 (−.04, .09)	.46

PCL = PTSD Checklist; PCL Memories = Repeated, disturbing memories, thoughts, or images of a stressful military experience; PCL Dreams = Repeated, disturbing dreams of a stressful military experience; PCL Flashbacks = Suddenly acting or feeling as if a stressful military experience were happening again; PCL Avoid reminders = Avoiding activities or situations because they reminded you of a stressful military experience; PCL On guard = Being "super alert" or watchful or on guard; PCL Startled = Feeling jumpy or easily startled; PCL Physical reactions = Having physical reactions (e.g., heart pounding, trouble breathing, sweating) when something reminded you of a stressful military experience.

deficits when conducting suicide risk assessments with military members. Second, experimental research finds that interoceptive deficits can be attenuated through relatively straightforward means, which suggests potential clinical applications. For example, looking at one's reflection in a mirror during interoceptive processing (i.e., counting one's heartbeats without taking one's pulse) has been associated with improved interoceptive accuracy (Ainley, Tajadura-Jiménez, Fotopoulou, & Tsakiris, 2012). Another study found that having people think about self-relevant stimuli, like one's name and hometown, led to better interoceptive accuracy (Ainley, Maister, Brokfeld, Farmer, & Tsakiris, 2013). This suggests that teaching people to be more attuned to certain aspects of the self holds promise as a way to improve interoceptive abilities.

Several strengths of the current study are worth noting. First, we used a large, primarily male military sample, whereas much previous work on the topic has relied on female eating disorders samples (e.g., Dodd et al., 2018; Smith et al., 2018). Second, we employed MGCFA to test for latent mean differences, which has several advantages over traditional ANOVA-based group testing. Third, we demonstrated that interoceptive deficits positively associated with attempt lethality. This is a novel finding, as to our knowledge, this the first study to test for such an association.

When interpreting these results, however, it is important to keep in mind that the interoceptive deficits latent variable was only partially invariant across groups. This means that nonsuicidal individuals, ideators, and attempters do not respond the same to all the items we used to measure interoceptive deficits, and thus, group comparisons are somewhat limited. Future research using more psychometrically sound measurements of interoception, such as the Multidimensional Assessment of Interoceptive Awareness (Mehling, Acree, Stewart, Silas, & Jones, 2018; Mehling et al., 2012), is needed, though this research would also benefit from considering an MGCFA approach before testing for group differences.

There are additional limitations to note, which further influence the interpretations of the results and inform future research. Perhaps the most significant limitation was the creation of an interoceptive deficits latent variable from items not specifically designed to measure this construct. However, we attempted to mitigate this limitation in a number of ways. First, we selected items that tapped both emotional numbing and physiological sensations relevant to self-injury, namely pain tolerance. Much previous work has relied on a measure that primarily assesses emotional numbing with a few items that tap gut sensations (e.g., Dodd et al., 2018; Forrest et al., 2015; Smith et al., 2018), which are arguably less relevant to self-injury. Though it is important to note that although all items loaded significantly onto the latent factor in the Ideator and Attempter groups, the pain tolerance item did not significantly load in the No Suicide group. Additionally, three of the four factor items came from a scale assessing PTSD. However, in order to demonstrate discriminant validity of our interoceptive deficits latent variable we controlled for additional PTSD symptoms in all the structural regressions. Further, we employed rigorous validity checks including external validation in a separate sample and EFA testing in a subsample of the data. However, despite these checks, our interoceptive deficits latent variable still did not encompass all forms of interoception (e.g., cardiac awareness, gut sensations) and was partially invariant across groups. Another limitation was that suicide attempt was assessed via self-report. However, here again we employed rigorous validity checks by only including attempts that had narrative descriptions which were deemed by two independent raters to have been enacted upon with nonzero intent. An additional notable limitation was the cross-sectional design, which precludes any determination of directionality. Finally, the gender composition varied across our two studies, with our Study 2 sample being primarily male, which could impact the generalizability of the findings. Given that much of the existing work on interoception and suicidality has been conducted with female samples, the replication of these patterns in a largely male sample suggests that the relation may hold across genders. However, it will be important for future work to consider gender, as recent research suggests that women have better interoceptive sensibilities than men in some domains, but men outperform women in others (Grabauskaitė, Baranauskas, & Griškova-Bulanova, 2017).

These limitations provide several clear directions for future research. First, researchers investigating interoceptive deficits need to think carefully about the construct of interoception and its measurement. Currently, few self-report measures with strong psychometric properties exist. Although the MAIA appears to be the most comprehensive, some subscales have not demonstrated good reliability (Mehling et al., 2018), and not all subscales relate to SITBs (Rogers, Hagan, & Joiner, 2018). Additionally, self-report measures are prone to their own limitations, which could be exacerbated among individuals who have trouble perceiving their physiological sensations. In other words, if one is numb to their sensations, it is likely difficult to accurately report on them. Including objective assessments may thus be useful, but even with objective measurements caution is warranted. The heartbeat perception test (Schandry, 1981) is the most widely used assessment of interoceptive accuracy; however, several recent articles have questioned its validity along a number of dimensions (Murphy, Brewer, Hobson, Catmur, & Bird, 2018; Ring, Brener, Knapp, & Mailloux, 2015; Zamariola, Maurage, Luminet, & Corneille, 2018). Additionally, interoception is a broad construct and encompasses awareness of multiple physiological symptoms, so relying only on cardiac awareness risks being overly reductive. Further, recent research demonstrates that not all objectively assessed components of interoception (i.e., cardiac awareness, emotion awareness, pain awareness) are correlated and that cardiac awareness may be less relevant to SITBs than other components of interoception (Forrest & Smith, under review). Thus, going forward, multimodal assessments are needed in order to determine whether some forms of deficits are more strongly related to SITBs than others.

Second, longitudinal data are needed to test prospective relations and determine whether interoceptive deficits are causally related to suicidal behavior. Longitudinal data could also help our understanding of how interoception develops and changes over time and within situations. Related, it will be important to test whether aspects of being in the military may increase and/or maintain interoceptive deficits, and whether deficits persist postdeployment and when individuals are no longer active duty. In particular, it would be worthwhile for future research to examine associations between combat exposure, traumatic brain injury, interoception, and suicidality. This is particularly salient given that traumatic brain injuries are associated with both interoceptive deficits (Hynes, Stone, & Kelso, 2011) and suicide risk (Wadhawan et al., 2019).

CONCLUSION

These results suggest that interoceptive deficits can help differentiate suicide groups and that interoceptive deficits may provide important information about suicide risk among military members. However, given the limitations of the current study, future longitudinal research employing psychometrically sound measures of interoception is needed.

REFERENCES

AINLEY, V., MAISTER, L., BROKFELD, J., FARMER, H., & TSAKIRIS, M. (2013). More of myself: Manipulating interoceptive awareness by heightened attention to bodily and narrative aspects of the self. *Consciousness and Cognition*, *22* (4), 1231–1238.

AINLEY, V., TAJADURA-JIMÉNEZ, A., FOTOPOULOU, A., & TSAKIRIS, M. (2012). Looking into myself: The effect of self-focused attention on interoceptive sensitivity. *Psychophysiology*, *49*(11), 1504–1508.

Armed Forces Health Surveillance Center (2012). Deaths by suicide while on active duty, active and reserve components, US Armed Forces, 1998–2011. *MSMR*, *19*(6), 7.

Bagby, R. M., Parker, J. D. A., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia Scale—Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research*, *38*(1), 23–32.

Beck, A. T., Weissman, A., Lester, D., & Trexler, L. (1974). The measurement of pessimism: The Hopelessness Scale. *Journal of Consulting and Clinical Psychology*, *42*, 861–865.

Berman, A. L., Shepherd, G., & Silverman, M. M. (2003). The LSARS-II: Lethality of suicide attempt rating scale—updated. *Suicide and Life-Threatening Behavior*, *33*(3), 261–276.

Bizeul, C., Sadowsky, N., & Rigaud, D. (2001). The prognostic value of initial EDI scores in anorexia nervosa patients: A prospective follow-up study of 5–10 years. *European Psychiatry*, *16*(4), 232–238.

Boscarino, J. A. (2006). Posttraumatic stress disorder and mortality among US Army veterans 30 years after military service. *Annals of Epidemiology*, *16*, 248–256.

Brewer, R., Cook, R., & Bird, G. (2016). Alexithymia: A general deficit of interoception. *Royal Society Open Science*, *3*(10), 150664.

Brown, T. A. (2014). *Confirmatory factor analysis for applied research*. New York, NY: Guilford Publications.

Byrne, B. M. (2012). *Structural equation modeling with Mplus: Basic concepts, applications, and programming*. New York, NY: Routledge.

Craig, A. D. (2003). Interoception: The sense of the physiological condition of the body. *Current Opinion in Neurobiology*, *13*(4), 500–505.

Department of Veterans Affairs, Veterans Health Administration, Office of Mental Health and Suicide Prevention (2018). *Veteran suicide data report, 2005–2016*. Retrieved from https://www.mentalhealth.va.gov/docs/data-sheets/OMHSP_National_Suicide_Data_Report_2005-2016_508.pdf.

Dodd, D. R., Smith, A. R., Forrest, L. N., Witte, T. K., Bodell, L., Bartlett, M., et al. (2018). Interoceptive deficits, nonsuicidal self-injury, and suicide attempts among women with eating disorders. *Suicide and Life-Threatening Behavior*, *48*(4), 438–448.

Enders, C. K. (2010). *Applied missing data analysis*. New York, NY: Guilford Press.

Evren, C., & Can, S. (2007). Clinical correlates of dissociative tendencies in male soldiers with conversion disorder. *Israel Journal of Psychiatry and Related Science*, *44*, 33–39.

Fassino, S., Pierò, A., Gramaglia, C., & Abbate-Daga, G. (2004). Clinical, psychopathological and personality correlates of interoceptive awareness in anorexia nervosa, bulimia nervosa and obesity. *Psychopathology*, *37*(4), 168–174.

Favaro, A., & Santonastaso, P. (1998). Impulsive and compulsive self-injurious behavior in bulimia nervosa: Prevalence and psychological correlates. *The Journal of Nervous and Mental Disease*, *186*(3), 157–165.

Forcano, L., Fernández-Aranda, F., Alvarez-Moya, E., Bulik, C., Granero, R., Gratacos, M., et al. (2009). Suicide attempts in bulimia nervosa: Personality and psychopathological correlates. *European Psychiatry*, *24*(2), 91–97.

Forrest, L. N., & Smith, A. R. (under review). A multi-measure examination of interoception in people with self-injurious behaviors. *Journal of Abnormal Psychology*.

Forrest, L. N., Smith, A. R., White, R. D., & Joiner, T. E. (2015). (Dis) connected: An examination of interoception in individuals with suicidality. *Journal of Abnormal Psychology*, *124*(3), 754–763.

Franklin, J. C., Aaron, R. V., Arthur, M. S., Shorkey, S. P., & Prinstein, M. J. (2012). Nonsuicidal self-injury and diminished pain perception: The role of emotion dysregulation. *Comprehensive Psychiatry*, *53*(6), 691–700.

Franklin, J. C., Ribeiro, J. D., Fox, K. R., Bentley, K. H., Kleiman, E. M., Huang, X., et al. (2017). Risk factors for suicidal thoughts and behaviors: A meta-analysis of 50 years of research. *Psychological Bulletin*, *143*(2), 187.

Franko, D. L., Keel, P. K., Dorer, D. J., Blais, M. A., Delinsky, S. S., Eddy, K. T., et al. (2004). What predicts suicide attempts in women with eating disorders? *Psychological Medicine*, *34*(5), 843–853.

Garner, D. M. (2004). *Eating disorder inventory-3 (EDI-3)*. Professional manual. Odessa, FL: Psychological Assessment Resources.

Garner, D. M., Olmstead, M. P., & Polivy, J. (1983). Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. *International Journal of Eating Disorders*, *2*, 15–34.

Grabauskaitė, A., Baranauskas, M., & Griškova-Bulanova, I. (2017). Interoception and gender: What aspects should we pay attention to? *Consciousness and Cognition*, *48*, 129–137.

Guerra, V. S., & Calhoun, P. S. (2011). Examining the relation between posttraumatic stress disorder and suicidal ideation in an OEF/OIF Veteran sample. *Journal of Anxiety Disorders*, *25*, 12–18.

HASLAM, N., & LOUGHNAN, S. (2014). Dehumanization and infrahumanization. *Annual Review of Psychology*, *65*, 399–423.

HU, L. T., & BENTLER, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55.

HYNES, C. A., STONE, V. E., & KELSO, L. A. (2011). Social and emotional competence in traumatic brain injury: New and established assessment tools. *Social Neuroscience*, *6*, 599–614.

JENKINSON, P. M., TAYLOR, L., & LAWS, K. R. (2018). Self-reported interoceptive deficits in eating disorders: A meta-analysis of studies using the eating disorder inventory. *Journal of Psychosomatic Research*, *110*, 38–45.

JOINER, T. E. (2005). *Why people die by suicide*. Cambridge, MA: Harvard University Press.

JOINER JR,, T. E., PFAFF, J. J., & ACRES, J. G. (2002). A brief screening tool for suicidal symptoms in adolescents and young adults in general health settings: Reliability and validity data from the Australian National General Practice Youth Suicide Prevention Project. *Behaviour Research and Therapy*, *40*(4), 471–481.

KLONSKY, E. D., & MAY, A. M. (2015). The three-step theory (3ST): A new theory of suicide rooted in the "ideation-to-action" framework. *International Journal of Cognitive Therapy*, *8*(2), 114–129.

KTEILY, N., BRUNEAU, E., WAYTZ, A., & COTTERILL, S. (2015). The ascent of man: Theoretical and empirical evidence for blatant dehumanization. *Journal of Personality and Social Psychology*, *109*(5), 901–931.

KUEHN, B. M. (2009). Soldier suicide rates continue to rise. *Journal of the American Medical Association*, *301*(11), 1111–1113.

LEON, G. R., FULKERSON, J. A., PERRY, C. L., & EARLY-ZALD, M. B. (1995). Prospective analysis of personality and behavioral vulnerabilities and gender influences in the later development of disordered eating. *Journal of Abnormal Psychology*, *104*(1), 140.

LITTLE, T. D. (1997). Mean and covariance structures (MACS) analyses of cross-cultural data: Practical and theoretical issues. *Multivariate Behavioral Research*, *32*(1), 53–76.

MAY, A. M., & KLONSKY, E. D. (2016). What distinguishes suicide attempters from suicide ideators? A meta-analysis of potential factors. *Clinical Psychology: Science and Practice*, *23*(1), 5–20.

MEHLING, W. E., ACREE, M., STEWART, A., SILAS, J., & JONES, A. (2018). The multidimensional assessment of interoceptive awareness, version 2 (MAIA-2). *PLoS ONE*, *13*(12), e0208034.

MEHLING, W. E., PRICE, C., DAUBENMIER, J. J., ACREE, M., BARTMESS, E., & STEWART, A. (2012). The multidimensional assessment of interoceptive awareness (MAIA). *PLoS ONE*, 7(11), e48230.

METALSKY, G. I., & JOINER, T. E. (1997). The hopelessness depression symptom questionnaire. *Cognitive Therapy and Research*, *21*, 359–384.

MUEHLENKAMP, J. J. (2012). Body regard in nonsuicidal self-injury: Theoretical explanations and treatment directions. *Journal of Cognitive Psychotherapy*, *26*(4), 331–347.

MUEHLENKAMP, J. J., PEAT, C. M., CLAES, L., & SMITS, D. (2012). Self-injury and disordered eating: Expressing emotion dysregulation through the body. *Suicide and Life-Threatening Behavior*, *42* (4), 416–425.

MURPHY, J., BREWER, R., HOBSON, H., CATMUR, C., & BIRD, G. (2018). Is alexithymia characterised by impaired interoception? Further evidence, the importance of control variables, and the problems with the Heartbeat Counting Task. *Biological Psychology*, *136*, 189–197.

MUTHÉN, L. K., & MUTHÉN, B. O. (1998–2012). *Mplus user's guide* (7th edn). Los Angeles, CA: Muthén & Muthén.

NADEMIN, E., JOBES, D. A., PFLANZ, S. E., JACOBY, A. M., GHAHRAMANLOU-HOLLOWAY, M., CAMPISE, R., ET AL. (2008). An investigation of interpersonal–psychological variables in Air Force suicides: A controlled-comparison study. *Archives of Suicide Research*, *12*, 309–326.

PAULUS, M. P., FEINSTEIN, J. S., & KHALSA, S. S. (2019). An active inference approach to interoceptive psychopathology. *Annual Review of Clinical Psychology*, *15*, 97–122.

POLLATOS, O., KURZ, A.-L., ALBRECHT, J., SCHREDER, T., KLEEMANN, A. M., SCHÖPF, V., ET AL. (2008). Reduced perception of bodily signals in anorexia nervosa. *Eating Behaviors*, *9*(4), 381–388.

RAMCHAND, R., SCHELL, T. L., KARNEY, B. R., OSILLA, K. C., BURNS, R. M., & CALDARONE, L. B. (2010). Disparate prevalence estimates of PTSD among service members who served in Iraq and Afghanistan: Possible explanations. *Journal of Traumatic Stress*, *23*, 59–68.

REIMANN, C. A., & MAZUCHOWSKI, E. L. (2018). Suicide rates among active duty service members compared with civilian counterparts, 2005–2014. *Military Medicine*, *183*, 396–402.

RIBEIRO, J. D., FRANKLIN, J. C., FOX, K. R., BENTLEY, K. H., KLEIMAN, E. M., CHANG, B. P., ET AL. (2016). Self-injurious thoughts and behaviors as risk factors for future suicide ideation, attempts, and death: A meta-analysis of longitudinal studies. *Psychological Medicine*, *46*(2), 225–236.

RIBEIRO, J. D., WITTE, T. K., VAN ORDEN, K. A., SELBY, E. A., GORDON, K. H., BENDER, T. W., ET AL. (2014). Fearlessness about death: The psychometric properties and construct validity of the revision to the Acquired Capability for Suicide Scale. *Psychological Assessment*, *26*(1), 115.

RING, C., BRENER, J., KNAPP, K., & MAILLOUX, J. (2015). Effects of heartbeat feedback on beliefs about heart rate and heartbeat counting: A cautionary tale about interoceptive awareness. *Biological Psychology*, *104*, 193–198.

RINGER, F. B., SOBERAY, K. A., ROGERS, M. L., HAGAN, C. R., CHU, C., SCHNEIDER, M., ET AL. (2018). Initial validation of brief measures of suicide risk factors: Common data elements used by the Military Suicide Research Consortium. *Psychological Assessment*, *30*, 767.

ROGERS, M. L., HAGAN, C. R., & JOINER, T. E. (2018). Examination of interoception along the suicidality continuum. *Journal of Clinical Psychology*, *74*(6), 1004–1016.

ROSS, S., HEATH, N. L., & TOSTE, J. R. (2009). Non-suicidal self-injury and eating pathology in high school students. *American Journal of Orthopsychiatry*, *79*(1), 83–92.

SCHANDRY, R. (1981). Heart beat perception and emotional experience. *Psychophysiology*, *18*, 483–488.

SCHMIDT, N. B., RICHEY, J. A., & FITZPATRICK, K. K. (2006). Discomfort intolerance: Development of a construct and measure relevant to panic disorder. *Journal of Anxiety Disorders*, *20* (3), 263–280.

SHELEF, L., LEVI-BELZ, Y., & FRUCHTER, E. (2014). Dissociation and acquired capability as facilitators of suicide ideation among soldiers. *Crisis*, *35*, 388–397.

SMITH, A., FORREST, L., & VELKOFF, E. (2018). Out of touch: Interoceptive deficits are elevated in suicide attempters with eating disorders. *Eating Disorders*, *26*(1), 52–65.

SMITH, D. L. (2011). *Less than human: Why we demean, enslave, and exterminate others*. New York, NY: Macmillan.

VAN ORDEN, K. A., CUKROWICZ, K. C., WITTE, T. K., BRAITHWAITE, S. R., SELBY, E. A., & JOINER, T. E. (2010). The interpersonal theory of suicide. *Psychological Review*, *117*(2), 575–600.

WADHAWAN, A., STILLER, J. W., POTOCKI, E., OKUSAGA, O., DAGDAG, A., LOWRY, C. A., ET AL. (2019). Traumatic brain injury and suicidal behavior: A review. *Journal of Alzheimer's Disease*, *68*, 1–32.

WEATHERS, F. W., LITZ, B. T., HUSKA, J. A., & KEANE, T. M. (1994). *The PTSD checklist (PCL)*. Unpublished scale available from the National Center for PTSD. Retrieved from https://www.ptsd.va.gov/professional/assessment/documents/APCLM.pdf.

WITTE, T. K., HOLM-DENOMA, J. M., ZUROMSKI, K. L., GAUTHIER, J. M., & RUSCIO, J. (2017). Individuals at high risk for suicide are categorically distinct from those at low risk. *Psychological Assessment*, *29*(4), 382–393.

World Health Organization (2019). *Mental health: Suicide data*. Retrieved from https://www.who.int/mental_health/prevention/suicide/suicideprevent/en/.

ZAMARIOLA, G., MAURAGE, P., LUMINET, O., & CORNEILLE, O. (2018). Interoceptive accuracy scores from the heartbeat counting task are problematic: Evidence from simple bivariate correlations. *Biological Psychology*, *137*, 12–17.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Table S1. Bivariate correlations among the latent interoceptive deficits variable and other measures of interoceptive deficits/awareness.

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RESEARCH ARTICLE

Developing an optimal short-form of the PTSD Checklist for DSM-5 (PCL-5)

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Abstract

Background: Although several short-forms of the posttraumatic stress disorder (PTSD) Checklist (PCL) exist, all were developed using heuristic methods. This report presents the results of analyses designed to create an optimal short-form PCL for DSM-5 (PCL-5) using both machine learning and conventional scale development methods.

Methods: The short-form scales were developed using independent datasets collected by the Army Study to Assess Risk and Resilience among Service members. We began by using a training dataset ($n = 8{,}917$) to fit short-form scales with between 1 and 8 items using different statistical methods (exploratory factor analysis, stepwise logistic regression, and a new machine learning method to find an optimal integer-scored short-form scale) to predict dichotomous PTSD diagnoses determined using the full PCL-5. A smaller subset of best short-form scales was then evaluated in an independent validation sample ($n = 11{,}728$) to select one optimal short-form scale based on multiple operating characteristics (area under curve [AUC], calibration, sensitivity, specificity, net benefit).

Results: Inspection of AUCs in the training sample and replication in the validation sample led to a focus on 4-item integer-scored short-form scales selected with stepwise regression. Brier scores in the validation sample showed that a number of these scales had comparable calibration (0.015–0.032) and AUC (0.984–0.994), but that one had consistently highest net benefit across a plausible range of decision thresholds.

Conclusions: The recommended 4-item integer-scored short-form PCL-5 generates diagnoses that closely parallel those of the full PCL-5, making it well-suited for screening.

KEYWORDS

diagnosis, military personnel, psychological tests/psychometrics, trauma- and stressor-related disorders

1 | INTRODUCTION

Posttraumatic stress disorder (PTSD) is a commonly occurring and seriously impairing disorder (Koenen et al., 2017) with a low treatment rate (Thornicroft et al., 2018). Given that screening is effective in detecting PTSD (Warner, Warner, Appenzeller, & Hoge, 2013), several validated screening scales have been developed for this purpose (Gates et al., 2012; Parker-Guilbert, Moshier, Marx, & Keane, 2018; Wisco, Marx, & Keane, 2012). The PTSD Checklist (PCL; F. Weathers, Litz, Herman, Huska, & Keane, 1993; F. W. Weathers et al., 2013) is one of the most widely used of these scales

[Correction added on 09 August 2019, after first online publication: The "department" for affiliation #4 has been changed]

(Elhai, Gray, Kashdan, & Franklin, 2005; Hoge, Riviere, Wilk, Herrell, & Weathers, 2014). The DSM-5 version of the PCL (PCL-5) assesses each of the 20 DSM-5 (American Psychiatric Association, 2013) criteria B-E symptoms of PTSD and is recommended for screening and monitoring PTSD symptoms throughout treatment in the Department of Veterans Affairs and Department of Defense (VA/DoD; Department of Veterans Affairs, 2017).

Although the PCL-5 has excellent psychometric properties (Blevins, Weathers, Davis, Witte, & Domino, 2015; Bovin et al., 2016; Keane et al., 2014; Wortmann et al., 2016), one weakness is the scale's length (5–10 min completion time; National Center for PTSD), which is problematic given that VA/DoD also recommend screening for many other psychiatric disorders (U.S. Department of Veterans Affairs). To reduce respondent burden, several short-form (2–6 item) versions of the DSM-IV PCL (Bliese et al., 2008; Lang & Stein, 2005) and PCL-5 (Price, Szafranski, van Stolk-Cooke, & Gros, 2016) have been created along with a computer-adaptive version of the PCL-5 (Finkelman et al., 2017, 2018). These short-forms are limited, though, either because they were developed using heuristic methods, or in the case of computer-adaptive testing, cannot be used with paper and pencil administration. Furthermore, research on the comparative performance of the different short-form PCLs is limited (Tiet, Schutte, & Leyva, 2013), creating uncertainty about the optimal number and content of items (Bressler, Erford, & Dean, 2018).

We carried out a secondary analysis of the Army Study to Assess Risk and Resilience among Servicemembers (Army STARRS; Ursano et al., 2014) to develop an optimal short-form PCL-5 using machine learning methods and conventional statistical methods like those used to develop earlier short-forms. Scale development and validation were based on separate subsamples of respondents. The results of these analyses are reported in this paper.

2 | MATERIALS AND METHODS

2.1 | Samples

Army STARRS was a 2009–2015 epidemiological-neurobiological study of risk-protective factors for suicidal behaviors among U.S. Army soldiers (Ursano et al., 2014). We used data from several Army STARRS surveys to create two independent samples for analysis: One in which our models were developed (Training Sample) and the other in which these models were tested (Validation Sample).

We used data from the Army STARRS Pre-Post Deployment Study (PPDS) for model development. The PPDS was a four-wave panel survey of three Brigade Combat Teams initially surveyed before deployment to Afghanistan (T0; October 2011–February 2012; $n = 8{,}558$), then shortly after returning from Afghanistan (T1; September 2012–February 2013), 1–2 months later (T2; October 2012–March 2013), and 9–15 months later (T3; June 2013–May 2014). Because PCL-5 only became available for PPDS T2-T3, these waves were our training sample ($n = 8{,}365$ in T2 and $n = 552$ in T3 but not T2).

The validation sample consisted of respondents to the Army STARRS Longitudinal Survey (LS), an ongoing follow-up study of Army STARRS survey respondents, who were not in PPDS T2-T3 ($n = 11{,}728$; including $n = 6{,}280$ ever-deployed and $n = 5{,}448$ never-deployed). The two Army STARRS surveys in this segment of STARRS-LS included (a) The New Soldier Study (NSS; January 2011–November 2012) of new soldiers interviewed within 48 hr of reporting for Basic Combat Training ($n = 39{,}132$); and (b) the All Army Study (January 2011–March 2013) of active duty soldiers not in basic training nor deployed to a combat theatre ($n = 24{,}894$).

The recruitment and consent procedures for all these surveys, which are discussed in more detail elsewhere (Heeringa et al., 2013; Kessler, Colpe et al., 2013), were approved by the Human Subjects Committees of all Army STARRS collaborating organizations.

2.2 | Measures

2.2.1 | PCL-5

The PCL-5 includes 20 questions to evaluate the presence and severity of the 20 DSM-5 Criteria B-E symptoms of PTSD over the past month (0 = not at all to 4 = extremely). Probable clinical diagnoses of DSM-5 PTSD were assigned based on PCL-5 responses using four PTSD diagnostic thresholds validated against DSM-IV PCL cutoffs in prior work (e.g., Hoge et al., 2014): One threshold based on DSM-5 scoring (i.e., at least one PCL-5 item for Criteria B and C and two for Criteria D and E endorsed at a score of 2 = moderately or higher) and three thresholds based on total PCL scores ≥28, ≥32, and ≥38. We aimed to create short-form PCL-5 scales that would reproduce each of these diagnoses derived from the full PCL-5 using responses to a subset of the 20 questions.

2.2.2 | Psychopathological correlates

We evaluated the convergent and discriminant validity of our short-form measure compared to the full PCL-5 by comparing their associations with known correlates that have been examined in prior psychometric work on the PCL-5 (Bovin et al., 2016) in the validation sample. The correlates considered were measures of DSM-IV major depressive episode, generalized anxiety disorder, panic disorder, and intermittent explosive disorder in the 30 days before the survey based on the self-administered version of the Composite International Diagnostic Interview Screening Scales (CIDI-SC; Kessler, Calabrese et al., 2013). Good concordance exists between CIDI-SC diagnoses and diagnoses based on blinded clinical reappraisal interviews with the Structured Clinical Interviews for DSM-IV (Kessler, Santiago et al., 2013). Suicide ideation in the 30 days before the LS1 survey was assessed with a modified version of the Columbia Suicidal Severity Rating Scale (Posner et al., 2011) that asked about lifetime history of active (i.e., "Did you ever in your life have thoughts of killing yourself?") and passive (i.e., "Did you ever wish you were dead or would go to sleep and never wake up?") ideation and recency in the 30 days before the survey to create a single dichotomous variable of presence/absence of recent suicide ideation.

2.2.3 | Sociodemographic correlates

We also compared associations of diagnoses based on our final short-form PCL-5 and full PCL-5 with several socio-demographic variables, including sex, low education (no education beyond high school graduation or GED), junior enlisted rank (E1-E4), and history of multiple combat deployments (2 vs. 0–1), all assessed with administrative records, and self-reported minority status (Non-Hispanic Black or Hispanic).

2.3 | Analysis methods

We created short-form PCL-5 scales using five statistical methods: Three methods that aimed to produce the same integer scoring system as the full PCL-5 (which can be scored without a computer or a calculator) and two methods that used weighted scoring.

The first integer-scored method used Risk-calibrated Supersparse Linear Integer Model (RiskSLIM; Ustun & Rudin, 2017), which is a machine learning algorithm to efficiently find the best-fitting logistic regression model that has small integer weights and obeys custom constraints. RiskSLIM optimized prediction of dichotomized PTSD diagnostic outcomes in the full PCL-5 (see Measures) from responses to between one and eight PCL-5 questions. Similar to prior work (Ustun & Rudin, 2017; Ustun et al., 2017), each model was required to obey constraints so that it would use a fixed number of questions (1–8) and produce a positive integer-valued score that was monotonic across response levels. One possible RiskSLIM integer scoring of the 0–4 PCL-5 response categories is 0,1,1,1,1. This is equivalent to dichotomous yes–no scoring, as in the Primary Care PTSD Screen for DSM-5 (PC-PTSD-5), a short screening scale often used in VA settings rather than a short-form PCL-5 (Prins et al., 2016).

In addition to RiskSLIM, we used two other statistical methods, each generating both integer-scored and weighted short-form scales. The first was forward stepwise logistic regression to select between one and eight items to predict the same dichotomous PTSD diagnostic outcomes as in RiskSLIM. We summed the 0–4 responses to the selected items to create integer-scored versions and created the weighted versions by multiplying the regression coefficients by the 0–4 responses, summing, and transforming the logit to create predicted probabilities of the diagnostic outcome. The second statistical method was to select between one and eight items based on strength of loadings in a unidimensional exploratory factor analysis of all PCL-5 questions. Integer-scored and weighted versions were created as in the stepwise scales by summing the 0–4 response scores (integer-scored) and estimating logistic regression equations to generate weighted versions with logit-transformed predicted probabilities.

We considered 160 short-form scales ($5 \times 8 \times 4$): Each scale was built using one of the five statistical methods, included between 1 and 8 PCL items, and was designed to predict each of the four dichotomous diagnostic outcomes defined by the full PCL-5. In particular, we considered the area under the receiver operating characteristic (ROC) curve (AUC), which reflects the probability that a randomly selected case on the dichotomous diagnostic outcome will have a higher short-form score than a randomly selected noncase.

We used inspection of the AUCs across models to narrow the range of short-form scales in the validation sample (Cortez & Mohri, 2004). We then evaluated the operating characteristics of each remaining scale using the following standard calibration and performance metrics:

1. Brier score: The mean-squared difference between predicted probabilities of case designations and observed designations based on the full PCL-5 to assess calibration,
2. Sensitivity (SN): The proportion of respondents defined as cases by the full PCL-5 that are classified correctly at being cases on the short-form scale,
3. Specificity (SP): The proportion of respondents defined as noncases by the full PCL-5 that are classified correctly as being noncases on the short-form scale),
4. Positive predictive value (PPV): The proportion of respondents at or above a given screening threshold on the short-form scale that are defined as cases by the full PCL-5,
5. Net benefit (NB): The number of true positives at or above the screening threshold minus the discounted number of false positives at or above the threshold, where the discount rate is defined as PPV/(1−PPV) at the threshold for each logically possible threshold on each scale.

Although seldom included in evaluations of screening scales, NB provides more intuitive and clinically useful information than SN, SP, and PPV in comparing scales because it accounts for between-clinician variation in the relative valuations of correctly detecting a true positive and correctly excluding a true negative (Van Calster et al., 2018). NB is typically evaluated through decision curves (Vickers & Elkin, 2006), which plot the minimum PPV the clinician would require to designate a patient as screening positive (*x*-axis), and the NB of the screening scale at that threshold (*y*-axis). Comparing decision curves for different screening scales shows the range of PPV over which each scale is optimal and the magnitude of this benefit.

The validation sample data were weighted when we calculated short-form scale operating characteristics to adjust for the over-sampling in LS1 of respondents who reported mental disorders or suicidality in their baseline survey.

3 | RESULTS

3.1 | Sociodemographic distribution of the samples

The unweighted sociodemographic distributions in the training sample and validation sample (including ever-deployed and never-deployed subsamples) were 6.3–24.3% female, 69.0–83.1% with no education beyond high school, 23.6–28.4% non-Hispanic Black or Hispanic, and 34.9–82.3% junior enlisted rank (Table 1). The much higher proportion of respondents with junior enlisted rank in the never-deployed validation sample (82.3%) than other samples (34.9–50.1%) reflects the high proportion of validation sample

TABLE 1 Unweighted sociodemographic and Army career characteristic distribution in the training and validation samples

	Training sample		Validation sample					
			Total		Ever deployed		Never deployed	
	%	(*SE*)	%	(*SE*)	%	(*SE*)	%	(*SE*)
Female	6.3	(0.3)	18.0	(0.4)	12.6	(0.4)	24.3	(0.6)
Low education (no college)	83.1	(0.4)	74.2	(0.4)	69.0	(0.6)	80.3	(0.5)
Minority status (non-Hispanic Black/Hispanic)	23.6	(0.4)	26.0	(0.4)	23.9	(0.5)	28.4	(0.6)
Junior enlisted rank (E1-E4)	50.1	(0.5)	56.9	(0.5)	34.9	(0.6)	82.3	(0.5)
History of multiple combat deployments	49.5	(0.5)	27.4	(0.4)	51.2	(0.6)	0.0	(0.0)
(n)	(8,917)		(11,728)		(6,280)		(5,448)	

Note: The training sample consisted of all T2 and T3 respondents to the Army STARRS Pre-Post Deployment Study. The validation sample consisted of all participants in the STARRS Longitudinal Study T1 survey who were not in the training sample. See the text for more detail on the samples.
Abbreviations: *SE*, standard error; STARRS, Study to Assess Risk and Resilience among Servicemembers.

respondents from the NSS, virtually none of whom (other than the few who were in another branch of service before their recent Army enlistment) previously deployed. Roughly half of the training and ever-deployed validation samples (49.5–51.2%) had a history of multiple combat deployments.

3.2 | Thirty-day prevalence estimates of DSM-5 PTSD based on the full PCL-5

Unweighted 30-day prevalence estimates of DSM-5 PTSD, determined by applying the aforementioned four diagnostic thresholds to the full PCL-5, were consistently highest in the ever-deployed validation sample (12.8–17.9%), lowest in the training sample (5.2–9.2%), and intermediate in the never-deployed validation sample (7.8–11.6%; Table 2). Prevalence estimates within sample were consistently highest using the liberal PCL-5 ≥28 scoring rule (9.2–17.9%), lowest using the conservative ≥38 scoring rule (5.2–12.8%), and intermediate using the ≥32 (7.0–15.9%) and DSM-5 Criteria B-E (6.2–15.6%) scoring rules.

3.3 | The PCL-5 items selected for the short-form scales

Given that integer-scored and weighted versions of the short-form scales have the same items, we considered a total of 96 (8 × 3 × 4) different short-form item sets: Each contained between one and eight items, created using one of three different statistical methods to select the subset of item (RiskSLIM, stepwise regression, factor analysis), and used to predict one of four different dichotomous PTSD outcomes.

Inspection of items in each set shows that those based on based on factor analysis were different from those based on RiskSLIM and stepwise regression (see Tables S1–S4). For example, the RiskSLIM and stepwise sets for the scales with six items (the minimum number required to determine PTSD diagnostic status based on DSM-5 diagnostic rules) included an average of two items from Criterion B (intrusive symptoms, compared to one required in DSM-5), one from Criterion C (avoidance, compared with at least one required in DSM-5), two from Criterion D (negative alterations in cognition and mood, compared with at least two required in DSM-5), and one from Criterion E (alterations in arousal and reactivity, compared with at least two required in DSM-5). In contrast, the factor analysis set included four symptoms from Criterion B, one symptom each from Criteria C and D, and none from Criterion E. These differences occurred because RiskSLIM and stepwise regression both select items to optimize explained variance in the outcomes, leading to selection of minimally redundant items, whereas factor analysis optimizes part-whole associations among the items, leading to selection of items with maximum redundancy.

The implications of these differences can be seen by inspecting AUCs in the training sample (Figure 1a–d). Four observations are noteworthy. First, short-form scales built using RiskSLIM and stepwise

TABLE 2 Thirty-day DSM-5 PTSD prevalence estimates based on responses to the full PCL-5 using four diagnostic thresholds in the unweighted training and validation samples

	DSM-5 Criteria B-E		PCL-5 ≥ 28+		PCL-5 ≥ 32+		PCL-5 ≥ 38+		
	%	(*SE*)	%	(*SE*)	%	(*SE*)	%	(*SE*)	
Training sample	6.2	(0.3)	9.2	(0.3)	7.0	(0.3)	5.2	(0.2)	(8,917)
Validation sample									
Total	13.1	(0.3)	15.0	(0.3)	13.2	(0.3)	10.5	(0.3)	(11,728)
Ever deployed	15.6	(0.5)	17.9	(0.5)	15.9	(0.5)	12.8	(0.4)	(6,280)
Never deployed	10.1	(0.4)	11.6	(0.4)	9.9	(0.4)	7.8	(0.4)	(5,448)

Abbreviations: PCL-5, DSM-5 version of the PCL; PTSD, posttraumatic stress disorder; SE, standard error.

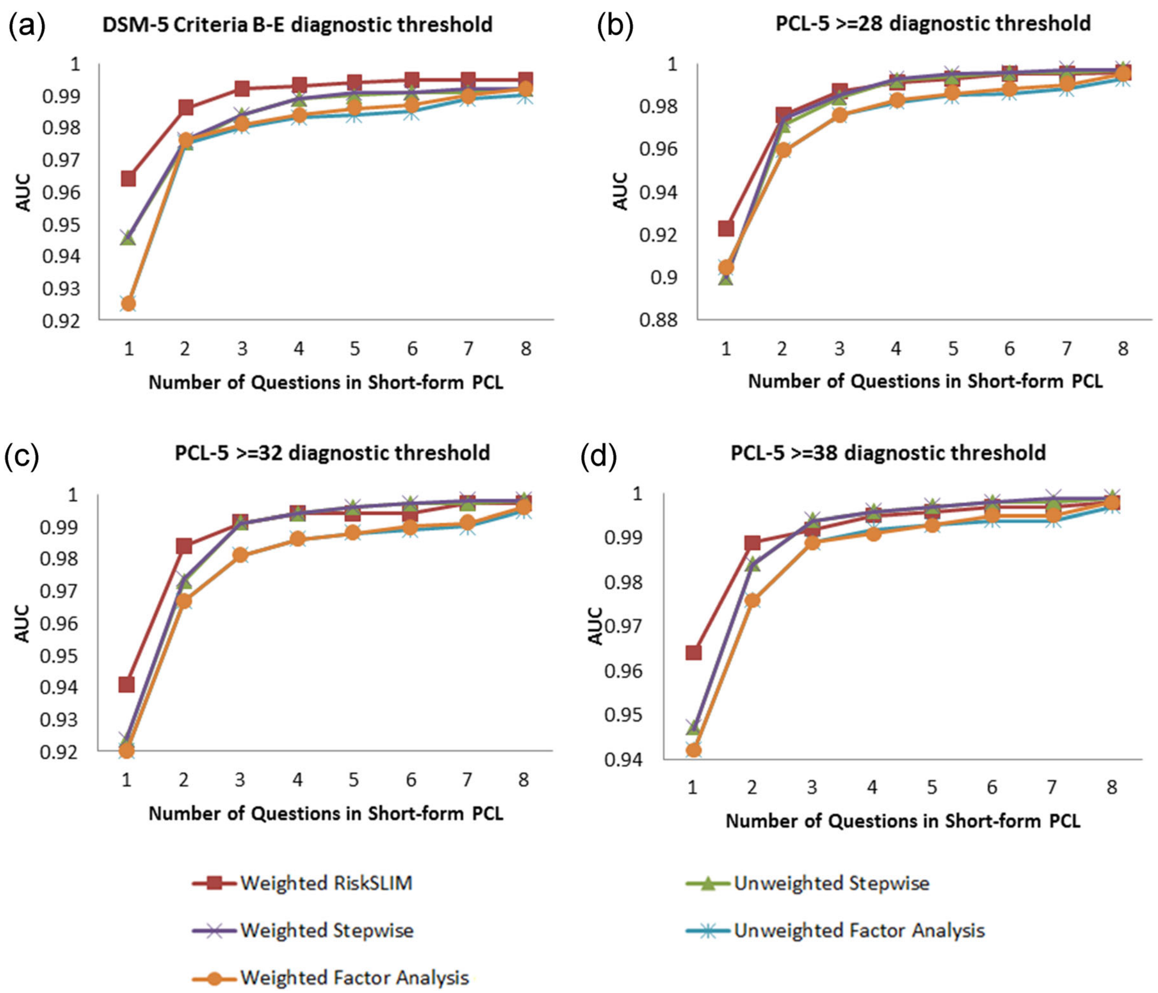

FIGURE 1 (a–d) AUCs of all short-form PCL-5 scales in the training sample (n = 8,917). Short-form PCL scales have between one and eight items and were created using three statistical methods (RiskSLIM, stepwise regression, and factor analysis), including both weighted and unweighted versions of stepwise and factor analysis. Each scale was used to predict dichotomous PTSD outcomes (shown in each panel, a–d), which were assigned based on full PCL-5 responses using four diagnostic thresholds (DSM-5 Criteria B-E, and total PCL-5 scores ≥28, ≥32, and ≥38). PCL-5, DSM-5 version of the PCL; PTSD, posttraumatic stress disorder; RiskSLIM, Risk-calibrated Supersparse Linear Integer Model

regression consistently outperformed those built via factor analysis. Second, although the AUCs continued to rise as number of questions increased, the marginal gain in performance of including a question became negligible after four questions, given that the AUC either approached or exceeded 0.99 for all scales predicting all diagnostic outcomes. Third, although we would expect scales built with weighted stepwise regression to outperform those built with unweighted stepwise regression (as the weights capture differences in relative importance of questions), the two methods yielded similar values of AUC (differences only in the third decimal place; see Table S5). Fourth, although we would expect performance of scales based on RiskSLIM to be better than performance of unweighted stepwise regression because the optimal integer scoring in RiskSLIM allows question-specific nonlinearities to be detected, these differences were small. The latter two observations tell us that optimal weights were similar across questions and that the original PCL linear scoring assumption was consistent with optimal scoring across response categories.

3.4 | Validation of short-form PCL-5 scales based on unweighted stepwise regression

3.4.1 | Narrowing the focus to four-item short-form scales

On the basis of the aforementioned results, we focused further analysis on the integer-scored short-form PCL-5 scales built with stepwise regression. We considered scales with between four and six items given that the incremental benefit of including more than six items was minimal. We expanded the analysis to consider 144 associations: Each of 12 integer-scored short-form scales (4- to 6-item scales selected to predict four different dichotomous PCL-5 diagnostic outcomes in the training sample) with the same outcomes in the validation sample and subsamples. AUCs of all 12 scales either approached or exceeded 0.99 predicting all outcomes in the validation sample and subsamples (see Table S6). We consequently focused subsequent analyses on the 4-item scales.

3.4.2 | Operating characteristics at clinically useful screening thresholds

Brier scores of all 4-item scales were consistently low in the total validation sample (0.019–0.028) and subsamples (0.015–0.032), indicating good calibration of all scales (see Table S7). Inspection of ROC curves was of little help in distinguishing among the different 4-item scales, as none was consistently higher than the others (see Supplemental Figures S1a-d, S2a-2d, S3a-3d) and all had excellent performance. For example, when SP was fixed at 0.9, SN was consistently greater than 0.9 in predicting each outcome.

Stronger discrimination between 4-item scales was found when examining NB. We focused on PPV in the range 0.25–0.75, although we examined the full range of PPV, based on the assumptions that: (a) Clinicians would not want to carry out further evaluations with more than three false positives for every one true positive (PPV = 0.25), noting that the vast majority of true positives would be screened in across scales and samples at that level of PPV (SN = 0.92–0.98) and (b) clinicians would not want to require more than three true positives for every one false positive (PPV = 0.75), noting that such a stringent rule would miss 20–30% of true cases across scales and samples. The decision curves in the total sample (Figures 2a–d) showed that the 4-item short-form scale designed to optimize prediction of the most liberal outcome (i.e., PCL-5 ≥ 28) had marginally higher NB than the other 4-item scales when PPV was in the specified range for three of the four diagnostic outcomes and equivalent to the other 4-item scales for the other outcome (the DSM-5 Criteria B-E outcome). This pattern was more pronounced in the never-deployed subsample (Figure S4a–d), whereas all 4-item short-form scales had equivalent NB in the 0.25–0.75 PPV range in the ever-deployed subsample (Figure S5a–d). On the basis of these results, we selected the 4-item short-form scale designed to optimize prediction of the most liberal outcome (i.e., PCL-5 ≥28) as our recommended scale (Appendix Table 1). We note that even outside this PPV range (<0.25 and >0.75), this pattern of results remains the same.

3.4.3 | Characteristics of the optimal short-form scale

The optimal 4-item short-form PCL-5 scale includes one item assessing each DSM-5 Criteria B-E: B3 (suddenly feeling or acting as if the stressful experience were actually happening again), C2 (avoidance of external reminders of the stressful experience), D6 (distant or cutoff from other people), and E1 (irritable or aggressive behavior). We do not recommend a single diagnostic threshold for this 0–16 integer-scored scale, as the appropriate threshold will depend on whether the user wants to use a conservative (PCL-5 ≥ 38), liberal (PCL-5 ≥ 28), or intermediate (PCL-5 ≥ 32 or DSM-5 Criteria B-E) definition of PTSD as well as the relative value to the user of correctly detecting true positives versus correctly excluding true negatives. However, full information in online supplemental materials (Tables S8–S10) allows users to select the appropriate threshold based on these considerations.

3.4.4 | Comparing correlates of diagnoses based on full PCL-5 and short-form scales

We compared sociodemographic and psychopathological correlates of PTSD diagnoses based on our recommended 4-item short-form PCL-5 scale with those of diagnoses based on the full PCL-5 in the validation sample (Table 3). Thresholds in the short-form scale were selected to make prevalence estimates equivalent to those using the full PCL-5. Odds ratios of correlates with the two diagnoses were very similar for all correlates across all diagnostic scoring systems.

4 | DISCUSSION

In this study, we sought to develop a short-form of the PCL with two goals in mind: (a) Building a clinically useful brief PTSD screener to reduce respondent burden and (b) improving upon statistical methods used to create such a screener, given existing short-form PCLs were created using heuristic methods. To do so, we investigated empirically which PCL-5 items should be used in an optimal short-form version of the scale. Comparing several statistical methods, we found that regression-based short-form PCL-5 scales outperform factor analysis-based short-form scales but that the advantages of weighting (either unrestricted with logistic regression or restricted integer-score weighting with RiskSLIM) are minimal. The latter result indicates that the optimal logistic regression weights are very similar across PCL-5 questions and that the 0–4 scoring assumption is consistent with optimal scoring. One implication of the latter finding is that 0–4 scoring is superior to the 0–1 scoring used in the PC-PTSD-5. We also found that performance does not improve meaningfully with the addition of more than four items, leading us to recommend a 4-item short-form scale. This short-form PCL generates diagnoses that closely parallel those of the full PCL-5 and demonstrates similar psychometric properties (e.g., convergent and discriminant validity), making it well-suited for screening.

It is important to note that this study is not an attempt to ascertain which symptoms do or do not belong in the PTSD diagnostic criteria. Our results should not be interpreted as speaking to this question. Given the very strong associations among DSM-5 Criteria B-E symptoms of PTSD and the strong psychometric properties of the PCL-5, numerous 4-item short-form PCL-5 scales could be created that have operating characteristics close to those of our recommended short-form scale. The four items in our recommended scale are somewhat better than these others, though, in being the minimally redundant set of the 20 PCL-5 items distinguishing cases from noncases according to previously identified PCL-5 PTSD diagnostic thresholds (Hoge et al., 2014). This differs from the content-driven item selection methods used in other PTSD screeners (e.g., the PC-PTSD-5; Prins et al., 2016). As in any stepwise regression scheme, the optimal items included on our short-form should be interpreted broadly as capturing the variance due to all scale items with which they are correlated rather than representing unique effects of specific symptoms. Like other PTSD screeners (i.e., PC-PTSD-5 and the 4-item PCL-5 developed by Price et al., 2016), however, our final short-form includes items assessing for at least one symptom from each DSM-5 PTSD criterion, though the individual items are mostly

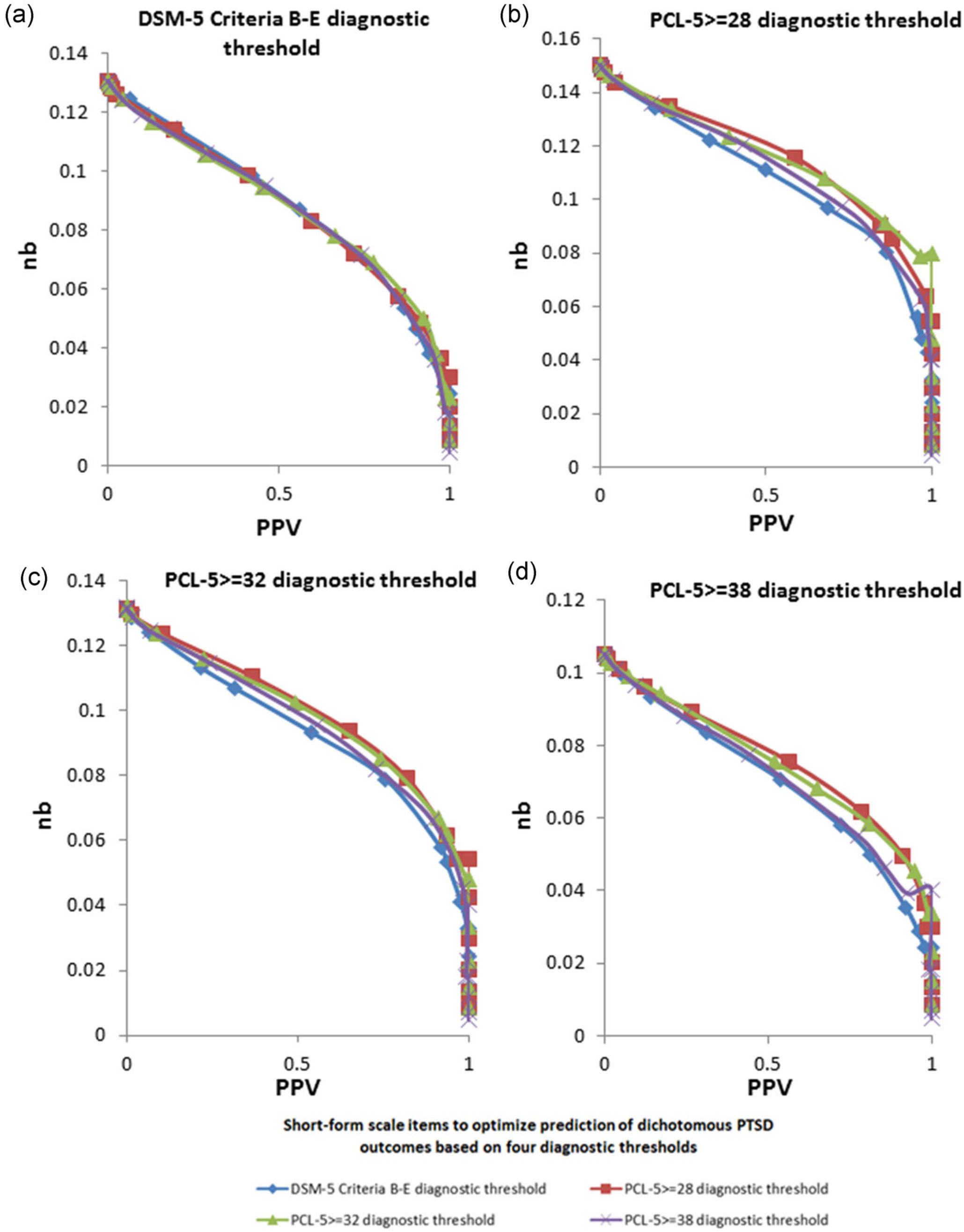

FIGURE 2 (a–d) Decision curves for all unweighted stepwise 4-item short-form scales predicting PTSD outcomes in the total validation sample (n = 11,728). The items included on each 4-item scale were optimized in the training sample to predict dichotomous PTSD outcomes assigned based on full PCL-5 responses using four diagnostic thresholds (DSM-5 Criteria B-E, and total PCL-5 scores ≥28, ≥32, and ≥38). We then used each of these 4-item unweighted stepwise short-form scales to predict these same dichotomous PTSD outcomes in the validation sample, as shown in each panel of the figure (a–d). PCL-5, DSM-5 version of the PCL; PTSD, posttraumatic stress disorder

different (e.g., only one overlapping item between our 4-item short-form and Price et al.'s).

Screening scales should not be used to render clinical diagnoses (McDonald & Calhoun, 2010) but rather to focus attention on individuals most likely to warrant clinical evaluation. As shown in the supplemental materials, our recommended 4-item short-form scale would be well-suited to screen for PTSD in contexts where administration of the full PCL is not possible. At a threshold of 5+, for example, the scale would detect virtually all cases defined by the full PCL-5 as meeting DSM-5 criteria (SN = 0.976) while screening in only a small proportion of PCL-5 noncases (1−SP = 0.066). At a threshold of 6+, the scale would detect an even higher proportion of cases using the conservative PCL-5 ≥ 38 threshold (SN = 0.982) with an even lower false positive rate (1−SP = 0.059).

Our findings should be interpreted in the context of several limitations. First, although our samples were large, they consisted

TABLE 3 Bivariate associations of socio-demographics, Army career variables, and 30-day psychopathology with DSM-5 PTSD based on the final 4-item short-form PCL-5 scale[a] and the full PCL-5, assigned using four diagnostic thresholds in the unweighted validation sample (n = 11,728)[b]

	PTSD diagnostic threshold															
	DSM-5 Criteria B-E				PCL-5 ≥ 28				PCL-5 ≥ 32				PCL-5 ≥ 38			
	Short-form		Full PCL-5		Short-form		Full PCL-5		Short-form		Full PCL-5		Short-form		Full PCL-5	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
I. Sociodemographics and Army Career																
Female	1.5[c]	(1.4–1.8)	1.5[c]	(1.3–1.7)	1.5[c]	(1.3–1.7)	1.5[c]	(1.3–1.7)	1.5[c]	(1.3–1.7)	1.5[c]	(1.3–1.7)	1.5[c]	(1.3–1.7)	1.5[c]	(1.3–1.8)
Low education	1.7[c]	(1.5–1.9)	1.8[c]	(1.5–2.0)	1.7[c]	(1.5–1.9)	1.6[c]	(1.5–1.9)	1.7[c]	(1.5–1.9)	1.7[c]	(1.5–2.0)	1.6[c]	(1.4–1.8)	1.6[c]	(1.4–1.9)
Low family income	1.5[c]	(1.3–1.7)	1.4[c]	(1.2–1.5)	1.4[c]	(1.3–1.6)	1.3[c]	(1.2–1.5)	1.4[c]	(1.3–1.6)	1.4[c]	(1.2–1.5)	1.5[c]	(1.4–1.7)	1.5[c]	(1.3–1.7)
Minority status	1.3[c]	(1.2–1.5)	1.2[c]	(1.1–1.4)	1.3[c]	(1.1–1.4)	1.2[c]	(1.1–1.3)	1.3[c]	(1.1–1.4)	1.3[c]	(1.1–1.4)	1.3[c]	(1.2–1.5)	1.3[c]	(1.1–1.5)
Junior enlisted rank (E1-E4)	1.2[c]	(1.1–1.3)	1.2[c]	(1.1–1.4)	1.2[c]	(1.0–1.3)	1.2	(1.0–1.3)	1.2	(1.0–1.3)	1.1[c]	(1.0–1.2)	1.2[c]	(1.0–1.3)	1.1	(1.0–1.2)
History of multiple combat deployments	1.3[c]	(1.2–1.5)	1.4[c]	(1.2–1.6)	1.4[c]	(1.3–1.6)	1.4[c]	(1.3–1.6)	1.4[c]	(1.3–1.6)	1.5[c]	(1.3–1.6)	1.4[c]	(1.3–1.6)	1.5[c]	(1.4–1.7)
II. Psychopathology																
Major depressive episode	39.4[c]	(34.3–45.3)	35.3[c]	(30.8–40.5)	35.5[c]	(31.0–40.6)	42.5[c]	(37.0–48.8)	35.5[c]	(31.0–40.6)	42.1[c]	(36.6–48.4)	44.3[c]	(38.2–41.4)	46.4[c]	(39.8–53.9)
Generalized anxiety disorder	41.9[c]	(36.3–48.3)	39.1[c]	(34.0–45.0)	39.7[c]	(34.5–45.7)	45.7[c]	(39.6–52.8)	39.7[c]	(34.5–45.7)	47.7[c]	(41.3–55.2)	48.3[c]	(41.5–56.1)	56.5[c]	(48.4–66.0)
Panic disorder	14.5[c]	(11.7–17.8)	16.1[c]	(13.0–20.0)	16.3[c]	(13.1–20.4)	18.8[c]	(15.0–23.6)	16.3[c]	(13.1–20.4)	18.8[c]	(15.1–23.4)	13.5[c]	(11.0–16.5)	15.3[c]	(12.4–18.8)
Intermittent explosive disorder	10.4[c]	(9.1–11.8)	9.4[c]	(8.3–10.7)	10.5[c]	(9.2–11.8)	10.2[c]	(9.0–11.6)	10.5[c]	(9.2–11.9)	10.1[c]	(8.9–11.5)	11.1[c]	(9.8–12.7)	10.7[c]	(9.3–12.2)
Suicide ideation	9.9[c]	(8.4–11.5)	8.6[c]	(7.4–10.0)	9.8[c]	(8.4–11.4)	10.7[c]	(9.2–12.5)	9.8[c]	(8.4–11.4)	10.9[c]	(9.3–12.7)	10.2[c]	(8.7–11.9)	10.2[c]	(8.7–11.9)

Abbreviations: CI, confidence interval; OR, odds ratio; PCL-5, DSM-5 version of the PCL; PTSD, posttraumatic stress disorder.

[a]The final 4-item short-form PCL scale was optimized to predict PCL ≥ 28. See text for more detail.

[b]PTSD diagnoses using the short-form scale were dichotomized at the threshold with the lowest McNemar test (i.e., with a prevalence estimate closest to the prevalence estimate in the full PCL-5) for each of the four PTSD outcomes.

[c]Significant at the 0.05 level, two-sided test.

entirely of U.S. Army soldiers and recently-separated Veterans. It would be useful to evaluate our recommended short-form scale in other populations, including civilian populations, given that past research has highlighted population-specific variation in PCL operating characteristics (Wilkins, Lang, & Norman, 2011). Such differences may be due to exposure to different traumatic event types between populations (e.g., experience of military-specific traumatic events such as combat) or time since event exposure. These factors may affect likelihood of experiencing a given PTSD symptom, which may necessitate development of additional short-form PCL-5 scales that are population-specific. Second, we did not evaluate the test-retest reliability of our recommended scale. This would be useful given the use of short-form scales for symptom tracking as part of measurement-based care (Fortney et al., 2017). Third, we did not have access to clinical interviews to validate PTSD diagnoses, instead using probable diagnoses based on the full PCL-5 as the outcomes. Although diagnoses based on the PCL have been shown to correlate highly with diagnoses based on blinded clinical interviews, including the “gold standard” Clinician-Administered PTSD Scale (Keen, Kutter, Niles, & Krinsley, 2008), additional testing of our short-form scale in predicting interview-based PTSD diagnoses would be useful.

5 | CONCLUSIONS

With the increased emphasis on screening for common mental disorders, the development and use of psychometrically sound and efficient screening tools is critical. To this end, we derived short-form PCL-5 scales using several statistical methods and found that the optimal one is a 4-item scale created using stepwise regression. Instead of a single diagnostic threshold, we offer clinicians the opportunity to select cutoffs on this short-form scale based on clinical setting and judgment using the detailed information provided in our Supplemental Materials. Given its brevity and excellent operating characteristics, this short-form PCL-5 could have great utility for case-finding in a variety of settings, particularly where screening time is a concern.

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CONFLICT OF INTERESTS

In the past 3 years, Dr. Kessler received support for his epidemiological studies from Sanofi Aventis; was a consultant for Johnson & Johnson Wellness and Prevention, Sage Pharmaceuticals, Shire, Takeda; and served on an advisory board for the Johnson & Johnson Services Inc. Lake Nona Life Project. Kessler is a co-owner of DataStat, Inc., a market research firm that carries out healthcare research. Dr. Stein has been a consultant for the past 3 years for Actelion, Alkermes, Aptinyx, Bionomics, Dart Neuroscience, Healthcare Management Technologies, Janssen, Neurocrine Biosciences, Oxeia Biopharmaceuticals, Pfizer, and Resilience Therapeutics. Dr. Stein has stock options in Oxeia Biopharmaceticals. The remaining authors declare that there are no conflict of interests.

DATA ACCESSIBILITY

The Army STARRS datasets, including the NSS, generated and analyzed during the current study are available in the Interuniversity Consortium for Political and Social research (ICPSR) repository at the University of Michigan, https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/35197.

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REFERENCES

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Publishing.

Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5): Development and initial psychometric evaluation. *Journal of Traumatic Stress*, *28*, 489–498. https://doi.org/10.1002/jts.22059

Bliese, P. D., Wright, K. M., Adler, A. B., Cabrera, O., Castro, C. A., & Hoge, C. W. (2008). Validating the primary care posttraumatic stress disorder screen and the posttraumatic stress disorder checklist with soldiers returning from combat. *Journal of Consulting and Clinical Psychology*, *76*, 272–281. https://doi.org/10.1037/0022-006x.76.2.272

Bovin, M. J., Marx, B. P., Weathers, F. W., Gallagher, M. W., Rodriguez, P., Schnurr, P. P., & Keane, T. M. (2016). Psychometric properties of the PTSD Checklist for Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (PCL-5) in veterans. *Psychological Assessment*, *28*, 1379–1391. https://doi.org/10.1037/pas0000254

Bressler, R., Erford, B. T., & Dean, S. (2018). A systematic review of the Posttraumatic Stress Disorder Checklist (PCL). *Journal of Counseling & Development*, *96*, 167–186. https://doi.org/10.1002/jcad.12190

Van Calster, B., Wynants, L., Verbeek, J. F. M., Verbakel, J. Y., Christodoulou, E., Vickers, A. J., … Steyerberg, E. W. (2018). Reporting and interpreting decision curve analysis: A guide for investigators. *European Urology*, *74*, 796–804. https://doi.org/10.1016/j.eururo.2018.08.038

Cortez, C., & Mohri, M. (2004). AUC optimization vs. error rate minimization. In L. K. Saul, Y. Weiss, & L. Bottou (Eds.), *Advances in neural information processing systems 17: Proceedings of the 2004 Conference*. Cambridge, MA: MIT Press.

Department of Veterans Affairs. (2017). VA/DoD clinical practice guideline for the management of posttraumatic stress disorder and acute stress disorder. (Version 3). Retrieved from https://www.healthquality.va.gov/guidelines/MH/ptsd/

Elhai, J. D., Gray, M. J., Kashdan, T. B., & Franklin, C. L. (2005). Which instruments are most commonly used to assess traumatic event exposure and posttraumatic effects?: A survey of traumatic stress professionals. *Journal of Traumatic Stress*, *18*, 541–545. https://doi.org/10.1002/jts.20062

Finkelman, M. D., Lowe, S. R., Kim, W., Gruebner, O., Smits, N., & Galea, S. (2017). Customized computer-based administration of the PCL-5 for the efficient assessment of PTSD: A proof-of-principle study. *Psychological Trauma*, *9*, 379–389. https://doi.org/10.1037/tra0000226

Finkelman, M. D., Lowe, S. R., Kim, W., Gruebner, O., Smits, N., & Galea, S. (2018). Item ordering and computerized classification tests with cluster-based scoring: An investigation of the countdown method. *Psychological Assessment*, *30*, 204–219. https://doi.org/10.1037/pas0000470

Fortney, J. C., Unutzer, J., Wrenn, G., Pyne, J. M., Smith, G. R., Schoenbaum, M., & Harbin, H. T. (2017). A tipping point for measurement-based care. *Psychiatric Services*, *68*, 179–188. https://doi.org/10.1176/appi.ps.201500439

Gates, M. A., Holowka, D. W., Vasterling, J. J., Keane, T. M., Marx, B. P., & Rosen, R. C. (2012). Posttraumatic stress disorder in veterans and military personnel: Epidemiology, screening, and case recognition. *Psychological Services*, *9*, 361–382. https://doi.org/10.1037/a0027649

Heeringa, S. G., Gebler, N., Colpe, L. J., Fullerton, C. S., Hwang, I., Kessler, R. C., … Ursano, R. J. (2013). Field procedures in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *International Journal of Methods in Psychiatric Research*, *22*, 276–287. https://doi.org/10.1002/mpr.1400

Hirschel, M. J., & Schulenberg, S. E. (2010). On the viability of PTSD Checklist (PCL) short form use: Analyses from Mississippi Gulf Coast Hurricane Katrina survivors. *Psychological Assessment*, *22*, 460–464. https://doi.org/10.1037/a0018336

Hoge, C. W., Riviere, L. A., Wilk, J. E., Herrell, R. K., & Weathers, F. W. (2014). The prevalence of post-traumatic stress disorder (PTSD) in US combat soldiers: A head-to-head comparison of DSM-5 versus DSM-IV-TR symptom criteria with the PTSD Checklist. *The Lancet Psychiatry*, *1*, 269–277. https://doi.org/10.1016/s2215-0366(14)70235-4

Keane, T. M., Rubin, A., Lachowicz, M., Brief, D. J., Enggasser, J. L., Roy, M., … Rosenbloom, D. (2014). Temporal stability of DSM-5 posttraumatic stress disorder criteria in a problem-drinking sample. *Psychological Assessment*, *26*, 1138–1145. https://doi.org/10.1037/a0037133

Keen, S. M., Kutter, C. J., Niles, B. L., & Krinsley, K. E. (2008). Psychometric properties of PTSD Checklist in sample of male veterans. *Journal of Rehabilitation Research & Development*, *45*, 465–474. https://doi.org/10.1682/jrrd.2007.09.0138

Kessler, R. C., Calabrese, J. R., Farley, P. A., Gruber, M. J., Jewell, M. A., Katon, W., … Wittchen, H. U. (2013). Composite International Diagnostic Interview Screening Scales for DSM-IV anxiety and mood disorders. *Psychological Medicine*, *43*, 1625–1637. https://doi.org/10.1017/s0033291712002334

Kessler, R. C., Colpe, L. J., Fullerton, C. S., Gebler, N., Naifeh, J. A., Nock, M. K., … Heeringa, S. G. (2013). Design of the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *International Journal of Methods in Psychiatric Research*, *22*, 267–275. https://doi.org/10.1002/mpr.1401

Kessler, R. C., Santiago, P. N., Colpe, L. J., Dempsey, C. L., First, M. B., Heeringa, S. G., … Ursano, R. J. (2013). Clinical reappraisal of the Composite International Diagnostic Interview Screening Scales (CIDI-SC) in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *International Journal of Methods in Psychiatric Research*, *22*, 303–321. https://doi.org/10.1002/mpr.1398

Koenen, K. C., Ratanatharathorn, A., Ng, L., McLaughlin, K. A., Bromet, E. J., Stein, D. J., … Kessler, R. C. (2017). Posttraumatic stress disorder in the World Mental Health surveys. *Psychological Medicine*, *47*, 2260–2274. https://doi.org/10.1017/s0033291717000708

Lang, A. J., & Stein, M. B. (2005). An abbreviated PTSD Checklist for use as a screening instrument in primary care. *Behaviour Research and Therapy*, *43*, 585–594. https://doi.org/10.1016/j.brat.2004.04.005

McDonald, S. D., & Calhoun, P. S. (2010). The diagnostic accuracy of the PTSD Checklist: A critical review. *Clinical Psychology Review*, *30*, 976–987. https://doi.org/10.1016/j.cpr.2010.06.012

National Center for PTSD. Using the PTSD Checklist for DSM-5 (PCL-5). Retrieved from https://www.ptsd.va.gov/professional/assessment/documents/using-PCL5.pdf

Parker-Guilbert, K., Moshier, S. J., Marx, B. P., & Keane, T. M. (2018). Measures of PTSD symptom severity. In C. R. Nemeroff, & C. B. Marmar (Eds.), *Post-traumatic stress disorder*. New York, NY: Oxford University Press.

Posner, K., Brown, G. K., Stanley, B., Brent, D. A., Yershova, K. V., Oquendo, M. A., & Mann, J. J. (2011). The Columbia-Suicide Severity Rating Scale: Initial validity and internal consistency findings from three multisite studies with adolescents and adults. *American Journal of Psychiatry*, *168*, 1266–1277. https://doi.org/10.1176/appi.ajp.2011.10111704

Price, M., Szafranski, D. D., van Stolk-Cooke, K., & Gros, D. F. (2016). Investigation of abbreviated 4 and 8 item versions of the PTSD

Checklist 5. *Psychiatry Research*, *239*, 124–130. https://doi.org/10.1016/j.psychres.2016.03.014

Prins, A., Bovin, M. J., Smolenski, D. J., Marx, B. P., Kimerling, R., Jenkins-Guarnieri, M. A., … Tiet, Q. Q. (2016). The primary care PTSD screen for DSM-5 (PC-PTSD-5): Development and evaluation within a veteran primary care sample. *Journal of General Internal Medicine*, *31*, 1206–1211. https://doi.org/10.1007/s11606-016-3703-5

Steele, N. M., Benassi, H. P., Chesney, C. J., Nicholson, C., & Fogarty, G. J. (2014). Evaluating the merits of using brief measures of PTSD or general mental health measures in two-stage PTSD screening. *Military Medicine*, *179*, 1497–1502. https://doi.org/10.7205/milmed-d-14-00183

Thornicroft, G., Evans-Lacko, S., Koenen, K. C., Kovess-Masfety, V., Williams, D. R., & Kessler, R. C. (2018). Patterns of treatment and barriers to care in posttraumatic stress disorder. In E. J. Bromet, E. G. Karam, K. C. Koenen, & D. J. Stein (Eds.), *Trauma and posttraumatic stress disorder: Global perspectives from the WHO World Mental Health surveys* (pp. 137–152). New York: Cambridge University Press.

Tiet, Q. Q., Schutte, K. K., & Leyva, Y. E. (2013). Diagnostic accuracy of brief PTSD screening instruments in military veterans. *Journal of Substance Abuse Treatment*, *45*, 134–142. https://doi.org/10.1016/j.jsat.2013.01.010

U.S. Department of Veterans Affairs. VA/DoD Clinical Practice Guidelines. Retrieved from https://www.healthquality.va.gov/

Ursano, R. J., Colpe, L. J., Heeringa, S. G., Kessler, R. C., Schoenbaum, M., & Stein, M. B. (2014). The Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Psychiatry*, *77*, 107–119. https://doi.org/10.1521/psyc.2014.77.2.107

Ustun, B., Adler, L. A., Rudin, C., Faraone, S. V., Spencer, T. J., Berglund, P., … Kessler, R. C. (2017). The World Health Organization adult attention-deficit/hyperactivity disorder self-report screening scale for DSM-5. *JAMA Psychiatry*, *74*, 520–526. https://doi.org/10.1001/jamapsychiatry.2017.0298

Ustun, B., & Rudin, C. (2017). Learning optimized risk scores on large-scale datasets. *axrix.org*, axriv: 1610.00168. Retreived from http://arxiv.org/abs/1610.00168

Vickers, A. J., & Elkin, E. B. (2006). Decision curve analysis: A novel method for evaluating prediction models. *Medical Decision Making*, *26*, 565–574. https://doi.org/10.1177/0272989x06295361

Warner, C. H., Warner, C. M., Appenzeller, G. N., & Hoge, C. W. (2013). Identifying and managing posttraumatic stress disorder. *American Family Physician*, *88*, 827–834.

Weathers, F., Litz, B., Herman, D., Huska, J. A., & Keane, T. (1993). *The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility*. Paper presented at the Annual Convention of the International Society for Traumatic Stress Studies, San Antonio, TX.

Weathers, F. W., Litz, B. T., Keane, T. M., Palmieri, P. A., Marx, B. P., & Schnurr, P. P. (2013). The PTSD Checklist for DSM-5 (PCL-5). Retrieved from https://www.ptsd.va.gov/professional/assessment/adult-sr/ptsd-checklist.asp

Wilkins, K. C., Lang, A. J., & Norman, S. B. (2011). Synthesis of the psychometric properties of the PTSD Checklist (PCL) military, civilian, and specific versions. *Depression and Anxiety*, *28*, 596–606. https://doi.org/10.1002/da.20837.

Wisco, B. E., Marx, B. P., & Keane, T. M. (2012). Screening, diagnosis, and treatment of post-traumatic stress disorder. *Military Medicine*, *177*, 7–13.

Wortmann, J. H., Jordan, A. H., Weathers, F. W., Resick, P. A., Dondanville, K. A., Hall-Clark, B., … Litz, B. T. (2016). Psychometric analysis of the PTSD Checklist-5 (PCL-5) among treatment-seeking military service members. *Psychological Assessment*, *28*, 1392–1403. https://doi.org/10.1037/pas0000260

Zhang, Y., & Yang, Y. (2015). Cross-validation for selecting a model selection procedure. *Journal of Econometrics*, *187*, 95–112. https://doi.org/10.1016/j.jeconom.2015.02.006

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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APPENDIX: SHORT-FORM PCL-5[1]

Instructions: Below is a list of problems that people sometimes have in response to a very stressful experience. Please read each problem carefully and then circle one of the numbers to the right to indicate how much you have been bothered by that problem in the past month.

In the past month, how much were you bothered by:

	Not at all	A little bit	Moderately	Quite a bit	Extremely
1. Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)?	0	1	2	3	4
2. Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)?	0	1	2	3	4
3. Feeling distant or cut off from other people?	0	1	2	3	4
4. Irritable behavior, angry outbursts, or acting aggressively?	0	1	2	3	4

[1]The final short-form PCL-5 scale was created using unweighted stepwise regression optimized to predict PTSD diagnoses using the PCL-5 ≥ 28 threshold

Suicidal Ideation and Ability to Serve

Thomas E. Joiner, Ph.D. & Peter M. Gutierrez, Ph.D.

19 July 2019

This white paper was written by the Military Suicide Research Consortium (MSRC), an effort supported by the Office of the Assistant Secretary of Defense for Health Affairs under Award No. W81XWH-16-2-0003 & W81XWH-16-2-0004. Opinions, interpretations, conclusions and recommendations are those of the authors and are not necessarily endorsed by the Department of Defense.

Statement of the Problem

Suicidal ideation and suicide attempts are relatively prevalent among military personnel (Nock et al., 2014). Given this, there is some concern that soldiers experiencing suicidal ideation, in treatment for suicidal ideation, or recovering from an acute suicidal crisis, may be unable to serve. Addressing this concern is the purpose of this white paper.

Summary of the Relevant Literature

First, some may be concerned that if an individual is experiencing suicidal ideation, s/he is at acute risk for engaging in suicidal behavior. However, suicidal ideation is defined by a broad range of thoughts, ranging from passive thoughts of wishing for death, or passive ideation, and thoughts about taking one's life, otherwise known as active suicidal ideation (Silverman, Berman, Sanddal, O'Carroll, & Joiner, 2007). Given this, suicidal ideation alone does not necessarily indicate that an individual is at acute risk for attempting suicide. Indeed, research suggests that while about 14% of soldiers experience suicidal ideation, only about 2% attempt suicide in their lifetime (Nock et al., 2014). Even among treatment-seeking soldiers, who may constitute a group experiencing more severe suicidal ideation, most will not engage in suicidal behavior. For example, in a study of military service-members who sought treatment for suicide risk concerns, only about 6.5% reported making a suicide attempt within three months of initial assessment (Gutierrez et al., under review).

While there is still work to be done regarding the percentage of soldiers engaging in suicidal behavior, these statistics indicate that even though suicidal ideation is of concern and should be treated using practices that are supported by the empirical literature (Jobes & Joiner, 2019), the vast majority of those who experience suicidal ideation will not attempt suicide in their lifetime. Therefore, those experiencing suicidal ideation are not necessarily at high risk. Rather, suicide risk should be assessed and stratified based on current suicidal ideation and other important factors, including, but not limited to, current suicide intent, history of suicidal behavior, social withdrawal, presence of insomnia, and agitation (Chu et al., 2015; Joiner, Walker, Rudd, & Jobes, 1999). It should be noted that based on the years of clinical experience of the authors, those experiencing suicidal ideation are often determined to be at relatively low risk for dying by suicide.

Furthermore, evidence suggests that suicidal ideation remits, and suicidal behavior is amenable to various psychotherapeutic and pharmacological treatments. In a study examining the longitudinal course of suicidal ideation and behaviors over ten years, researchers found that only

35% of individuals reporting lifetime suicidal ideation at baseline continued to report suicidal ideation occurring during the follow-up period (Borges, Angst, Nock, Ruscio, & Kessler, 2008). Gunnell and colleagues (2004) also found that over half of individuals reporting suicidal ideation at baseline recovered at an 18-month follow-up, supporting the finding that many individuals recover from suicidal thoughts. Several treatments have also been shown to be effective when treating the occurrence of suicidal ideation and behavior. A number of psychotherapeutic approaches may be useful for decreasing the frequency of suicide attempts among adults, including cognitive-behavioral therapy, dialectical behavior therapy, and interpersonal psychotherapy (Calati & Courtet, 2016). Additionally, the Collaborative Assessment and Management of Suicidality may reduce suicidal ideation within military populations (Jobes, Lento, & Brazaitis, 2012). Several pharmacological treatments have also been shown to be effective at reducing suicidal ideation as well, including lithium and clozapine (Hennen & Baldessarini, 2005; Smith & Cipriani, 2017). In sum, there are a multitude of approaches which may be useful for the treatment of suicidal ideation, indicating that suicidal ideation is not necessarily a chronic condition.

There is also some concern that if an individual is experiencing suicidal thoughts, that the individual is unable to work. However, to our knowledge, there is no research to date that indicates that participating in treatment for suicidal thoughts or other mental health disorders may lead an individual to be unable to work. Even after a period of acute stress, such as a suicidal crisis, many individuals are able to return to their workplace. In fact, research suggests that not returning to work in the form of unemployment is associated with an increased risk of attempting suicide (Gunnell et al., 2004; Milner, Page, & LaMontagne, 2013). Not only is an individual typically able to work while recovering from a period of acute stress, the opportunity to continue working may a critical factor in the recovery process. One of the main factors theorized to lead to a suicide attempt is disconnection from others (Chu et al., 2017; Joiner, 2005; Klonsky & May, 2015; Van Orden et al., 2010), with prior research supporting the importance of connection among military personnel (Anestis, Bryan, Cornette, & Joiner, 2008). Returning to work provides an opportunity to re-connect with others, an important factor in recovery from a period of acute stress, and particularly following a suicide attempt (Joiner & Silva, 2012). Indeed, an increase in social connectedness following hospitalization due to acute suicide risk significantly decreased the chances of engaging in a suicide attempt within a 12-month follow-up period (Czyz, Liu, & King, 2012). Additional research among firefighters underscores the importance of enhanced social connectedness as well, especially in the context of occupational stressors. Carpenter and colleagues (2015) found only firefighters with low levels of social support demonstrated a significant association between levels of occupational stress and suicidal ideation.

In a qualitative investigation of the importance of employment during recovery from a mental illness, Dunn and colleagues (2008) identified several important benefits to work, including providing an increase in self-esteem, opportunity for developing effective coping strategies, and ultimately, aid in the recovery process. Although this study is limited by its qualitative nature, it provides important insight into the importance of employment while recovering from serious mental illness. Furthermore, employment provides a set of functions, including a sense of identity (Jahoda, 1981). Importantly, in a meta-synthesis examining lived experiences of severe mental illness, a loss of identity was identified as a significant theme, further supporting the notion that return to employment following a period of acute stress may be particularly important in an individual's prognosis (Kaite, Karanikola, Merkouris, & Papathanassoglou, 2015). Finally, it must be noted that recovery trajectories are subjective and may be dependent on the severity of suicide ideation or attempt. Therefore, return to work following a period of acute stress should be collaboratively determined by the individual and their mental health professionals.

Recommendations

Given the reviewed literature and the decades of clinical experience of the authors, there is evidence that in isolation, presence of suicidal ideation does not necessarily prevent people from being able to work, including in high stress environments like the military. In fact, employment can be a source of meaning and social support for individuals who have experienced suicidal thoughts, and therefore plays a critical role in recovery and future well-being. Further, given the stratification of suicide risk and the remitting nature of suicidal thought and behaviors, disclosure of suicidal thoughts and behaviors does not necessarily indicate a future trajectory leading to a suicide attempt or death. Therefore, experiencing suicidal thoughts, receiving treatment for suicidal thoughts and behaviors, or recovering from a suicidal crisis does not necessarily preclude a service member from being able to serve.

Therefore, we recommend that military personnel who disclose suicidal thoughts receive a full suicide risk assessment, and are provided access to treatments that are supported by scientific evidence, including psychotherapy and medication. Given the subjectivity of recovery trajectories, we recommend the adoption of a collaborative return-to-work policy. Best practices from organizational research and other return-to-work programs can be used to create guidelines for determining when the individual is ready to return to work, and to promote a smooth transition back into work. Therefore, we also recommend that treatment for suicidal thoughts and behaviors be covered similarly as the current Department of Defense policies for other problems requiring medical intervention. Use of a return-to-work policy can provide a smooth transition back into work as soon as appropriate for the individual (Ellen, Sue, Kosny, & Chambers, 2007).

References

Anestis, M., Bryan, C., Cornette, M., & Joiner, T. (2008). Understanding suicidal behavior in the military: An evaluation of Joiner's interpersonal-psychological theory of suicidal behavior in two case studies of active duty post-deployers. *Journal of Mental Health Counseling*, *31*(1), 60–75.

Borges, G., Angst, J., Nock, M. K., Ruscio, A. M., & Kessler, R. C. (2008). Risk factors for the incidence and persistence of suicide-related outcomes: A 10-year follow-up study using the National Comorbidity Surveys. *Journal of Affective Disorders*, *105*, 25–33. https://doi.org/10.1016/j.jad.2007.01.036

Calati, R., & Courtet, P. (2016). Is psychotherapy effective for reducing suicide attempt and non-suicidal self-injury rates? Meta-analysis and meta-regression of literature data. *Journal of Psychiatric Research*, *79*, 8–20. https://doi.org/10.1016/j.jpsychires.2016.04.003

Carpenter, G. S. J., Carpenter, T. P., Kimbrel, N. A., Flynn, E. J., Pennington, M. L., Cammarata, C., … Gulliver, S. B. (2015). Social Support, Stress, and Suicidal Ideation in Professional Firefighters. *American Journal of Health Behavior*, *39*(2), 191–196. https://doi.org/10.5993/AJHB.39.2.5
Chu, C., Buchman-Schmitt, J. M., Stanley, I. H., Hom, M. A., Tucker, R. P., Hagan, C. R., … Joiner, T. E. (2017). The interpersonal theory of suicide: A systematic review and meta-analysis of a decade of cross-national research. *Psychological Bulletin*, *143*(12), 1313–1345. https://doi.org/10.1037/bul0000123

Chu, C., Klein, K. M., Buchman-Schmitt, J. M., Hom, M. A., Hagan, C. R., & Joiner, T. E. (2015). Routinized assessment of suicide risk in clinical practice: An empirically informed update. *Journal of Clinical Psychology, 71*(12), 1186–1200. https://doi.org/10.1002/jclp.22210

Czyz, E. K., Liu, Z., & King, C. A. (2012). Social connectedness and one-year trajectories among suicidal adolescents following psychiatric hospitalization. *Journal of Clinical Child & Adolescent Psychology*, *41*(2), 214–226.

Dunn, E. C., Wewiorski, N. J., & Rogers, E. S. (2008). The meaning and importance of employment to people in recovery from serious mental illness: results of a qualitative study. *Psychiatric Rehabilitation Journal*, *32*(1), 59.

Ellen, M., Sue, F., Kosny, A., & Chambers, L. (2007). A Deliberation on 'Hurt Versus Harm' Logic in Early-Return-to-Work Policy. *Policy and Practice in Health and Safety*, *5*(2), 41–62. https://doi.org/10.1080/14774003.2007.11667693

Gunnell, D., Harbord, R., Singleton, N., & Jenkins, R. (2004). *Factors influencing the development and amelioration of suicidal thoughts in the general population*. 9.

Gutierrez, P. M., Joiner, T. E., Hanson, J., Avery, K., Fender, A., Harrison, T., … Rogers, M. L. (under review). *Clinical utility of suicide behavior and ideation measures: Implications for military suicide risk assessment*.

Hennen, J., & Baldessarini, R. J. (2005). Suicidal risk during treatment with clozapine: A meta-analysis. *Schizophrenia Research*, *73*(2–3), 139–145. https://doi.org/10.1016/j.schres.2004.05.015

Jahoda, M. (1981). Work, employment, and unemployment: Values, theories, and approaches in social research. *American Psychologist*, *36*(2), 184.

Jobes, D. A., & Joiner, T. E. (2019). Reflections on Suicidal Ideation. *Crisis*, *40*(4), 227–230. https://doi.org/10.1027/0227-5910/a000615

Jobes, D. A., Lento, R., & Brazaitis, K. (2012). An Evidence-Based Clinical Approach to Suicide Prevention in the Department of Defense: The Collaborative Assessment and Management of

Suicidality (CAMS). *Military Psychology*, *24*(6), 604–623. https://doi.org/10.1080/08995605.2012.736327

Joiner, T. E. (2005). *Why people die by suicide*. Cambridge: Harvard University Press.
Joiner, T., & Silva, C. (2012). Why people die by suicide: Further development and tests of the interpersonal-psychological theory of suicidal behavior. *Meaning, Mortality, and Choice: The Social Psychology of Existential Concerns*, 325–336.

Joiner, Thomas E., Walker, R. L., Rudd, M. D., & Jobes, D. A. (1999). Scientizing and routinizing the assessment of suicidality in outpatient practice. *Professional Psychology: Research and Practice*, *30*(5), 447–453.

Kaite, C. P., Karanikola, M., Merkouris, A., & Papathanassoglou, E. D. (2015). "An ongoing struggle with the self and illness": α meta-synthesis of the studies of the lived experience of severe mental illness. *Archives of Psychiatric Nursing*, *29*(6), 458–473.

Klonsky, E. D., & May, A. M. (2015). The Three-Step Theory (3ST): A new theory of suicide in the "ideation-to-action" framework. *International Journal of Cognitive Therapy*, *8*(2), 114–129.

Milner, A., Page, A., & LaMontagne, A. D. (2013). Long-Term Unemployment and Suicide: A Systematic Review and Meta-Analysis. *PLoS ONE*, *8*(1), e51333. https://doi.org/10.1371/journal.pone.0051333

Nock, M. K., Stein, M. B., Heeringa, S. G., Ursano, R. J., Colpe, L. J., Fullerton, C. S., … Kessler, R. C. (2014). Prevalence and correlates of suicidal behavior among soldiers: results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *JAMA Psychiatry*, *71*(5), 514–522. https://doi.org/10.1001/jamapsychiatry.2014.30

Silverman, M. M., Berman, A. L., Sanddal, N. D., O'Carroll, P. W., & Joiner, T. E. (2007). Rebuilding the tower of Babel: A revised nomenclature for the study of suicide and suicidal behaviors - Part 2: Suicide-related ideations, communications, and behaviors. *Suicide and Life-Threatening Behavior*, *37*, 264–277. https://doi.org/10.1521/suli.2007.37.3.264

Smith, K. A., & Cipriani, A. (2017). Lithium and suicide in mood disorders: Updated meta-review of the scientific literature. *Bipolar Disorders*, *19*(7), 575–586. https://doi.org/10.1111/bdi.12543

Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., & Joiner, T. E. (2010). The interpersonal theory of suicide. *Psychological Review*, *117*(2), 575–600. https://doi.org/10.1037/a0018697

Military Suicide Research Consortium: Extensions to New Opportunities and Challenges

13172001; 13172002

W81XWH-16-2-0003; W81XWH-16-2-0004

PIs:. Thomas Joiner, Ph.D. & Peter M. Gutierrez, Ph.D

Org: Florida State University & Denver Research Institute

Award Amount: $15,865,461 FSU
$17,894,035 DRI

Study/Product Aim(s)

•Maintain situational readiness, research infrastructure, intellectual capacity, and institutional memory to ensure that the resources exist to meet future military suicide research needs as they change and develop.
•Continuing to produce new scientific knowledge about suicidal behavior in the military.
•Use high quality research methods and analyses to extend significant findings from studies completed in the first five years of MSRC.
•Conduct after-action analyses of null findings from initial MSRC studies to determine whether interventions significantly affected other outcomes (e.g., mechanism variables covered by the Common Data Elements [CDE]).
•Capitalize on the CDE (variables collected by all currently funded studies) to encourage rigorous secondary analyses, exploring rival mediators and mechanisms, and moving toward making the data available to the broader research community.
•Build on the first five years of research conducted by the MSRC, by continuing to disseminate Consortium knowledge, information, and findings through a variety of methods appropriate for decision makers, practitioners, and others who are accountable for ensuring the mental health of military personnel.
•Train future leaders in military suicide research.

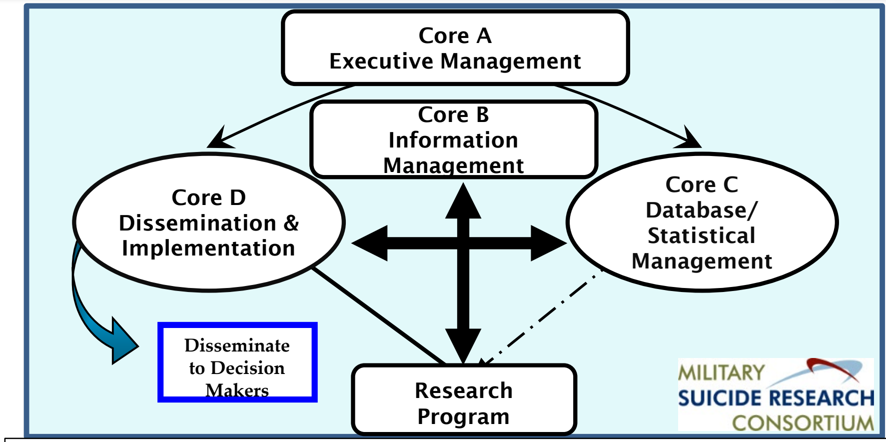
Approach

The MSRC's ultimate impact is on suicide prevention in the military through research. Findings will be used to influence policy, best practices, and programmatic changes.

Timeline and Cost

Activities	CY16	CY17	CY18	CY19	CY20
Revise infrastructure and refine and develop research priorities					
Fund and oversee funded studies					
Perform analyses on findings from years 1-5 and after-action analyses					
Capitalize on CDE secondary analyses					
Development of D&I plans					
Organized dissemination					
Continue training experiences					
FSU Estimated Budget ($Million)	**$5.4**	**$5.9**	**$1.5**	**$1.5**	**$1.5**
DRI Estimated Budget ($Million)	**$3.9**	**$4.8**	**$4.2**	**$3.2**	**$1.8**

Updated: (04/06/2020)



Accomplishments: The MSRC supports a total of 25 funded projects, including 5 long-term follow-up studies of MSRC 1.0 projects; 4 secondary data analyses of the MSRC Common Data Elements; 11 intervention studies; 3 assessment studies; 1 implementation study; and 1 postvention study.

Goals/Milestones

Year 1 Goal:
☑ Infrastructure updated and review functions defined and in place
☑ Research priorities updated and research studies funded
☑ Establish dissemination & implementation (D&I) relationships and create D&I plans for funded studies

Year 2 Goal:
☑ Maintain defined schedule of data uploads and meetings
☑ Analyses completed on previous studies
☑ Start dissemination of research findings
☑ Career development and training experiences established

Year 3 Goal:
☑ Maintain defined schedule of data uploads and meetings
☑ Refine research priorities and continue research projects

Year 4 Goal:
☑ Refine research priorities and continue research projects
☑ Continued dissemination of research findings

Year 5 Goal:
❑ Present at relevant conferences and develop manuscripts

Year 5 Goal:
❑ Communication of MSRC deliverables achieved

Budget Expenditure to Date

FSU Actual Expenditure: $7,552,345
DRI Actual Expenditure: $7,173,678

Efficacy of a Computerized Cognitive Behavioral Treatment for Insomnia: Increasing Access to Insomnia Treatment to Decrease Suicide Risk

Award Number: W81XWH-16-2-0004

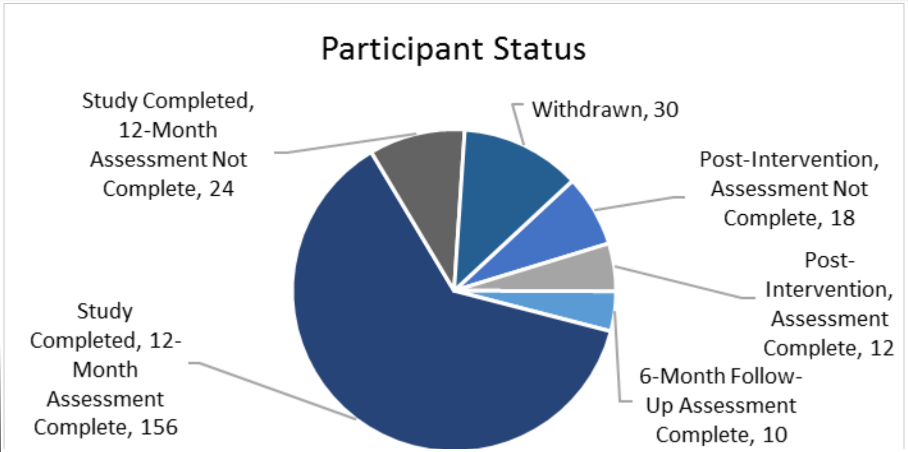
PI: Sarra Nazem, Ph.D. **Org:** Rocky Mountain MIRECC **Award Amount:** $1,155,292

Study Aim & Hypotheses

Specific Aim: Determine the efficacy of Sleep Healthy Using the Internet (SHUTi), a potential upstream suicide prevention intervention, for treatment of insomnia in OEF/OIF/OND Veterans.
Hypothesis 1.1: Participants randomized to SHUTi will report a significant pre-intervention to post-intervention decrease in insomnia symptoms, and improvement in functioning compared to participants who are randomized to the educational website control.
Hypothesis 1.2 & 1.3: Participants randomized to SHUTi will report a significant pre-intervention to six-months and one-year post-intervention decrease in insomnia symptoms, and improvement in functioning compared to participants who are randomized to the educational website control.
Exploratory Objective: Determine whether SHUTi is associated with significant reductions in sleep parameters and key suicide risk variables (e.g., suicidal ideation, depressive symptoms).

Approach

Efficacy will be evaluated using a two group (SHUTi vs. educational website control) longitudinal (four time points: baseline, post-intervention, 6-month and 1-year follow-up) RCT design.



Accomplishments: Continued collecting 12-month follow-up assessment data. Collected assessment data from an additional 59 participants at 12-month follow-up. A total of 180 participants have now completed the study.

Timeline and Cost: Project Period: 04/10/17-03/31/21

Activities	04/17-04/18	04/18-04/19	04/19-04/20	04/20-04/21
Study Start Up	████	████		
Conduct RCT: Baseline & Post-Intervention Assessments		████		
Conduct RCT: 6-Month and 1-Year Follow-Up Assessments	████	████	████	████
Evaluate and Disseminate RCT			████	████
Estimated Budget ($1,155,292)	**$314,005**	**$333,016**	**$359,168**	**$149,103**

Goals/Milestones

Year 1 Goals
- Research staff hired and trained (completed)
- Regulatory approvals obtained (completed)
- Begin RCT recruitment and enrollment (completed)

Year 2 Goals
- 226 participants randomized to RCT (completed)
- Begin 6-month and 1-year assessments (completed)

Year 3 Goals
- 6-month assessment data collected (completed)
- Baseline and post-intervention data checked for accuracy (completed)

Year 4 Goals
- 1-year assessment data collected (in progress)
- Data analyzed and results interpreted (in progress)
- Disseminate findings (in progress)
- Submit final research progress and fiscal reports

Comments/Challenges/Issues/Concerns: None

Budget Expenditure to Date
- Projected Expenditure: $1,155,292 (Initial); $1,006,189 (NCE Revision)
- Actual Expenditure: $953,475

Profiles of Behavioral Warning Signs (BWS) for Suicide Attempts in the Prediction of Future Suicidality Award #: W81XWH-16-2-0004

PI: Courtney L. Bagge, PhD; **Org**: Univ. of Michigan Medical Center; **Amount**: **$149,355**

Study/Product Aims: Start date (3/15/18)

Key Question: Can BWS predict future suicidal thoughts and behaviors during a period of pronounced risk (w/in 12 mo. of hospitalization)?

Aims: Determine if BWS groups can predict presence of, and onset to, reattempt and worst suicidal ideation

- Over and above traditional risk factors

Specific Hypothesis: No extant data to inform this question

Military Relevance: Inform more precise discharge decisions, innovative treatments, and longer-term prevention efforts to reducing the burden of suicide among service members.

Follow-Up Methodology:

Participants: N=181 adults hospitalized after an attempt

Procedure: Phone follow-up. Use of well-established follow-up measures

- SASI-Count: Presence of reattempt; # days to first attempt within 12 mo
- SSI-Worst: Level, and time to, worst SI within 12 mo

Accomplishments: We completed data collection and obtained IRB and HRPO approvals for change in institution. We just received all data from UMMC to conduct key follow-up analyses. All coding of reliability and original data (including variables using dates) has been completed.

Timeline and Cost (Direct and Indirect)

Activities	Mo. 1-12	Mo. 13-26
Build Infrastructure for the project		
Recruit/Consent 144 Participants; Enter Data		
Variables Created/Data Cleaned/Coded Analyzed		
Disseminate Findings		
Submit Final Research/Fiscal Report		
Estimated Total Budget ($K)	$123,333	$26,022

Goals/Milestones

Build Infrastructure for Project–

☐ Hire and train assessor (completed)

☐ UMMC/HRPO Regulatory approval (completed)

☐ Creation of databases (completed)

☐ UM/HRPO Regulatory approval (completed)

Recruit and Collect Data; Enter Data

☐ Enroll participants (completed data collection)

☐ Data double-entered (completed)

Manage and Analyze Data; Disseminate Findings

☐ Variables created (completed)

☐ Data cleaned, coded, and analyzed (in progress)

☐ Manuscript and report writing; Disseminate findings

Projected Budget: $149,355; Expenditures: $133,037

Couples Crisis Response Planning to Reduce Post-Discharge Suicide Risk

Award Number: W81XWH-16-2-0004

PI: Alexis May, PhD **Org:** University of Utah **Award Amount: $1,481,083**

Study/Product Aim(s)

Objective: To develop and test the C-CRP, a single-session suicide-specific couples intervention, among post-9/11 military service members, veterans, and their partners.

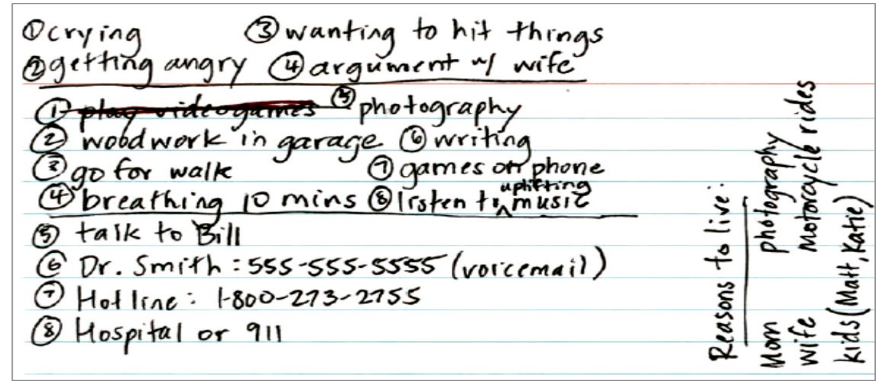
Aims:

- To compare the effect of C-CRP to TAU on suicide ideation in the 6 months following treatment service members hospitalized for suicide risk.
- To determine how use of the C-CRP impacts suicide ideation and identify the role of partners in use of the plan and managing risk.
- To to determine the needs and preferences of service members, veterans and their partners for suicide prevention interventions.

Approach

50 military couples will complete an online survey to determine the needs and preferences of service members and their partners for suicide prevention interventions. 78 service members hospitalized for suicidal thoughts and/or behaviors and their partners will be randomized to C-CRP or Psychoed. Follow up assessments will occur at discharge, 1, 3, and 6 months.

Sample Crisis Response Plan



Accomplishment: This Quarter, 8 couples participated in the intervention session, 10 follow up interviews were completed and 1 couple completed the online study. Changes to increase RCT enrollment have been successful. Advertisements were placed in Military Times and Rally Point to increase online study enrollment. RCT recruitment was paused due to COVID19.

Timeline and Cost

Activities CY	18	19	20	21
IRB approvals, database construction, staff hiring & training				
Participant enrollment (P1 and P2), completion of baseline assessments				
Follow up interviews				
Data analyses, manuscript and report writing, dissemination of results				
Estimated Budget ($K)	**$345**	**$526**	**$496**	**$115**

Updated: March 31, 2020

Goals/Milestones

CY18 Goal – IRB approvals and Hiring

☑Obtain IRB and HRPO approval

☑ Begin P1 data collection

CY19 Goals – Begin P2 Data Collection

☑ Begin P2 Enrollment

☑ Begin P2 Follow up assessments

☐P1 Data analysis and dissemination

CY20 Goal – Continue P2 Data collection

☑ Continue P2 enrollment

☑ Continue P2 follow up assessments

CY21 Goal – Conclude follow up assessments

☐Complete P2 follow up assessments

☐P2 data analysis and dissemination

Comments/Challenges/Issues/Concerns

Regulatory approval delays, recently resolved.

Budget Expenditure to Date

Projected Expenditure: $1,028,525

Actual Expenditure: $518,382

Facilitating Assessment of At-Risk Sailors with Technology (FAAST)

Award Number: W81XWH-16-2-0004

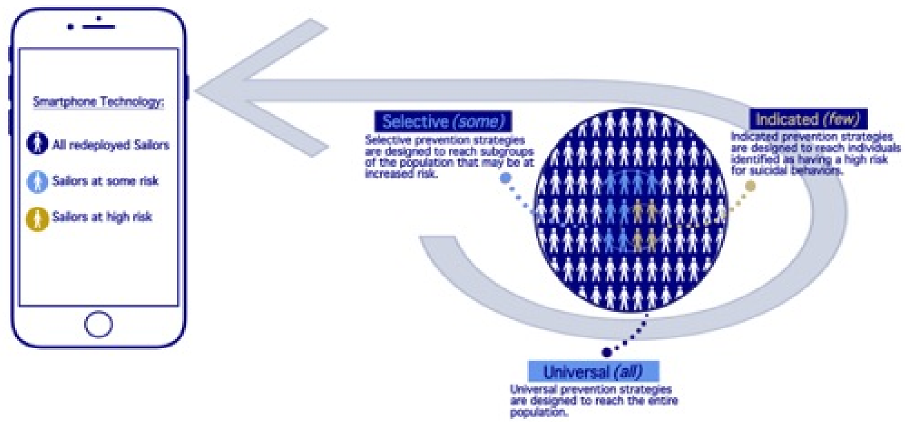
PI: Lisa A Brenner, PhD **Org:** University of Colorado, VHA Rocky Mountain MIRECC **Award Amount:** $1,499,884

Study/Product Aim(s)

- Aim1. Evaluate the efficacy of the Cogito Companion as an upstream suicide prevention intervention.
- Aim 2. Evaluate the acceptability and feasibility of the Cogito Companion among military personnel.
- Exploratory Aim. Identify patterns of distress, depressive symptoms, post-traumatic symptoms, suicide-related thoughts, and perceived physical and psychological health functioning over the course of the study among the entire sample, as well as within the Cogito Companion and Active Control groups.

Approach

Randomized controlled trial, with individuals being allocated to experimental (Cogito Companion) or Active Control arms. Those in the latter will receive information regarding widely available mobile self help applications via a custom mobile application built in MyCAP.



Accomplishments: Data collection continued and was successfully completed for the Sailors enrolled at Joint Base Pearl Harbor-Hickman. We also obtained a letter of support from the Commanding Officer of the USS Theodore Roosevelt.

Timeline and Cost

Major Tasks	CY19	CY20	CY21
Prepare for Randomized Control Trial			
Recruit and consent participants			
Collect follow-up data and monitor Cogito dashboard and MyCAP			
Evaluate and disseminate findings			
Budget	$563K	$750K	$187K

Updated: (4/8/2020)

Goals/Milestones

CY19 Goal – Prepare for randomized control trial; begin to recruit participants

- ■ Hire research staff
- ■ Local IRB approval
- ■ HRPO approval
- ■ Recruit and consent participants

CY20 Goal – Continue to recruit and consent participants; collect follow-up data; monitor Cogito dashboard and REDCap database

- ■ Recruit and consent participants
- ■ Monitor dashboard and databases

CY21 Goal – Evaluate and disseminate findings

- ☐ All data analyzed and results interpreted

Comments/Challenges/Issues/Concerns

- None

Budget Expenditure to Date

Projected Expenditure: $265,000.00

Actual Expenditure: $263,917.67

Suicide Risk and Sleep in Treatment: An Intensive Daily Sampling Study

Award Number: W81XWH-16-2-0004

PI: Lily Brown, Ph.D. **Org:** University of Pennsylvania **Award Amount:** $1,291,232

Study/Product Aim(s)

- **Aim 1**: To examine whether key sleep variables are significant near-term predictors of increased suicidal ideation (1a), and the critical periods of heightened suicidal ideation (1b).
- **Aim 2**: To examine mediators and moderators of the associations among sleep disturbances and suicidal ideation.
- **Aim 3**: To determine the optimal strategies for assessing sleep and suicide risk in military personnel receiving treatment.

Approach

We are implementing continuous active and passive digital phenotyping assessments of sleep disturbances and suicidal ideation alongside a trial comparing two treatments for suicide prevention in active duty military personnel from Camp Lejeune, NC. Participants will be provided with a Fitbit to track sleep and activity and will be queried with EMA about sleep, purported mediators and suicidal ideation in treatment.

0 Assessed for eligibility

0 Excluded from parent trial
- 0 Did not meet inclusion criteria
  - 0 Did not report past two-week suicidal ideation with intent/suicide attempt
  - 0 Did not receive command support to attend study treatment
  - 0 Declined to participate
  - 0 Did not speak English
- 0 Met exclusion criteria
  - 0 Psychiatric or medical condition that precluded ability to provide informed consent or participate

0 Excluded from MSRC trial
- 0 Declined to participate

0 Assigned to intervention for parent trial
- 0 Received full intervention
- 0 Did not receive full intervention
  - 0 Requested to dropout
  - 0 Never began treatment
  - 0 Illness, medical condition, or inpatient
  - 0 No longer met criteria
  - 0 Separated from military service
  - 0 Began proceedings to separate from military
  - 0 Left area due to military orders
  - 0 Lost contact

0 Consented to MSRC assessments
- 0 Completed assessments
- 0 Did not complete assessments

Accomplishment: We have received IRB approval from the Naval Medical Center Camp Lejeune (NMCCL) IRB and are awaiting HRPO approval.

Timeline and Cost

Activities CY	19	20	21
Obtain and maintain regulatory approvals and prepare protocol			
Recruit and enroll 100 participants			
Data cleaning and analysis			
Dissemination of findings			
Estimated Budget ($K)	**$322,828**	**$645,655**	**$322,828**

Updated: April 1, 2020

Goals/Milestones (Example)

CY19 Goal – IRB approval and begin recruitment

☑ Submit modification of parent trial to NMCCL IRB

CY20 Goals – Begin enrollment and data management

☐ Begin enrollment

CY21 Goal – Data cleaning and analysis

☐ Clean data, validate algorithm, prepare report on findings

CY21 Goal – Dissemination of findings

☐ Disseminate findings in collaboration with MSRC D&I core

Comments/Challenges/Issues/Concerns

- We have HRPO documents have been submitted. We have a modification under review to alter the demographics form.

Budget Expenditure to Date

Projected Expenditure: $645,655.50

Actual Expenditure: $254,167.34

A Brief Peer-Support Cognitive Behavioral Intervention for Military Life Transitions (Mil-iTransition) Following Medical and Physical Evaluation Boards

Award Number: W81XWH-16-2-0004 Subaward Number: MSRC-FY19-03

PI: Marjan G. Holloway, Ph.D. **Organization:** Uniformed Services University & Henry Jackson Foundation

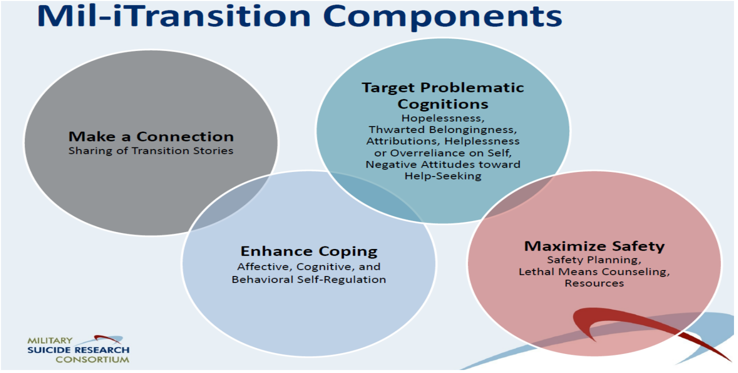
Award Amount: $1,500,000

Study Aim(s)

(1) Use a biographical narrative approach to learn about service members' lives and experiences with the Medical Evaluation Board (MEB) and Physical Evaluation Board (PEB) processes and subsequent transitions to civilian life;
(2) Develop and tailor an innovative, low-intensity, peer-support cognitive behavioral intervention, Mil-iTransition, for service members who received an "unfit for duty";
(3) Train Veterans with MEB experience to administer Mil-iTransition via phone;
(4) Evaluate the acceptability and satisfaction of the Mil-iTransition intervention;
(5) Test feasibility of recruitment, intervention delivery, and retention;
(6) Determine the degree of change and variability of response to the Mil-iTransition intervention compared with a Transition as Usual (TAU) comparison group on psychological, suicide-related, and help-seeking outcomes measures

Approach

(1) Phase I: Conduct phone interviews with 25 current military service members who received an "unfit for duty" MEB/PEB notice; **(2) Phase II:** Develop the manuals for Mil-iTransition intervention and peer facilitator training; **(3) Phase III:** Deliver the Mil-iTransition intervention; **(4) Phase IV:** Implement a pilot RCT (*N* = 50 service members who recently received an "unfit for duty" MEB notice) to assess preliminary change.



Accomplishments for Year 1, Quarter 4: (1) hired & trained qualified staff; (2) prepared IRB protocols; (3) submitted Study 1 IRB protocol (currently under revision); (4) developed biographical narrative interview; (5) coordinated with the WRNMMC MEB office leadership; (6) prepared first-draft of Mil-iTransition intervention protocol; and (7) consulted with USU IRB to overcome challenges presented by the paperwork reduction act.

Timeline and Cost

Activities CY	19	20	21
Conduct Interviews & Perform Qualitative Analyses			
Conduct Pilot Randomized Controlled Trial (RCT)			
Conduct Data Analysis & Disseminate Findings			
Estimated Budget ($K)	**$536**	**$768**	**$196**

Updated: April 10, 2020

Study Goals and Milestones

CY19: Conduct Interviews + Qualitative Analyses, Prepare for Pilot RCT
☐ Obtain IRB Approvals at USUHS & HRPO for Study 1
☐ Conduct Biographical Narrative Interviews (N=25), Examine Themes
☐ Finalize Mil-iTransition Manual, Pilot RCT Forms, and Train Personnel
CY20: Conduct Pilot RCT
☐ Obtain IRB Approval at USUHS & HRPO for Study 2
☐ Enroll Participants (N=50) + Deliver Mil-iTransition to Those in Treatment Arm
☐ Complete 3-Month and 6-Month Follow-Up Assessments
CY21: Conduct Data Analysis and Disseminate Findings
☐ Understand Study Findings
☐ Think Strategically through Next Steps + Dissemination Plan (if applicable)

Ongoing Challenges

2-Year Timeline for Study Activities; IRB Approvals; COVID-19 Pandemic

Budget Expenditure to Date

Projected Expenditure for Remainder of Study: $1,377,348
Actual Expenditure: $122,652

Medicine Uniformed Services University
SUICIDE CPR INITIATIVE Suicide Care, Prevention, and Research Initiative

Mobile Interpretation Bias Modification (M-IBM) Clinical Trial

Award Number: W81XWH-16-2-0004

PI: Dan Capron **Org:** University of Southern Mississippi **Award Amount:** $669,911

Study/Product Aim(s)

- Test M-IBM, a smartphone-delivered anxiety sensitivity cognitive concerns intervention, in reducing suicide risk correlates among Mississippi National Guard members
- Test the acceptability and usability of M-IBM

Approach

114 Mississippi National Guard members with elevated anxiety sensitivity cognitive concerns and presence of suicidal ideation will be randomized to receive M-IBM, or a control IBM. Follow-ups will be conducted at 1 and 3 month post-intervention.

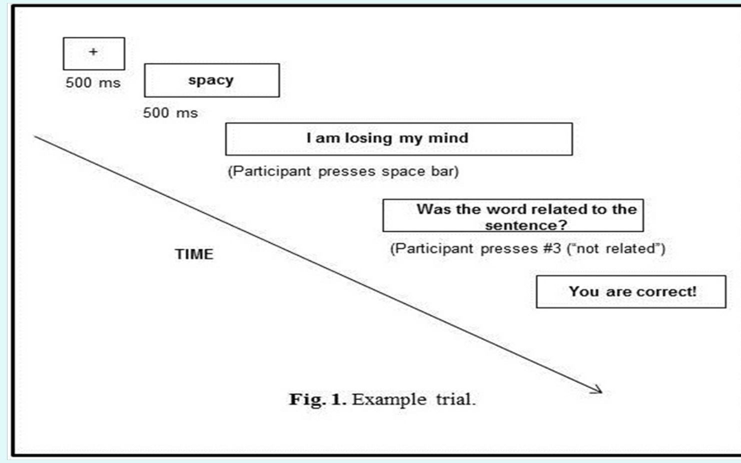


Fig. 1. Example trial.

Accomplishment: Have completed four baseline appointments and one follow-up.

Timeline and Cost

Activities **CY**	**19**	**20**	**21**	
Develop Study Infrastructure				
Randomized Controlled Trial				
Data Analysis				
Estimated Budget ($669K)	**$251K**	**$335K**	**$83K**	

Updated: (March 31, 2020)

Goals/Milestones

CY19 Goal – Develop study infrastructure

☑ Obtain all regulatory approvals

☑Hire all staff

☑ Initial protocol training

☑ Begin data collection (baseline and initial follow-ups)

CY20 Goals – Conduct clinical trial

☐Complete data collection

CY21 Goal – Data analysis+ diss./implement. Plan

☐Data Analysis

☐Work on dissemination of results

Comments/Challenges/Issues/Concerns

- Recruitment was successful in terms of garnering 16 screeners; however, it was not successful in that 0 met eligibility. Will ramp up and diversity recruitment efforts in Q1 2020.

Budget Expenditure to Date

Projected Expenditure: $ 218,628.47

Actual Expenditure: $ 218,628.47

Personal & Professional Exposure to Suicide in Military Populations

Award Number: W81XWH-16-2-0004

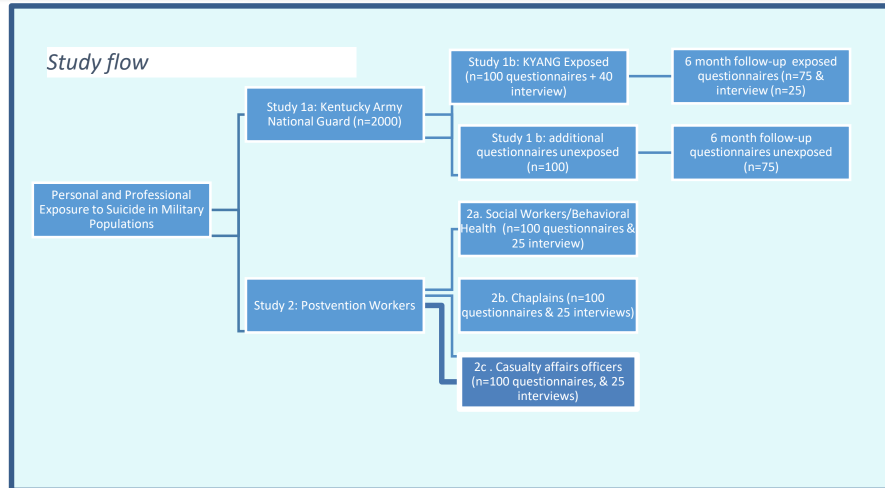
PI: Cerel **Org:** University of Kentucky **Award Amount:** $1,104,521

Study/Product Aim(s)

•**Study 1 Specific Aim:** To better understand the correlates and mental health outcomes of exposure to suicide in national guard personnel and how exposure effects personnel over time. **Study 2 Specific Aim:** To explore the experience of suicide exposure in military personal who assist in postvention efforts.

Approach

Now that suicide exposure has been shown to be common and associated with psychiatric and suicide risk, it is imperative to distinguish the variables most associated with risk following exposure in order to identify unit members in greatest need of support and services and determine when such support will be most beneficial in reducing harm associated with exposure. The study does this while by addressing the impact of military colleague suicide exposure in National Guard personnel and examining the effect of suicide exposure on personnel who directly intervene in postvention response -- behavioral health personnel, casualty assistance & chaplains.



Accomplishment: working on IRB submissions

Timeline and Cost

Activities CY	19	20	21	
Startup and IRB	74,489			
Collect Study Data		779,880		
Analyze and report findings			250,152	
Estimated Budget ($K)	**$000**	**$000**	**$000**	**$000**

Updated: 4 2020

Goals/Milestones (Example)

CY19 Goal

- ❑ Local and HRPO IRB approval
- ❑ Begin Study 1-2
- ❑ Begin process of testing modules

CY20 Goals – conduct studies

- ❑ Begin initial surveys
- ❑ Conduct follow up interviews and surveys

CY2 1 Goal – finish studies and reporting

- ❑ Finish follow up interviews
- ❑ Analyze data and report

Comments/Challenges/Issues/Concerns

Budget Expenditure to Date

Projected Expenditure: $170,274

Actual Expenditure: $170,274

Bolstering the Implementation Quality and Impact of Zero Suicide Efforts in the Air Force

Award Number: W81XWH-16-2-0004

PI: Keith R. Aronson **Org:** Pennsylvania State University **Award Amount:** $1,500,000

Study/Product Aim(s)

• Evaluate implementation outcomes (IOs) for universal suicide screening and suicide assessment (Identify), suicide prevention care pathway (Transition), safety planning intervention (Treat), and lethal means counseling (Treat).

• Enhance ZSSA implementation quality, reach, and sustainability by developing local ZSSA-focused care management and technical assistance (TA) (ZCM; 1 new positions funded by the AF) and ZSSA-focused implementation coaching (ZIC; 1 new position funded by the grant).

• Augment ZSSA implementation quality, reach, and sustainability by identifying, gathering, and analyzing relevant AF healthcare and dissemination and implementation data.

Approach

Timeline and Cost

Activities CY	**19**	**20**	**21**	
Develop training and hire ZICS				
Train and deploy ZICS to bases				
Collect data				
Analyze data and disseminate				
Estimated Budget ($K)	**$13734**	**$450**	**$450**	

Updated: 04/07/2020

Accomplishments: One Air Force base has agreed to continue their participation in the pilot study. Penn State IRB determined the project is exempt. HRPO concurred. Broad area agreement with Air Force received.

Goals/Milestones

CY20 Goal – Attempt to secure two more bases in the pilot (unsuccessful).

CY20 Goal – Continue to develop training materials and implementation protocol and marketing documents and hire ZSSA implementation coaches

CY20 Goals – Train and deploy ZIC to base

☐ On board one ZICs

☐ Conduct training at Penn State and one week in vivo training

CY20 Goal – Collect implementation and outcome data

☐ Deploy MTF wide ZSSA survey and outcome data

☐ Collect implementation data from ZIC and Care Coordinator

CY21 Goal – Analyze data and disseminate findings

Comments/Challenges/Issues/Concerns

• NA

Budget Expenditure to Date

Projected Expenditure: $150,000

Actual Expenditure: $42,721