The Association Between Physical and Psychological Symptoms and Traumatic Military Deployment Exposures

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Abstract

Current paradigms regarding the effects of traumatic exposures on military personnel do not consider physical symptoms unrelated to injury or illness as independent outcomes of trauma exposure, characteristically dealing with these symptoms as comorbidities of psychological disorders. Our objective was to ascertain the proportions of deployed military personnel who experienced predominantly physical symptoms, predominantly psychological symptoms, and comorbidity of the two and to examine the association between traumatic deployment

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exposures (TDEs) and these symptomatic profiles. Data were taken from a cross-sectional study of Australian Defence Force personnel who were deployed to the Middle East during 2001–2009 ($N = 14,032$). Four groups were created based on distributional splits of physical and psychological symptom scales: low-symptom, psychological, physical, and comorbid. Multinomial logistic regression models assessed the probability of symptom group membership, compared with low-symptom, as predicted by self-reported TDEs. Group proportions were: low-symptom, 78.3%; physical, 5.0%; psychological, 9.3%; and comorbid, 7.5%. TDEs were significant predictors of all symptom profiles. For subjective, objective, and human death and degradation exposures, respectively, the largest relative risk ratios (*RRRs*) were for the comorbid profile, *RRRs* = 1.47, 1.19, 1.48; followed by the physical profile, *RRRs* = 1.27, 1.15, 1.40; and the psychological profile, *RRRs* = 1.22, 1.07, 1.22. Almost half of participants with physical symptoms did not have comorbid psychological symptoms, suggesting that physical symptoms can occur as a discrete outcome trauma exposure. The similar dose–response association between TDEs and the physical and psychological profiles suggests trauma is similarly associated with both outcomes.

The Association Between Physical and Psychological Symptoms and Traumatic Military Deployment Exposures

There is a long history of military members deployed to conflict zones reporting distressing and disabling nonspecific physical symptoms that occur across many health domains (Unwin et al., 1999). Research from the first Gulf War as well as from more recent conflicts in Iraq and Afghanistan has provided evidence of elevated rates of physical symptoms in deployed compared to nondeployed military members (McCutchan et al., 2016; Unwin et al., 1999; Vanderploeg et al., 2012). Many military studies have reported an

association between physical symptoms and psychological disorders, often concluding that psychological disorder is a major driver of physical symptoms (Nissen, Marott, Gyntelberg, & Guldager, 2011; Quartana, Wilk, Balkin, & Hoge, 2015). However, a few studies have found that physical symptoms can occur as discrete outcomes (Wolfe et al., 1999). Most veterans contest a psychological etiology for physical symptoms, believing that these symptoms are associated with deployment exposures and that psychological etiologies place blame on veterans and diminish their unique deployment experiences (Kilshaw, 2008). This clash of beliefs over causation has led to much controversy over the existence of postwar syndromes, including “shellshock” after World War I, Agent Orange exposure after the Vietnam War, and more recently, Gulf War Syndrome after the Gulf War, with broad-reaching implications, such as the validity of pension entitlements for such invisible injuries (Hyams, Wignall, & Roswell, 1996; Miley & Read, 2017).

When researching nonspecific physical symptoms that are not a result of injury or illness, determining their pathophysiology can be difficult, particularly as postdeployment physical and psychological health outcomes often co-occur and overlap (McFarlane, Ellis, Barton, Browne, & Van Hooff, 2008). Moreover, although traumatic deployment exposures (TDEs), along with demographic factors such as lower education and non-officer rank (Xue et al., 2015), have been well established as a major risk factor for psychological distress in veterans, the associations found between TDEs and physical symptoms have been inconsistent. Importantly, one study that examined the physical and psychological health effects of military deployment experiences found that combat exposure was associated with physical symptoms with or without physical injury, suggesting that combat exposure may have a mechanistic association with physical symptoms (Vanderploeg et al., 2012).

Reid et al. (2001) suggested that physical symptoms in military personnel may be caused by functional somatic disorders, such as chronic fatigue syndrome. However, the

symptoms of such disorders have high levels of overlap with the symptoms of psychological disorders, and, as such, they do not allow for differentiation of physical symptoms when exploring symptom profiles. A fundamental challenge of medicine has been the inability to determine the specificity and overlap of the symptoms of somatic disorders and functional syndromes, such as chronic fatigue syndrome (Sharpe & Carson, 2001). This challenge is reflected in the removal of functional somatic disorders from the recently released fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*, a move that also suggests that this diagnosis is unsuitable (Sharpe & Carson, 2001). Current treatment recommendations for nonspecific physical symptoms include cognitive behavior therapy (CBT) and antidepressant medication, both of which suggest an assumption of psychological etiology (olde Hartman et al., 2017). However, in general, the reported effect sizes for these treatments have been small, highlighting the need to explore alternate causal mechanisms that may suggest new treatment targets (olde Hartman et al., 2017).

In the psychiatric domain, somatization has traditionally been used to explain the etiology of physical symptoms, suggesting that psychological processes are the predominant causal factors of those physical symptoms (Sharpe & Carson, 2001). However, modern theories of the impact of stress, such as the influence of allostatic load, highlight the complex nature of neurobiological processes that occur in response to stress and posit the possibility of bidirectional or synergistic associations between physical and psychological processes in the stress reaction (McEwen, 1998; Taylor, 2010). Such theories highlight that psychological disorders may not be the sole mechanism in the development of physical symptoms for some veterans (Bai, Chiou, Su, Li, & Chen, 2014). The first step in exploring these theories is to determine whether any veterans have experienced physical symptoms without psychological distress.

Several military studies suggest that certain TDEs may be associated with negative physical and psychological outcomes (Killgore, Stetz, Castro, & Hoge, 2006; Kroenke, Koslowe, & Roy, 1998; Searle et al., 2017). Subjective threat-to-self exposures and witnessing human atrocities have been found to be predictors of both physical and psychological symptoms, whereas objective combat exposures appear to have less impact (de Silva, Jayasekera, & Hanwella, 2013; Nissen et al., 2011; Waller et al., 2012). Other studies have found that deployment rather than combat is associated with physical symptoms (de Silva et al., 2013; Hotopf et al., 2006; McCutchan et al., 2016). This variability in findings may be due to the wide range of tools used to measure physical symptoms. Additionally, some measures contain symptoms such as “anger and irritability” or “fatigue,” which share construct overlap with psychological symptoms. The ambiguity in how to conceptualize physical symptoms has further impeded research (Khan, Khan, Harezlak, Tu, & Kroenke, 2003). As such, there are still many gaps in our understanding of the association between TDEs and physical symptoms independent of psychological disorders.

Determining whether sufferers can be separated into physical, psychological, and comorbid profiles, apart from having significant prognostic implications, may help in the development of alternate theories regarding pathological mechanisms. Consequently, the current study examined the degree of overlap and differentiation of physical and psychological symptoms in a large cohort of deployed Australian Defence Force (ADF) personnel who served in the recent military conflict in Iraq and Afghanistan from 2001 to 2009. Our aim was to identify symptom profiles of personnel who had experienced high levels of physical symptoms alone, high levels of psychological symptoms alone, and a pattern of comorbid physical and psychological symptoms. As this is a unique approach, we had no hypotheses regarding the prevalence of the different profiles.

An additional aim was to examine potential correlates of these symptom profiles, including demographic and service characteristics, and various deployment trauma exposures. We hypothesized that total trauma exposure would be positively associated with symptom counts and, therefore, all profile memberships. Like the previous research discussed earlier, we also examined different trauma types to determine whether stressors for physical and psychological distress differed. However, as findings regarding the correlates of physical symptoms are equivocal, these analyses were exploratory, and we had no hypotheses.

Method

Participants and Procedure

Data came from the Middle East Area of Operations (MEAO) Census Study (Dobson et al., 2012), a retrospective, self-report survey of currently serving, formerly serving, and Reserve ADF members who were deployed to Iraq, Afghanistan, or supporting operations between October 2001 and December 2009. The full nominal roll of 26,915 ADF members deployed to the MEAO during this period were invited to participate, and 14,032 (53%) accepted the invitation. Data were collected in 2010 and 2011 using online surveys or hard-copy questionnaires that included questions on deployment history, current health, and deployment experiences based on the participants' most recent MEAO deployment. Participation was voluntary and all data were deidentified. Further details of the data collection methods have been described elsewhere (Dobson et al., 2012). Response rates were significantly higher among female military personnel, older ADF members, Air Force members, officers, and currently serving service members (Dobson et al., 2012).

Respondents completed a battery of questionnaires (described in the Measures section), including the Kessler Psychological Distress Scale (K10) and Health Symptom Checklist (HSC). Four symptom groups were defined based on combinations of dichotomized

scores: a “low symptoms” group, comprising participants who scored less than 16 on the HSC and less than 20 on the K10; a “physical only” group, comprising participants who scored 16 or above on the HSC and less than 20 on the K10; a “psychological only” group, composed of participants who scored less than 16 on the HSC and 20 or higher on the K10; and a “comorbid” group, which included participants who scored 16 or higher on the HSC and 20 or higher on the K10. This study received appropriate research ethics committee approval.

Measures

Psychological distress. The Kessler Psychological Distress Scale (K10; Kessler et al., 2002) is a global measure of nonspecific psychological distress that has demonstrated strong psychometric properties and the capacity to discriminate psychiatric caseness in civilians and military personnel (Kessler & Ustun, 2004; Searle et al., 2015). Participants were asked to rate 10 items with reference to the last 4 weeks on a 5-point Likert-type scale, with sum scores ranging from 10 to 50. Higher scores are indicative of higher levels of psychological distress. For the present study, psychological distress was defined by a cutoff score of 20, representing the postoperational screening cutoff used by the ADF (McFarlane & Hodson, 2011). This cutoff also aligns with that used in the 2007 Australian National Mental Health and Wellbeing Survey (Slade, Johnston, Oakley Browne, Andrews, & Whiteford, 2009). The K10 had high internal consistency in our sample, Cronbach's $\alpha = .92$.

Physical symptoms. Physical symptoms were assessed with the 67-item self-report Health Symptom Checklist (HSC; provided in the Supplementary Materials), which was adapted from the King's College Gulf War Survey (Unwin et al., 1999) and the Australian Gulf War Veterans Health Study (Kelsall et al., 2004). As this instrument contains symptoms that could be considered psychological (e.g., “distressing dreams”) or physical (e.g., “joint stiffness”), any items included in the diagnostic criteria for posttraumatic stress disorder

(PTSD) or depression in the fourth edition of the *DSM (DSM-IV)* were excluded in order to avoid construct overlap between the HSC and the K10. This resulted in a final list of 53 physical symptoms. Participants were asked to indicate the severity of each symptom over the past month on a 4-point scale that included the response options of *never*, *mild*, *moderate*, or *severe*. Each symptom was further dichotomized as *no* (response of *never*) or *yes* (responses of *mild*, *moderate*, or *severe*) as per previous military studies (Kelsall et al., 2004; Unwin et al., 1999). We assigned physical distress caseness as an endorsement of 16 or more physical symptoms; this represented the top 12.4% of our sample, which was comparable to cutoffs established in previous military research (de Silva et al., 2013; Hoge, Terhakopian, Castro, Messer, & Engel, 2007; Hotopf et al., 2006; McCutchan et al., 2016). The HSC had high internal consistency in our sample, Cronbach's $\alpha = .92$.

Traumatic experiences. A traumatic exposures questionnaire, adapted from the Deployment Risk and Resilience Inventory (King, King, Vogt, Knight, & Samper, 2006), the King's College Gulf War Survey (Unwin et al., 1999), and the Traumatic Stressors Exposure Scale (TSES-R; Swann & Hodson, 2004), was used to measure the frequency of 27 deployment exposures from participants' most recent MEAO deployment. Participants indicated exposures on a response scale that included *never*, *once*, *2–4 times*, *5–9 times*, and *10 or more times*. Two items were excluded from our analysis: “Did you clear/search caves?”, as this item only related to Afghanistan deployments; and “Were you present when a loved one was injured or killed?”, as the prevalence rate for this item was less than 1%. The items were dichotomized into *no exposure* or *exposed* and then summed to provide a count of total combat exposure types. Previous military studies have found that the number of different types of TDEs has more impact on health outcomes than frequency of exposure (Killgore et al., 2006; Kroenke et al., 1998; Searle et al., 2017). The total trauma type count

had high internal consistency in our sample, Cronbach's $\alpha = .90$. A full list of the trauma items is available in the Supplementary Materials.

We divided the traumatic exposure items into three subscales that are described in the literature as influencing physical and psychological symptoms: Subjective Combat (i.e., perceived threat), which included eight items (e.g. "Were you in danger of being injured?"); Objective Combat (i.e., measurable events), which included 11 items (e.g. "Did you experience a landmine strike?"); and Human Death or Degradation, which included six items (e.g., "Did you handle dead bodies?"; de Silva et al., 2013; Nissen et al., 2011; Waller et al., 2012). Each subscale score was a count of the number of subscale items to which participants were exposed.

Demographic and military variables. Demographic and military covariates included those previously found to influence symptom reporting (de Silva et al., 2013; Horn et al., 2006; Hotopf et al., 2006; Kroenke, et al., 1998; Storzach et al., 2000). Covariates that were assessed in reference to participants' most recent MEAO deployment included gender, age, service (Navy, Army, Air Force), service status (currently serving, active Reserve, formerly serving, inactive Reserve), rank (commissioned officer: Lieutenant to General equivalents; non-commissioned officer: Sergeant to Warrant Officer equivalents; or other rank: Private to Corporal equivalents), number of times deployed to the MEAO, time since last MEAO deployment, and education (high school, certificate, graduate [diploma or degree], and postgraduate). Two additional items were included as covariates to adjust for their possible confounding effects on symptom reporting: injury sustained on MEAO deployment that required attendance at sick parade, and doctor-diagnosed medical conditions ("Since returning from your last MEAO deployment, has a medical doctor diagnosed you with, or treated you for any of the following medical problems or conditions?").

Data Analysis

All analyses were conducted using Stata (Version 14; Stata Corporation, College Station, TX, USA). Missing values in outcome and exposure variables were addressed using multiple imputation implemented under a “missing at random” assumption, which was deemed plausible as we were unable to find any predictor of missingness outside of these variables. Multiple imputation (MI) was carried out using fully conditioned specification, with 20 complete datasets created based on the rule of thumb that the number of imputations should be at least equal to the percentage of incomplete cases (White, Royston, & Wood, 2011). Estimates were combined across imputed datasets using Rubin’s rules (Amital et al., 2006). In addition to analysis model variables, the imputation model included two auxiliary variables that demonstrated moderate correlation with the outcome variable; imputed outcomes were therefore retained in the analysis (Sullivan, Salter, Ryan, & Lee, 2015). Complete case analyses showed only minimal differences to the imputed analysis; thus, only the imputed results have been reported. Multinomial logistic regression (MLR) was chosen for the imputation and analysis of the outcome as it has been shown to perform well in simultaneously modeling estimates for the probability of multiple diagnoses (Bertens et al., 2016). Effect sizes were measured using relative risk ratios (*RRRs*), which in MLR is the exponentiated coefficient calculated relative to a base category. Wald statistics were used for hypothesis testing as these are superior with imputed data (White et al., 2011). The results from MI models were pooled using Rubin’s rules. However, pooling goodness-of-fit test statistics such as log likelihood or chi squared tests of difference across imputations is not recommended with Rubin’s rules (White et al., 2011). As an alternative, *F* tests were used to test the same hypothesis that all coefficients were identically zero.

Results

Most participants were male, with a mean age of 36.9 years ($SD = 8.56$). Half of the sample had been deployed to the MEAO more than once, with 61.2% having been deployed to Afghanistan, 72.0% to Iraq, and 34.6% to both areas. The mean time since last deployment to the MEAO was 4.28 years ($SD = 2.46$). Most of the sample was in the Army, currently serving, and had a rank of non-commissioned officer.

Table 1 shows the proportion of personnel in each of the four symptom groups and includes the mean K10 and HSC scores used to define our symptom groups. Most respondents were in the low-symptom group (78.3%) and reported the lowest average number of total trauma exposures ($M = 4.10$). The physical-only group included the fewest members (5.0% of the sample), and the psychological-only group included the most (9.3%). The comorbid group (i.e., the most symptomatic group) had a prevalence of 7.5% and the highest mean total trauma exposures of any group at 7.32. The correlation between physical and psychological symptom severity was moderate, $r = .61$.

We initially tested the demographic and service characteristics as well as total trauma exposure simultaneously in Model 1, using multivariate MLR to determine which variables were predictors of symptom group membership. Model 1 predicted a significant amount of variance, $F(5, 120,066.1) = 26.80, p < .001$. Table 2 shows that time since deployment to MEAO and number of deployments to the MEAO did not predict group membership, whereas total trauma exposure, female sex, being in the Navy, or having a doctor-diagnosed medical condition increased the risk of membership in all symptomatic groups. Some differences in risk were found between the groups. Participants in the physical-only group were likely to be slightly older, of lower rank (i.e., non-commissioned officers), and have completed only a high school education. Psychological-only group membership was associated not currently serving (i.e., formerly serving) or being an inactive Reserve and

having sustained an injury at the MEAO. Comorbid group membership was associated with being slightly older, in the RAAF, an inactive Reserve or non-currently serving service member, of lower rank (non-commissioned officer or “other” rank), and having sustained an injury.

The Army is reputed to have the worst postdeployment health outcomes of the three services (Van Hooff et al., 2014). Univariate analyses in this data found little difference between (a) the Army (reference group): $RRR = 1.00$; (b) the Navy: physical $RRR = 1.01$, 95% CI [0.83, 1.24], psychological $RRR = 1.21$, 95% CI [1.03, 1.42]; comorbid $RRR = 1.00$, 95% CI [0.85, 1.19]; and (c) the RAAF: physical $RRR = 0.82$, 95% CI [0.67, 1.01]; psychological $RRR = 0.81$, 95% CI [0.69, 0.94]; comorbid $RRR = 0.71$, 95% CI [0.59, 0.84]. However, being in the Navy carried the highest risk of belonging to all symptom groups in the multivariate analysis.

We conducted several sensitivity analyses. First, we analyzed Model 1 with “physical” as the reference category, and we found that total trauma exposure was associated with a slightly reduced and statistically significant risk of belonging to the psychological group, $RRR = 0.97$, 95% CI [0.94, 0.99]. Next, we examined the total frequency of TDEs (i.e., retaining each trauma’s original Likert scaling). However, this did not change the pattern of association beyond that expected by a measure with a range of 0 to 140 compared to the original trauma-type range of 1 to 27. Thus, for cross-comparison with similar research, we retained total trauma type. Finally, we examined whether injury would impact symptom group membership. The likelihood of symptomatic group membership only increased by approximately 3% for the physical-only and comorbid groups and not at all for the psychological-only group. Given that there were only nonsignificant differences seen, we have reported analyses on the total population and not the groups stratified by injury.

We then tested the three TDE subscales separately (Subjective Combat, Objective Combat, and Human Death and Degradation) rather than simultaneously to determine whether the influence of trauma type varied across our symptom profiles. Examining the TDE scales separately allowed us to avoid diminishing the constructs of interest, which can occur when removing large proportions of shared variance within a combined model. Correlations between TDE scales were moderate to high, ranging from $r = .61$ to $.72$; however, tests of collinearity were negative. For completeness, we also conducted subsidiary analyses with the three TDE scales in one model. Results (see Supplementary Materials) showed little difference in the impact of the three scales on the physical profile and slightly attenuated their impact on the comorbid profile. The association between the subjective trauma scale and the psychological profile became nonsignificant, suggesting a suppression effect, but due to the loss of significance and small effect size, interpretation should be considered with caution.

The F ratios in Models 2, 3, and 4 indicate that the null hypothesis, which states that coefficients were zero, can be rejected: Model 2: $F(51, 20,030.7) = 27.75, p < .001$; Model 3: $F(51, 20,133.0) = 24.79, p > .001$; and Model 4: $F(51, 19,968.8) = 25.88, p < .001$. The results shown in Table 2 demonstrate that all three TDE scales were predictive of increased risk of all symptom profiles. The comorbid profile had the highest relative risk ratio, followed by the physical-only profile, and then the psychological-only profile. Patterns of association between the three TDE scales and the profiles were very similar; that is, the Human Death and Degradation scale was the most predictive of all symptom group memberships and the Objective Combat scale the least predictive. The relative risk ratio of 1.48 for the comorbid group with the Human Death and Degradation exposure scale indicated that for each additional exposure, there was a 48% increase in the risk of comorbid group membership relative to the low-symptom group.

Discussion

Although TDEs have been accepted as a key risk factor for psychological symptoms, there is continued conceptual uncertainty regarding how to account for the many physical symptoms experienced by veterans (Iversen et al., 2008; McFarlane et al., 2008; Xue et al., 2015). To explore this question, four symptom profiles were identified: a low-symptom group and three symptomatic profiles incorporating physical only, psychological only, and both (i.e., comorbid). The physical profile included the smallest proportion of the sample (5.0%), psychological the largest (9.3%), and comorbid (7.5% size) the most symptomatic. Despite the stringent requirement of needing to endorse 16 physical symptoms to be considered symptomatic, we found that physical symptoms without comorbid psychological symptoms was a sizeable symptom profile.

Identifying a physical symptom-only profile (independent of psychological symptoms) corroborates the concerns expressed by veterans that their physical health could have a direct link to TDEs rather than being of psychological origin. Clinicians often struggle to explain or treat these symptoms effectively, and clinical management of this group is not well developed (Kilshaw, 2008; McFarlane, Lawrence-Wood, Van Hooff, Malhi, & Yehuda, 2017; Olde Hartman et al., 2017). These difficulties may be indicative of a significant burden of distress and impairment for these veterans, although more longitudinal research is needed to confirm the health progression of this group. Thus, identifying the existence of this symptom profile is an important step in characterizing a group that requires further investigation regarding the mechanisms of symptom formation and treatment.

The predictive probabilities generated from our regressions (see Supplementary Figure S1) showed a dose-response association between total trauma exposure and all symptom profiles. Moreover, participants in the comorbid group, which included members with the highest symptom counts, also experienced the highest levels of TDEs. The increased

rate of ADF deployments during the MEAO may have increased levels of TDEs (McFarlane & Hodson, 2011). As our findings suggest that TDEs may be associated with an increase in poor health outcomes, military planners may need to account for higher levels of ill health for this cohort.

Comorbidity of physical and psychological conditions is recognized as a clinically important marker of illness severity and presents a significant challenge in treatment management, often resulting in poorer outcomes (Hruska, Irish, Pacella, Sledjeski, & Delahanty, 2014; Librero, Peiró, & Ordiñana, 1999). If physical symptoms are dismissed as a secondary somatic complaint or insignificant in nature, the true severity of a patient's disorder may be overlooked by clinicians. Research into major depressive disorder has found that rates of relapse are higher if physical symptoms are not considered (Trivedi, 2004). Such findings demonstrate the clinical importance of how physical symptoms are conceptualized.

Our findings do not remove the ambiguity around demographic and service risk factors. We found that the nonmilitary characteristics of sex, age, and education were predictive of symptomatic outcomes, whereas other researchers have found no impact of demographic variables (Kroenke et al., 1998). In addition, we found that female participants were at an increased risk of belonging to all symptom profiles yet others have found that female veterans are more likely to suffer from depression, and male veterans are more likely to report pain (Haskell et al., 2010). However, these results should be interpreted with caution as the small number of female military personnel involved in combat roles does not provide the statistical power required to examine these effects. We also found a small increase in the risk of belonging to the physical-only profile with increasing age. In contrast, de Silva et al. (2013) found no association with age, whereas Killgore et al. (2006) found that risk decreased with age. Interestingly, lower educational attainment only predicted membership in the physical-only group.

The military factors of rank, service, and service status differed between the profiles. We found that lower rank, a factor often associated with poor psychological outcomes (Xue et al., 2015), was only associated with physical or comorbid profiles, whereas de Silva et al. (2013) found no association between rank and physical symptoms. However, the increased risk of belonging to the comorbid profile, the profile most likely to include individuals with PTSD, supported other research findings linking PTSD to lower rank (Iversen et al., 2008). We found that formerly serving and inactive Reserves had an increased risk of psychological and comorbid profiles, which supports the findings of Hotopf et al. (2006). However, unlike Hotopf et al. (2006), our findings did not support an increased risk of physical symptoms for these service status groups. We identified that serving in the Navy was predictive of all symptomatic profiles and being in the RAAF was predictive of the comorbid profile. These results may reflect the specific roles that these groups perform, an element found to be an important consideration when assessing health outcomes (Kok, Herrell, Thomas, & Hoge, 2012). However, as roles were not specifically examined in the current study, we were unable to generalize our findings.

We assessed the risk of symptomatic profile membership for three types of TDEs: objective, subjective, and human death and degradation. Of the three trauma exposure types, objective exposure showed the smallest associations with all symptomatic profiles, a finding consistent with what has been reported in other research (de Silva et al., 2013; Waller et al., 2012). The subjective and human death and degradation exposures predicted all three symptom profiles, a finding also supported by previous research (de Silva et al., 2013; Nissen et al., 2011). The similar patterns of association with all symptomatic groups suggest that there may be similar underlying mechanisms in the development of all symptomatic outcomes.

In the present study, we found that the physical-only profile showed a slightly, but statistically significant, stronger association with TDEs than did the psychological-only profile. Although the differences in relative risk ratio were small and the cross-sectional nature of the data do not provide evidence of causation, this finding suggests that TDEs play a role in both physical and psychological symptom development, at least partly independent of each other. Therefore, assuming all physical symptoms share a dimensional association with psychological disorders may be invalid.

If both the physical and psychological profiles share a similar association with trauma, it may be time to reflect on the current paradigm that TDEs result in psychological disruption, which results in ill health (for example, the model presented by Schnurr and Green, 2004). If there is a shared mechanism of trauma in both physical and psychological symptoms, a possible alternative theory is that trauma leads to neurobiological shifts that in turn play a role in the physical and psychological outcomes associated with trauma. Exploring alternative causal mechanisms may assist in advancing treatment options and developing explanatory frameworks.

A potential explanation for physical symptoms being a substantial consequence of TDEs is that physiological arousal in high-threat situations may be an indicator of long-term dysregulation of physiological homeostasis. A prospective study of World War II veterans found that physiological reactivity during combat exposure was a significant predictor of later health outcomes (Lee, Vaillant, Torrey, & Elder, 1996). This suggests that physical symptoms during combat may represent a long-term signature of how later combat-related distress is reexperienced. Subtle changes in physiological reactivity are not assessed in clinical settings as they are not indicators of frank pathology. However, reported physical symptoms may provide an early indicator of physiological dysregulation and may be a

marker for individuals at an increased risk of future ill health, a possibility requiring further investigation.

To our knowledge, this was the first study to examine the comparative strength of the association between TDEs and physical and psychological symptoms. Physical symptoms are often dismissed by health professionals as having psychological sources, and they tend to receive negative evaluations or their legitimacy as a “medical” condition is questioned (McFarlane et al., 2008; Salmon, 2000). The current findings demonstrate that, after controlling for other known risk factors, such as gender and rank, TDEs are a significant independent risk factor for both physical and psychological symptoms.

Recognizing that there may be an independent association between physical symptoms and trauma rather than physical symptoms being secondary to psychological disorder is important in validating patients’ experience of these symptoms. The lack of a coherent narrative for patients to make sense of distressing symptoms creates a potential for conflict between clinician and patient (Engel, Adkins, & Cowan, 2002; Stone, 2014). In attempting to deal with physical symptoms, both patients and clinicians often express high levels of dissatisfaction with the lack of a shared illness schema, with practitioners often classifying these patients as “difficult” (Steinmetz & Tabenkin, 2001; Stone, 2014). The lack of an adequate explanatory framework motivates patients to find alternate theories of causality, which can contribute to an increasing focus on the need for compensation and blame (Engel et al., 2002). Identifying that the physical profile can be associated with TDEs independent of psychological distress is a crucial first step in research and identifies the need to improve our understanding of the pathophysiology of physical symptoms and develop explanatory frameworks that better validate patients’ suffering (Engel et al., 2002; Stone, 2014).

The present study was not without limitations. First, our data were derived from self-reported measures which, although economical in large-scale studies, are prone to recall bias. Research suggests that the reporting of deployment exposures can change over time (Southwick, Morgan, Nicolaou, & Charney, 1997). However, we found no association between time since deployment and symptom reporting, which suggests minimal amplification of traumatic memory in our sample. Additionally, we were unable to differentiate nonspecific physical symptoms from those caused by disease, injury, or age. However, by controlling for injury and doctor-diagnosed medical conditions, we have accounted for some factors that may impact symptom reporting. The utility of the chosen cutoff of 16 for physical symptoms was conservative. Sensitivity analyses conducted with the lower cutoffs of 15 and 14 demonstrated good construct validity for our physical symptom profile. We limited the covariates included in the study for parsimony and because we were limited to information collected by the survey. Finally, the cross-sectional nature of the data limits conclusions about causation.

Key strengths of our study include our large, non-treatment-seeking sample. Longitudinal studies examining the temporal and causal associations between trauma exposure, physical symptoms, and psychological disorder, and the impact of demographic and military factors, with a particular focus on physiological mechanisms are needed in the future. In conclusion, this research identified a physical symptom only profile (without psychological comorbidity), a group that is not adequately conceptualized in clinical settings. It is noteworthy that the association between the physical and psychological symptom profiles and TDEs suggests that these exposures are similarly significant in the etiology of both symptom types. These findings highlight the need to understand causal mechanisms for this physical symptom profile as well as to develop adequate explanatory frameworks and expand available treatments.

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Table 1

Mean Assessment Scores, Frequency of Military Service Variables, and Demographic Characteristics, by Symptom Group

	Low Symptoms (<i>n</i> = 11,435)			Physical (<i>n</i> = 723)			Psychological (<i>n</i> = 1,353)			Comorbid (<i>n</i> = 1,088)		
Characteristic	%	<i>M</i>	<i>SD</i>	%	<i>M</i>	<i>SD</i>	%	<i>M</i>	<i>SD</i>	%	<i>M</i>	<i>SD</i>
Proportion of sample	78.3			5.0			9.3			7.5		
HSC score		4.26	4.10		19.3	5.18		7.94	4.77		24.5	8.75

				7						1	
K10 score	12.6	2.73		15.4	3.07		23.6	5.32		26.9	7.17
	4						9			4	
Age (years)	36.5	8.51		40.3	9.64		36.2	8.00		39.6	6.69
	4			1			1			8	
Total trauma types	4.10	4.76		6.09	5.61		5.34	5.41		7.32	5.98
Male gender	87.8			88.1			85.9			85.6	
Service branch											
Army	46.5			49.1			47.3			51.2	
Navy	21.7			23.3			26.6			24.1	
RAAF	31.8			27.6			26.1			24.7	
Service status											
Currentl	74.			69.			65.			51.	

y serving	7			0			3			6		
Active	11.			15.			11.			14.		
Reserve	6			8			9			6		
No longer serving	4.3			6.5			10.5			15.3		
Inactive Reserve	9.4			8.7			12.3			15.3		
Rank												
Commissioned	29.8			22.0			25.1			19.6		
Non-commissioned	49.5			63.8			52.0			58.4		
Other	20.7			14.2			22.8			22.0		
Deployments		1.96	1.93		2.09	1.84		1.83	1.52		2.11	6.33
Years since MEAO		4.15	2.43		4.58	2.45		4.64	2.51		5	2.44

Educational attainment												
High school	35.6			34.4			36.3			35.5		
Certificate	20.3			23.7			23.2			22.4		
Graduate	28.0			28.9			26.6			31.3		
Postgraduate	16.1			13.1			13.8			10.8		
Injury at MEAO	18.9			30.9			23.4			37.3		
Doctor-diagnosed medical conditions		6,061	52.97		862	77.82		870	64.34		830	76.31

Note. $N=14,032$. MEAO = Middle East Area of Operations; CO = commissioned officer;

NCO = non-commissioned officer; RAAF = Royal Australian Airforce; K10 = Kessler

Psychological Distress Scale; HSC = Health Symptom Checklist

Table 2

Four Multivariate Logistic Regression Models Testing Predictors of Symptom Group Membership

Predictor	Physical vs. Low Symptoms		Psychological vs. Low Symptoms		Comorbid vs. Low Symptoms		<i>p</i>
	<i>RRR</i>	95% CI	<i>RRR</i>	95% CI	<i>RRR</i>	95% CI	
Age	1.05	[1.04, 1.06]	0.99	[0.98, 1.00]	1.05	[1.04, 1.06]	< .001
Gender: Female	1.46	[1.11, 1.94]	1.29	[1.05, 1.59]	1.98	[1.56, 2.50]	< .001
Service: Army (ref.)				[1.21, 1.81]		[1.31, 1.99]	< .001
Navy	1.44	[1.11, 1.87]	1.48	1.81]	1.69	1.99]	
RAAF	1.13	[0.88, 1.46]	1.14	[0.95, 1.37]	1.30	[1.03, 1.65]	
Service status current serving (ref.)				[0.86, 1.30]		[0.98, 1.61]	< .001
Active Reserve	1.04	[0.78, 1.37]	1.05		1.26		
No longer serving	1.08	[0.73, 1.59]	2.07	[1.61, 2.69]	3.77	[2.88, 4.93]	
Inactive Reserve	0.73	[0.52, 1.02]	1.30	[1.04, 1.62]	1.67	[1.29, 2.15]	

Rank on deployment:							
CO (ref.)				[0.85,		[1.23,	<
NCO	1.77	[1.32, 2.37]	1.03	1.26]	1.57	01]	.001
Other	1.44	[0.95, 2.19]	0.95	[0.74,	1.93	[1.39,	
				1.24]		69]	
Number of deployments	1.03	[0.99, 1.06]	0.98	[0.94,	1.03	[1.00,	.124
				1.02]		06]	
Years since deployment	1.01	[0.97, 1.06]	1.04	[1.01,	1.02	[0.98,	.112
				1.08]		06]	
Education: High school							
(ref.)				[0.94,		[0.91,	.013
Certificate	1.40	[1.10, 1.19]	1.11	1.33]	1.12	38]	
Graduate	1.01	[0.79, 1.30]	0.89	[0.74,	0.97	[0.78,	
Postgraduate	0.89	[0.60, 1.32]	0.83	1.07]	0.65	20]	
				[0.63,		[0.46,	
				1.08]		91]	
Injury	1.14	[0.99, 1.31]	1.14	[1.02,	1.36	[1.23,	<
				1.27]		50]	.001
Doctor-diagnosed	1.28	[1.24, 1.32]	1.10	[1.07,	1.30	[1.23,	<
medical conditions				1.14]		50]	.001
Total trauma types	1.10	[1.08, 1.12]	1.05	[1.03,	1.14	[1.12,	<
				1.07]		16]	.001
Model 2: Subjective ^a	1.27	[1.20, 1.33]	1.22	[1.17,	1.47	[1.40,	<
				1.28]		53]	.001

Model 3: Objective ^a	1.15	[1.10, 1.19]	1.07	[1.04, 1.10]	1.19	[1.15, 1.24]	< .001
Model 4: Human Death and Degradation ^a	1.40	[1.30, 1.51]	1.22	[1.14, 1.30]	1.48	[1.40, 1.57]	< .001

Note. The baseline category is low symptoms. RRR = relative risk ratio; ref.= ref reference

group; CO = commissioned officer; NCO = non-commissioned officer; MEAO = Middle East Area of Operations.

^aAdjusted for age, sex, service, service status, rank, education, number of deployments to the MEAO, years since deployment to the MEAO, injury, and doctor-diagnosed medical conditions.

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