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Occupational Sources of Stress and Symptoms of Distress among C-17 Pilots and Loadmasters

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14. ABSTRACT

The U.S. Air Force relies upon the C-17 Globemaster aircraft and aircrew for the effective and strategic transportation of materials, supplies, and manpower to sustain a diverse number of missions. This study utilized a web-based occupational health screening survey to examine the main sources of occupational stress and levels of psychological distress among active duty C-17 Globemaster pilots and loadmasters based in the continental United States engaging in short- and long-duration overseas flights in support of operational missions. Participants included 233 (67.93%) pilots and 110 (32.07%) loadmasters. Based on the number of aircrew assigned to the units surveyed, the response rate was 32%. Respondents answered questions regarding demographics, occupational factors, and sources of occupational stress. Levels of psychological distress were assessed using the Outcome Questionnaire 45.2. Qualitative analyses of textual responses to the items assessing self-reported sources of stress were performed. Descriptive statistics were calculated for the overall and subscale total scores. Univariate analyses of covariance and chi-square analyses were conducted to identify group differences between pilots and loadmasters on means and elevated levels of psychological distress, as well as subscales assessing symptom distress, interpersonal relations distress, and social role distress. Results indicated that the top sources of stress for both pilots and loadmasters were operational in nature (i.e., operational and administrative workload, organizational management issues, professional career development, and balancing work and home life demands and obligations). Aeromedical implications of the study's findings and recommendations are discussed. Separate, yet cohesive, recommendations are provided for line and medical leadership to address the elevated levels of distress found among C-17 pilots. The recommendations are based on early identification and intervention of aircrew experiencing emotional and relational distress that may negatively impact performance. The value of routine, anonymous, organizational health stress screenings is also discussed along with limitations of assessments based upon genuine self-disclosure.

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1.0 SUMMARY

The U.S. Air Force relies upon the C-17 Globemaster aircraft and aircrew for the effective and strategic transportation of materials, supplies, and manpower to sustain a diverse number of missions. Although C-17 Globemaster functioning and maintenance are key to such operations, the health and readiness of the aircrew are equally important. This study utilized a web-based occupational health screening survey to examine the main sources of occupational stress and levels of psychological distress among active duty C-17 Globemaster pilots and loadmasters based in the continental United States engaging in short- and long-duration overseas flights in support of operational missions.

Participants included 233 (67.93%) pilots and 110 (32.07%) loadmasters. Based on the number of aircrew assigned to the units surveyed, the response rate was 32%. Respondents answered questions regarding demographics, occupational factors, and sources of occupational stress. The levels of psychological distress were assessed using the Outcome Questionnaire 45.2. Qualitative analyses of textual responses to the items assessing self-reported sources of stress were performed. Responses were categorized into domains and facets and tabulated to identify which self-reported sources of stress were the most frequently endorsed among aircrew. Descriptive statistics were calculated for the overall and subscale total scores for the Outcome Questionnaire 45.2. Univariate analyses of covariance and chi-square analyses were conducted to identify group differences between pilots and loadmasters on means and elevated levels of psychological distress, as well as subscales assessing symptom distress, interpersonal relations distress, and social role distress.

Results indicated that the top sources of stress for both pilots and loadmasters were operational in nature (i.e., operational and administrative workload, organizational management issues, professional career development, and balancing work and home life demands and obligations). However, loadmasters also reported difficulty with sustaining healthy lifestyle habits (e.g., exercise, nutritional intake, etc.). The results of the study revealed pilots had higher levels of social role distress when compared to loadmasters and that pilots were more likely to endorse elevated social role distress when compared to loadmasters. Furthermore, relative risks indicated that pilots who had been working in their assigned units for more than 2 years were more likely to report elevated general psychological distress, symptom distress, and interpersonal relations distress. Pilots who reported working more than 50 hours per week, on average, were also more likely to report elevated social role distress, and pilots 31-35 years of age were more likely to endorse elevated social role distress than pilots 18-25 years old.

Aeromedical implications of the study's findings and recommendations are discussed. Separate, yet cohesive, recommendations are provided for line and medical leadership to address the elevated levels of distress found among C-17 pilots. The recommendations are based on early identification and intervention of aircrew experiencing emotional and relational distress that may negatively impact performance. The value of routine, anonymous, organizational health stress screenings is also discussed along with limitations of assessments based upon genuine self-disclosure.

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2.0 INTRODUCTION

Over the past decade, the U.S. Air Force (USAF) has sustained a high operational tempo supporting multiple combat and humanitarian missions throughout the globe. The capability of sustaining such operations hinges on the effective and strategic transportation of materials, supplies, and manpower to sustain the diverse number of USAF global missions. Although there is a wide range of aircraft that are utilized for such missions, the C-17 Globemaster has emerged as a critical asset for supporting diverse missions. For example, the C-17 Globemaster provides aeromedical evacuation, aerial refueling, cargo delivery, and military personnel transportation [1]. The C-17 is known for its ability to land on short and austere airfields, ground maneuverability, and high payload capacity of both passengers and cargo [2]. As a result of the effectiveness of the C-17 Globemaster, this aircraft is increasingly relied upon for short- and long-range missions.

Although C-17 aircrew may not be engaged in direct combat, the combination of having to continuously adapt to a wide range of operational, combat-humanitarian, and career-related stressors may be reasonably perceived as increasing the risk for elevated levels of distress. As a result, there are questions among aeromedical and line leadership regarding the main sources of occupational stress, the prevalence of elevated distress levels among aircrew (e.g., pilots, co-pilots, and loadmasters), and if there are differences between officer and enlisted duty positions.

2.1 Aeromedical Concerns Regarding Occupational Stress

The term "*distress*" is characterized as a psychological state with negative emotional (e.g., feelings of anger, agitation, sadness), cognitive (e.g., difficulty concentrating, sustaining attention), behavioral (e.g., trouble getting along with others), and physical (e.g., difficulty sleeping, fatigue, muscle tension, headaches) changes in daily functioning. High levels of distress can include feelings of loneliness, relational conflict with peers and family members, and difficulty accomplishing tasks [3]. Elevated levels of distress have been found among those seeking outpatient mental healthcare [4].

According to USAF aeromedical policy, performing and operating in a high-demand, high-operational, and high-precision aviation-related position require an optimal level of physical and psychological functioning [5]. Although operators may be perceived as generally healthy, if they suffer from a psychological condition (i.e., fatigue, elevated distress levels) that has the potential to lead to degradation in the performance of their duties, then they are disqualified from such aviation-related operations. Such conditions do not have to represent a diagnosable categorical disorder. Rather, high states of temporary or chronic fatigue can be reasonably perceived as elevating the risk to safety and mission completion and may be enough to warrant removal from flying from a flight medicine perspective. The reason for such high aeromedical standards is due to the perceived risk that subtle decrements in psychological functioning can have on elevating the risk for an aviation mishap. Although an elevated level of distress is not a categorical psychiatric diagnosis, it stands to reason that such a condition leads to performance degradation. If the condition is chronic and untreated, it may also lead to significant and more substantial psychological difficulties (e.g., anxiety and depression).

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2.2 Occupational Stressors

As mentioned previously, the sources of occupational stress and prevalence of elevated distress can be wide ranging. When evaluating both conditions, it is important to understand an aircrew member's occupational environment as a whole. This includes consideration of the variety of operational stressors (e.g., workload, work hours, frequency of overseas support missions, circadian rhythm adjustments to frequent time zone changes) as well as combat-related stressors (e.g., exposure to wounded or suffering military personnel and civilian bystanders) that may impact an aircrew member's psychological health. Although occupational stressors may differ across occupational positions (e.g., enlisted vs. officer), an important aspect of this study is to address common sources of stress.

Operational stressors are defined as those related to sustaining operations [6]. These include issues such as available manpower, equipment, and general resources needed to accomplish occupational tasks and objectives. There are several important operational stressors to consider when assessing the impact on health. For C-17 aircrew, such stressors may include, but are not limited to, the following:

- Long work hours during the duty day or work week
- Frequent long- and short-duration flights making it difficult to maintain domestic life routines
- Continual disruption to circadian rhythms due to operational and training temporary duty tempo and time zone changes
- Increasing administrative duties and responsibilities due to downsizing of support and logistics personnel – this includes increasing budget and economic constraints placed on aircrew to accomplish mission sets with fewer support personnel resources

It stands to reason such stressors can lead to elevated levels of distress when faced on an unending basis.

Combat and humanitarian stressors are defined as those that involve direct support to combat and humanitarian operations and include direct exposure to human suffering [6]. For many C-17 aircrew, combat- and humanitarian-related stressors may include, but are not limited to, the following:

- Landing and taking off in combat zones where a threat to weapon strikes are high
- Being under fire (to include mortar attacks) while deployed to a combat zone
- Exposure to injured or killed military personnel during deployments
- Exposure to suffering, wounded, and starving civilians when providing humanitarian assistance

These conditions are also reasonably perceived to accentuate occupational distress.

Career-oriented stressors are those that involve requirements for promotion and progression [6]. First, career progression is a competitive process, and promotion is centered on demonstrating high levels of leadership and aviation skill proficiencies. As a result, aircrew must continually seek out opportunities that allow for advancement and the demonstration of such skills. This may lead to increased workload on top of an already demanding operational tempo. Second, aircrew must continue in both military and civilian education to demonstrate continual

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progression in their capabilities. For pilots, this includes obtaining a graduate level education, and for loadmasters a 4-year college education. As a result, many must balance the requirement of advanced levels of academic training with their operational tempo and duties. The requirement to support long- and short-duration missions may directly conflict with educational instruction and requirements for pursuing an advanced degree.

Although a single stressor from the categories above may not lead to high levels of distress, it is reasonable to perceive the collective combination of multiple stressors over a daily or condensed period of time elevates the risk for stress-related difficulties. The elevations in distress may, in turn, negatively affect aircrew readiness and performance. In developing strategies for improving performance and mitigating distress, it is essential that leadership clearly understand the prevalence of elevated levels of distress among aircrew, as well as target those areas aircrew perceive as negatively affecting their performance and accentuating psychological distress.

2.3 Policies that Mitigate Aircrew Stress

There are a number of resources to assist active duty aircrew with identifying and mitigating psychological stress. Such resources include periodic and annual health assessments (e.g., annual web-based health assessment screening and health exams upon request by their flight medicine physician). Aircrew also have routine, daily access to flight medicine providers, health and wellness resources (such as the base gym), and programs for promoting health (e.g., tobacco cessation). However, the operational tempo and career promotion requirements may interfere with access to health promotion resources and participating in activities. Strategies may also vary by unit, such as weekly or monthly social morale events and regularly scheduled unit fitness exercise throughout the week.

Additionally, there are official policies and instructions in place for leadership to follow to ensure adequate rest for aircrew supporting a unit with a high operational tempo. For example, Air Force Instruction (AFI) 11-202, Volume 3, *General Flight Rules*, assists unit commanders with developing schedules to reduce the incidence of performance-degrading fatigue among aircrew [7]. According to AFI 11-202V3, aircrew members cannot exceed a certain amount of flight hours over a specified period of time: (a) 56 hours of flight time in a 7-day period, (b) 125 hours of flight time in a 30-day period, and (c) 330 hours of flight time in a consecutive 90-day period, based on the flight time period (FTP), or the time spent in the air. Flight duty period (FDP) is also recorded according to flight rules and is defined as the time from the beginning of an alert sequence to the shutdown of aircraft engines. AFI 11-202V3 also specifies that aircrew crew rest is a minimum of 12 hours before the next FDP. Crew rest involves free time, meals, transportation, and 8 hours of uninterrupted sleep/rest [7]. AFI 11-202V3 helps to mitigate psychological stress by setting parameters and ensuring aircrew have adequate rest periods between missions.

The USAF also uses a fatigue management software program titled “Fly Awake” for scheduling C-17 aircrews. This software is based on the Sleep, Activity, Fatigue, and Task Effectiveness/Fatigue Avoidance Scheduling Tool (SAFTE/FAST) model and predicts aircrew member alertness on any given day, based on their schedule in the last week [8]. The software considers the sleep-wake cycle of each aircrew member over a period of several days to assess level of alertness (i.e., fatigue). It has been suggested that Fly Awake works well for long FDP and FTP missions, but may not work as well for long FDP and short FTP missions because it

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does not adequately consider time spent conducting on-ground duties [9]. Recently, additions to AFI 11-202V3 have stipulated that a commander in charge should consider shortening the FDP in cases where post-flight duties exceed 2 hours [7]. Although fatigue management software is in effect and contingencies are found in AFI 11-202V3 to aid aircrew members with mitigating fatigue, there are many scenarios in which aircrew with a long FDP and short FTP may be given shorter than adequate time off before their next alert sequence, which may increase the risk for distress.

2.4 Purpose of the Study

Based on conversations with line commanders and flight medicine physicians supporting active duty C-17 operations within the continental United States, there are diverse opinions regarding which stressors are perceived by aircrew to be the most distressing. It is also unknown whether or not there are differences in the rates of distress between enlisted and officer aircrew. The purpose of this study is to assess (a) similarities and differences in self-reported top sources of occupational stress among C-17 aircrew and (b) differences in general and elevated levels of distress (to include symptom, interpersonal, and social role distress) between pilots and loadmasters, as well as demographic and occupational variables associated with elevated levels of clinical distress, symptom distress, interpersonal relations distress, and social role distress among C-17 pilots.

3.0 METHOD

3.1 Participants

A total of 343 C-17 aircrew participated in the study; 233 (67.93%) were pilots and 110 (32.07%) were loadmasters. To calculate the response rate, the total number of C-17 pilots and loadmasters assigned to each unit was obtained from USAF operational leadership. This number was then compared with the number of C-17 pilots and loadmasters that participated in the study to obtain an overall estimated response rate. Based on the number of aircrew assigned to the units surveyed, the response rate was 32% (95% confidence interval (CI) = 29-35%). Demographic responses for pilots, loadmasters, and overall C-17 are shown in Table 1.

3.2 Instruments

3.2.1 Demographics Questionnaire. Participants were asked to complete a series of items assessing demographic (i.e., rank range, gender, age range, marital status) and operational variables (i.e., duty position, assigned unit, months in current unit assignment, hours worked per week). This section of the survey was designed so that no personally identifiable information was obtained (e.g., Social Security number, name, date of birth, etc.). This was to help ensure anonymity was maintained and to promote genuine self-disclosure.

3.2.2 Self-Reported Sources of Occupational Stress. There were two open-ended response items on the survey assessing for top self-reported sources of perceived occupational stress. First, participants were asked, "*Please describe the top five sources of occupational stress that directly impact your operational effectiveness*." Second, participants were then asked, "*If there are any additional sources of occupational stress that you wish to note, please list below*." Participants

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were asked to write in their responses and provide details so that researchers could fully understand their sources of occupational stress.

Table 1. Demographics for C-17 Pilots and Loadmasters

Demographic	Pilots		Loadmasters		Total	
	n	%	n	%	n	%
Gender						
Male	214	92.24	98	89.09	312	91.23
Female	18	7.76	12	10.91	30	8.77
Age Range (yr)						
18-25	22	9.44	37	33.64	59	17.20
26-30	117	50.21	32	29.09	149	43.44
31-35	69	29.61	19	17.27	88	25.66
36-40	17	7.30	13	11.82	30	8.75
41+	8	3.43	9	8.18	17	4.96
Marital Status						
Single	76	32.62	44	40.00	120	34.99
Married	157	67.38	66	60.00	223	65.01
Months in Current Unit						
0-24	117	50.21	61	55.96	178	52.05
25+	116	49.79	48	44.04	164	47.95
Hours Worked per Week						
30-50	107	45.92	98	89.91	205	59.94
51+	126	54.08	11	10.09	137	40.06

3.2.3 Outcome Questionnaire-45 (OQ-45.2). The OQ-45.2 is a self-report survey composed of 45 items. The scale assesses symptoms of distress experienced within the past week. Each item has a response option on a 5-point Likert scale ranging from *never* to *always*. Responses are scored from 0 to 4, respectively. Nine items throughout the survey are reverse-scored to reduce random responding. The items are summed to yield an overall distress score ranging from 0 to 180. A total cut-off score of 63 or greater is indicative of elevated levels of distress. Concurrent validity estimates for the total score with similar standardized scales range in the mid-0.80s [3].

In addition to the total score, the OQ-45.2 has three subscales: symptom distress, interpersonal relations distress, and social role distress. The symptom distress subscale is composed of 25 items and has a score ranging from 0 to 100. A recommended clinical cut-off score of 36 or greater is indicative of experiencing symptoms of stress-related illnesses. The interpersonal relations subscale is made up of 11 items and has a score ranging from 0 to 44. The recommended cut-off score of 15 or greater represents difficulties such as loneliness and conflict with loved ones. The social role subscale has nine items and has a score ranging from 0 to 36. The recommended cut-off score of 12 or greater reflects difficulties experienced in the individual's personal roles, such as spouse, parent, or employee [3]. The OQ-45.2 also contains "critical items," which assess suicidal ideation, feelings of aggression or acting out in anger, and substance abuse.

3.3 Procedures

A request to participate in the survey was sent to all C-17 active duty pilots and loadmasters assigned to Charleston and McChord Air Force Bases via group e-mails sent by unit group commanders. The e-mail request to participate informed aircrew that responses were

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anonymous and voluntary and that the purpose of the survey was to gain situational awareness of the sources of occupational stress and current levels of distress among aircrew. The information would be used to develop strategies and improve line and medical leadership capabilities for improving health and performance.

The email request for participation had an internet link to the USAF School of Aerospace Medicine web-based survey that contained an opening page with an introductory script further explaining the study was conducted by independent aeromedical practitioners and researchers. The introductory script also explained to potential participants the nature, purpose, and instructions for the study and informed participants that operational leadership would not have access to individual responses and results would be presented in a summarized format. Participants were informed that survey results would also be utilized by medical leadership to consult with AF commanders on areas of concern and to develop strategies to mitigate stressful working conditions. The introductory script informed participants they could withdraw at any time without negative repercussions. Furthermore, before proceeding, participants were asked to respond to a question asking if they understood the nature, purpose, and instructions of the survey and were voluntarily consenting to participate. Those who endorsed "yes" were then allowed to proceed and take the survey. Participants were then directed to the survey, which took an average of 25-30 minutes to complete. Upon completing the survey, respondents were given information regarding where and when they could access the general results of the study. A total of six individuals indicated that they did not wish to participate in the survey. These individuals were not given the survey and were redirected to another web page that instructed them on how to contact the independent researchers of the study for additional information.

3.4 Data Analysis

Qualitative analyses were conducted for the open-ended, write-in responses to the sources of occupational stress. Participants' textual responses were analyzed and grouped into categories by three subject matter experts and behavioral scientists. For example, the responses of *too much work, task overload*, and *too many tasks* were all coded into the category Work Overload. Each self-reported source of stress constituted one tally, and stressors were coded such that a respondent could have multiple tallies in a single category. Similar categories were combined into facets. For example, the categories Work Overload, Manning Issues, Long Work Hours, and Operational Tempo were combined into the facet of *Workload and Manning*. Each facet of coded responses was tabulated separately for pilots and loadmasters.

SPSS version 16 (IBM Corp., Armonk, NY) was used for data analyses. Descriptive statistics were calculated for the overall and subscale scores for the OQ-45.2. Univariate analyses of covariance (ANCOVAs) were conducted to identify group differences between pilots and loadmasters for overall total and subscale scores assessing symptom distress, interpersonal relations distress, and social role distress. Gender, age range, marital status, months in current unit, and hours worked per week were included as covariates. Similar studies in the past have also included rank range as a covariate, but this was not feasible for the C-17 population because pilots are all officers and loadmasters are all enlisted. A statistical significance level of $p < .05$ was established *a priori*. Results were not considered meaningful unless they were statistically significant with a Hedges' g effect size of 0.30 or greater.

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Threshold variables were calculated to differentiate between those who met and those who fell below the recommended cut-off scores for the overall total and subscale measures. The threshold variables used were based on elevated scores and for comparison with previous research [10,11]. Frequencies for the elevated psychological distress and subscale thresholds were calculated. Contingency tables (i.e., cross-tabulations) and chi-square analyses were performed to assess differences between pilots and loadmasters on elevated levels of distress, symptom distress, interpersonal relations distress, and social role distress. Fisher's exact tests were used in lieu of chi-square analyses when one or more cells in a contingency table had an expected frequency of $n < 5$. Relative risks were reported comparing the probabilities of pilots and loadmasters meeting each of the thresholds [12].

While assessing pilot participant responses only, separate contingency table analyses were calculated to determine the association of demographic (age range, gender, and marital status) and occupational variables (months in current unit and hours worked per week) with elevated levels of psychological distress, symptom distress, interpersonal relations distress, and social role distress. Relative risks were reported. Each of the five age range categories was compared to the other four age range categories. Similar previous reports utilized logistic regressions for the listed associations, but the small sample sizes with elevated levels (meeting thresholds) limited the analyses in the current study. Lastly, frequencies were run for pilots and loadmasters endorsing the OQ-45.2 critical items pertaining to suicidal ideation and feelings of acting out in anger.

4.0 RESULTS

4.1 Self-Reported Sources of Occupational Stress

Stress facets were rank-ordered based on the number of pilots and loadmasters identifying the facet as a top source of occupational stress. The top five facets for sources of occupational stress reported by C-17 pilots and loadmasters are shown in Table 2.

4.2 Overall Total and Subscale Distress

4.2.1 Overall Distress. The mean overall OQ-45.2 total distress score was 32.10 (standard deviation (*SD*) = 16.60) for pilots and 28.56 (*SD* = 16.97) for loadmasters. An ANCOVA with gender, age range, marital status, months in current unit, and hours worked per week as covariates did not identify differences between pilots (estimated marginal mean (*EMM*) = 31.43, *SD* = 16.97) and loadmasters (*EMM* = 30.10, *SD* = 17.54) on overall distress, $F(6, 328) = 0.39$, $p = .53$, $g = 0.08$ (95% CI = -0.04-0.19). Mean differences for one covariate, months in current unit, were identified. Those in their current unit 25 months or longer scored higher on clinical distress than those in their current unit 24 months or less, $F(6, 328) = 14.43$, $p < .01$, $g = 0.48$ (95% CI = 0.36-0.60). Mean group differences were not found for the gender, age range, marital status, and hours worked per week covariates.

The number and percentage of those who had elevated levels of distress, indicated by a score of 63 or greater, were 15 out of 229 (6.55%) pilots and 3 out of 109 (2.75%) loadmasters. A contingency table analysis was performed to identify differences between pilots and loadmasters. A subsequent chi-square analysis did not reveal a significant between group difference, $\chi^2 (1) = 2.11$, $p = .15$.

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Selecting for pilots only, chi-square tests were run to identify associations among demographic and occupational variables with elevated clinical distress. Relative risks indicated that pilots who had been with their unit for 25 months or longer were 6.56 times (95% CI = 1.51-28.40) more likely to endorse elevated clinical distress than pilots who had been with their unit less time, χ^2 (1) = 8.74, $p < .01$. Associations were not identified for gender, age range, marital status, and hours worked per week.

Table 2. Top Reported Sources of Occupational Stress among C-17 Pilots and Loadmasters

Pilots (total stressors reported, n = 815)			Loadmasters (total stressors reported, n = 264)		
Stress Facet	**n**	**%**	**Stress Facet**	**n**	**%**
Operational Workload & Manning (e.g., deployment and temporary duty issues, high operational tempo, long work hours)	177	21.72	**Operational Workload & Manning** (e.g., deployment and temporary duty issues, high operational tempo, long work hours)	72	27.27
Professional Career Development & Proficiency (e.g., professional military education and advanced academic degrees, job confidence, career progression)	118	14.48	**Administrative Workload** (e.g., excessive administrative or extra duties, administrative needs conflicting with mission needs, preparing for compliance inspections)	29	10.98
Organizational Management (e.g., inefficiency, poor organizational planning and prioritization, low duty accountability)	95	11.66	**Organizational Management** (e.g., inefficiency, poor organizational planning and prioritization, low duty accountability)	28	10.61
Personal Home Life Stressors (e.g., personal finance struggles, work life balance issues, permanent changes of station)	92	11.29	**Personal Home Life Stressors** (e.g., personal finance struggles, work life balance issues, permanent changes of station)	24	9.09
Administrative Workload (e.g., excessive administrative or extra duties, administrative needs conflicting with mission needs, preparing for compliance inspections)	90	11.04	**Professional Career Development & Proficiency** (e.g., professional military education and advanced academic degrees, job confidence, career progression)	22	8.33
			Sustaining a Healthy Lifestyle (e.g., physical health and fitness, mental health, alcohol related issues, healthy food options, sleep and circadian rhythm issues)	22	8.33

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4.2.2 Symptom Distress. Pilots had a mean symptom distress subscale score of 15.50 (*SD* = 9.10) and loadmasters had a mean score of 14.12 (*SD* = 8.97). An ANCOVA did not identify differences between pilots (*EMM* = 15.19, *SD* = 9.25) and loadmasters (*EMM* = 14.82, *SD* = 9.58) on symptom distress, $F(6, 329) = 0.10$, $p = .75$, $g = 0.04$ (95% CI = -0.08-0.16). Mean differences for one covariate, months in current unit, were identified. Those in their current unit 25 months or longer scored higher on symptom distress, $F(6, 329) = 11.00$, $p < .01$, $g = 0.44$ (95% CI = 0.33-0.55). Mean group differences were not found for the gender, age range, marital status, and hours worked per week covariates.

The number and percentage of those who had an elevated symptom distress subscale score of 36 or greater were 11 out of 230 (4.78%) pilots and 2 out of 109 (1.83%) loadmasters. A contingency table analysis was performed to identify differences between pilots and loadmasters. A Fisher's exact test was not significant between groups ($p = .24$).

Selecting for pilots only, chi-square tests were run to identify associations among demographic and occupational variables with elevated symptom distress. Relative risks indicated that pilots who had been with their unit for 25 months or longer were 4.58 times (95% CI = 1.01-20.73) more likely to endorse elevated symptom distress than pilots who had been with their unit for less time, $\chi^2 (1) = 4.81$, $p < .05$. Associations were not found for gender, age range, marital status, and hours worked per week.

4.2.3 Interpersonal Relations Distress. The average interpersonal relations distress subscale score was 7.32 (*SD* = 5.64) for pilots and 7.02 (*SD* = 5.58) for loadmasters. An ANCOVA did not identify differences between pilots (*EMM* = 7.19, *SD* = 5.72) and loadmasters (*EMM* = 7.34, *SD* = 5.93) on interpersonal relations distress, $F(6, 328) = 0.04$, $p = .83$, $g = -0.03$ (95% CI = -0.14-0.09). Mean differences for one covariate, months in current unit, were identified. Those in their current unit 25 months or longer scored higher on interpersonal relations distress than those in their current unit less time, $F(6, 328) = 9.26$, $p < .01$, $g = 0.31$ (95% CI = 0.20-0.42). Mean group differences were not found for the gender, age range, marital status, and hours worked per week covariates.

The number and percentage of those who had an elevated interpersonal relations distress score of 15 or greater were 26 out of 229 (11.35%) pilots and 12 out of 109 (11.01%) loadmasters. A contingency table analysis was performed to identify differences between pilots and loadmasters. A subsequent chi-square test for differences was not significant between groups, $\chi^2 (1) = 0.01$, $p = .93$.

Selecting for pilots only, chi-square tests were run to identify associations among demographic and occupational variables with elevated interpersonal relations distress. Relative risks indicated that pilots who had been with their unit for 25 months or longer were 2.74 times (95% CI = 1.20-6.26) more likely to endorse elevated interpersonal relations distress than pilots who had been with their unit less time, $\chi^2 (1) = 6.37$, $p < .05$. Associations were not found for gender, age range, marital status, and hours worked per week.

4.2.4 Social Role Distress. Pilots had a mean social role distress subscale score of 9.29 (*SD* = 3.80) and loadmasters had a mean score of 7.42 (*SD* = 3.92). An ANCOVA identified that pilots (*EMM* = 9.07, *SD* = 3.83) scored higher on social role distress than loadmasters (*EMM* = 7.92, *SD* = 3.97), $F(6, 329) = 5.77$, $p < .05$, $g = 0.30$ (95% CI = 0.18-0.42). Mean differences for two covariates, months in current unit and hours worked per week, were identified. Those in their current unit 25 months or longer scored higher on social role distress than those in their current

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unit less time, $F(6, 329) = 17.54$, $p < .01$, $g = 0.53$ (95% CI = 0.41-0.64). Those working 51 hours or more per week scored higher on social role distress than those working 30-50 hours per week, $F(6, 329) = 8.61$, $p < .01$, $g = 0.50$ (95% CI = 0.39-0.62). Mean group differences were not found for the gender, age range, and marital status covariates.

The number and percentage of those who had an elevated social role distress score of 12 or greater were 58 out of 230 (25.22%) pilots and 13 out of 109 (11.93%) loadmasters. A contingency table analysis was performed to identify differences between pilots and loadmasters. The relative risks identified that pilots were 2.11 times (95% CI = 1.21-3.69) more likely to endorse elevated social role distress than loadmasters, χ^2 (1) = 7.89, $p < .01$.

Selecting for pilots only, chi-square tests were run to identify associations among demographic and occupational variables with elevated social role distress. Relative risks indicated that pilots 31-35 years of age were 3.35 times (95% CI = 0.86-13.08) more likely to endorse elevated social role distress than pilots 18-25 years old, χ^2 (1) = 4.12, $p = .05$. Pilots who worked 51 hours or more per week were 1.76 times (95% CI = 1.08-2.85) more likely to endorse elevated social role distress than pilots who worked 30-50 hours per week, χ^2 (1) = 5.55, $p < .05$. Associations were not found for gender, marital status, and time in current unit.

4.2.5 Critical Items (Suicidal Ideation and Anger). Responses of *sometimes*, *frequently*, or *always* to the question "*I have thoughts of ending my life*" were considered indicative of suicidal ideation. Overall, 1 out of 341 (0.29%) respondents endorsed suicidal ideation. This respondent was a pilot and selected *sometimes* as his/her response option. Responses of *frequently* or *always* to the question "*I feel angry enough at work to do something I may regret*" were considered indicative of elevated anger. One out of 339 (0.29%) respondents endorsed feelings of elevated anger and at risk for acting out on such anger. This respondent was a pilot and answered *always* as his/her response option. The results of the study did not identify any loadmasters with suicidal ideation or elevated anger.

The percentages of individuals with a OQ-45.2 total score of 63 or greater, symptom distress score of 36 or greater, interpersonal relations score of 15 or greater, and/or social role score of 12 or greater are shown in Figure 1.

5.0 DISCUSSION

5.1 Self-Reported Sources of Occupational Stress

Self-reported sources of occupational stress for pilots and loadmasters tended to be operational in nature. Both groups reported the following operational stress facets: *Workload and Manning*, *Professional Career Development and Proficiency*, *Organizational Management*, and *Administrative Workload*. Although the rank order varied between pilots and loadmasters, the same top five facets were reported. The only stressor listed in the top by loadmasters that was not listed for pilots was *Sustaining a Healthy Lifestyle*, included in the list because it had the same number of responses as *Professional Career Development and Proficiency*. The results of the study are similar to the occupational stressors reported by the aircrew pilots and sensor operators of USAF unmanned airframes [10,11]. The repeated finding of operational stressors as the most problematic self-reported sources of stress is helpful for line commanders and medical personnel in developing interventions for mitigating stress and promoting performance.

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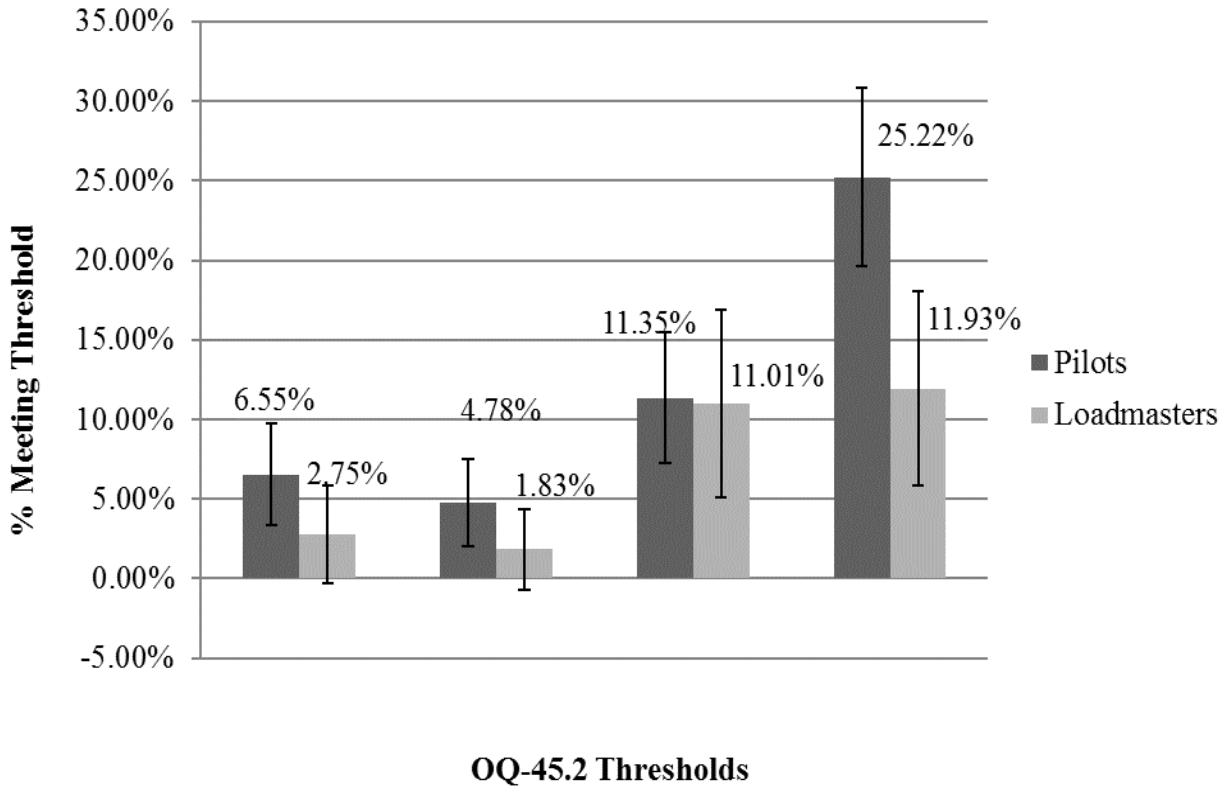

Figure 1. C-17 pilots and loadmasters self-reporting elevated clinical, symptom, interpersonal relations, and social role distress (95% CI shown)

Leadership strategies that aim to promote balanced workloads and reductions in task saturation will likely have a positive impact on health. This may be particularly beneficial for pilots and those on station for greater than 2 years. Additional areas to assess include the requirement to obtain advanced degrees as part of career progression/promotion. This requirement may be difficult to acquire while having to sustain flying and non-flying mission requirements and duties. It is likely the stressors above, for both groups of aircrew, are interrelated. For example, low manning and long hours are likely tied to increased administrative workload requirements, increasing difficulty with achieving advanced academic degrees and additional leadership duties required for promotion, as well as organizational management challenges related to task prioritization and competing task requirements. As a result, it is speculated that an improvement in one area (e.g., low manning) would likely lead to improvements in other areas (e.g., organizational management). Regardless, the list of stressors above provides a rich source of information for line leadership to consider and target when developing strategies that promote performance of flying operations.

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5.2 Overall and Subscale Distress Levels

5.2.1 Overall Distress. Results of the study indicate that approximately 1 out of every 15 pilots and 1 out of every 36 loadmasters self-reported elevated levels of clinical distress. To reach the elevated distress threshold in this study, such pilots and loadmasters needed to endorse a variety of symptoms (e.g., difficulty concentrating and sustaining attention; increased thoughts of worry; difficulty falling and staying asleep; increased feelings of anger, sadness, anxiety; increased alcohol usage; trouble getting along with peers) tied to a decline in their general health and well-being. This includes negative changes in social and interpersonal functioning that increase the difficulty of juggling the daily duties of pilot or loadmaster work roles with domestic and personal life obligations (and vice versa). It stands to reason that such distress (whether temporary or chronic) elevates the risk for problems with performance, mishaps, and force sustainment. Although any elevation in distress among such aircrew is a cause for concern, the percentages of pilots and loadmasters endorsing elevated distress among C-17 aircrew in this study are lower than the percentages of remotely piloted aircraft pilots and sensor operators endorsing elevated distress [11].

Although no differences were found between pilots and loadmasters on general and elevated levels of psychological distress, those working in their current unit 25 months or longer had higher general distress scores than those in their current unit less time. The results suggest that sustaining a high operational tempo and workload (as reported as the top source of stress for both pilots and loadmasters) likely increases the incident rate of distress. Such aircrew may benefit from increased screening for elevated distress by a physician or operational psychologist within flight medicine. Early identification of those experiencing chronically high levels of stress may help with preventive healthcare that subsequently mitigates health-related illness and performance problems.

The results of the study also revealed that pilots working in their current unit 25 months or longer were six and a half times more likely to endorse elevated levels of distress than pilots working in their current unit for less time. Although the observational and descriptive nature of the study does not allow for cause-effect conclusions, there are a number of salient reasons such pilots are at greater risk for elevated distress. It is likely a combination of having to manage and effectively respond to the sources of stress cited by pilots and loadmasters. It is also logical to perceive that pilots in their current unit for 25 months or longer may be more impacted by operational workload, more concerned with professional career development, and have more demanding organizational roles than less experienced pilots. Such pilots are more likely to have additional responsibilities such as unit leadership positions, mandatory professional military education, and mandatory completion of advanced degree programs. The results suggest that pilots with 2 or more years on station would likely benefit from closer monitoring by commanders, as well as outreach efforts by medical and mental health providers assigned to such units.

It is important to note that pilots and loadmasters were compared regarding the prevalence of elevated levels of distress and there was no significant difference between the two groups. As a result, the distress of experienced loadmasters should also be of concern to leadership.

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5.2.2 Symptom Distress. As mentioned previously, symptom distress refers to a clustering of anxiety- and depression-related symptoms. Overall, there was no significant difference in total self-reported symptom distress scores or the frequency of elevated symptom distress between pilots and loadmasters. However, those who had been working in their assigned unit for 25 months or longer had higher average symptom distress scores compared to those who had been in their current unit less time, and pilots who had been working in their assigned unit for 25 months or longer were four and a half times more likely to have elevated levels of symptom distress than pilots who had been working in their assigned unit less time. This finding suggests that, in general, the longer a pilot has been functioning in his/her assigned capacity, the higher the risk that he or she is experiencing distress and becoming vulnerable to stress-related illness. While this study did not assess the association for months in current unit and elevated symptom distress for loadmasters, there was no significant difference between pilots and loadmasters, and symptom distress of experienced loadmasters should also be of concern to leadership. The finding supports the assertion that additional psychological screening of experienced pilots may help to identify those at risk for anxiety- and depression-related symptoms.

5.2.3 Interpersonal Relations Distress. As mentioned previously, interpersonal relations distress refers to general satisfaction and problems with interpersonal relationships involving family and friends. Overall, there was no significant difference in the total self-reported symptoms of interpersonal relations distress or the frequency of elevated scores among pilots and loadmasters. However, those who had been working in their assigned unit for 25 months or longer had higher average interpersonal relations distress scores compared to those who had been in their current unit less time, and pilots working in their current unit 25 months or longer were three times more likely to endorse elevated interpersonal relations distress than pilots working in their current unit less time. The results suggest that the longer a pilot has been functioning in his/her assigned capacity, the higher the risk of emotional and social issues. Additionally, the common occupational facet of *Personal Home Life Stressors* for both pilots and loadmasters suggests that these individuals are struggling emotionally and socially.

Additional psychological screening of experienced pilots may also help to identify those at risk for dissatisfaction with interpersonal relationships at work and home. The top occupational stressors reported were *Workload and Manning*, *Extra Administrative Duties*, and *Professional Career Development and Proficiency*, and considering the amount of time occupied based on those three facets, pilots and loadmasters may not have enough time to engage in and maintain interpersonal relationships. Experienced pilots may have struggled with maintaining interpersonal relationships for some time and are now feeling the distress of having a lack of interpersonal relationships in their life.

It is important to note, pilots and loadmasters were compared on elevated levels of interpersonal relations distress and there were no significant differences between the two groups. Therefore, interpersonal relations distress of experienced loadmasters should also be of concern to leadership. Additionally, events that promote interpersonal relationships in the workplace may help reduce this form of distress.

5.2.4 Social Role Distress. As previously mentioned, social role distress assesses the level of conflict, stress, and sense of inadequacy in fulfilling tasks at home and work. The results of the study revealed pilots had higher social role distress scores and were two times more likely to endorse elevated social role distress (25.22%) when compared with loadmasters (11.93%).

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Furthermore, those in their current unit 25 months or longer had higher average social role distress scores than those in their current unit less time. Pilots between the ages of 31-35 were approximately four and a half times more likely to endorse elevated social role distress than pilots between the ages of 18-25. These results also revealed those working 51 hours or more per week were more likely to endorse elevated social role distress than those working 30-50 hours per week. Additionally, one of the top occupational stressors reported for both pilots and loadmasters was *Personal Home Life Stressors*. This facet included responses such as issues with maintaining a home/life balance, and given that participants who were older, had been in their current unit longer, and were working 51 hours or more per week were endorsing higher social role distress, this finding is not surprising. Those taking on more roles at work (indicated by a higher ranking, longer work hours, or longer time in their current unit) may be experiencing more issues with balancing their work and home roles when compared to those with less duties at work. The findings of the study suggest that pilots in general (and pilots between the ages of 31-35 in particular), as well as aircrew working chronically long hours and/or stationed for more than 2 years at their unit, may benefit from line leadership further assessing the contribution of operational and administrative workload, organizational management, and career development stressors on the impact of social role distress. Similarly, physicians and operational psychologists within flight medicine may further investigate the sources of social role distress and provide intervention to help pilots manage role conflict at home and work.

5.2.5 Critical Items (Suicidal and Anger Ideation). While only one pilot endorsed feelings of suicidal ideation and one other pilot endorsed feelings of acting out in anger, it is important in the workplace to ensure that no individuals are a danger to themselves or others and for leadership and mental health providers to identify early warning signs of these possible feelings or behaviors. The finding reinforces the importance of routine access to medical as well as mental healthcare.

5.3 Operational and Medical Leadership Recommendations

The findings in this study suggest that sources of high occupational stress among C-17 aircrew are operational in nature and similar to those of other military organizations conducting extended or 24-hour operations with limited manpower. The results of the study suggest C-17 operational leadership should develop stress-mitigating strategies that target operational stressors (i.e., organizational management, manning, and workload distribution). Actionable mitigation efforts may include streamlining administrative tasks and reducing emphasis on pursuit of advanced degrees during periods of operational surges or diminished manning. Ensuring an adequate balance of experienced personnel and standardized resources may also aid in optimizing aircrew qualification training and overall force sustainment.

The results of the study (i.e., operational and administrative workload, low manning, and operational tempo) suggest operational leadership should also seek to optimize work/rest cycles and deployment rotation schedules as a part of force sustainment efforts. In so doing, tasking authorities should increase efforts to consider circadian rhythms and total mission duration of both previous and projected missions, regardless of whether they are heavy on ground or air duties, when allocating mission tasking.

Along the line of fatigue management, leadership should foster education regarding frequency and quantity of alcohol, caffeine, and tobacco usage (i.e., problematic single-incident and high chronic use) as they relate to crew rest, critical phases of flight, and overall health and

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wellness. This may also help to target the area of sustaining a healthy lifestyle, which is critical to performance and readiness. Leadership should also recognize that problematic usage of these substances could signal potential physical and mental health concerns and make every effort to foster and model appropriate energy and fatigue management strategies.

An additional strategy to consider is the supplementation of flight medicine with experienced mental health providers to provide tailored mental health support. Such a strategy would likely help increase the understanding of organizational and occupational-specific stressors affecting C-17 aircrew, as well as increase their access to mental healthcare. A mental health provider educated in the culture and dynamics of the C-17 mission area may also help promote understanding of the psychological impact of stress and facilitate self-disclosure among C-17 personnel. Reluctance to disclose mental health concerns is typical and frequent among military members.

A mental health strategy that mitigates obstacles to self-disclosure is essential to providing outreach for mental health problems among military members and specifically among aircrew. Flight medicine training of mental health providers can ensure aeromedically specific issues are addressed with referrals, treatment, and appropriate evaluations. Tailored mental healthcare combined with improved health habits (diet, caffeine, alcohol, and tobacco consumption) and core-oriented fitness strategies can go far in mitigating the physical and mental health impacts of stress.

5.4 Considerations Regarding Self-Disclosure

Capturing an exact estimate of the rates of distress is difficult and centered on genuine self-disclosure. The reluctance to disclose emotional, behavioral, or social difficulties (or any condition impacting duty or retention status) is a well-known problem among flight medicine physicians and operational psychologists working with aircrew. When screening for psychiatric difficulties among aircrew, a methodology that maximizes self-disclosure is important, especially when gathering data on those who must adhere to strict aeromedical standards and whose competition for promotion may be affected by an untimely and prolonged period of illness (whether physical or psychological). Additional obstacles to genuine disclosure among aircrew include concerns regarding how self-disclosure may affect security clearances or participation in sensitive operations and limit career opportunities. However, the anonymous nature of the survey helps mitigate such problems.

A total of one C-17 aircrew member (out of 343 pilot and loadmaster participants) did not complete (or only partially completed) the demographic items (i.e., age range, gender, marital status, time in their current unit, hours worked per week) and six aircrew members opted not to participate in the survey after reading the consent form. Despite the design of the study and reassurances from the independent researchers and AF operational leadership, it is possible some respondents remained concerned regarding anonymity. However, the number of respondents was small (2% of the total sample), and data analyses were not likely impacted.

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5.5 Limitations of the Study

The current study has several limitations that bear consideration:

- The descriptive nature of the study does not warrant definitive cause-effect conclusions between sources and levels of distress.
- Although conservative thresholds were developed for identifying individuals with elevated levels of distress, it is difficult to determine who are experiencing chronic versus situational-specific conditions.
- Caution should be taken when interpreting results, as this is the first time this population has been surveyed for this purpose and there is no previous research to use as a reference.
- Self-report surveys are prone to response bias from a self-selected sample that might affect generalization of results.

Whenever assessing for the impact within an organization, it is always a possibility there will be sampling bias. This bias occurs as a result of those individuals responding who are at risk and wanting to expose their concerns. While this is often viewed as negative sampling bias, one cannot lose sight of the purpose of this survey. The survey is designed to expose those who are at risk for experiencing elevated levels of psychological distress, and the results should be viewed from within that framework. Sampling bias is not necessarily a negative aspect of the study if it helps reveal the intended, at-risk population. While bias could reduce generalizability to the population at large, it may also have the beneficial effect of exposing exactly what the survey was designed to assess.

Furthermore, the response rate for this study was higher than those found in studies comparing response rates of in-person versus online surveys [13-15]. Additionally, there is some evidence that computer-based surveys increase self-report of sensitive information as compared to paper-based surveys [16]. However, there is no widely accepted standard for what is considered an adequate or sufficient response rate on surveys for reporting in research. Nevertheless, online surveys, such as the type utilized in this study, represent a cost-effective, pragmatic way to collect data on health-related information.

5.6 Conclusions

The findings of this study provide a baseline for C-17 aircrew sources of occupational stress and percentages of pilots and loadmasters experiencing elevated levels of clinical distress. The results have implications for future studies and raise awareness regarding key facets of occupational stress and clinical distress among aircrew. These airmen are increasingly relied upon to support a vast array of military operations across the globe. Therefore, further analyses on occupational stress and clinical distress among C-17 pilots and loadmasters are warranted to aid in ensuring the occupational well-being of these essential airmen.

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LIST OF ABBREVIATIONS AND ACRONYMS

AFI	Air Force Instruction
ANCOVA	analysis of covariance
CI	confidence interval
EMM	estimated marginal mean
FDP	flight duty period
FTP	flight time period
OQ-45.2	Outcome Questionnaire-45
SD	standard deviation
USAF	U.S. Air Force

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