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TITLE: Project VALOR: Trajectories of Change in PTSD in Combat-Exposed Veterans

PRINCIPAL INVESTIGATOR: Terence M. Keane, PhD

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

This goal of this project is to develop a large-scale, longitudinal registry of PTSD in combat-exposed OIF/OEF/OND male and female veterans. The objective of the current study is to systematically expand the longitudinal assessment by collecting follow-up data at additional time points for multiple domains of interest. Patterns of longitudinal change in the VALOR cohort will be empirically classified into trajectory subtypes by means of latent growth mixture modeling. The availability of comprehensive data on PTSD symptoms and related exposures and outcomes at multiple time points in a cohort of VA users with and without PTSD provide a unique opportunity to examine a number of hypotheses regarding longitudinal trajectories in combat-exposed veterans. In addition, the large proportion of women in our sample will allow us to examine variation in the associations by gender.

15. SUBJECT TERMS
Risk factors for PTSD, PTSD symptom development, VA healthcare utilization.

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON: USAMRMC**
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1. **INTRODUCTION:**

Project VALOR is a large-scale, longitudinal registry of PTSD in combat-exposed OIF/OEF/OND male and female veterans. The objective of the current study is to systematically expand the longitudinal assessment by collecting follow-up data at additional time points for multiple domains of interest. Patterns of longitudinal change in the VALOR cohort will be empirically classified into trajectory subtypes by means of latent growth mixture modeling. The availability of comprehensive data on PTSD symptoms, related exposures, and outcomes at multiple time points in a cohort of VA users with and without PTSD provides a unique opportunity to examine a number of hypotheses regarding longitudinal trajectories in combat-exposed veterans. In addition, the large proportion of women in our sample will allow us to examine variation in the associations by gender.

Using baseline and follow-up data from participants in Project VALOR, we will evaluate the following specific aims:

1. Examine trajectories of PTSD symptomatology and diagnosis by chart and diagnostic interview assessments in combat-exposed men and women.
2. Examine the nature and extent of military sexual trauma (MST) in combat-exposed men and women who have utilized the VA Healthcare System, including the contribution of MST to PTSD symptoms and diagnosis.
3. Examine associations of PTSD, mTBI, major depressive disorder (MDD), and treatment utilization in relation to changes in suicidal ideation.

2. **KEYWORDS:**

Post-traumatic stress disorder (PTSD), military sexual trauma (MST), suicide, combat-exposed veterans, PTSD trajectory, longitudinal, VA treatment utilization

3. **OVERALL PROJECT SUMMARY:**

In quarter one of this year, 1527 participants were consented to participate in the study and 257 subjects completed their participation in the third phase (consisting of an online questionnaire and telephone interview). By the end of quarter two, a total of 1530 subjects were consented to participate and 559 subjects had completed the third phase of the study. At the end of quarter three, a total of 1535 participants were consented and 816 subjects had completed the third phase of the study. In quarter four, we continued to work toward completion of the third round of data collection. Out of the total Project VALOR sample (n=1649), 1543 participants (93.6%) have been consented for participation and 1068 participants (64.8%) have completed their participation in the third phase of the study. In total, 56 participants (3.3% of the sample) declined to participate in the study.

We also continue to make progress on other aspects of the project. For quality assurance, assessors attend weekly reliability meetings in which they review a sample of completed interviews. Additionally, we are continuing the process of abstracting EMR data and merging it with both round 3 phase 2 data and phase 3 data. Further, both VA and NERI personnel are actively working to de-identify data and transfer it to NERI as it is collected so it can be appropriately cleaned

and made available for subsequent analyses. NERI personnel have made trips to the VA to streamline this process. In particular, NERI personnel download the datasets once data collection is completed at each time point. Once the datasets are downloaded, the data is coded and checked for accuracy. Once coding is completed, data sets are pulled from the study data and VINCI data based on the needs of each individual paper.

Interim analyses using data collected during the three rounds of phase 2 are ongoing. To date, a number of projects which are in line with study aims have been presented to an international audience at a range of conferences. Each of these projects has involved a combination of data collected via self-report, interview, and/or the EMR.

Although we are not able to study our first goal of examining the trajectories of PTSD symptomatology and diagnosis in full as of yet (this requires that we complete data collection at all three phases), we have conducted interim analyses to better understand how PTSD affects other outcomes across time. For example, our interim analyses have provided insight into factors that influence treatment utilization behaviors of OEF/OIF Veterans; the longitudinal association between PTSD and metabolic syndrome; and how Veterans with unique presentations of PTSD (e.g., dissociative subtype) differ from those with a more traditional diagnosis.

Our second aim is to examine the nature and extent of military sexual trauma (MST) in combat-exposed men and women who have utilized the VA Healthcare System, including the contribution of MST to PTSD symptoms and diagnosis. We have made excellent progress on this goal in our interim analyses, finding and presenting research which investigated the utility of repeated screening for MST; associations between childhood sexual trauma and the dissociative subtype of PTSD; as well as the prevalence of PTSD and depression for sexual minority and non-sexual minority female veterans exposed to MST.

Through interim analyses, we have also made progress on our third aim, which is to examine associations of PTSD, mTBI, major depressive disorder (MDD), and treatment utilization in relation to changes in suicidal ideation. We have presented the results of our findings at various conferences. These results provide information about potential risk factors for suicidal behaviors (which include peritraumatic emotion and trauma type); post deployment social support as a key protective factor for suicide risk; and the effectiveness of VA safety plans in reducing risk of suicidality. The presentations associated with the interim analyses for all three aims are listed in section 6 of this document.

We are beginning to formulate research questions that the phase 3 data can answer beyond those proposed, and we are planning to conduct analyses and to present the results of these in future presentations and publications. Our last scientific advisory board meeting (SAB) was held in December of 2014. Since then, the team has been in regular contact with key members of the advisory board who have been briefed on interim research findings. An update was sent to

the advisory board on January 28th, 2016 and the next meeting is scheduled for November 2nd, 2016.

4. **KEY RESEARCH ACCOMPLISHMENTS:**
   Nothing to report

5. **CONCLUSION:**
   The PTSD registry will provide information to assist researchers, military leaders, and treatment providers to better understand PTSD and related problems, with a specific focus on the course of the disease, suicidal ideation, and military sexual trauma. This knowledge will be of benefit to health care providers, policy makers and current service members as well as victims of trauma in the broader community. It will include:
   • Evaluation of long-term outcomes of PTSD;
   • A more accurate assessment of current theoretical models of symptom development, and;
   • Documentation of health resource utilization and development of a database that will serve as a resource for health services planning and policy.

   Furthermore, this study will contribute:
   • The formation of a potential cohort of subjects for ancillary studies, ranging from genomic influences to quality of life and psychosocial outcomes, as well as future clinical trials;
   • The creation of a representative sample of PTSD OEF/OIF/OND Veterans who use the VA medical system available for use in epidemiologic studies, particularly for comparisons with active duty and other Veteran or civilian populations;
   • Utility to clinicians, patient advocacy groups, and health policy planners;
   • Publications and dissemination of the registry results to provide a representative perspective of what is achieved in actual current care settings, thereby augmenting outcomes data from clinical trials.

6. **PUBLICATIONS, ABSTRACTS, AND PRESENTATIONS:**

   PUBLICATIONS

Marx, B. P., Engel-Rebitzer, E., Bovin, M. J., Parker-Guilbert, K. S., Moshier, S., Barretto, K., Szafranski, D., Gallagher, M. W., Holowka, D. W., Rosen, R. C., & Keane, T. M. (In press). The influence of veteran race and psychometric testing on VA PTSD disability exam outcomes. *Psychological Assessment*.

Wisco, B. E., Miller, M. W., Wolf, E. J., Kilpatrick, D., Resnick, H. S., Badour, C. L., ... & Friedman, M. J. (2016). The impact of proposed changes to ICD-11 on estimates of PTSD prevalence and comorbidity. *Psychiatry Research*, 240, 226-233.

Wolf, E. J., Bovin, M. J., Green, J. D., Mitchell, K. S., Stoop, T. B., Barretto, K. M., ... & Rosen, R. C. (2016). Longitudinal associations between post-traumatic stress disorder and metabolic syndrome severity. *Psychological Medicine*, 46(10), 2215-2226.

   PRESENTATIONS

Black, S.K., Harwell, A.M., Klein, A.B., Bovin, M.J., Green, J.D., Keane, T.M. Rosen, R.C., & Marx, B.P. (October, 2016) *Implications of the recent and upcoming diagnostic changes to posttraumatic stress disorder: A comparison of DSM-5 and ICD-11*. Poster to be presented at the Association for Behavioral and Cognitive Therapy 50th Annual Meeting. New York, NY.

Black, S. K., Erb, S. Green, J. D., Bovin, M., Sloan, D. M., & Marx, B. (November, 2015). *Alcohol consumption, emotional regulation, and reactivity in sexual revictimization*. Paper presented as part of a symposium (Emotion reactivity and regulation in PTSD; Chair: K. McHugh) at the Association for Behavioral and Cognitive Therapies 49th Annual Meeting. Chicago, IL.

Black, S. K., Erb, S. Bovin, M. J., Green, J., Marx, B. P., Rosen, R. C., & Keane, T. M. (November, 2015). *Utility of repeated screening for military sexual trauma*. Poster presented at the International Society for Traumatic Stress Studies 31st Annual Meeting. New Orleans, LA.

Cikesh, B., Rosen, R.C., Wilkinson, A.M., Bliwise, D., Seal, K., Trachtenberg, F., Marx, B.P., & Keane, T.M. (August, 2016). *Sleep health and Sleep disturbances in combat-exposed OIF/OEF veterans: Longitudinal findings from Project VALOR*. Poster presented at the Military Health System Research Symposium (MHSRS), Kissimmee, FL.

Erb, S., Green, J. D., Bovin, M., Marx, B. P., Keane, T. M., & Rosen, R. C. (November, 2015). *The effect of combat on PTSD prevalence rates: A comparison of OIF deployment phases.* Poster presented at the Association for Behavioral and Cognitive Therapies 49th Annual Meeting. Chicago, IL.

Erb, S., Kearns, J., Bovin, M. J., Black, S., Annunziata, A., & Marx, B. P. (November, 2015). *Psychometric properties of the Brief Inventory of Psychosocial Functioning*. Poster presented at the International Society for Traumatic Stress Studies 31st Annual Meeting. New Orleans, LA.

Green, J.D., Kearns, J.C., Marx, B.P., Rosen, R.C., & Keane, T.M. (November, 2015). *Future directions in managing suicidal crises: evidence-based longitudinal evaluations of safety planning*. In P. Saraff (Chair), ABCT suicide and self-injury special interest group data blitz. Symposium conducted at the 49th annual convention Association for Behavioral and Cognitive Therapies, Chicago, IL.

Green, J.D., Kearns, J.C., Marx, B.P., Rosen, R.C., & Keane, T.M. (November, 2015). *Trauma types and peritraumatic emotions predict suicide risk among veterans*. Symposium conducted at the 31st annual meeting of the International Society for Traumatic Stress Studies, New Orleans, LA.

Green, J.D., Kearns, J.C., Marx, B.P., Nock, M.K., Rosen, R.C., & Keane, T.M. (October, 2016). Evaluating safety plan effectiveness: Do safety plans tailored to individual veteran characteristics decrease risk? In D. Lee (Chair), *Preventing suicide among military and veteran populations*. Symposium to be conducted at the 50th annual convention Association for Behavioral and Cognitive Therapies, New York, NY.

Gorman, K.R., Klein, A.B., Kearns, J.C., Parker-Guilbert, K.S., Bovin, M.J., Rosen, R.C., Keane, T.M. & Marx, B.P. (October, 2016). *Comparison of PTSD and depression in sexual minority and non-sexual minority female veterans exposed to military sexual assault, combat, and harassment.* Poster accepted for presentation at the 50th annual meeting of the Association for Behavioral and Cognitive Therapies, New York, NY.

Harwell, A.M., Klein, A.B., Erb, S.E., Green, J.D., Holowka, D.W., Barretto, K.M., Bovin, M.J., Marx, B.P., Keane, T.M. & Rosen, R.C. (October, 2016). *Wartime atrocity exposure and PTSD symptom severity among OEF/OIF veterans: Evaluating the role of gender.* Poster accepted for presentation at the 50th annual meeting of the Association for Behavioral and Cognitive Therapies, New York, NY.

Harwell, A.M., Moshier, S.J., Klein, A.B., Rosen, R.C., Keane, T.M. & Marx, B.P. (November, 2016). *Wartime atrocity exposure type, PTSD diagnosis and symptom severity prediction among OEF/OIF Veterans.* Poster accepted for presentation at the 32nd annual meeting of the International Society for Traumatic Stress Studies, Dallas, TX.

Kearns, J.C., Gorman, K.R., Harris, J.A., Green, J.D., Nock, M.K. & Marx, B.P. (2015, November). *Examining the relationship between recent suicidal ideation, depression, and PTSD in veterans in VHA inpatient psychiatric hospital.* Poster presented at the International Society for Traumatic Stress Studies annual meeting, New Orleans, LA.

Klein, A.B., Green, J.D., Gorman, K.R., Bovin, M.J., Rosen, R.C., Keane, T.M. & Marx, B.P. (October, 2016). *Associations between childhood trauma and the dissociative sexual type of PTSD in OEF/OIF veterans.* Poster accepted for presentation at the 50th annual meeting of the Association for Behavioral and Cognitive Therapies, New York, NY.

Klein, A.B., Moshier, S.J., Harwell, A.M., Rosen, R.C., Keane, T.M. & Marx, B.P. (November, 2016). *Associations between treatment satisfaction and one-year clinical outcomes in OEF/OIF veterans with PTSD.* Poster accepted for presentation at the 32nd annual meeting of the International Society for Traumatic Stress Studies, Dallas, TX.

Marx, B.P., Green, J.D., Bovin, M.J., Wolf, E.J., Annunziata, A., Rosen, R.C., & Keane, T.M. (November, 2015). *Risk factors and correlates of the PTSD dissociative subtype*. In C. Fleming (Chair), *Understanding trauma-related dissociation: Risk factors and outcomes*. Symposium conducted at the 49th annual convention Association for Behavioral and Cognitive Therapies, Chicago, IL.

Marx, B. P., Green, J., Bovin, M. J., Wolf, E., Annunziata, A., Rosen, R. C., & Keane, T. M. (November, 2015). *Risk factors and correlates of the PTSD dissociative subtype*. Paper presented as part of a symposium (The dissociative subtype of PTSD: Theory, clinical and biological studies, and treatment implications; Chair: R. Lanius) at the International Society for Traumatic Stress Studies 31st Annual Meeting. New Orleans, LA.

Marx, B.P., Green, J.D., Kearns, J.C., Gradus, J., Rosen, R.C., & Keane, T.M. (April, 2016). Postdeployment social support as a protective factor for suicide risk among OEF/OIF veterans. In Marx, B.P. (Chair), *Suicide risk and resiliency in active duty military personnel and returning military veterans.* Symposium conducted at the 30th meeting of the Anxiety and Depression Association of America, Philadelphia, PA.

Moshier, S.J., Erb, S., Parker-Guilbert, K., Trachtenberg, F., Rosen, R.C., Keane, T.M., & Marx B.P. (November, 2016). *Less symptomatic but more impaired: Correlates of early treatment termination among returning veterans with PTSD*. Poster to be presented at the 32nd annual meeting of the International Society for Traumatic Stress Studies, Dallas, TX.

Moshier, S.J., Klein, A.B., Harwell, A.M., Parker-Guilbert, K., Erb, S., Trachtenberg, F., Rosen, R.C., Keane, T.M., Marx, B.P. (November, 2016) *Who can't get no satisfaction? Satisfaction with VA and non-VA mental health care among OIF/OEF veterans with PTSD*. Poster accepted for presentation at the 32nd annual meeting of the International Society for Traumatic Stress Studies, Dallas, TX.

Parker-Guilbert, K.S., Erb, S., Moshier, S. J., Trachtenberg, F. L, Rosen, R. C., Keane, T. M., & Marx, B. P. (August, 2016). *The influence of PTSD Service Connection on mental health treatment utilization.* Poster presented at the Military Health System Research Symposium (MHSRS), Kissimmee, FL.

Trachtenberg, F. L., Marx, B. P., Seal, K., Bovin, M. J., Green, J. D., Wilkinson, A., Rosen, R. C., & Keane, T. M. (August, 2016). *Accuracy of PTSD diagnosis and mental health service utilization: Longitudinal findings from Project VALOR*. Poster presented at the Military Health System Research Symposium Annual Meeting. Orlando, FL.

Trachtenberg, F. L., Rosen, R. C., Marx, B. P., Seal, K., Fang, S., Bovin, M. J., Green, J. D., Wilkinson, A., & Keane, T. M. (August, 2016). *Mental health treatment utilization among combat-exposed OIF/OEF veterans with and without PTSD*. Poster presented at the Military Health System Research Symposium Annual Meeting. Orlando, FL.

7. **INVENTIONS, PATENTS AND LICENSES:**

Nothing to report

8. **REPORTABLE OUTCOMES:**

Marx and colleagues (in press) examined the influence of veterans' race and examiners' use of psychometric testing during a Department of Veterans Affairs posttraumatic stress disorder (PTSD) disability examination on diagnostic and service connection status outcomes. Current and lifetime PTSD diagnostic status were determined with the Structured Clinical Interview for DSM-IV (SCID) and were compared with PTSD diagnosis conferred upon veterans by their compensation and pension (C&P) examiners as well as with ultimate Veterans Affairs (VA) PTSD service connected (SC) status. The concordance rate between independent SCID PTSD diagnosis and PTSD disability examination diagnosis was 70.4% when utilizing the current version of the SCID and was 77.7% when utilizing the lifetime version of the SCID. Among veterans with current SCID diagnosed PTSD, Black veterans were significantly less likely than White veterans to receive a PTSD diagnosis from their C&P examiner (*OR* = .39, *p* = .003, CI = .20-.73). Among veterans without current SCID diagnosed PTSD, White veterans were significantly more likely than Black veterans to receive a PTSD diagnosis from their C&P examiner (*OR* = 4.07, *p* = .005, CI = 1.51-10.92). Splitting the sample by use of psychometric testing revealed that disability examinations that did not include psychometric testing demonstrated the same relationship between veteran race and diagnostic concordance. However, for examinations in which psychometric testing was used, the racial disparity between SCID PTSD status and disability exam PTSD status was no longer significant. Results suggest that psychometric testing may reduce disparities in VA PTSD disability exam outcomes. The above detailed paper is attached for reference.

Wisco and colleagues (2016) examined the impact of the proposed International Classification of Diseases *ICD-11* changes on PTSD prevalence relative to the *ICD-10* and the Diagnostic and Statistical Manual of Mental Disorders *(DSM-5)* definitions of PTSD. Wisco and colleagues also evaluated the extent to which these changes would accomplish the stated aim of reducing the comorbidity associated with PTSD. The *ICD-11* definition yielded prevalence estimates 10–30% lower than *DSM-5* and 25% and 50% lower than *ICD-10* with no reduction in the prevalence of common comorbidities. Findings suggest that by constraining the diagnosis to a narrower set of symptoms, the proposed *ICD-11* criteria set would substantially reduce the number of individuals with PTSD. These findings raise doubt about the extent to which the *ICD-11* proposal would achieve the aim of reducing comorbidity associated with PTSD and highlight the public health and policy implications of such a redefinition. The above detailed paper is attached for reference.

Wolf and colleagues (2016) examined the longitudinal associations between PTSD and metabolic syndrome. PTSD has been previously associated with elevated risk for metabolic syndrome (MetS). However, the direction of this association had not yet been established, as most prior studies employed cross-sectional designs. Wolf and colleagues (2016) evaluated bidirectional associations between PTSD and metabolic syndrome (MetS) using the diagnostic assessment and EMR data from the longitudinal Project VALOR sample at two time points (spanning ~2.5 years, n = 971 at the second timepoint).The prevalence of MetS among veterans with PTSD was just under 40% at both timepoints and was significantly greater than that for veterans without PTSD; the prevalence of MetS among those with PTSD was also elevated relative to age-matched population estimates. Cross-lagged panel models revealed that PTSD severity predicted subsequent increases in MetS severity ($\beta = 0.08$, $p = 0.002$), after controlling for initial MetS severity, but MetS did not predict later PTSD symptoms. Logistic regression results suggested that for every 10 PTSD symptoms endorsed at time 1, the odds of a subsequent MetS diagnosis increased by 56%. Results highlight the substantial cardiometabolic concerns of young veterans with PTSD and raise the possibility that PTSD may predispose individuals to accelerated aging, in part, manifested clinically as MetS. This demonstrates the need to identify those with PTSD at greatest risk for MetS and to develop interventions that improve both conditions. The above detailed paper is attached for reference.

9. **OTHER ACHIEVEMENTS:**
   Nothing to report

10. **REFERENCES**
    N/A

11. **APPENDICES**
    Attached

Project VALOR: Trajectories of Change in PTSD in Combat-Exposed Veterans
Quarterly Report
W81XWH-12-2-0117

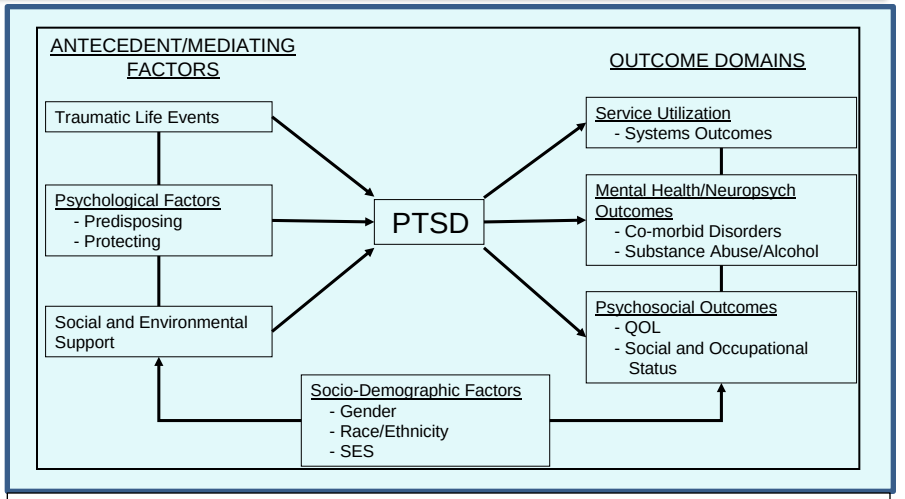
PI: Terence M. Keane, PhD **Org**: VA Boston Healthcare System **Award Amount:** $3,295,994

Study/Product Aim(s)

- Examine trajectories of PTSD symptomatology and diagnosis by medical chart abstractions and diagnostic interview assessments in combat-exposed men and women.
- Examine the nature and extent of military sexual trauma (MST) in combat-exposed men and women who have utilized the VA Healthcare System, including the contribution of MST to PTSD symptoms and diagnosis.
- Examine associations of PTSD, mTBI, major depressive disorder (MDD), and treatment utilization in relation to changes in suicidal ideation.

Approach

To develop the first longitudinal registry of combat-exposed men and women with post-traumatic stress disorder (PTSD), 1649 participants from across the country will complete a second follow-up round of online questionnaires, and telephone interviews. We will also have access to our participants' electronic VA medical charts.



Given the no-cost extension, data collection for the third time point which began in 09/2015 will now continue until 01/2017. Analysis of data from VALOR 1 and from the first and second time points of VALOR 2 is ongoing.

Timeline and Cost

Activities CY	12	13	14	15
IRB and HRPO Approval				
Data Collection (Rounds 1-3)				
Analysis of Data (Phases 1 and 2)				
Preparation of Dataset for Future Use				
Estimated Budget ($K)	**$759.8**	**$852.5**	**$875.5**	**$808.2**

Updated: 10/20/2016

Goals/Milestones

CY12 Goal – Start Data Collection
☑ Training of study stuff
☑ Continue analysis of data from Valor 1
CY13 Goals – Continue Data Collection
☑ Training of study staff
☑ Continue analysis of data from Valor 1
CY14 Goal – Continue Data Collection
☑ Start collection of Round 2 data
☑ Finish collection of Round 2 data
☑ Start Round 3 data collection
CY15 Goal – Complete Data Collection and Analyze Data
☐ Finish collection of Round 3 data
☐ Continue data analysis and prepare database for future use

Budget Expenditure to Date
Projected Expenditure: $ 3,295,994
Actual Expenditure: $2,543,821.64

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Psychological Assessment

http://dx.doi.org/10.1037/pas0000378

The Influence of Veteran Race and Psychometric Testing on VA PTSD Disability Exam Outcomes

AQ: au
AQ: 1

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Veterans Affairs Boston Healthcare System, Boston, Massachusetts and Boston University

This study examined the influence of veterans' race and examiners' use of psychometric testing during a Department of Veterans Affairs posttraumatic stress disorder (PTSD) disability examination on diagnostic and service connection status outcomes. Participants were 764 veterans enrolled in a national longitudinal registry. Current and lifetime PTSD diagnostic status was determined with the Structured Clinical Interview for *DSM–IV* (SCID) and was compared with PTSD diagnosis conferred upon veterans by their compensation and pension (C&P) examiners as well as with ultimate Veterans Affairs (VA) PTSD service connected status. The concordance rate between independent SCID current PTSD diagnosis and PTSD disability examination diagnosis was 70.4%, and between SCID lifetime PTSD diagnosis and PTSD disability examination diagnosis was 77.7%. Among veterans with current SCID diagnosed PTSD, Black veterans were significantly less likely than White veterans to receive a PTSD diagnosis from their C&P examiner (odds ratio [OR] = .39, p = .003, confidence interval [CI] = .20–.73). Among veterans without current SCID diagnosed PTSD, White veterans were significantly more likely than Black veterans to receive a PTSD diagnosis from their C&P examiner (*OR* = 4.07, p = .005, CI = 1.51–10.92). Splitting the sample by use of psychometric testing revealed that examinations that did not include psychometric testing demonstrated the same relation between veteran race and diagnostic concordance. However, for examinations in which psychometric testing was used, the racial disparity between SCID PTSD status and disability exam PTSD status was no longer significant. Results suggest that psychometric testing may reduce disparities in VA PTSD disability exam outcomes.

AQ: 2

Keywords: veterans, PTSD, disability, disparities, ~~assessment,~~ service connection

Brian P. Marx, National Center for PTSD, Veterans Affairs Boston Healthcare System, Boston, Massachusetts and Department of Psychiatry, School of Medicine, Boston University; Eden Engel-Rebitzer, Research Service, Veterans Affairs Boston Healthcare System; Michelle J. Bovin, National Center for PTSD, Veterans Affairs Boston Healthcare System and Department of Psychiatry, School of Medicine, Boston University; Kelly S. Parker-Guilbert, Samantha Moshier, Kenneth Barretto, and Derek Szafranski, Research Service, Veterans Affairs Boston Healthcare System; Matthew W. Gallagher and Darren W. Holowka, National Center for PTSD, Veterans Affairs Boston Healthcare System and Department of Psychiatry, School of Medicine, Boston University; Raymond C. Rosen, New England Research Institutes, Watertown, Massachusetts; Terence M. Keane, National Center for PTSD, Veterans Affairs Boston Healthcare System and Department of Psychiatry, School of Medicine, Boston University.

Derek Szafranski is now at Ralph Johnson Veterans Affairs Medical Center, Charleston, South Carolina. Matthew W. Gallagher is now at Department of Psychology, University of Houston. Darren W. Holowka is now at Rhode Island Hospital, Providence, Rhode Island.

This research was funded by the Department of Defense, Congressionally Directed Medical Research Program under designations W81XWH-08-2-0100/W81XWH-08-2-0102 and W81XWH-12-2-0117/W81XWH-12-2-0121.

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Over the past 15 years, the number of veterans who have applied for and received posttraumatic stress disorder (PTSD) related disability compensation from the U.S. Department of Veterans Affairs (VA) has risen dramatically. For example, between 2008 and 2013, the number of veterans receiving disability compensation for PTSD rose from 467,274 to 648,992 (U.S. Department of Veterans Affairs, 2013), a 72% increase. VA disability compensation is a tax-free monetary benefit paid to veterans for service connected (SC) disabilities (i.e., those which arose during, or were worsened by, military service). To receive benefits (e.g., free health care, financial compensation) for disability related to service conditions, veterans must submit a claim to the Veterans Benefits Administration (VBA), which then gathers evidence to determine whether the condition in question is present, associated with a disability, and started or got worse as a result of military service. One major component reviewed by the VBA to make these determinations is the compensation and pension (C&P) examination. For PTSD claims, this involves an in-person clinical interview conducted by a licensed psychologist or psychiatrist. Examiners are asked to determine whether the claimant's symptoms meet the diagnostic criteria for PTSD as defined by the *Diagnostic and Statistical Manual for Mental Disorders* (*DSM*; American Psychiatric Association, 2000) and must document related changes in quality of life and psychosocial functioning (VBA, 2014). However, there is no standard methodology required to conduct the examination. Following the C&P examination, a VBA adjudication board reviews all evidence (e.g., service records, Social Security disability records, C&P examination results) and either approves or denies the provision of financial and other benefits.

As the number of PTSD disability claims began to increase, the VA Office of the Inspector General (OIG; 2005) conducted an internal investigation to determine the causes of both this unprecedented increase in claims and the notable disparities in disability payments made to veterans living in different states. A key finding of this investigation was that the accuracy of the disability rating and amount of compensation benefits paid for military SC disabilities is highly dependent upon the methodology used in disability evaluations. The report also noted that, because of the reliance upon an individual's self-report during the examination, determinations about the diagnostic status of mental health conditions (e.g., PTSD) are open to examiner interpretation. This is especially concerning because many VA PTSD disability examiners do not use evidence-based assessment methods during their examinations, even though these methods result in more complete and accurate coverage of PTSD symptoms and associated functional impairment during PTSD disability examinations (Jackson et al., 2011; Speroff et al., 2012). Concerns voiced about the accuracy and quality of the PTSD disability examination were further substantiated by a recent study by Marx and colleagues (2016) showing that the association between a PTSD diagnosis as determined by an independent evaluator using evidence-based methods and PTSD SC status is often discordant. Specifically, Marx et al. found that a significant minority of veterans who are currently receiving VA benefits for SC PTSD do not actually meet criteria for the disorder. Similarly, the authors' results indicated that a substantial number of veterans with military service-related PTSD who are sufficiently disabled by the disorder were denied these same benefits. However, Marx et al. (2016) did not examine the concordance between PTSD diagnosis determined by an independent assessor and the diagnosis made by the PTSD C&P examiner.

The VA OIG investigation also suggested that a number of other factors outside of the diagnostic criteria (e.g., veterans' age, branch of service) might impact VA disability rating outcomes. Notably, the influence of veteran racial status on these ratings was not examined. This exclusion is noteworthy, as research both prior to and since the VA OIG investigation has shown that Black veterans receive different VA care than White veterans for a wide range of conditions (Saha et al., 2008); receive less intensive treatment for PTSD specifically (Rosenheck, Fontana, & Cottrol, 1995); are less likely to receive a minimal trial of treatment in the 6 months following PTSD diagnosis (Spoont et al., 2015); are less satisfied with the quality of their PTSD disability examinations (Rosen et al., 2013); and are less likely to be service connected for PTSD, even after controlling for PTSD symptom severity and level of functional impairment (Murdoch, Hodges, Cowper, Fortier, & van Ryn, 2003). These findings suggest that veteran racial status may also influence the outcomes of VA PTSD disability examinations as well as the potential eligibility for disability compensation and other VA benefits. However, researchers have not yet examined whether veterans' race moderates the concordance between the C&P examiner's diagnosis and an independent assessor's diagnosis of PTSD, particularly in the absence of psychometric testing during the disability exam.

This study extends the previous work on this topic by examining the extent to which diagnoses rendered by PTSD C&P examiners were concordant with diagnoses determined by assessors who conducted an independent, semistructured diagnostic examination subsequent to the PTSD disability examination. In addition, we examined if veterans' race contributed to discordance between these diagnostic outcomes, and whether the use of psychometric testing by the C&P examiner moderated any association between veteran race and the degree of concordance between PTSD diagnoses rendered by C&P examiners and PTSD diagnoses rendered by independent evaluators. We hypothesized that (a) among veterans diagnosed with PTSD by an independent evaluator, Black veterans would be more likely than White veterans to be denied a PTSD diagnosis by their C&P examiner; (b) among veterans who did not meet criteria for PTSD based on an independent evaluation, White veterans would be more likely than Black veterans to be granted a PTSD diagnosis by their C&P examiner; (c) the use of psychometric testing during disability exams would moderate the association between race and concordance, such that the use of psychometric testing would reduce the racial disparity between the independent PTSD diagnosis and the C&P examiner diagnosis; (d) the C&P examiner diagnosis would be associated with SC status; and (e) race would also affect concordance between PTSD diagnosis determined by an independent evaluator and SC status.

Method

Participants

Participants were a subsample of U.S. Army or Marine veterans enrolled between 2009 and 2012 in the baseline assessment of the Veterans After-Discharge Longitudinal Registry (Project VALOR), a registry of VA mental health care users with and without PTSD who deployed in support of Operation Enduring

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Freedom, Operation Iraqi Freedom, or Operation New Dawn (OEF/OIF/OND). To be included in the cohort, veterans must have undergone a mental health evaluation at a VA facility. Veterans with probable PTSD according to VA medical records (i.e., at least two instances of a PTSD diagnosis by a mental health professional associated with two separate visits) were oversampled at a 3:1 ratio. Female veterans were oversampled at a rate of 1:1 (female: male). Potential Project VALOR participants (n = 4,331) were contacted by phone; of these, 2,712 (62.6%) consented to participate in the Project VALOR registry. Of consented participants, 2,169 (80.0%) completed the questionnaires and 1,649 (60.8%) completed both the questionnaires and the diagnostic interview, which comprised the final Project VALOR sample.

In this study, we included participants from Project VALOR who reported a military-related trauma as their index event for the Structured Clinical Interview for *DSM–IV* (SCID), were assessed for current and lifetime PTSD diagnostic status, had documentation of a PTSD disability exam in their electronic medical records (EMRs), and reported being either Black or White. Participants reporting a different racial status were excluded from our analyses because of small cell sizes, which would have limited statistical power. Seven hundred ninety-seven participants were excluded because they did not have a documented PTSD disability exam, 15 participants were excluded because they were not assessed for current PTSD, and 73 participants were excluded because they reported being a race other than Black or White. Our final sample (n = 764) ranged in age from 22 to 67 years (M = 38.2; SD = 9.9) and the majority of the sample (83.9%) had completed at least some college. Fifty-five percent (n = 422) of participants were men. Eighty-four percent (n = 645) were White veterans, whereas the remaining 16% (n = 119) were Black veterans. Ninety-two percent (n = 703) served in the Army and 8% (n = 61) served in the Marines. Respondents who did not meet the inclusion criteria were younger (M = 36.6, SD = 9.5 for the excluded participants), $t(1644) = 3.34$, $p < .001$, and less likely to be male (45.4% of the excluded participants; $\chi^2 = 15.79$, $p < .001$).

Procedure

Participants provided informed consent verbally over the telephone in accordance with the research protocol approved by all local Institutional Review Boards and the Human Research Protection Office of the U.S. Army Medical Research and Material Command. After receiving verbal consent, study staff scheduled the telephone interview and reminded the participant to complete the self-administered questionnaires online. Participants were compensated $50 for their participation in the study.

Measures

Independent evaluation of PTSD diagnostic status. Trained, doctoral-level diagnosticians assessed current (past month) and lifetime PTSD via telephone using the PTSD Module of the Structured Clinical Interview for *DSM–IV* (SCID; First, Spitzer, Gibbon, & Williams, 2002). The SCID is a semistructured interview that assesses diagnoses associated with *DSM–IV*. Data collected with the PTSD SCID module has demonstrated good psychometric properties in veteran samples (Kulka, Schlenger, Fairbank, & Hough, 1988).

Interviewers were blind to PTSD disability exam outcomes, PTSD SC status, and participant race. Throughout the study, we held regular meetings with assessment personnel during which cases were discussed to ensure diagnostic reliability and to prevent rater drift. Interrater reliability for SCID interview data, computed based on a randomly selected subsample (n = 54), was excellent (κ = .91). SCID PTSD diagnostic status was the independent standard to which both C&P examiner PTSD diagnosis and PTSD SC status were compared.

PTSD disability exams and SC status. Trained research assistants collected C&P examiner-determined diagnoses and information on the use of psychometric testing by accessing the C&P section, the progress notes section, and the health summaries section of participants' EMRs. When multiple PTSD C&P exams were found in the EMR, we compared the C&P exams that were most proximal to our PTSD assessment, regardless of whether or not they were initial or review C&P exams, to minimize the possibility that any discrepancies would be due to change in diagnostic status over time. The mean time between disability exams and the Project VALOR assessment was 22.11 months (SD = 18.35). Research assistants also collected PTSD SC status information by accessing the disabilities section of participants' EMRs. These data were abstracted concurrently with the collection of Project VALOR self-report questionnaire and interview data.

Demographics. Participants completed a self-report questionnaire that gathered information about participant age, race, gender, education, and income.

Deployment Risk and Resilience Inventory. The Deployment Risk and Resilience Inventory (DRRI; King, King, Vogt, Knight, & Samper, 2006) is a collection of scales that assess combat-related factors associated with mental health conditions noted in veteran populations. DRRI scores have shown good internal consistency and satisfactory reliability among samples of Gulf War and Operation Iraqi Freedom veterans (Vogt, Proctor, King, King, & Vasterling, 2008). To assess combat exposure, the Combat Experiences subscale of the DRRI was included in the self-administered questionnaire.

Data Analysis Plan

We conducted three sets of analyses to examine the association between C&P examiner PTSD diagnosis and SCID PTSD diagnosis. First, we calculated 2 × 2 contingency tables to examine both the overall concordance between C&P examiner PTSD diagnosis and SCID PTSD diagnosis and the directionality of concordance/discordance. Participants were classified into four possible outcomes in these concordance analyses as (a) true positives (C&P examiner PTSD diagnosis is Yes and SCID PTSD diagnosis is Yes), (b) false negatives (C&P examiner PTSD diagnosis is No and SCID PTSD diagnosis is Yes), (c) false positives (C&P examiner PTSD diagnosis is Yes and SCID PTSD diagnosis is No), and (d) true negatives (C&P examiner PTSD diagnosis is No and SCID PTSD diagnosis is No). Overall concordance was calculated by summing the true positives and true negatives and discordance was calculated by summing the false positives and false negatives. In these initial analyses, we examined both current and lifetime diagnostic SCID PTSD status compared with C&P examiner PTSD status. Given that current PTSD symptoms, distress, and functional impairment are the typical focus of VA PTSD

disability examinations and PTSD service connection decisions, we focused our primary analyses on comparing disability examination and service connection outcomes with current SCID PTSD diagnostic status. However, in an attempt to account for any discrepancies in diagnostic outcomes that might be unrelated to any of our variables of interest, we reran all analyses using lifetime SCID PTSD diagnostic status, instead of current SCID PTSD diagnostic status.

Next, we examined the effect of race on three different aspects of concordance/discordance. First, we examined whether Black veterans demonstrated significantly different patterns of overall concordance/discordance than White veterans. This was conducted as an omnibus test to see if differences appeared prior to examining the components of concordance. Second, we examined if race affected whether veterans who met criteria for a SCID PTSD diagnosis were classified as having PTSD by their C&P examiner (i.e., true positive) or not (i.e., false negative). If race does not affect concordance, we would expect rates at which veterans with a SCID PTSD diagnosis to be classified as true positives versus false negatives to be equivalent for White and Black veterans. Third, we examined if race affected whether veterans who did not meet criteria for a SCID PTSD diagnosis were classified as having PTSD by their C&P examiner (i.e., false positive) or not (i.e., true negative). If race does not affect concordance, we would expect rates at which veterans without a SCID PTSD diagnosis to be classified as true negatives versus false positives to be equivalent for White and Black veterans. For each of these questions, we conducted logistic regressions to see if race affected these different aspects of concordance after controlling for demographic variables that could potentially influence PTSD status (i.e., age, gender, education and income), as well as combat exposure, as assessed by the DRRI, and the amount of time between the Project VALOR assessment and the PTSD disability exam.

Finally, we examined whether the use of psychometric testing during a PTSD disability exam affected concordance between the C&P exam and the SCID. To do so, we first split the sample by whether psychometric testing was used during the disability exam. For each group, we then reran the logistic regressions examining the effect of race on overall concordance, categorization of SCID PTSD positive participants into true positive versus false negative, and categorization of SCID PTSD negative participants into true negative versus false positive. If psychometric testing had no effect, we would expect the outcomes of two sets of analyses to match each other as well as those for the full sample.

Because the PTSD disability examination is only one (albeit important) aspect of determining SC status, we were also interested in how the C&P examiner diagnosis related to SC status among participants in our sample. Therefore, we conducted a Pearson correlation to determine the association between C&P examiner PTSD diagnosis and SC status. Further, we were interested in examining whether our findings regarding race for C&P examiner PTSD also held for SC status. Therefore, we classified participants into true positives, true negatives, false positives, and false negatives based on SCID PTSD status and SC status (rather than C&P examiner PTSD diagnosis), and reran the three logistic regressions described previously.

Results

Diagnostic Concordance Between C&P Examiner PTSD Diagnosis and SCID PTSD Diagnosis

Concordance between both current and lifetime SCID PTSD diagnosis and C&P examiner PTSD diagnosis is reported in Table 1. The overall concordance rate was 70.4% for current PTSD and 77.7% for lifetime PTSD. Individuals who received a PTSD diagnosis from their C&P examiners were more than three times as likely as those who did not to also receive a current SCID PTSD diagnosis (odds ratio [OR] = 3.39, 95% confidence interval [CI] = 2.25–5.15, $p < .001$). The most frequent outcome using current SCID PTSD was true positive (62.9%) and the least frequent outcome was true negative (7.4%). There were slightly more false positives than false negatives (16.4% vs. 13.1%). T1

Race and Diagnostic Concordance

The average number of PTSD symptoms reported during the current SCID interview did not significantly differ between White ($M = 11.45$, $SD = 3.59$) and Black veterans ($M = 11.76$, $SD = 3.43$); $t(747) = -.87$, $p = .39$. Logistic analyses revealed that race did not significantly affect the overall concordance between current SCID PTSD diagnosis and C&P examiner PTSD diagnosis (74.8% concordance for White veterans vs. 74.4% concordance for Black veterans; OR = .97, $p = .90$; CI = .60–1.57; see Table 2). However, race did significantly affect several important aspects of concordance. Specifically, compared with Black veterans who did not receive a current PTSD diagnosis on the SCID, the odds were four times as great that White veterans who did not receive a current PTSD diagnosis on the SCID would receive a PTSD diagnosis from their C&P examiner (i.e., White veterans were more likely to be false positives than Black veterans; 26.5% vs. 54.5%, respectively; OR = 4.07, $p < .001$; CI = 1.51–10.92; see Table 2). T2

Among veterans who received a current SCID PTSD diagnosis, Black veterans were again less likely to receive a PTSD diagnosis from the C&P examiner than White veterans (78.9% vs. 90.8%, respectively). Specifically, Black veterans who received a current

Table 1
Contingency Tables for C&P Examiner PTSD Diagnosis and SCID PTSD Diagnosis

Diagnosis	C&P PTSD diagnosis: No	C&P PTSD diagnosis: Yes
Current SCID PTSD diagnosis		
No	57 (7.4%)[a]	100 (13.1%)[b]
Yes	126 (16.4%)[c]	481(62.9%)[d]
Lifetime SCID PTSD diagnosis		
No	31 (4.1%)[a]	125 (16.4%)[b]
Yes	45 (5.9%)[c]	560 (73.5%)

Note. C&P = compensation and pension; SCID = Structured Clinical Interview for DSM-IV; PTSD = posttraumatic stress disorder; TN = true negatives; FP = false positives; FN = false negatives; TP = true positives. Overall concordance for C&P Diagnosis and Current SCID Diagnosis (TP + TN) = 70.4% ($n = 538$). Overall concordance for C&P Diagnosis and Lifetime SCID Diagnosis (TP + TN) = 77.7% ($n = 591$).

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Table 2
Race As A Predictor of Concordance Between Current SCID PTSD Status and C&P PTSD Status

Variable	Concordance vs. discordance		False positive vs. true negative		False negative vs. true positive	
	OR	CI	OR	CI	OR	CI
White vs. Black	.97	.60–1.57	4.07**	1.51–10.92	.39**	.20–.73
Combat exposure	.97**	.96–.99	.98	.94–1.01	1.04**	1.02–1.07
Education	1.02	.90–1.16	1.05	.82–1.36	1.01	.83–1.23
Gender	1.30	.89–1.92	1.47	.67–3.25	.65	.35–1.22
Income	.94	.83–1.06	.98	.76–1.27	1.06	.88–1.29
Age	.99	.97–1.01	1.01	.97–1.04	1.01	.98–1.04
Months between Project VALOR assessment and C&P examination	1.01	1.00–1.02	1.02*	1.00–1.04	.99	.98–1.01

Note. C&P = compensation and pension; OR = odds ratio; CI = confidence interval.
* $p < .05$. ** $p < .01$.

SCID PTSD diagnosis had less than half the odds of White veterans of receiving a PTSD diagnosis from their C&P examiners (i.e., Black veterans were more likely to be false negatives than White veterans; OR = .39, $p < .001$, CI = .20–.73, see Table 2).

When we reran these analyses using lifetime SCID PTSD diagnostic status, overall concordance was significantly different as a product of race, such that White veterans had higher rates of concordance than Black veterans (84.1% vs. 74.4%; OR = 1.70, $p = .04$, CI = 1.03–2.81). This effect was due likely to the fact that although White veterans were still more likely to be false positives than Black veterans, this effect was no longer significant (61.5% vs. 40.0%; OR = 3.32, $p = .14$, CI = .68–16.26). Consistent with our findings for current SCID PTSD, when examining lifetime SCID PTSD, Black veterans were again significantly more likely to be false negatives than White veterans (24.3% vs. 10.6%; OR = .37, $p < .001$, CI = .21–.65).

Psychometric Testing, Race, and Diagnostic Concordance

Most disability exams (75.8% of exams overall; 80.3% of exams for Black veterans; 75.0% of exams for White veterans) did not include any psychometric testing. Of those that did, the most commonly used instruments, in order, were the PTSD Checklist (Weathers, Litz, Herman, Huska, & Keane, 1993; 15.4%), the Minnesota Multiphasic Personality Inventory (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989; 11.8%), the Mississippi Scale for Combat-Related PTSD (Keane, Caddell, & Taylor, 1988; 10.6%), the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961; 9.4%), and the Clinician-Administered PTSD Scale (Blake et al., 1995; 7.1%).

To examine whether the use of testing during PTSD disability exams moderated the association between race and diagnostic concordance, the sample was split based on whether psychometric testing was used during the disability exam conducted most proximally to the Project VALOR SCID interview. In the subgroup of veterans that was administered a psychometric test during their disability exam, race did not significantly affect the overall concordance between current SCID PTSD diagnosis and C&P examiner PTSD diagnosis (OR = .92, $p = .88$; CI = .32–2.66; see Table 3). Interestingly, in this subgroup, White veterans were no more likely than Black veterans to be false positives (63.9% vs. 75.0%, respectively; OR = .43, $p = .56$, CI = .03–7.28), and Black veterans were no more likely than White veterans to be false negatives (15.8% vs. 15.5%; OR = 1.45, $p = .62$, CI = .34–6.24, see Table 3). In the subgroup that was not administered a psychometric test during their disability exam, overall concordance was again not significantly affected by race (OR = .89, $p = .69$; CI = T3

Table 3
Race as a Predictor of Concordance Between Current SCID PTSD Status and C&P PTSD Status for Cases in Which Psychometric Testing Was Used

Variable	Concordance vs. discordance		False positive vs. true negative		False negative vs. true positive	
	OR	CI	OR	CI	OR	CI
White vs. Black	.92	.32–2.66	.43	.03–7.28	1.45	.34–6.24
Combat exposure	.97	.94–1.01	.89*	.80–1.00	1.05	1.00–1.10
Education	.85	.64–1.12	1.73	.89–3.35	1.17	.77–1.78
Gender	1.38	.63–3.06	5.12	.67–39.30	.48	.15–1.60
Income	1.04	.81–1.35	.74	.43–1.27	1.28	.86–1.91
Age	1.00	.96–1.04	.97	.89–1.06	1.00	.92–1.04
Months between Project VALOR assessment and C&P examination	1.00	.98–1.02	1.02	.97–1.07	1.01	.98–1.04

Note. C&P = compensation and pension; OR = odds ratio; CI = confidence interval.
* $p < .05$.

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T4 .52–1.56; see Table 4). However, unlike the subgroup that was administered a psychometric test during their disability exam, for this group, the previously described relationships remained significant. Specifically, White veterans were significantly more likely to be false positives than Black veterans (76.1% vs. 38.9%; OR = 7.00, $p < .001$, CI = 2.21–22.14), and Black veterans were significantly more likely to be false negatives than White veterans (21.3% vs. 7.2%; *OR* = .29, $p < .001$, CI = .14-.61; see Table 4).

Results of analyses with lifetime SCID PTSD diagnosis followed the same general pattern of results. For the subgroup that did not receive psychometric testing, White veterans demonstrated significantly more overall concordance than Black veterans (85.5% vs. 73.1%; OR = 1.80, $p = .04$, CI = 1.02–3.17). In addition, more White veterans (64.0%) than Black veterans (37.5%) were false positives and this effect was marginally significant (OR = 8.35, $p = .06$, CI = .92–75.71). Similar to both the overall lifetime SCID PTSD findings and the findings for current SCID PTSD, Black veterans were significantly more likely to be false negatives than White veterans (25.9% vs. 8.5%; OR = .28, $p < .001$, CI = .15–.53). However, for the subgroup that received psychometric testing, these effects disappeared. There was no longer a significant effect of race on overall concordance (79.3% of White veterans vs. 82.6% of Black veterans; OR = .94, $p = .93$, CI = .28–3.25), rate of false positives (50% of White veterans vs. 50% of Black veterans; OR = 3.16, $p = .67$, CI = .02–656.64), or rate of false negatives (14.3% of White veterans vs. 17.6% of Black veterans; OR = 1.40, $p = .64$, CI = .35–5.62).

SC Status

As expected, a Pearson correlation revealed a significant positive relationship between C&P PTSD status and the respondent's SC status, $r = .73$, $p < .001$. Among respondents who were diagnosed with PTSD during their C&P exam, 91.9% were service connected for PTSD. Among respondents who were denied a PTSD diagnosis during the C&P exam, 86.6% were not service connected for PTSD. Further, when we examined the association between race and concordance between SCID PTSD status and SC status, the pattern of results was identical to those of race and concordance between SCID PTSD status and C&P PTSD status. Specifically, similar to the results reported earlier, there was no significant relation between race and overall concordance (OR = .90, $p = .65$, CI = .57–1.43). However, race did significantly affect several important aspects of concordance, such that White veterans who did not meet SCID PTSD criteria were less likely than Black veterans who did not meet SCID PTSD criteria to be denied PTSD service connection (26.9% vs. 60.9%, respectively; OR = 4.50, $p < .001$, CI = 1.71–11.82), and Black veterans who met PTSD SCID criteria were less likely to receive PTSD service connection compared with White veterans who met PTSD SCID criteria (74.0% vs. 84.5%, respectively; OR = .54, $p = .03$, CI = .31-.94; see Table 5). T5

Results of the analyses examining concordance between SC status and lifetime SCID PTSD diagnostic status demonstrated a pattern of results nearly identical to those for C&P examiner PTSD diagnostic status and lifetime SCID PTSD diagnostic status. Specifically, overall concordance was again significantly different by race, such that White veterans demonstrated significantly higher levels of overall concordance than Black veterans (79.3% vs. 68.9%; OR = 1.61, $p = .04$, CI = 1.01–2.57). Although nonsignificant, White veterans had higher rates of false positives than Black veterans (62.1% vs. 40%; OR = 3.34, $p = .13$, CI = .69–16.13). Further, Black veterans were significantly more likely to be false negatives than White veterans (30.3% vs. 16.0%; OR = .45, $p < .001$, CI = .27–.75).

Discussion

We found that C&P PTSD diagnoses were concordant with current SCID PTSD status in 70.4% of cases and with lifetime SCID PTSD status in 77.7% of cases. These finding builds upon previous work by Marx et al. (2016), which demonstrated a similar concordance rate between SCID PTSD status and SC status using the same dataset. Although these results suggest that, in most cases, PTSD diagnoses rendered by C&P examiners are likely accurate, the number of false positives and false negatives does support prior concerns that PTSD disability exam outcomes may be incorrect for a significant minority of veterans. Our findings support concerns raised by others about the possible failings of the VA PTSD disability examination process (e.g., Frueh, Grubaugh, Elhai, & Buckley, 2007; Jackson et al., 2011; McNally & Frueh, 2013; OIG, 2005; Sperroff et al., 2012; Worthen & Moering, 2011)

Table 4
Race As A Predictor of Concordance Between Current SCID PTSD Status and C&P PTSD Status For Cases In Which Psychometric Testing Was Not Used

Variable	Concordance vs. discordance		False positive vs. true negative		False negative vs. true positive	
	OR	CI	OR	CI	OR	CI
White vs. Black	.89	.52–1.56	7.00**	2.21–22.14	.29**	.14–.61
Combat exposure	.98**	.96–.99	.99	.95–1.02	1.05**	1.01–1.08
Education	1.08	.94–1.25	.88	.65–1.19	.99	.78–1.25
Gender	1.17	.75–1.85	1.01	.40–2.65	.74	.34–1.61
Income	.89	.77–1.03	1.10	.80–1.51	1.04	.82–1.32
Age	.99	.97–1.02	1.01	.97–1.05	1.01	.97–1.05
Months between Project VALOR assessment and C&P examination	1.01	1.00–1.02	1.02	1.00–1.04	.99	.97–1.00

Note. C&P = compensation and pension; OR = odds ratio; CI = confidence interval.
** $p < .01$.

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Table 5
Race as a Predictor of Concordance Between Current SCID PTSD Status and SC Status

Variable	Concordance vs. discordance		False positive vs. true negative		False negative vs. true positive	
	OR	CI	OR	CI	OR	CI
White vs. Black	.90	.57–1.43	4.50**	1.71–11.82	.54*	.31–.94
Combat exposure	.97**	.95–.98	.98	.95–1.01	1.05**	1.03–1.08
Education	1.10	.97–1.23	.92	.72–1.18	.91	.77–1.08
Gender	1.32	.92–1.90	1.05	.50–2.22	.72	.43–1.21
Income	.98	.88–1.10	.84	.65–1.08	1.06	.91–1.25
Age	.99	.98–1.01	1.00	.97–1.03	1.01	.99–1.04
Months between Project VALOR assessment and C&P examination	1.01	1.00–1.01	1.01	1.00–1.03	.99	.98–1.01

Note. C&P = compensation and pension; OR = odds ratio; CI = confidence interval.
** $p < .01$.

and indicate that we should be concerned about both the number of veterans who may have PTSD who are not given the diagnosis by a C&P examiner (and are, therefore, also most likely denied the associated benefits including recognition that their disorder is military service related, access to free health care, and potential monetary compensation) and the number of veterans who are diagnosed with PTSD by a C&P examiner and receiving associated benefits when they may not be entitled to do so. Although questions and concerns about the latter have been discussed at great length, much less attention has been paid to the former even though research has shown that veterans receiving PTSD disability benefits report greater reductions in PTSD symptoms as well as less poverty and less homelessness than those who are denied these benefits (Murdoch et al., 2011).

Importantly, our study cannot provide a definitive explanation for discrepancies between C&P examiner PTSD diagnoses and SCID PTSD diagnoses. Possible explanations include insufficient knowledge or inadequate disability examination practices among C&P examiners, patient or institutional pressures, atypical symptom presentation, examiner biases, and inaccurate symptom reporting by veterans during either the disability exam or the SCID interview. In addition, because in many cases the SCID assessment occurred many months after the disability exam, it is entirely possible that some discrepancies may be the result of natural symptom fluctuations over time and remission or reduction of symptoms as function of treatment or other factors (though time from the disability exam to the SCID assessment was controlled for in our analyses and we also used the lifetime SCID PTSD diagnosis in subsequent analyses and those results generally supported those using the current SCID PTSD diagnosis).

Perhaps even more concerning than the discovery of these diagnostic discrepancies per se is the finding that, among veterans diagnosed with PTSD by an independent evaluator, Black veterans were significantly less likely than White veterans to receive both a C&P PTSD diagnosis and to be given PTSD service connection status. Further, among veterans not meeting diagnostic criteria for SCID PTSD, Black veterans tended to be more likely than White veterans to be denied both C&P PTSD status and PTSD service connection status. These results are consistent with our hypotheses as well as with findings from other studies that have documented racial disparities in VA care (Rosenheck et al., 1995), the amount of compensation given for service connected PTSD (Murdoch et al., 2003), and satisfaction with VA PTSD disability exams (Rosen et al., 2013).

Although our results provide evidence of racial disparities in the PTSD disability exam and PTSD service connection rating process, the source of such disparities remains unclear. One possibility could be implicit racial biases (i.e., beliefs that occur without conscious awareness which are frequently contrary to an individual's explicit beliefs; Devine, 1989) among C&P examiners. Research has demonstrated that the existence of implicit bias from the automatic activation of race and other stereotypes can influence judgment of, and behavior toward, individuals from a stereotyped group (Devine & Plant, 2012). Medical professionals, who work under conditions of uncertainty and time pressure, may be more likely to rely on stereotypes in decision-making (Chapman, Kaatz, & Carnes, 2013); this may make them vulnerable to their implicit bias. Indeed, a number of studies have documented the presence of implicit racial biases among medical professionals, despite the absence of explicit bias (Cooper et al., 2012; Green et al., 2007; Sabin & Greenwald, 2012; Sabin, Nosek, Greenwald, & Rivara, 2009). Further, research has suggested that these implicit racial biases can result in health care disparities (Chapman et al., 2013; Cooper et al., 2012).

Implicit biases, in turn, may influence how Black patients perceive their providers and interactions with them. Specifically, research indicates that stereotype threat (i.e., a situation in which one is "at risk of confirming, as self-characteristic, a negative stereotype about one's group;" Steele & Aronson, 1995, p. 797), may occur in health care environments. As such, if Black patients perceive cues that suggest implicit biases in their providers, these cues may threaten clinical interactions and patient adherence (Aronson, Burgess, Phelan, & Juarez, 2013). For instance, Black patients tend to perceive physicians with greater implicit racial bias, even when they have positive explicit racial attitudes, as less warm and friendly (Penner et al., 2013) and have less trust and confidence in them (Blair et al., 2013; Cooper et al., 2012). Importantly, patients with these perceptions may be less likely to cooperate with their doctors (Penner et al., 2013) or follow through on their recommendations (e.g., Bogart, Wagner, Galvan, & Banks, 2010; Dovidio et al., 2008). In the context of a VA PTSD disability examination, these interpersonal dynamics are important to be mindful of, as veterans who are suspicious, uncooperative, and/or unwilling to answer certain questions about their legal

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histories or other sensitive topics may be perceived by their examiners as devious or dishonest about their reported PTSD symptoms and their association with military service for secondary gain purposes.

Health care systems and institutional factors may also contribute to disparities; for instance, studies have found that Black and White patients tend to seek care in different settings (because of factors such as geography and socioeconomic status), and that Black patients are more likely to receive care in settings with fewer resources or in which providers are not as well trained (Bach, Pham, Schrag, Tate, & Hargraves, 2004). These sources are especially important to consider in light of the OIG investigation (OIG, 2005), which indicated that the state where disability exams are given influenced results. Previous research shows that the average rate of PTSD SC granted varies widely by region (Murdoch, Hodges, Cowper, & Sayer, 2005); therefore, it is also possible that the racial differences found in this study are consequences of regional differences in the C&P disability exam process. The relatively small proportion of Black participants in our sample prevented us from conducting follow-up analyses on the impact of geographic region on racial disparities found in concordance rates. Future research should study the provider, institution, and regional level characteristics that may contribute to the diagnostic accuracy of C&P examinations for PTSD.

We also found that the use of psychometric testing during a disability exam influenced the association between race and diagnostic concordance. For the disability exams in which psychometric testing was not used, discrepancies continued to emerge which favored White veterans over Black veterans. In contrast, in the disability exams in which psychometric testing was used, there was no significant relationship between race and diagnostic concordance. These findings were consistent with our hypothesis that, especially in the absence of psychometric testing, there is a discrepancy in PTSD-related outcomes between Black and White veterans in the VA disability process.

Our findings suggest that more widespread use of psychometric testing in VA PTSD disability exams may help to reduce the racial differences found in both C&P examiner and SC concordance. It may be that the use of psychometric measures of PTSD reduces the possibility that the examiner will be influenced by factors other than those pertinent to the diagnostic process (e.g., implicit racial bias). Consistent with this possibility, research has suggested that the effect of implicit bias can be reduced through individuating (i.e., applying conscious effort to focus on specific information about an individual; Chapman et al., 2013). One method for individuating is providing specific diagnostic information about an individual patient (e.g., test results); this practice has been shown to reduce implicit bias in diagnostic decisions specifically (Chapman, Tashkin, & Pye, 2001). The standardized use of empirically supported psychometric tests in VA PTSD disability exams is also consistent with prior recommendations to reduce health disparities by improving the quality of medical care (McGuire & Miranda, 2008). Unfortunately, the use of such tests in VA PTSD disability exams is the exception, not the rule. We found that only 24.2% of C&P exams used a psychometric test of some form, consistent with previous survey results in which the majority of C&P examiners reported "rarely" or "never" using testing (Jackson et al., 2011).

The findings of racial differences in concordance are particularly important to address due to the high correlation between the outcome of the disability exam and SC status. This suggests that a failure to use psychometric tests in PTSD disability exams may be directly responsible for fewer Black veterans receiving the disability benefits owed to them, and a greater number of White veterans without PTSD erroneously receiving benefits. Given that SC status has been associated with reduced rates of impoverishment (Murdoch et al., 2005) and homelessness (Edens, Kasprow, Tsai, & Rosenheck, 2011), such a pattern is highly detrimental to Black veterans and their families.

There are several limitations to this study. First, the current sample is not representative of all VA patients. Only veterans of OEF/OIF/OND were included in the present analyses, all participants had previously undergone a mental health assessment at a VA facility, and veterans with probable PTSD were oversampled at a ratio of 3:1. In addition, it is possible that the relationship between race and diagnostic concordance found here is better explained by a third variable that was not examined, such as the region in which the exam was conducted. Furthermore, because respondents were not randomly assigned to the psychometric testing group, it is possible that the psychometric testing variable is actually capturing some other feature of the exam process, such as the training of the C&P examiner, the number of evaluations a veteran has completed, or the amount of time allowed for an examination. Future research is needed to explore these possibilities.

Our results indicate that racial disparities may account for the 30% discordance observed between the VA PTSD disability exam diagnosis and an independently administered semistructured PTSD diagnostic interview. Psychometric testing during PTSD disability exams shows promise as a means of reducing these racial differences. Future research should continue to examine the impact of psychometric testing on the VA PTSD disability process. Because the C&P exam results are a key component in determining whether a veteran receives PTSD SC, findings of racial disparities in concordance involving C&P exams may also translate into racial differences in rates of PTSD SC. Such a disparity would have important financial implications for veterans seeking disability benefits through the C&P exam process. Therefore, implementation of psychometric testing and other clinical practices that can improve the validity of disability exam outcomes and eliminate racial differences in the VA disability exam process is necessary.

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The impact of proposed changes to *ICD-11* on estimates of PTSD prevalence and comorbidity

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ABSTRACT

The World Health Organization's posttraumatic stress disorder (PTSD) work group has published a proposal for the forthcoming edition of the International Classification of Diseases (*ICD-11*) that would yield a very different diagnosis relative to *DSM-5*. This study examined the impact of the proposed *ICD-11* changes on PTSD prevalence relative to the *ICD-10* and *DSM-5* definitions and also evaluated the extent to which these changes would accomplish the stated aim of reducing the comorbidity associated with PTSD. Diagnostic prevalence estimates were compared using a U.S. national community sample and two U.S. Department of Veterans Affairs clinical samples. The *ICD-11* definition yielded prevalence estimates 10–30% lower than *DSM-5* and 25% and 50% lower than *ICD-10* with no reduction in the prevalence of common comorbidities. Findings suggest that by constraining the diagnosis to a narrower set of symptoms, the proposed *ICD-11* criteria set would substantially reduce the number of individuals with the disorder. These findings raise doubt about the extent to which the *ICD-11* proposal would achieve the aim of reducing comorbidity associated with PTSD and highlight the public health and policy implications of such a redefinition.

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1. Introduction

Mental disorders are defined and classified according to two systems: the *Diagnostic and Statistical Manual of Mental Disorders*, published by the American Psychiatric Association and now in its fifth edition (*DSM-5*; APA, 2013), and the World Health Organization's *International Classification of Diseases*, now in its tenth edition (*ICD-10*; WHO, 1992). At first glance, the two systems look quite similar–they comprise an almost identical collection of major diagnoses, they classify them under similar categories, and the codes for individual diagnoses are used interchangeably in medical record and billing systems throughout the world. Upon closer inspection, however, important distinctions become evident for certain disorders, with posttraumatic stress disorder (PTSD) showing some of the most striking differences between the two systems. Though both define PTSD as a constellation of symptoms including re-experiencing, avoidance, and hyperarousal, among others, that emerge following exposure to trauma, they differ with respect to the definition of traumatic events, the requisite number, combination, and duration of symptoms, and whether functional impairment is required. It is perhaps not surprising then that studies that have compared PTSD diagnostic prevalence estimates using the two definitions have yielded higher levels of discordance for this diagnosis relative to others. For example, Andrews et al. (1999) compared prevalence estimates for common mental disorders using *ICD-10* versus *DSM-IV* criteria and found that PTSD

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showed the highest level of disagreement of all the anxiety disorders. In that large epidemiological survey sample, the *DSM-IV* criteria yielded a 3.0% 12-month prevalence estimate for PTSD whereas the *ICD-10* criteria resulted in a 6.9% estimate. Subsequent analyses revealed the primary source of the discrepancy to be attributable to the *DSM-IV* requirement that the symptoms cause clinically significant distress or impairment (Peters et al., 1999).

Though *DSM-IV* and *ICD-10* have co-existed for 20 years, few other studies comparing diagnostic prevalence estimates can be found in the scientific literature. Such comparisons are important given policy changes that may dramatically increase the use of the ICD in the United States. The U.S. Health Insurance Portability and Accountability Act (HIPPA) of 1996, best known for setting new standards for patient privacy in the U.S., also established that ICD codes would be required for all billing and reimbursement transactions covered by the law. Though implementation has been slow, as of October 2015 the U.S. Centers for Medicare and Medicaid Services require *ICD-10* coding for all services. Further, the U.S. government, as a participating member of the WHO, is obligated to implement *ICD-11* when it is finalized, and as Reed (2010, p. 458) noted, "it would be extremely difficult to justify the U.S. continuing not to use the same system that has been adopted as the standard by the rest of the world." The development and existence of two distinct PTSD diagnoses has the potential to complicate use and interpretation of the PTSD diagnosis among clinicians, researchers, and policy-makers alike.

The WHO Working Group on the "Classification of Disorders Specifically Associated with Stress" has published several papers outlining their proposal for revisions to the PTSD diagnosis in *ICD-11* (e.g., Maercker et al., 2013a, 2013b). Although some parts of the proposal outlined in these papers paralleled changes made to PTSD for *DSM-5* (e.g., moving the diagnosis out of the anxiety disorders and into its own class of stress-related conditions) and the working definition of trauma for *ICD-11* remains a close approximation to the *DSM-5* Criterion A, other modifications would represent a more radical departure from *DSM-5*. Specifically, Maercker et al.'s (2013a) and (2013b) proposal (outlined also by Brewin, 2013) seeks to reduce the large number of "non-specific symptoms" of PTSD that overlap with symptoms of other disorders, such as mood and anxiety disorders, thereby increasing the discriminant validity of the diagnosis. Following similar recommendations made previously (Brewin et al., 2009; Rosen et al., 2010), the new proposal would narrow the scope of the construct by focusing on three core elements: re-experiencing of the trauma, avoidance of reminders of the event, and a heightened perception of threat and arousal. Maercker et al. (2013b) noted that the objectives of these changes would be to reduce the high rate of comorbidity with other diagnoses, reduce the number of symptom combinations that are mathematically possible under the *DSM-5* definition, and enhance the "clinical utility" of the diagnosis, which Brewin (2013, p. 557) noted "specifically refers to ease of use in nonspecialist, minimally resourced, and non-English-speaking settings."

In contrast to *DSM-5*, which provides a list of symptoms and specifies a minimum number of requisite symptoms for each diagnostic criterion, *ICD-11* would provide a narrative description of each of the three core elements. Specifically, re-experiencing symptoms would be defined as "reexperiencing the traumatic event(s) in the present in the form of vivid intrusive memories accompanied by fear or horror, flashbacks, or nightmares," avoidance defined as "avoidance of thoughts and memories of the event (s) or avoidance of activities or situations reminiscent of the event (s)," and heightened perception of threat and arousal defined as "a state of perceived current threat in the form of excessive hypervigilance or enhanced startle reactions" (Maercker et al., 2013b). The members of the *ICD-11* work group have operationalized this definition as endorsement of at least one re-experiencing symptom (i.e., flashbacks or nightmares), one avoidance symptom (i.e., avoidance of internal or external reminders) and one hyperarousal symptom (i.e., hypervigilance or exaggerated startle; Cloitre et al., 2013). The proposed *ICD-11* criteria also include a new functional impairment requirement which, as noted earlier, was absent from the *ICD-10* diagnosis.

The *ICD-11* proposal would therefore omit all seven of the *DSM-5* "negative alterations in cognitions and mood" symptoms and substantially narrow the definitions of re-experiencing and hyperarousal symptoms. Specifically, the *ICD-11* definition provides a stricter definition of intrusive memories, limited to "vivid intrusive memories accompanied by fear or horror" (*DSM-5* B1), omits two other re-experiencing symptoms (emotional or physiological reactivity to trauma reminders; *DSM-5* B4 and B5), and omits four "nonspecific" hyperarousal symptoms (irritability, reckless or self-destructive behavior, concentration difficulties, and sleep disturbance; *DSM-5* E1, E2, E5, and E6). The primary changes relative to *ICD-10* would be the more narrow definition of intrusive thoughts, elimination of emotional distress or physiological reactivity when reminded of the traumatic event, the removal of psychogenic amnesia, the omission of three non-specific symptoms (sleep disturbance, anger, and concentration difficulties), and again, the addition of the functional impairment requirement.

To summarize, the proposed *ICD-11* PTSD definition stands in contrast with the broader *DSM-5* conceptualization and the two approaches represent very different views of the disorder and how to achieve a clinically useful diagnosis. Prior studies that have compared diagnostic prevalence estimates using the two approaches have yielded mixed results. Stein and colleagues (Stein et al., 2014) examined prevalence estimates derived from using Composite International Diagnostic Interview (CIDI) in the multinational population-based World Mental Health Surveys, and found equivalent PTSD prevalence estimates using the *DSM-5* (3.0%) and *ICD-11* (3.2%) algorithms. However, this study was based on a *DSM-IV* referenced assessment that did not reflect the new symptoms or other important changes evident in *DSM-5* and was based on retrospective reports of lifetime symptoms. In contrast, O'Donnell et al. (2014) used a modified version of the Clinician Administered PTSD Scale (Blake et al., 1995) that incorporated the new symptoms into the interview to estimate current PTSD prevalence in a random sample of hospital patients 72 months postdischarge and found that significantly fewer individuals would meet criteria under *ICD-11* compared with *DSM-5* (3.3% versus 6.7%, respectively). They also compared the proportions of cases with PTSD who met criteria for comorbid major depression and found that the more restrictive *ICD-11* definition did not significantly reduce depression comorbidity. These results are broadly consistent with prior findings indicating that eliminating overlapping symptoms from the *DSM-IV* PTSD definition does not reduce depression comorbidity (Elhai et al., 2008; Grubaugh et al., 2010). Other studies have examined comorbidity among individuals whose PTSD diagnostic status was discordant (i.e., they met criteria for PTSD according to *DSM-IV* but not *ICD-11* or vice versa). Individuals who met *ICD-11* criteria only were significantly less likely to be depressed than the *DSM-IV* only cases (Morina et al., 2014; Stammel et al., 2015). However, these statistical comparisons excluded those who meet criteria for PTSD according to both diagnostic systems, which is the majority of individuals with PTSD according to *ICD-11*. Another relevant comparison is with the proportion of individuals who meet criteria for PTSD according to *ICD-11* (whether or not they also meet criteria according to *DSM-IV*) and those who only meet criteria according to *DSM-IV* (the group who would lose the diagnosis under *ICD-11*). Both Morina et al. (2014) and Stammel et al. (2015) examined this

question and found that the *ICD-11* group had higher or comparable rates of depression compared with the *DSM-IV* only group (49.7% vs. 43.8%; Morina et al., 2014; Sample 1: 79.3% vs. 79.0%, Sample 2: 89.1% vs. 84.2%; Stammel et al., 2015), again, implying that the *ICD-11* revision may not meet the aim of lowering psychiatric comorbidity by removing non-specific PTSD symptoms from the criteria set.

Given the wide-reaching implications of a revision that could substantially alter diagnostic prevalence estimates, we compared *DSM-5* with *ICD-10* and *ICD-11* PTSD estimates in a U.S. national community sample and a U.S. Department of Veterans Affairs clinical sample. Then, in a third sample that was more comprehensively assessed for an array of other disorders that commonly co-occur with PTSD, we examined the extent to which proposed changes to *ICD-11* would reduce such comorbidity (Maercker et al., 2013a, 2013b).

2. Methods

2.1. Participants

2.1.1. Sample 1—On-line survey of a U.S. national community sample

Table 1 provides demographic characteristics of each of the three samples included in this paper. Sample 1 participants were recruited from an online probability-based panel representative of the U.S. adult population maintained by an internet survey research firm. This sample and study methods were described at length in prior publications based on this dataset (Kilpatrick et al., 2013; Miller et al., 2013a) and so will be summarized briefly here. Eligible panel participants were stratified on the basis of sex and age categories within the U.S. Census breakdown of the population. Though this method does not yield a true national probability sample (since an estimated 20% of households do not have internet access) it does provide a diverse sample that is generally demographically and geographically representative of U.S. adults. 3756 Individuals connected to the survey website and 92% ($n=3457$) of those agreed to participate. 2953 Completed the survey representing 85.4% of those who agreed to participate and a 78.6% of those who accessed the URL. Data are not available regarding how many individuals received invitations to participate or the proportion of those receiving invitations that accessed the website (Kilpatrick et al., 2013).

As reported previously (Kilpatrick et al., 2013; Wolf et al., 2015), participants reported exposure to a wide range of *DSM-5* traumatic events including being a victim of physical or sexual assault (53.1%), death of a family member or close friend due to an accident, violence, or disaster (51.8%), natural disaster (50.5%), accident/fire (48.3%), witnessing a physical or sexual assault (33.2%), threat or injury to a family member or close friend due to violence/accident/disaster (32.4%), and witnessing a dead body unexpectedly (22.6%). Combat or war zone exposure was endorsed by 7.8%. The modal number of *DSM-5* Criterion A events within the full sample was three, with a mean of 3.3 and standard deviation of 2.3. Analyses were based on 2695 participants who completed the simple and complex PTSD sections of the survey. All survey data from Sample 1 were weighted by age, sex, and race/ethnicity based on 2010 U.S. Census data.

Table 1
Sample characteristics across the three studies.

	Study 1	Study 2	Study 3
n	2953	323	748
Sample	Population-based Community Sample	Veterans	Veterans and Partners
Sex (% Female)	52%	39%	41%
Age distribution, *n*, (%)			
18–24	332 (11.3%)	4 (1.2%)	17 (2.3%)
25–34	563 (19.1%)	101 (31.3%)	56 (7.5%)
35–44	508 (17.2%)	72 (22.3%)	106 (14.2%)
45–54	571 (19.3%)	72 (22.3%)	213 (28.5%)
55–64	488 (16.5%)	53 (16.4%)	327 (43.7%)
65 or older	490 (16.6%)	16 (5.0%)	29 (3.9%)
Race			
Caucasian/White	75%	80%	81%
African American/Black	12%	16%	12%
American Indian/Alaskan Native	2%	4%	9%
Asian/Pacific Islander	5%	1%	2%
Multiracial	5%	–	–
"Other" or "Unknown"	2%	–	6%
Ethnicity (% Hispanic)	17%	5%	15.5%
Exposure to one or more *DSM-5* Criterion A events	89.7%	100%	100%

Note: Totals for race may sum to greater than 100% because participants could select more than one racial ancestry category. Five participants in Study 2 did not report age.

2.1.2. Sample 2—On-line survey of U.S. military veterans

Sample 2 was comprised of U.S. military veterans who were recruited from one of two recruitment sources. The first was a letter mailed to 700 veterans who had previously consented to be contacted for research studies. One hundred seven letters were returned for bad addresses. Of the remaining 593 potential participants, 123 (21%) completed the survey. The second recruitment source was an emailed invitation to 278 veterans of Operations Enduring Freedom and Iraqi Freedom (OEF/OIF) who were enrolled in a PTSD registry, the Veterans' After discharge Longitudinal Registry (Project VALOR; Rosen et al., 2012). Project VALOR was designed as a longitudinal patient registry of OEF/OIF veterans who have undergone a mental health evaluation in the Veterans Affairs healthcare system, with an overrepresentation of veterans with a PTSD diagnosis (75% of the final sample) and of female veterans (50% of final sample). Of the 278 invited veterans, 222 veterans (80%) endorsed trauma exposure and completed the survey, yielding a total of 345 study participants from the two recruitment sources. After providing informed consent on-line, participants were then linked to the webpage with the survey questions. Twenty-two did not complete the symptom assessment and were excluded, yielding a final sample of 323 veterans (83% with a history of combat exposure). Of these, 75% had served during the OEF/OIF era, 15% in the Vietnam War era, 4% in the Operation Desert Storm era, and 1% served in the Korean War or World War II eras.

2.1.3. Sample 3—Clinical interview sample of veterans and partners

Sample 3 was based on a cohort of 852 participants enrolled into one of two research protocols at U.S. Department of Veterans Affairs medical centers. This sample and the relevant recruitment and data collection methods have been described at length previously (e.g., Logue et al., 2013; Miller et al., 2013b). Briefly, the first protocol enrolled trauma-exposed veterans who screened positive for *DSM-IV* PTSD during a telephone interview; the second recruited military veterans with trauma histories and their cohabitating partners. Four hundred and sixty-nine veterans and 279 partners completed the structured diagnostic interviews, yielding a final sample size of 748 for these analyses. They reported exposure to a wide variety of traumatic events on the Traumatic Life Events Questionnaire (Kubany et al., 2000) and exposure to multiple events over the course of the lifespan was the norm. Events most frequently endorsed by male participants were combat (54.9%), sudden and unexpected death of a loved one (6.1%), and assault by acquaintance/stranger (5.4%). For women, the most

frequently endorsed events were childhood and/or adult sexual assault (19.3%), childhood and/or adult physical abuse (15.0%), and sudden and unexpected death of a loved one (14.4%).

2.2. Measures

2.2.1. Samples 1 and 2: national stressful events survey (NSES; Kilpatrick et al., 2011)

Participants in Samples 1 and 2 were administered the NSES to assess exposure to traumatic events and the 20 *DSM-5*-defined PTSD symptoms. Twenty-five close-ended questions assessed exposure to a range of events that would meet Criterion A1 under the *DSM-IV* definition and/or Criterion A under the *DSM-5* definition. Each symptom was assessed using a series of items that began by asking if the participant had "ever" experienced the symptom. Those who endorsed this question then indicated when they had last experienced it using an interval ranging from "during the past month" to "more than one year ago." Participants who endorsed a symptom in the past month were then asked to rate how bothered they had been by it using a Likert-like scale that ranged from 1 (*not at all*) to 5 (*extremely*). Following methods established for the PTSD Checklist (Weathers et al., 1993) which uses the same response options, only symptoms endorsed at a level of 3 ("moderately") or greater were coded as present for estimating diagnosis. For symptoms not explicitly linked to trauma (e.g., the majority of the DSM-5 criterion D and E symptoms), participants were also asked whether the symptom "began or got worse" after trauma and this item had to be answered affirmatively for the symptom to count towards a diagnosis. The symptom assessment was then followed by a series of questions assessing psychological distress and functional impairment. Coefficient alpha for the past-month symptoms in Sample 1 was 0.90 for the items corresponding to *DSM-IV*, 0.91 for *DSM-5*, 0.87 for *ICD-10*, and 0.77 for *ICD-11*. Corresponding alphas for Sample 2 were 0.93 for *DSM-IV*, 0.94 for *DSM-5*, 0.92 for *ICD-10*, and 0.87 for *ICD-11*.

2.2.2. Sample 3: Clinician administered PTSD scale (CAPS; Blake et al., 1995) and structured clinical interview for DSM-IV (SCID-IV; First et al., 1994)

In Sample 3, PTSD was assessed using the Clinician Administered PTSD Scale for *DSM-IV*, a 30-item structured diagnostic interview used to measure each of the 17 *DSM-IV* PTSD symptoms and functional impairment with each symptom rated on separate frequency and intensity scales. Other Axis I disorders were assessed using the Structured Clinical Interview for *DSM-IV*. All interviews were administered by experienced clinicians who received extensive training prior to data collection. Each interview was video-recorded and approximately 25% were later viewed by independent raters for purposes of maintaining quality control and evaluating inter-rater reliability. To minimize rater-drift and enhance interview quality, rating discrepancies were discussed in weekly team meetings throughout the course of data collection. Reliability statistics (kappas for past month diagnosis) for the diagnoses examined in these analyses were as follows: PTSD (0.74), alcohol abuse (0.72), alcohol dependence (0.56), generalized anxiety disorder (0.83), major depressive episode (0.86), panic disorder with agoraphobia (0.91), and panic disorder with or without agoraphobia (0.83).

2.3. Operational definitions of PTSD

2.3.1. ICD-11

As noted earlier, the working definition of trauma (e.g., Criterion A) for *ICD-11* is highly similar to the *DSM-5* definition so, to keep this factor constant across analyses, we applied the *DSM-5* Criterion A definition in coding the *ICD-11* diagnosis. Following the operationalization proposed by Cloitre et al. (2013), an *ICD-11* diagnosis was coded positive when there was (a) exposure to a *DSM-5* qualifying event accompanied by (b) at least one re-experiencing symptom (nightmares or flashbacks), (c) one avoidance symptom (avoidance of either internal or external trauma reminders), (d) one "sense of threat" symptom (hypervigilence or startle) and (e) significant distress or functional impairment as indexed by endorsement of at least one of four items assessing this criterion.

2.3.2. ICD-10

To facilitate cross-definition comparison we held the traumatic stressor definition constant in applying the *ICD-10* algorithm. Thus, the *ICD-10* diagnosis was coded positive when there was (a) exposure to a *DSM-5* qualifying event, (b) at least one of four possible re-experiencing symptoms, (c) one avoidance symptom, and (d) either psychogenic amnesia or two or more hyperarousal symptoms endorsed at a level of 3 or greater. There was no separate distress or functional impairment requirement.

2.3.3. DSM-5

The *DSM-5* diagnosis was coded positive when there was (a) exposure to a qualifying event, (b) at least one intrusion symptom, (c) one avoidance symptom, (d) two negative alterations of cognitions and mood symptoms, (e) two alterations in arousal and reactivity symptoms, and (f) significant distress or functional impairment as indexed by endorsement of at least one of four items assessing this criterion.

2.3.4. DSM-IV

In Sample 3, which used the CAPS, a *DSM-IV* diagnosis was coded positive when there was (a) exposure to a *DSM-IV* qualifying event, (b) at least one intrusion symptom, (c) at least three numbing symptoms, (d) at least two hyperarousal symptoms scored at a frequency of one or greater (i.e., occurred at least once or twice in the past month) and an intensity of two or more (i.e., caused at least moderate distress) along with functional impairment.

2.4. Statistical analyses

First, we computed the prevalence of PTSD using the *ICD-11*, *ICD-10,* and *DSM-5* definitions in Samples 1 and 2 and the *ICD-11*, *ICD-10,* and *DSM-IV* definitions in Sample 3. We then examined patterns of agreement and disagreement between *ICD-11* and *DSM-5*, the two systems which will be used concurrently, in Samples 1 and 2 with McNemar's test, which is appropriate for tests of differences in a dichotomous variable between two related groups. Because clinical interview data were only available for Sample 3, comorbidity analyses were conducted in Sample 3 only. In Sample 3, we computed the prevalence of the four most common comorbidities relative to *ICD-11* and *DSM-IV* PTSD diagnoses. We calculated these comorbidities for five different groups: all individuals who met *DSM-IV* PTSD criteria ("All *DSM-IV*"), all individuals who met *ICD-11* PTSD criteria ("All *ICD-11*"), individuals who met PTSD criteria for both *DSM-IV* and *ICD-11* ("*DSM-IV* and *ICD-11*"), individuals who met *ICD-11* but not *DSM-IV* PTSD criteria ("*ICD-11* only"), and individuals who met *DSM-IV* but not *ICD-11* PTSD criteria ("*DSM-IV* only"). We planned chi-square tests to compare comorbidity estimates among non-overlapping groups (required for chi-square analyses) with sufficient sample size (>5 per cell; Yates, 1934). The two groups that met these criteria were the "All *ICD-11*" and "*DSM-IV* only" groups.

3. Results

Table 2 lists the estimated prevalence of PTSD across the three

Table 2
Prevalence estimates (%) for DSM and ICD past-month PTSD across the 3 samples.

	DSM-IV	DSM-5	ICD-10	ICD-11
Sample 1 (community; N=2,695)	3.8	3.7	4.6	2.4
Sample 2 (veterans; N=323)	38.7	38.7	45.5	34.4
Sample 3 (veterans and partners; N=748)	35.3	–	38.0	25.3

Note: DSM=Diagnostic and Statistical Manual; ICD=International Classification of Diseases; PTSD=posttraumatic stress disorder. Using DSM-IV Criterion A exposure resulted in 67 ICD-11 PTSD cases as opposed to 66 ICD-11 cases when requiring exposure to a DSM-5 Criterion A event.

Table 3
Concordance between past-month ICD-11 and past-month DSM-5 PTSD diagnoses for Samples 1 (U.S. national) & 2 (VA PTSD clinic sample).

		DSM-5 Diagnosis		
		Negative	Positive	Total
Sample 1 (Community)	ICD-11			
	Negative	2,575 (95.6)	54 (2.0)	2,629 (97.6)
	Positive	21 (0.8)	45 (1.7)	66 (2.4)
	Total	2,596 (96.3)	99 (3.7)	2,695 (100.0)
Sample 2 (VA)	ICD-11			
	Negative	182 (57.0)	26 (8.1)	208 (65.2)
	Positive	12 (3.7)	99 (31.0)	111 (34.8)
	Total	194 (60.8)	125 (39.2)	319 (100)

Note: DSM=Diagnostic and Statistical Manual; ICD=International Classification of Diseases; PTSD=posttraumatic stress disorder; Values in each cell are numbers of participants followed be the percentage of total in parentheses. Diagnoses were based on symptoms endorsed moderately severe or higher (i.e., 3 or greater on a 5 point severity scale). In Sample 2, 4 subjects had missing data that precluded calculation of these cross-tabs so percentages differ slightly from Table 2.

samples using the various diagnostic algorithms. Across all three samples, *ICD-10* yielded the highest prevalence; *ICD-11* produced the lowest, and the *DSM-5* (Samples 1 and 2) and *DSM-IV* (Sample 3) estimates fell between those two. Table 3 shows the pattern of diagnostic concordance/discordance between *ICD-11* and *DSM-5* in Samples 1 and 2. Of 120 participants in Sample 1 who met PTSD criteria according to either *DSM-5, ICD-11,* or both, 75 (62.5%) had discordant diagnoses, meaning that they met criteria for PTSD according to one diagnostic system but not the other. The McNemar's test indicated that the proportion of participants meeting criteria for *ICD-11* in Sample 1 was significantly less than that for the *DSM-5* definition, χ^2 (1, N=2695)=14.52, $p<0.001$, $\varphi=0.07$. In Sample 2, of 137 participants who met criteria according to either *DSM-5, ICD-11,* or both, 38 (27.7%) had discordant diagnoses. Again, the McNemar's test indicated that the prevalence of *ICD-11* PTSD was significantly less than that of *DSM-5* PTSD, χ^2 (1, N=323)=5.16, $p=0.03$, $\varphi=0.13$. In both samples, the majority of discrepancies across the two definitions involved instances in which a participant met criteria for PTSD under the *DSM-5* definition but did not meet criteria according to *ICD-11*. Specifically, in Sample 1, 99 participants met criteria for past-month *DSM-5* PTSD but 54 of them (54.7%) did not meet criteria using the *ICD-11* definition. Similarly, in Sample 2, 125 participants met criteria for past-month *DSM-5* PTSD but 26 (20.8%) did not meet under the *ICD-11* definition. Conversely, of the 66 individuals in Sample 1 who met criteria for past-month PTSD under *ICD-11*, 21 (31.8%) did not meet under *DSM-5* whereas, of the 111 participants in Sample 2 who met according *ICD-11* criteria, 12 (10.8%) did not meet under *DSM-5*.

We then sought to identify which component(s) of the two diagnostic algorithms contributed to lower prevalence estimates under *ICD-11* relative to *DSM-5*. In Sample 1, there were 54 cases who met criteria for *DSM-5* but not *ICD-11*. Of these, 32 (59.6%) did not endorse at least one of the two requisite *ICD-11* re-experiencing symptoms (nightmares or flashbacks), and 30 (55.9%) did not endorse at least one of the requisite hyperarousal symptoms (hypervigilance or startle); of these, 8 (15.6%) failed to meet *both* the *ICD-11* re-experiencing and hyperarousal criteria. In Sample 2, we found that 15 (57.7%) of those who met for *DSM-5* did not meet criteria for *ICD-11* because they did not endorse either nightmares or flashbacks, 12 (46.2%) did not meet for *ICD-11* due to the absence of hypervigilance or startle, and 1 (3.8%) did not meet based on lack of endorsement of both re-experiencing and hyperarousal symptoms.

Finally, we evaluated the hypothesis that eliminating the "non-specific symptoms" by paring the definition down to core symptoms would reduce comorbidity by examining patterns of comorbidity prevalence for *ICD-11* compared with *DSM-IV* PTSD diagnoses. Table 4 presents the prevalence of comorbid alcohol abuse/dependence, generalized anxiety disorder, major depressive episode and panic disorder across the different PTSD definitions. Prevalence of comorbid conditions was very similar (within three percentage points) for individuals diagnosed with PTSD according to *ICD-11* ("all *ICD-11*") compared with *DSM-IV* ("all *DSM-IV*"). We also ran chi-square tests comparing non-overlapping groups of individuals with PTSD according to *ICD-11* ("all *ICD-11*") with individuals with PTSD according to *DSM-IV* but not *ICD-11* ("*DSM-IV* only"). The only significant difference between the "all *ICD*-11" and "*DSM-IV* only" groups occurred for alcohol abuse/dependence, which was significantly *more* common in the *ICD-11* group (12.2% vs. 4.3% in *DSM-IV* only), χ^2 (1, N=273)=4.3, $p=0.04$, $\varphi=0.13$. The prevalence of comorbid generalized anxiety disorder, major depressive episode, and panic disorder did not differ by group, χ^2s <0.5, *ns*.

Table 4
Sample 3 current psychiatric comorbidity prevalence (%) for cases meeting criteria for the DSM-IV versus ICD-11 PTSD diagnosis.

Diagnosis	All DSM-IV $n=264$	All ICD-11 $n=189$	DSM-IV only $n=96$	ICD-11 only $n=21$	DSM-IV and ICD-11 $n=168$
Alcohol abuse/dependence	25/253 (9.9%)	22/181 (12.2%)	4/92 (4.3%)	1/20 (5.0%)	21/161 (13.0%)
Generalized anxiety disorder	34/253 (13.4%)	24/181 (13.3%)	12/92 (13.0%)	2/20 (10.0%)	22/161 (13.7%)
Major depressive episode	93/254 (36.6%)	65/183 (35.5%)	29/92 (31.5%)	1/21 (4.8%)	64/162 (39.5%)
Panic disorder	9/252 (3.6%)	6/180 (3.3%)	4/92 (4.3%)	1/20 (5.0%)	5/160 (3.1%)

Note: "All DSM-IV" and "All ICD-11" refer to all individuals with PTSD according to the respective diagnostic system. "DSM-IV only" and "ICD-11 only" refers to individuals with discordant diagnoses (PTSD according to one diagnostic system but not the other). "DSM-IV and ICD-11" refers to the group of individuals with PTSD according to both systems. Numerator values represent the number of participants diagnosed with the given comorbidity, whereas denominators represent the number of participants diagnosed with PTSD according to the respective diagnostic system. Denominators differ by cell because comorbidity data were missing for some participants; missing data represented $<5\%$ of the data collected in any given cell.

4. Discussion

This study examined the impact of changes proposed for the PTSD diagnosis in *ICD-11* by comparing estimates of PTSD prevalence derived using *ICD-11*, *ICD-10, DSM-IV,* and *DSM-5* definitions of the disorder. We also tested the hypothesis that these changes would reduce the level of comorbidity associated with the diagnosis. Our analyses revealed that, across three samples, the estimated prevalence of PTSD varied considerably as a function of the diagnostic definition. *ICD-10*, by virtue of not requiring functional impairment, yielded the highest prevalence in each sample. This result is consistent with findings of prior studies that compared the *ICD-10* and *DSM-IV* criteria for PTSD (Andrews et al., 1999; Peters et al., 1999; Rosenman, 2002) and underscores the importance of functional impairment in defining the diagnosis. In contrast, the *ICD-11* diagnostic algorithm yielded prevalence estimates between 25% and 50% lower than *ICD-10* and between 10% and 30% lower than the *DSM-5* (Samples 1 and 2) or *DSM-IV* (Sample 3) definitions. We also compared the concordance between the *DSM-5* and *ICD-11* diagnoses, and found that a significant proportion of individuals who would be diagnosed with PTSD according to one set of criteria would not be diagnosed with PTSD according to the other set of criteria (62.5% in Study 1% and 27.7% in Study 2). The majority of these discrepancies were due to individuals who met PTSD criteria according to *DSM-5* but not *ICD-11,* consistent with our findings of lower *ICD-11* prevalence. In the future, *DSM-5* and *ICD-11* may be used concurrently in both clinical and research settings. The discordance raises doubts about the interchangeability of these two diagnoses and new questions about what distinguishes individuals who are diagnosed with PTSD according to one system but not the other.

Analyses that examined which component(s) of the two diagnostic algorithms contributed to the lower prevalence in *ICD-11* revealed that the re-experiencing and hyperarousal clusters were equally likely to account for the discrepancies. These findings are consistent with those of O'Donnell et al. (2014) and suggest that by narrowing the definitions of re-experiencing and hyperarousal symptoms in *DSM-5,* the *ICD-11* diagnosis may capture substantially fewer cases with clinically significant PTSD symptomatology (but see also Stein et al., 2014). The WHO workgroup aimed to restrict re-experiencing symptoms to those in which the traumatic event is "not only remembered, but experienced as occurring again" (Maercker et al., 2013a). Under *ICD-11*, physiological or emotional distress upon exposure to trauma-related reminders would be insufficient to meet the re-experiencing criterion. The eliminated symptoms are primary targets of exposure-based treatments (e.g., Foa et al., 2009) and conceptual cornerstones for fear-conditioning models and psychophysiological assessment methods in PTSD research (Keane et al., 1998; Pole, 2007). The more narrow definition and exclusion of these two symptoms represents a significant departure from current conceptualizations of traumatic re-experiencing. Additionally, from an assessment perspective, emphasizing symptoms in the domains of unconscious experience (nightmares) and dissociation (flashbacks) while excluding symptoms that are more readily reportable and observable (distress upon exposure) may introduce new problems of reliability.

The *DSM-5* workgroup considered but rejected the circumscribed approach embodied in the *ICD-11* proposal because it eliminated too many clinically significant components of the syndrome. To extend the *ICD-11* argument to medical diseases, one would never include fever, pain, or edema as indicators of any diagnosis because they are found in so many different diseases (Friedman, 2013). Thus, the narrow versus broad approaches of *ICD-11* and *DSM-5*, respectively, represent different conceptual models of PTSD and opposing beliefs about the clinical utility of such different diagnostic schemes. Although it is conceivable that the narrow approach would confer benefits such as increased discriminant validity or clinical utility, our findings indicate that the simplified set of criteria also would also come with a cost: failure to identify some individuals with clinically significant PTSD symptoms.

The second aim of this study was to test the *ICD-11* workgroup's prediction that eliminating the "non-specific" symptoms of PTSD would reduce the level of comorbidity with other disorders, especially depression. Analysis of data from a carefully-assessed sample of over 700 veterans and their partners showed no substantial reduction in comorbidity of alcohol abuse/dependence, generalized anxiety disorder, major depressive episode and panic disorder using the *ICD-11* definition compared with the *DSM-IV* definition. But more fundamentally, we disagree with the notion that the high level of comorbidity between PTSD and other disorders reflects a problem with the definition of the disorder that should be fixed by dropping symptoms. Eliminating overlapping symptoms has not emerged as an effective strategy for reducing comorbidity (Elhai et al., 2008; Grubaugh et al., 2010). Moreover, comorbidity is ubiquitous in mental illness and widely thought to be a reflection of the dimensional structure of psychopathology whereby broad classes of symptoms covary as a function of latent brain-behavior traits – attempting to eliminate it by redefining the construct and removing clinically relevant symptoms may prove counterproductive. Previous research suggests that one approach to addressing the challenges associated with diagnostic heterogeneity is to identify clinically and scientifically meaningful subtypes within samples of individuals with the diagnosis (Miller et al., 2004; Wolf et al., 2012).

That said, there are attractive aspects of the *ICD-11* proposal. The working group has recommended a separate grouping of disorders specifically associated with stress rather than combining them with the anxiety disorders as has historically been the case in both diagnostic systems. As noted previously, we believe this to better reflect the causal role of trauma in the etiology of these disorders as well as the extensive phenotypic heterogeneity observed in samples with posttraumatic psychopathology (Miller et al., 2009; Resick and Miller, 2009). Furthermore, we agree with Maercker, Brewin, and others (Brewin, 2013; Maercker et al., 2013a, 2013b) that re-experiencing symptoms are the cardinal features of PTSD and that the avoidance symptoms are highly intertwined with them. Less convincing are arguments for defining hypervigilance and startle as pathognomonic to PTSD (Brewin, 2013; Maercker et al., 2013a, 2013b). Hypervigilance is a salient feature of panic disorder, simple phobia, and trait fearfulness so is, therefore, by no means unique to PTSD. Similarly, exaggerated startle has been observed in many other patient samples including those with panic disorder and social phobia (e.g., Grillon et al., 2008; Larsen et al., 2002; Melzig et al., 2007), obsessive-compulsive disorder (Kumari et al., 2001), and individuals with a familial risk for depression (Grillon et al., 2005). Further, while some research suggests that these symptoms may indeed be less saturated with "general distress variance" compared to other non-specific symptoms, to our knowledge, no study to date provides evidence for the more specific and improved associations between these symptoms and other putative indicators of threat and hyperarousal that would support the discriminant validity of this model over others (Miller, 2010; Miller et al., 2010).

Conclusions from this study should be considered in light of certain limitations. First, Samples 1 and 2 were based on internet surveys using a newly-developed instrument that has yet to undergo validation in direct relation to a clinical interview, the proposed *ICD-11* criteria include a third re-experiencing symptom (vivid intrusive memories including fear or horror) which has not yet been examined empirically, and no comorbidity variables were

available in the first two datasets. Second, the same survey was used to derive *DSM-5* and *ICD-11*-defined PTSD (as opposed to independent *DSM-5* and *ICD-11* surveys) and this could have inflated concordance estimates. Third, Sample 3 featured diagnostic information derived from clinical interviews but those interviews were based on *DSM-IV* criteria, rather than *DSM-5*, and we did not have a large enough sample of individuals with PTSD according to *ICD-11* but not *DSM-IV* to include this group in statistical comparisons. Fourth, Sample 1 was a national U.S. community sample whereas Samples 2 and 3 were not national samples of veterans; the extent to which these findings will generalize to the entire veteran population or to other populations (i.e., outside the U.S.) is not certain. Finally, we did not address other aspects of the WHO Working Group's proposal, most notably, their plan for a complex PTSD diagnosis, though we have previously reported results calling into question the distinction between PTSD and complex PTSD (Wolf et al., 2015).

To conclude, the proposed *ICD-11* criteria represent a major revision to the definition of PTSD and have stimulated new debate about the diagnosis. While one can debate the advantages and disadvantages of constraining the diagnosis to a narrower set of symptoms, the findings of this study demonstrate that doing so would substantially reduce the number of individuals reporting clinically significant symptoms who would meet criteria for the disorder. The public health and policy implications of a PTSD diagnosis that would yield substantially lower estimates of PTSD prevalence and caseness is concerning because of the potential impact on services available to those who are symptomatic. We suspect that this was not the intent of the *ICD-11* workgroup and hope that these findings will stimulate investigation into the clinical, scientific, and policy implications of redefining the PTSD diagnosis.

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ORIGINAL ARTICLE

Longitudinal associations between post-traumatic stress disorder and metabolic syndrome severity

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Background. Post-traumatic stress disorder (PTSD) is associated with elevated risk for metabolic syndrome (MetS). However, the direction of this association is not yet established, as most prior studies employed cross-sectional designs. The primary goal of this study was to evaluate bidirectional associations between PTSD and MetS using a longitudinal design.

Method. A total of 1355 male and female veterans of the conflicts in Iraq and Afghanistan underwent PTSD diagnostic assessments and their biometric profiles pertaining to MetS were extracted from the electronic medical record at two time points (spanning ~2.5 years, $n = 971$ at time 2).

Results. The prevalence of MetS among veterans with PTSD was just under 40% at both time points and was significantly greater than that for veterans without PTSD; the prevalence of MetS among those with PTSD was also elevated relative to age-matched population estimates. Cross-lagged panel models revealed that PTSD severity predicted subsequent increases in MetS severity ($\beta = 0.08$, $p = 0.002$), after controlling for initial MetS severity, but MetS did not predict later PTSD symptoms. Logistic regression results suggested that for every 10 PTSD symptoms endorsed at time 1, the odds of a subsequent MetS diagnosis increased by 56%.

Conclusions. Results highlight the substantial cardiometabolic concerns of young veterans with PTSD and raise the possibility that PTSD may predispose individuals to accelerated aging, in part, manifested clinically as MetS. This demonstrates the need to identify those with PTSD at greatest risk for MetS and to develop interventions that improve both conditions.

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Key words: Accelerated aging, cross-lagged design, longitudinal, metabolic syndrome, PTSD, veterans.

Introduction

Post-traumatic stress disorder (PTSD) is associated with substantial medical morbidity (Schnurr *et al.* 2000; Ahmadi *et al.* 2011; Bartoli *et al.* 2013; O'Donovan *et al.* 2015), with striking effects observed for obesity (Bartoli *et al.* 2015), and cardiometabolic and cardiovascular conditions (Ahmadi *et al.* 2011; Heppner *et al.* 2012; Bartoli *et al.* 2013; Wentworth *et al.*, 2013; Roberts *et al.* 2015; Rosenbaum *et al.* 2015*b*; Roy *et al.* 2015; Sumner *et al.* 2015). The co-occurrence of PTSD with metabolic syndrome (MetS), as defined by three or more of central obesity, hypertension, dyslipidemia, and elevated blood sugars [National Cholesterol Education Program (NCEP), 2001; Grundy *et al.* 2005], is particularly high, with recent meta-analyses suggesting that MetS is prevalent in nearly 40% of those with PTSD (Bartoli *et al.* 2013; Rosenbaum *et al.* 2015*b*). The association between PTSD and MetS is intriguing given that stress is implicated in the pathogenesis and course of MetS (Vitaliano *et al.* 2002; see also Epel, 2009) and that MetS may be part of the pathway linking PTSD to subsequent deleterious health conditions, such as cardiovascular disease (Roy *et al.* 2015; Sumner *et al.* 2015), type 2 diabetes (Roberts *et al.* 2015), decreased

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cortical thickness (Wolf *et al.* in press), cognitive impairment (Green *et al.* 2016), and premature mortality (Ahmadi *et al.* 2011).

Although nearly all of the studies linking PTSD to MetS employed a cross-sectional design, many investigators hypothesize that the stress of PTSD influences MetS risk (e.g. Bartoli *et al.* 2013). This could occur through biological pathways, such as increased autonomic reactivity, immune and hypothalamic-pituitary-adrenal (HPA) axis system dysregulation (Kibler *et al.* 2014; Levine *et al.* 2014), and/or oxidative stress processes (Grattagliano *et al.* 2008). Potential PTSD-related behavioral pathways include poor nutrition and sedentary lifestyle (Hall *et al.* 2015), cigarette and alcohol use (Dennis *et al.* 2014), and poor sleep (Talbot *et al.* 2015). It is also possible that MetS may negatively affect PTSD symptoms. For example, greater pre-deployment inflammation (C-reactive protein), which often co-occurs with MetS, was recently shown to predict subsequent post-deployment PTSD (Eraly *et al.* 2014). PTSD and MetS may also exert bidirectional effects on the severity of each other, particularly in trauma-exposed samples. In support of this, bidirectional effects have been reported for depression and MetS (Pulkki-Råback *et al.* 2009), and this may generalize to PTSD given that PTSD is highly comorbid with depression (Pietrzak *et al.* 2012) and both disorders may arise out of a shared underlying vulnerability towards internalizing psychopathology (Miller *et al.* 2008). Only longitudinal designs can address the question of directionality. To our knowledge, two such studies exist to date, and both had analytic concerns that limited the strength of the causal conclusions.

Specifically, Francis *et al.* (2015) followed 78 physically abused children and 349 non-abused children into middle age and found that childhood abuse was associated with PTSD symptoms during young adulthood, which, in turn, predicted obesity in middle age. Baseline obesity was not controlled for analytically, making it difficult to draw conclusions about the direction of this association. Farr *et al.* (2015) also suggested that PTSD was associated with increasing metabolic risk by showing that, among 55 urban-area community adults, greater PTSD severity was associated with increased obesity and systolic blood pressure over the course of 2.5 years, controlling for baseline body mass index (BMI). Unfortunately, results were difficult to interpret because of the small sample size, control for only baseline BMI, and the fact that PTSD symptoms were split into quartiles based on sample distribution (i.e. not evaluated per the DSM diagnostic definition or total severity). Neither study tested whether MetS predicted subsequent PTSD.

In light of these concerns, our aim was to evaluate potential bidirectional influences between PTSD and MetS using a cross-lagged panel model (Rosenthal & Rosnow, 1991), which simultaneously evaluates the longitudinal effect of each variable on the other while controlling for baseline levels of both PTSD and MetS. We hypothesized that PTSD would be associated with increasing MetS risk over time, and that if there was evidence for MetS influencing subsequent PTSD, that this effect would be weaker in magnitude than that for PTSD predicting MetS. This aim was evaluated in a large national cohort of US military veterans deployed to the wars in Iraq and/or Afghanistan and who completed two waves of assessments, separated by approximately 2.5 years (see Rosen *et al.* 2012). As women were oversampled and represented just over 50% of the cohort, we were also able to evaluate potential sex differences in the relationship between PTSD and MetS.

Method

Participants

Participants were U.S. Army or Marine Corps veterans enrolled between 2009 and 2012 in the baseline assessment of Project VALOR (Veterans' After-Discharge Longitudinal Registry), a registry of VA mental health-care users with and without PTSD who deployed in support of Operation Enduring Freedom or Operation Iraqi Freedom (see Supplementary material and Rosen *et al.* 2012 for details). To be included veterans must have undergone a mental health evaluation at a VA facility. Veterans with probable PTSD according to VA medical records (i.e. at least two instances of a PTSD diagnosis by a mental health professional associated with two separate visits) were oversampled at a 3:1 ratio, and female veterans were oversampled to comprise ~50% of the cohort.

The current study included the largest possible subsample of $n = 1355$ participants from Project VALOR (out of 1649 total) who had data pertaining to, at least, time 1 (T1) PTSD severity and T1 MetS severity. Demographic characteristics of this sample are shown in Table 1. Time 2 (T2) PTSD severity was available for $n = 1124$ (83%) of the T1 sample and T2 MetS severity data were available for $n = 971$ (72%) of the T1 participants, yielding the final T2 total of 971 (see Supplementary material for comparisons of those with *v.* without T2 data).

Measures

PTSD module of the Structured Clinical Interview for DSM

Doctoral-level diagnosticians assessed current (past month) PTSD via telephone using the PTSD module of the Structured Clinical Interview for DSM (SCID). The SCID for DSM-IV (First *et al.* 2000) was

Table 1. *Demographic and PTSD-related characteristics of the sample*

Variable	Mean (S.D.)	Range	*n*	%
Age (years)	37.86 (9.96)	22–69		
Sex				
Male			655	48.3
Female			700	51.7
Race/ethnicity				
White			878	64.8
Black			224	16.5
Hispanic			174	12.8
Other			70	5.2
Missing			9	0.7
Education level				
High school degree or equivalent			136	10.0
Some post-high school education			760	56.1
College degree or higher			454	33.5
PTSD				
Dx at T1			902	66.6
Dx at T2			664	68.4
Severity at T1	9.99 (4.79)	0–17		
Severity at T2	11.87 (4.97)	0–20		

T1, Time 1; T2, time 2; PTSD, post-traumatic stress disorder; Dx, diagnosis; S.D., standard deviation.

Demographic characteristics are based on T1 data ($n = 1355$). The sample size at T2 was 971 and T2 PTSD percentages are based on that total. Comparisons of demographic and other differences between those with and without T2 data are presented in the Supplementary material. PTSD severity is based on a symptom count of the number of endorsed items on the SCID PTSD module.

administered at T1 and for DSM-5 (First *et al.* 2015) at T2. Both have demonstrated excellent psychometric properties (Bovin & Weathers, 2012; Regier *et al.* 2013). The SCID was administered up to two times at each time point in relation to two, distinct index traumatic experiences. *PTSD symptom severity* was operationalized as the maximum score (number of PTSD symptoms endorsed) from either of the two SCID administrations at each time point. *PTSD diagnosis* was operationalized as meeting the DSM-IV (at T1)/DSM-5 (at T2) diagnostic criteria based on either of the two concurrent SCID administrations. Interviews were digitally recorded and 100 were randomly chosen for secondary independent ratings at T1 and T2 yielding excellent inter-rater agreement at T1 ($\kappa = 0.91$) and T2 ($\kappa = 0.82$).

Life events checklist for DSM-IV (LEC)

The LEC (Gray *et al.* 2004) is a self-report questionnaire of trauma exposure that comprises the PTSD Criterion A1 assessment on the Clinician Administered PTSD Scale (Blake *et al.* 1995). Participants indicated if they experienced, witnessed, learned about, or were exposed to any of 16 potentially traumatic events.

Additional measures that were the focus of secondary analyses are described in the Supplementary material.

Procedure

At T1, participants provided informed consent verbally over the telephone in accordance with the research protocol approved by all institutional review boards and the Human Research Protection Office of the US Army Medical Research and Materiel Command. Study staff then invited participants to complete a self-administered survey either online or via mail. Once completed, participants underwent diagnostic interview by telephone and received $50 compensation. Approximately 2–4 years later, participants were re-contacted for the second phase of the study, which followed the same approach as T1. Participants were compensated $100 at T2.

Data pertaining to MetS features were extracted from the VA electronic medical record using laboratory values that were linked as closely as possible in time to the SCID-based PTSD assessment and were no more than ±6 months of the PTSD assessment. On average,

Table 2. *Metabolic syndrome criteria definitions*

Criterion	Definition	
Central obesity	BMI ⩾25[a]	
Dyslipidemia		
HDL (mg/dl)	<40 (men) <50 (women)	Or taking cholesterol-lowering medication
Triglycerides (mg/dl)	⩾150	Or taking medication for elevated triglycerides
Elevated blood sugars		
Fasting glucose (mg/dl)	⩾100	Or taking medication for diabetes or elevated glucose
Hypertension		
Systolic blood pressure (mmHg)	⩾130	Or taking medication for hypertension
Diastolic blood pressure (mmHg)	⩾85	

BMI, Body mass index; HDL, high-density lipoprotein.

Three out of five criteria (central obesity, low HDL, high triglycerides elevated glucose, and elevated systolic or diastolic blood pressure) were required for the metabolic syndrome diagnosis.

[a] See note 1.

there was well less than a month between the PTSD/biometric assessments (see Supplementary materials). The two PTSD assessments occurred, on average, ~2.5 years apart (range 18.80–56.50 months; see Supplementary material). Time difference variables were evaluated as covariates in preliminary analyses.

MetS was defined per the NCEP Adult Treatment Panel (ATP) III definition (NCEP, 2001; Grundy *et al.* 2006), as detailed in Table 2[1]†. *MetS severity* was defined as the number of MetS criteria present (0–5). *MetS diagnosis* was defined as meeting three or more of the MetS criteria (NCEP, 2001; Grundy *et al.* 2006).

Data analysis

We first examined the prevalence[2] of PTSD diagnosis (on the SCID) and MetS diagnosis (and each MetS criterion) at each time point in the sample overall and then conducted χ^2 analyses to evaluate MetS-related differences as a function of PTSD diagnosis at each time point. We also compared a population-based estimate of MetS among 20- to 39-year-olds (20.3%; Ervin, 2009) with the T1 MetS prevalence among veterans with PTSD in this same age group using a *Z* test for two population proportions. We then examined each dimensional MetS variable (raw laboratory values and criteria count) as a function of PTSD diagnosis using *t* tests for independent samples. We tested potential differences in metabolic profiles as a function of PTSD diagnosis and sex (and their interaction) using multivariate analysis of variance (MANOVA). Correlations between total lifetime trauma exposure, PTSD severity, and MetS severity at and across each time point and those between MetS, PTSD severity, and potential covariates were evaluated (see Supplementary material).

We then ran our primary cross-lagged panel model using the statistical modeling program Mplus 7.11 (Muthén & Muthén, 2012). In the path model, the autoregressive effects of each variable on itself over time (e.g. T1 PTSD to T2 PTSD) were modeled, as were the cross-lagged paths (e.g. T1 PTSD to T2 MetS). These models focused on PTSD severity (symptom count on the SCID) and MetS severity (number of MetS criteria met). The concurrent correlation between the two variables at T1 was modeled as was their residual correlation at T2. Total lifetime trauma exposure (on the LEC) was included as a predictor of T1 MetS and PTSD severity and the indirect effects of trauma exposure on T2 PTSD and MetS severity via T1 PTSD and MetS severity were estimated using the 'model indirect' command. Significant covariates, based on the results of initial bivariate correlations, were included as predictors of T1 PTSD and MetS severity. The model employed the robust maximum likelihood estimator, which accounts for non-normality in the data by adjusting the standard errors to reduce the likelihood of Type I error. This estimator includes all available data using full information likelihood estimation, conditional on the presence of at least one exogenous variable. Due to missing covariate data, the final sample size for the cross-lagged model was 1341. Path models were evaluated using standard fit indices and guidelines (Hu & Bentler, 1999).

We then conducted a logistic regression in SPSS v. 21 (IBM Corp., USA) to test whether T1 PTSD severity predicted T2 MetS diagnosis, controlling for T1 MetS

† The notes appear after the main text.

severity and demographic covariates. Analyses evaluating potential moderators, covariates, and confounders (including combat exposure, depression, substance use, and psychotropic medication use) of our main associations are detailed in the Supplementary material.

Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Results

Prevalence and severity of PTSD, MetS, and their co-occurrence

Descriptive statistics pertaining to the presence and severity of current PTSD at T1 and T2 are listed in Table 1 and descriptive statistics for MetS are shown in Table 3. Among veterans with PTSD aged <40 years at T1, the prevalence of MetS was 29.0%, which was significantly greater than the 20.3% previously reported (Ervin, 2009) in an age-matched epidemiological sample ($Z = -3.19$, $p = 0.001$). In contrast, the prevalence of MetS among veterans without current PTSD in this age group (20.2%) was nearly identical to that reported by Ervin (2009). In the full sample, the mean number of T1 MetS criteria was 2.00 (Table 3), with 89.4% meeting at least one MetS criterion and 70.0% meeting at least 2 MetS criteria. At T2, the mean number of MetS criteria was 2.10 (Table 3), with 90.5% above the threshold for at least one MetS criterion and 63.6% above the threshold for at least two criteria.[3] At T1, 17.4% were taking cholesterol-lowering medication, 27% anti-hypertensive medication, and 2.4% were taking diabetes-related medication. At T2, 15.1% were taking cholesterol-lowering medication, 23.6% were taking anti-hypertensive, and 3.2% were taking diabetes-related medications. This medication use was factored into the MetS definition (Table 2).

As shown in Table 3, χ^2 analyses revealed that the prevalence of T1 MetS diagnosis was greater among those with a concurrent PTSD diagnosis (36.6%) compared to those without (26.3%, $p < 0.001$). This held at T2, wherein the prevalence of T2 MetS diagnosis was 37.8% among those with a concurrent PTSD diagnosis and 30.9% among those without ($p = 0.038$). Individuals with PTSD at T1 also met criteria for a greater number of T1 MetS features compared to those without T1 PTSD (Table 3). χ^2 analyses suggested that a greater percentage of individuals with T1 PTSD met the criteria for central obesity, hypertension, elevated blood sugars, and high triglycerides than those without PTSD (Table 3). Additionally, *t* tests revealed higher mean raw laboratory values for each T1 MetS component among this group (Table 3). Those with PTSD at T2 also met criteria for a greater number of T2 MetS features compared with those without T2 PTSD (Table 3); however, no group differences emerged in the mean T2 raw metabolic values and the only T2 criterion difference was for hypertension (Table 3).

MANOVAs examined sex, PTSD, and sex × PTSD differences in raw metabolic laboratory values at each time point. At T1, the multivariate test yielded main effects for sex (Pillai's trace = 0.163, $F_{6,800} = 25.96$, $p < 0.001$) and PTSD (Pillai's trace = 0.030, $F_{6,800} = 4.14$, $p < 0.001$), but no significant interaction between the two (Pillai's trace = 0.013, $F_{6,800} = 1.78$, $p = 0.10$). All sex differences were in the direction of women evidencing less pathological laboratory values than the men (details available from first author). The main effect of sex held at T2 (Pillai's trace = 0.158, $F_{6,619} = 19.35$, $p < 0.001$), but there were no significant multivariate main effects of T2 PTSD or of PTSD × sex. Based on this, sex was not included as a moderator in primary models, though it was included as a covariate and evaluated further in secondary analyses (see Supplementary material).

Cross-lagged panel models

Preliminary correlation-based analyses are detailed in the Supplementary material and Supplementary Table S1. We found that none of the time difference variables were correlated with their respective dependent variables, so they were excluded from path models. In contrast, race, sex, age, and education were associated with some or all of the PTSD and MetS variables (detailed in the Supplementary material) and were therefore included as covariates of T1 PTSD and MetS.[4]

The cross-lagged panel model fit the data well: $\chi^2(10, n = 1341) = 59.10$, $p < 0.001$, root mean square error of approximation = 0.06, standardized root mean square residual = 0.02, confirmatory fit index = 0.97, Tucker–Lewis index = 0.91. As shown in Fig. 1, T1 PTSD severity was a strong predictor of T2 PTSD severity ($\beta = 0.67$, $p < 0.001$), and T1 MetS severity was strongly related to T2 MetS severity ($\beta = 0.62$, $p < 0.001$). After controlling for these autoregressive effects, we found a significant cross-lagged effect, such that T1 PTSD severity predicted T2 MetS severity ($\beta = 0.08$, $p = 0.002$), but T1 MetS did not predict T2 PTSD severity ($\beta = 0.005$, $p = 0.82$). The association between PTSD and MetS severity at T1 was significant; however, their residual correlation was not significant at T2 after controlling for the shared effects of T1 variables. Age, sex, and education were significant covariates of T1 MetS severity;

Table 3. *Metabolic syndrome diagnosis and features in the overall sample and as a function of PTSD diagnosis*

	Mean (S.D.)								% Meeting MetS criterion							
	All		PTSD+		PTSD-		*p*		All		PTSD+		PTSD−		*p*	
MetS variable	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Obesity (BMI, kg/m^2)	29.78 (5.41)	30.22 (5.69)	30.03 (5.29)	30.13 (5.58)	29.28 (5.60)	30.40 (5.92)	0.018	0.509	79.9	81.8	82.5	80.8	74.7	83.9	0.001	0.254
Blood pressure (mmHg)									50.6	53.6	56.1	57.7	39.6	44.6	0.000	0.000
Diastolic	76.22 (10.37)	77.42 (10.07)	76.83 (10.36)	77.41 (10.03)	75.02 (10.32)	77.43 (10.16)	0.003	0.973								
Systolic	122.14 (12.77)	123.26 (13.68)	122.76 (12.94)	123.44 (13.84)	120.92 (12.37)	122.87 (13.34)	0.013	0.555								
HDL cholesterol (mg/dl)	47.71 (15.08)	49.99 (15.71)	46.76 (15.08)	49.91 (15.62)	49.54 (14.93)	50.16 (15.96)	0.009	0.849	46.1	41.6	47.3	43.2	43.8	38.0	0.316	0.208
Triglycerides (mg/dl)	143.67 (107.16)	147.29 (105.16)	152.04 (115.51)	151.20 (114.42)	127.18 (86.28)	138.59 (80.41)	0.001	0.155	48.0	51.8	50.6	51.8	43.0	51.9	0.029	0.985
Glucose (mg/dl)	95.61 (19.23)	98.15 (28.13)	97.38 (21.34)	98.40 (25.53)	91.91 (13.09)	97.57 (33.46)	0.000	0.708	13.0	16.6	14.7	17.5	9.5	14.4	0.020	0.287
Total no. MetS features	2.00 (1.26)	2.10 (1.28)	2.11 (1.27)	2.16 (1.30)	1.77 (1.21)	1.96 (1.24)	0.000	0.026								
MetS Dx									33.1	35.6	36.6	37.8	26.3	30.9	0.000	0.038

MetS, Metabolic syndrome; S.D., standard deviation; PTSD+, positive post-traumatic stress disorder diagnosis; PTSD−, negative post-traumatic stress disorder diagnosis; T1, time 1; T2, time 2; BMI, body mass index; HDL, high-density lipoprotein; Dx, diagnosis. *p* values for dimensional variables are based on independent *t* tests as a function of current (T1 or T2) PTSD diagnosis. *p* values for categorical variables are based on Pearson χ^2 tests.

The number of participants for each analysis varied due to missing data. Details are as follows: At time 1: (*a*) BMI total = 1303, PTSD+ = 864, PTSD− = 439; (*b*) diastolic BP total = 1325, PTSD+ = 881, PTSD− = 444; (*c*) systolic BP total = 1326, PTSD+ = 882, PTSD− = 444; (*d*) HDL cholesterol total = 900, PTSD+ = 594, PTSD− = 306; (*e*) triglycerides total = 888, PTSD+ = 589, PTSD− = 299; (*f*) glucose total = 1013, PTSD+ = 686, PTSD− = 327; (*g*) total no. of MetS features total = 1355, PTSD+ = 741, PTSD− = 407; (*h*) Mets Dx total = 1355, PTSD+ = 741, PTSD− = 407. Sample sizes at time 2: (*a*) total = 927, PTSD+ = 635, PTSD− = 292; (*b*) total = 944, PTSD+ = 649, PTSD− = 295; (*c*) total = 946, PTSD + 649, PTSD− = 297; (*d*) total = 669, PTSD+ = 461, PTSD− = 208; (*e*) total = 658, PTSD+ = 454, PTSD− = 204; (*f*) total = 760, PTSD+ = 532, PTSD− = 228; (*g*) total = 971, PTSD+ = 664, PTSD− = 307; (*h*) total = 971, PTSD+ = 664, PTSD− = 307. Using the higher BMI cut-point of 30 in the diagnostic algorithm yielded a MetS prevalence of 25.7% at T1 and 28.5% at T2 (of those with T2 data). A greater percentage of individuals with PTSD were diagnosed with MetS using this more stringent BMI criterion at both T1 and T2, per χ^2 analysis. Using the higher BMI cut-point of 30 in the MetS criteria count revealed that 79% were above the threshold for at least 1 MetS criterion and 49% were above the threshold for at least 2 MetS criteria at T1. At T2, 80% were above the threshold on at least 1 MetS criterion and 52% were above the threshold on at least 2 MetS criteria. At both time points, *t* tests revealed that individuals with PTSD met the threshold for a greater number of MetS criteria than did those without PTSD.

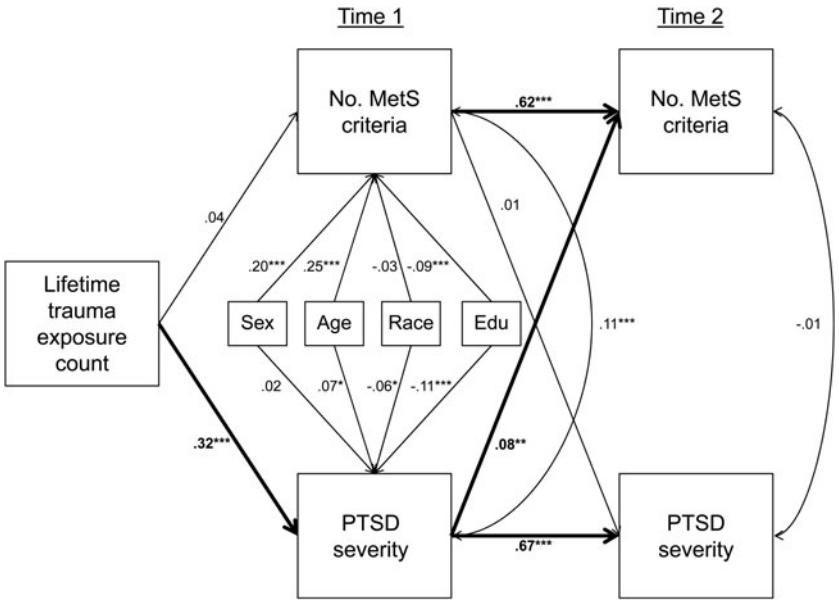

Fig. 1. The figure shows the results of the cross-lagged panel model. Primary and significant paths of interest are bolded. Correlations are represented via double-headed arrows and regressive paths via single-headed arrows. MetS, Metabolic syndrome; PTSD, post-traumatic stress disorder; Edu, educational attainment. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

age, race, and education were significant covariates of T1 PTSD severity (Fig. 1). Total lifetime trauma exposure at T1 was significantly associated with T1 PTSD severity but not with T1 MetS. Results suggested indirect effects of trauma on T2 MetS severity via T1 PTSD severity ($\beta = 0.03$, $p = 0.002$) and on T2 PTSD severity via T1 PTSD severity ($\beta = 0.21$, $p < 0.001$). In total, the model explained 40% of the variance in T2 MetS severity and 44% of the variance in T2 PTSD severity. Analyses of potential confounds of key associations are reported in the Supplementary material; none altered the primary pattern of results.

Effects of PTSD on subsequent MetS diagnosis

Finally, to evaluate the effects of PTSD severity on subsequent MetS diagnosis, we conducted a logistic regression with T1 PTSD severity and T1 MetS severity as predictors of T2 MetS diagnosis, controlling for age, race, sex, and education. We found that for every additional PTSD symptom at T1, the odds ratio (OR) for MetS diagnosis at T2 increased by 5.6% [95% confidence interval (CI) 1.9–9.4%, Wald $\chi^2(1, n = 961) = 9.09$, $p = 0.003$]. This means that for every 10 symptoms endorsed on the SCID at T1, the odds of a MetS diagnosis at T2 increased by 56%. Each increase in MetS criteria at T1 was associated with nearly three times the odds for a subsequent MetS diagnosis [OR 2.86, 95% CI 2.44–3.37, Wald $\chi^2(1, n = 961) = 124.31$, $p < 0.001$]. Nagelkerke's R^2 for the overall model was 0.40 ($p < 0.001$).[5]

Discussion

This study adds to a growing chorus of concerns regarding substantial PTSD-related metabolic health decline among veterans of the conflicts in Iraq and Afghanistan. In contrast to prior epidemiological estimates of MetS in the US population (20.3% among 20- to 39-year-olds; Ervin, 2009), we found substantially more veterans (29.0%) with PTSD in this age range with MetS. Our estimates of the prevalence of MetS (36.6% at T1 and 37.8% at T2) among those with PTSD are remarkably similar to the near 40% that has been reported in two recent meta-analyses (Bartoli *et al.* 2013; Rosenbaum *et al.* 2015*b*). This study extended prior work by addressing a critical question that has, to date, gone unanswered regarding the temporal relationships between PTSD and MetS. Results indicated that PTSD increased MetS risk over the course of, on average, 2.5 years, after controlling for initial MetS features, but that MetS did not predict subsequent PTSD symptoms.

That PTSD longitudinally predicted MetS carries implications for conceptualizing the course and treatment of both conditions. MetS is considered a syndrome (as opposed to a disease) in part because there is no obvious biological process that connects the individual MetS features. Traumatic stress may be one pathogenic environmental factor that, through biological and behavioral pathways, simultaneously intensifies the degeneration of multiple physiological processes and links them together. For example, PTSD may lead to both cardiovascular and HPA axis

system dysregulation (Kibler *et al.* 2014; Brudey *et al.* 2015), which would be expected to increase blood pressure, circulating lipids, blood sugars, and inflammation (Epel, 2009); together, these alterations can increase central fat deposits (Epel, 2009). At the same time, PTSD-related increases in reactive oxygen species (Miller & Sadeh, 2014; Gautam *et al.* 2015; Atli *et al.* in press) may alter the expression of genes important for regulating metabolic processes, ultimately compounding metabolic dysregulation (Grattagliano *et al.* 2008). In addition, PTSD-related poor sleep (Gavrieli *et al.* 2015; Talbot *et al.* 2015), unhealthy diet (Hall *et al.* 2015), insufficient exercise (Georgiades *et al.* 2000; Hall *et al.* 2015), cigarette and alcohol use (Dennis *et al.* 2014), and psychotropic medication use (Vancampfort *et al.* 2015) may exert effects on metabolic health that additively and/or synergistically further contribute to the cascade of broad metabolic dysfunction.

We suspect that PTSD-related MetS may reflect an underlying process wherein the stress and chronicity of PTSD symptoms contribute to accelerated cellular aging and premature disease onset (Miller & Sadeh, 2014; Lohr *et al.* 2015; Wolf *et al.* 2016). The prevalence of MetS is strongly associated with age in the US population (Ervin, 2009); however, we found that PTSD was associated with MetS independent of age, with a prevalence that was greater than expected by age. Thus, MetS may occur prematurely among those with PTSD and may be a clinical manifestation of accelerated aging. Consistent with this, prior work suggests that: (*a*) PTSD is related to advanced cellular age compared to chronological age, as reflected in DNA methylation (Wolf *et al.* 2016) and telomere length (Tyrka *et al.* 2016); and (*b*) metabolic dysregulation is also associated with shortened telomere length (Epel, 2009) and contributes to biological aging (Belsky *et al.* 2015). Moreover, in our prior work in an independent sample of veterans from the wars in Iraq and Afghanistan, we found that PTSD-related MetS was cross-sectionally associated with substantial and widespread decreases in cortical thickness across temporal, parietal, and frontal brain regions (Wolf *et al.* in press). Together, these findings suggest that PTSD-related accelerated cellular aging may be reflected in premature genomic, physical health, and neurocognitive decline, highlighting the need to identify those at greatest risk and develop effective interventions.

It may be prudent to closely monitor the metabolic profiles of individuals with PTSD, even among young adults, so that early indications of problems can be discussed with the patient, careful consideration paid to the potential for weight gain side effects in prescribed medications, lifestyle changes recommended, and an appropriate treatment plan aimed at reducing metabolic pathologies enacted. Early screening for other age-dependent health conditions (e.g. cardiovascular disease, type 2 diabetes) may also be warranted. Although we found sex-related differences in MetS features, we found no evidence that PTSD was differentially related to MetS as a function of sex; thus early MetS screening among individuals with PTSD should be conducted with both men and women.

With respect to treatment implications, a recent, if small, meta-analysis found that physical activity was an effective intervention for PTSD (Rosenbaum *et al.* 2015*c*) and may also improve physical health parameters among individuals with PTSD (Rosenbaum *et al.* 2015*a*). No study to date has evaluated if exercise intervention for PTSD can reverse MetS, making this an important area for future research. It is also important for future trials of PTSD treatments to evaluate if psychological interventions for PTSD have indirect beneficial effects on MetS.

Results should be interpreted in light of study limitations including that metabolic profiles were not directly measured but instead were extracted from the medical record. This undoubtedly added methodological variance to the measurement of MetS (e.g. time between assessments, laboratory procedures), which would be expected to attenuate the magnitude of our associations. This medical record approach also led to missing data that we addressed via our analytic design, but which may alter results compared with complete data. There are also a number of other potentially important covariates and health indicators (e.g. insulin, inflammation, waist-to-hip-ratio, waist circumference) that we were unable to reliably assess via medical record review and that could have allowed us to test the International Diabetes Federation's ethnicity-based MetS criteria (Alberti *et al.* 2005). With respect to the longitudinal design of the study, we controlled for baseline PTSD symptoms, but the metabolic profiles of individuals prior to trauma exposure and PTSD onset were not available. We did not observe PTSD group differences in raw laboratory values at T2 and this may have been due to differences in sample characteristics (e.g. PTSD severity; see Supplementary material) among those who did *v.* did not complete T2. The DSM changed from version IV to 5 between T1 and T2, and this could have also lead to different patterns of results in group-based analyses at T2 compared to T1. However, this would not be expected to substantively alter our primary results, which were focused on PTSD severity evaluated via regression, as prior work comparing DSM-IV with DSM-5 PTSD *severity* suggests very strong correlations across the two definitions (Miller *et al.* 2013; Bovin *et al.* in press).

The strengths of this study include that it is the first longitudinal evaluation of potential bi-directional

associations between PTSD and MetS that controls for baseline effects and does so parsimoniously in a single analysis. Additional study strengths include the large sample size, inclusion of Iraq/Afghanistan veterans from across the country, the ability to evaluate sex-specific effects, and our use of a structured diagnostic interview to assess PTSD.

In conclusion, we found that young veterans of the conflicts in Iraq and Afghanistan with PTSD exhibited signs of substantial premature health decline. This should be of grave concern to mental health and primary-care clinicians alike and suggests the critical importance of developing interventions that reduce both psychiatric and metabolic pathology. MetS is hugely costly on its own (Sullivan *et al.* 2007), and the economic, personal, and societal costs can only balloon if the condition gives rise to other associated diseases such as premature cardiovascular disease (Lakka *et al.* 2002), type 2 diabetes (Wilson *et al.* 2005), cancer (Esposito *et al.* 2012), dementia (Yaffe *et al.* 2004), and death (Lakka *et al.* 2002). This is a major public health concern and addressing it in this population now has the potential to reduce preventable morbidity and mortality among the nation's newest cohort of veterans.

Supplementary material

For supplementary material accompanying this paper visit http://dx.doi.org/10.1017/S0033291716000817.

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Declaration of Interest

None.

Notes

[1] Waist-to-hip ratio and waist circumference are superior metrics of central obesity but were not available in the medical record, so we used BMI instead. A BMI cut-off of 25 is classified as 'overweight' and a BMI of 30 is the cut-point for 'obese' (WHO, 2000), with a wide range of optimal cut-points for metabolic syndrome reported in the literature (e.g. Zandieh *et al.* 2012; Liu *et al.* 2013). Given this, we ran our primary cross-lagged analyses using both cut-points and found no differences in results (i.e. same pattern of statistical significance and cross-lagged path coefficients within 0.01 of each other). Thus, we retained the lower cut-point to be as inclusive as possible.

[2] We use the term 'prevalence' throughout the manuscript with the following caveat: as the registry over-sampled veterans with probable PTSD and also over-sampled women, prevalence may be over-estimated and may not generalize to the broader population of veterans of the wars in Iraq and Afghanistan.

[3] See note to Table 3 for discussion of results using the higher BMI cut-point.

[4] In a separate model, we also included these demographic variables as covariates of T2 MetS and PTSD severity and found that doing so did not alter the primary pattern of results. Therefore, for the sake of simplicity, we present the results with these variables included as covariates of the T1 variables only.

[5] Similar results were obtained when we substituted T1 PTSD diagnosis for T1 PTSD severity: the odds of a subsequent MetS diagnosis increased by 75% for veterans with T1 PTSD (95% CI 1.24–2.46, $p = 0.001$).

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Utility of Repeated Screening for Military Sexual Trauma (MST)

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INTRODUCTION

- In 1999, the Veterans Health Administration (VHA) implemented a procedure for screening of prior military sexual trauma (MST) among veterans
- Previous research among Operation Enduring Freedom(OEF)/Operation Iraqi Freedom (OIF) veterans seeking health services found that 15.1% of females and 0.7% of males report MST (Kimerling et al., 2010). However, these rates vary across studies (Suris & Lind, 2008)
- Stigma related barriers may also contribute to reporting variability, e.g. with victims fearing they will not be believed, belief in rape myths (e.g., victims secretly enjoy being assaulted), self-blame etc. (Turchik et al., 2013)
- The salience of gender role stereotypes/stigma among military personnel (Hosoda & Stone, 2000), may contribute to disparities in MST endorsement, particularly underreporting among male veterans (Turchik et al.,2013)
- Experiences of MST are widely under-reported, most often because of shame or fear of stigmatization and/or retribution. Moreover, servicemembers have the compounded fear of losing their jobs or ruining their reputations as a result of reporting sexual assault or harassment.7 Finally, many women experience the guilt and stigma of ruining a fellow serviceman's career by reporting him.
- We examined MST screening results, focusing on frequency of changed reporting over time, particularly in those veterans who initially decline to respond (Decliners).

STUDY AIM & HYPOTHESES

- This was an exploratory study examining screening of Military Sexual Trauma and related patterns of responding, within a healthcare system
- Study particularly focused on exploring responding style of veterans who decline to respond to screening questions in an initial screening

METHODS

Participants

- 1,642 OEF/OIF veterans enrolled in Project VALOR (Veterans' After-Discharge Longitudinal Registry)
  - Mean age = 37.4 years
  - 43.3% female
  - 79% Caucasian

Procedure

- Veteran's presenting for care at any VA Boston Healthcare Center (VA) are screened for history of Military Sexual Trauma and their responses to this screening is stored in their medical records
- For veteran's enrolled in project VALOR, MST screening data were pulled from Veteran electronic medical records

Screener Questions

- Introductory text for providers to screener: *I'm going to ask about some things that may have happened to you while you were in the military. We ask all Veterans these questions because VA offers free care related to these experiences. You can choose not to answer these questions if you prefer or you may simply say 'yes' or 'no.'*
- When you were in the military, did you ever receive unwanted, threatening, or repeated sexual attention (for example, touching, cornering, pressure for sexual favors, or inappropriate verbal remarks, etc)? (harassment)
- When you were in the military, did you have sexual contact against your will or when you were unable to say no (for example, after being forced or threatened or to avoid other consequences)?

RESULTS

- Results indicated that Veterans were generally screened for MST more than once (*M* = 1.29, *SD* = .66)
- Approximately 18% of the sample endorsed MST
  - 96.7% female
- 41.1% of those who endorsed MST, did not do so initially, changing their response over the course of inquiries
  - Original No: 92
  - Original Decline: 20

RESULTS CONT.

- Decliners (n = 39; 18% male)
  - 95% were screened more than once (M = 2.79, SD = 1.609)
  - 100% of Decliners changed their response across screenings, with 54.1% endorsing MST over time (100% female).

DISCUSSION

- Of particular importance, findings suggest that overall, male veterans are susceptible to decreased reporting in an interview format.

Future Directions/Implications

- Repeated screening of MST, may prevent missed screenings, particularly of female veterans.
- These findings may facilitate the development of a more efficient and standardized method of screening for MST, particularly for male veterans.
- Future studies could examine stigma in specific subpopulations (e.g. LGBT, racial/cultural) whose endorsement might be particularly influenced by assessment method
- Future studies should consider examining whether the sex of the interviewer influences disclosure rates during screen for MST

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Project VALOR: Trajectories of Change in PTSD in Combat-Exposed Veterans: W81XWH-12-2-0117

The Influence of PTSD Service Connection on Mental Health Treatment Utilization

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Background

- Posttraumatic stress disorder (PTSD) is the most commonly compensated mental disorder in the VA disability program, with veterans compensated for PTSD receiving 20.5% of all compensation payments in 2004, while representing only 8.7% of all compensation recipients (Department of Veterans Affairs, 2005). The number of veterans receiving PTSD disability compensation grew by 79.5% from 1999 to 2004, while the total number of all veterans receiving compensation increased by only 12.2%, making PTSD one of the fastest growing disability conditions (Department of Veterans Affairs, 2005).
- The implications of this increase on veterans has received significant academic and political attention. Some argue that individuals engage in treatment as they establish their disability claims, only to drop out following the award of benefits (e.g., Burkett & Whitley, 1998). The 2005 Office of the Inspector General (OIG) found that 29% of veterans exhibited a decrease in mental health visits after achieving 100 percent disability status, leading them to conclude that "the compensation program has a built-in disincentive to get well when veterans are reapplying to get their disability ratings increased."
- Conversely, in a sample of 439 PTSD claimants, researchers found that VA mental health service use increased after claimants received PTSD disability benefits compared with use in a pre-claim period, suggesting that compensation may promote treatment utilization (Sayer, Spoont, & Nelson, 2004). Similarly, in a prospective study of veteran disability claimants, treatment dropout did not increase among veterans who were no longer compensation seeking (Sayer et al., 2008).
- These somewhat contradictory findings point to the complicated nature of examining and interpreting evidence related to the impact of the VA disability compensation for PTSD, and suggests the need for more research on the topic.
- The current study sought to clarify the impact of PTSD-related disability compensation (i.e., service connection) on mental health treatment utilization, and to explore the impact of service connection for other mental disorders on treatment utilization. In line with Sayer et al., we hypothesized that service connection for PTSD at baseline would not be associated with lower treatment utilization at a two-year follow-up.

Method

- Participants were 1377 Operation Enduring Freedom / Operation Iraqi Freedom veterans (51.8% male, 73.1% Caucasian, average age 38.1 years (*SD* = 9.7) who were enrolled in Project VALOR (Veterans' After-Discharge Longitudinal Registry), a gender balanced longitudinal research registry where veterans with PTSD were oversampled 2-to-1.
- Included in analysis if data were available on whether they were service connected for PTSD (n = 726) or not (n = 651) at baseline and reported on mental health treatment utilization at follow-up. Average length of time between baseline and follow-up assessments was 2.49 years (*SD* = .59).
- PTSD diagnosis was assessed using the Structured Clinical Interview for DSM-IV (First, Spitzer, Gibbon, & Williams, 2002).
- Participants reported whether they utilized mental health treatment within the last 12 months.

Table 1

Treatment seeking differences among service connected and non-service connected individuals

	X^2 (df)	Service Connected	Not Service Connected
		Count	Count
Overall Sample	95.39 (1)***		
Tx Seeking		570	351
Non-Tx Seeking		151	296
PTSD Diagnosis	18.47(1)***		
Tx Seeking		466	108
Non-Tx Seeking		108	88
No PTSD Diagnosis	29.68(1)***		
Tx Seeking		104	165
Non-Tx Seeking		43	208

Note: *** = $p < .001$.

Results

- Chi-square analyses revealed that individuals who were service connected for PTSD at baseline were significantly more likely to report receiving mental health services at follow-up than those who were not service connected for PTSD at baseline (See Table 1).
  - This was the case for individuals with a PTSD diagnosis (81.2% of service connected vs. 67.9% non-service connected, $\chi^2(1) = 18.47$, $p < .001$) and without a PTSD diagnosis (70.7% vs. 44.2%, $\chi^2(1) = 29.68$, $p < .001$).
- Participants' service connection percentage (i.e., the amount of compensation received; see Figure 1 for frequency breakdown) was also significantly associated with receiving services at follow-up (r = .22, $p < .01$).
- Further, those who were not diagnosed with PTSD but were service connected for another mental disorder were more likely to have received services at follow-up than those who were not service

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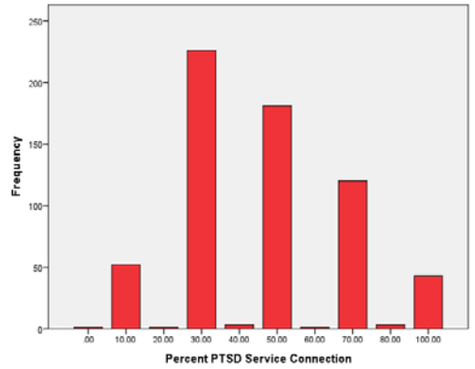
Figure 1

Service connection breakdown by percentage



Conclusions and Future Directions

- Our results suggest that veterans who are service connected for mental disorders are more likely to seek mental health treatment than those who are not service connected, regardless of PTSD diagnostic status
- This pattern of results remained the same regardless of whether veterans are service connected for PTSD or another mental health disorder.
- Additionally, receiving greater compensation was significantly related to greater mental health service use.
- Unlike prior studies, we assessed treatment seeking in multiple settings (i.e., VA, Vet Centers, community providers)
- These findings support our hypothesis, and suggest that being awarded PTSD service connection does not hinder treatment seeking.
- Our findings contradict the idea that veterans cease treatment once awarded benefits, and may incentivize veterans to seek treatment, an idea that has not received much research attention to date.
- Limitations include a non-representative VA sample and self-reported treatment seeking
- Future research would benefit from examining veterans' reasons for deciding whether to seek treatment , including incentives and barriers to seek treatment

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Trauma Types and Peritraumatic Emotions Predict Suicide Risk among Veterans

Presented at the Annual Convention of the International Society for Traumatic Stress Studies in
New Orleans, LA
November 5 – 7, 2015
Presentation time: Friday, November 6th, 10:00am – 11:15am CST

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National Center for PTSD
Posttraumatic Stress Disorder

Risk Factors and Correlates of the PTSD Dissociative Subtype

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International Society for Traumatic
Stress Studies - November 5, 2015

National Center for PTSD
Posttraumatic Stress Disorder

ADVANCING SCIENCE AND PROMOTING UNDERSTANDING OF TRAUMATIC STRESS

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I, Jonathan Green, have no commercial relationships to disclose.

PTSD and Suicide

- Risk factor
- Nature of trauma
  - Trauma types (Stein et al., 2012)
  - Killing
  - Moral Injury
  - Sexual assault
- Peritraumatic emotions

Bovin & Marx, 2011; Jakupcak et al., 2009; Maguen et al., 2012; Stein et al., 2012

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Posttraumatic Stress Disorder

Research Questions

1. Is the nature of trauma associated with later suicide risk?

2. Is the peritraumatic experience associated with suicide risk?

Project VALOR

- 1,649 U.S. Army & Marine OEF/OIF combat-exposed veterans in the VA healthcare system
- 50% female
- 75% with two PTSD encounter diagnoses within previous 12 months
- 25% without PTSD diagnosis

National Center for PTSD
Posttraumatic Stress Disorder

Participants (N = 743)

Age (mean and SD)	37.4 (9.98)
Female (%)	51.5
Race/ethnicity	
Asian (%)	2.2
American Indian (%)	2.8
Black (%)	15.6
Pacific Islander (%)	0.5
White (%)	75.5
Other/unknown (%)	3.4
Hispanic (%)	13.1
Military branch	
Army (%)	91.4
Marine Corps (%)	8.6

Measures

- SCID for DSM-IV
  - Trauma Types
  - Military Sexual Trauma (MST)
- Measure of Emotional Responses to Trauma (MERT)
- MINI suicide module

Bovin et al., 2012; First et al., 2002; Kroenke & Spitzer, 2002; Sheehan et al., 1998

Is the nature of trauma associated with suicide risk?

National Center for PTSD
Posttraumatic Stress Disorder

Prevalence of Trauma Types

Nature of Trauma	N Participants (%)
Life Threat – Self	334 (55.0)
Life Threat – Other	213 (28.7)
Aftermath of Violence	127 (17.1)
Traumatic Loss	105 (14.1)
Moral Injury – Self	60 (8.1)
Moral Injury – Other	162 (21.8)
MST	92 (12.4)

Trauma Types and Suicide

- Moral Injury – Other associated with increased suicide risk,
  $\beta = .10$, $p < .05$

- MST unrelated to suicide risk,
  $\beta = .06$, $p = .14$

Moral Injury-Other without MST

- “Buried children in Iraq”
- “Had to watch torture videos”
- “Attacked by fellow soldier”
- “Witnessed unwanted sexual experience”

Is the peritraumatic experience associated with suicide risk?

Peritraumatic Emotions

Peritraumatic Emotion	N Participants (%)
Afraid	541 (72.8)
Helpless	539 (72.5)
Horrified	470 (63.3)
Angry	606 (81.6)
Sad	502 (67.6)
Joyful	55 (7.4)
Disgusted	482 (64.9)
Surprised	474 (63.8)
Confused	474 (63.8)
Relaxed	49 (6.6)

Peritraumatic Emotion	N Participants (%)
Excited	240 (32.3)
Guilty	410 (55.2)
Ashamed	278 (37.4)
Humiliated	198 (26.6)
Embarrassed	197 (26.5)
Regretful	413 (55.6)
Frustrated	609 (82.0)
Anxious	592 (79.7)
Numb	464 (62.4)

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Peritraumatic Emotions

- Deleterious
  - Joyful, β = .06, p<.05
  - Ashamed, β = .08, p<.05
  - Humiliated, β = .08, p<.05
- Protective
  - Sad, β = -.07, p<.05

Summary

- Moral Injury
- MST
- Peritraumatic Emotions

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Implications

- Risk assessment
- Index events
- Peritraumatic emotions
  - Shame, embarrassment…blame?
  - Joy – acquired capability

Limitations and Future Directions

- PTSD registry
- OEF/OIF Veterans
- Retrospective assessment of peritraumatic emotions

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