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Research report

Grief and physical health outcomes in U.S. soldiers returning from combat ☆

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ABSTRACT

Background: Few studies have measured the burden of physical health problems after Iraq/Afghanistan deployment, except in association with post-traumatic stress disorder (PTSD) or mild traumatic brain injury (mTBI). Grief, a correlate of health problems in the general population, has not been systematically examined. We aimed to identify the prevalence of post-deployment physical health problems and their association with difficulty coping with grief.

Methods: Infantry soldiers (n = 1522) completed anonymous surveys using validated instruments six months following deployment in November–December 2008. Multiple logistic regression was used to assess the association of difficulty coping with grief and physical health.

Results: The most frequent physical health symptoms reported were: sleep problems (32.8%), musculoskeletal pain (32.7%), fatigue (32.3%), and back pain (28.1%). Difficulty coping with grief over the death of someone close affected 21.3%. There was a dose–response relationship between level of difficulty coping with grief and principal physical health outcomes (ps < .002). Controlling for demographics, combat experiences, injuries, PTSD, depression, and other factors, grief significantly and uniquely contributed to a high somatic symptom score (adjusted odds ratio (AOR) = 3.6), poor general health (AOR = 2.0), missed work (AOR = 1.7), medical utilization (AOR = 1.5), difficulty carrying a heavy load (AOR = 1.7), and difficulty performing physical training (AOR = 1.6; all 95% confidence intervals > 1).

Limitations: Data are cross-sectional and grief was measured with one item.

Conclusions: Over 20% of soldiers reported difficulty coping with grief. This difficulty was significantly associated with physical health outcomes and occupational impairment. Clinicians should be aware of the unique role grief plays in post-deployment physical health when treating patients.

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1. Introduction

Military service in a combat zone has been consistently linked to a broad range of health outcomes (Hoge et al., 2007; Hyams et al., 1996; Jones et al., 2002). The physical, neurocognitive, and psychological symptoms and occupational and social impairment associated with combat are well-documented. Despite an extensive literature on generalized health concerns following previous wars (Committee on Gulf War and Health, 2010; Engel et al., 1999; Proctor et al., 1998), few studies of the conflicts in Iraq and Afghanistan have characterized the prevalence or risk factors of post-war physical health problems (Hotopf et al., 2006), except in relation to post-traumatic stress disorder (PTSD) and/or mild traumatic brain injuries (mTBI; i.e., concussion) (Fear et al., 2009; Hoge et al., 2007, 2008; Polusny et al., 2011). Other mental health

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concerns also known to be associated with physical health, including grief, have received little attention (Papa et al., 2008).

In the general population, there is evidence that grief predicts negative health outcomes independently from PTSD and depression (Bonanno et al., 2007), and that direct exposure to trauma worsens grief (Neria et al., 2007; Sung et al., 2011). Grief has also been linked to poor physical health (Mancini and Bonanno, 2011; Stroebe et al., 2007) and functional impairment (Mancini and Bonanno, 2011; Neria et al., 2007; Stroebe et al., 2007). A 2010 study of soldiers returning from operations in Iraq found that over 80% "knew someone who had been seriously injured or killed," and over one-quarter "had a buddy shot or hit near them" (Thomas et al., 2010). The impact of losing a team member in combat has been likened to losing a close family member (Hoge, 2010; Papa et al., 2008). Although there have been over 6000 service members killed in Iraq or Afghanistan as of the writing of this paper (U.S. Department of Defense, 2011), little research has been conducted on the health consequences of grief in service members during the current wars (Papa et al., 2008).

The Congressional Budget Office estimated that medical costs to the Department of Veterans Affairs (VA) for the Iraq and Afghanistan wars will reach $7–9 billion over the next ten years (Goldberg, 2007). Given the large number of fatalities in these wars and the significant impact of post-war physical health outcomes, it is critical to understand how grief may contribute to these outcomes. This study reports the prevalence of post-deployment physical health problems and examines the unique role grief plays in physical health among soldiers after their return from combat.

2. Methods

2.1. Study population and data collection

From November to December 2008, we surveyed 2064 soldiers from three U.S. infantry brigade combat teams six months post-deployment. The survey was a later iteration within a larger effort to study the impact of combat that began in 2003 (Hoge et al., 2004; Thomas et al., 2010). We coordinated with unit commanders, who provided time for large group recruitment briefings. Soldiers could volunteer to participate in the study under a protocol approved by the institutional review board of the Walter Reed Army Institute of Research. Participants were informed of the anonymity/confidentiality of their responses and that they could skip individual items. Approximately 50% of all soldiers from participating units were present during the recruitment phase, consistent with similar surveys (Hoge et al., 2004, 2007, 2008; Thomas et al., 2010). Soldiers unable to attend the recruitment sessions had other work-related duties, were on leave, ill, or on temporary duty elsewhere. After description of the study, 86% of soldiers attending the recruitment sessions gave written informed consent. On average, 97% of those soldiers responded to each item associated with the outcomes examined.

Of the 2064 soldiers who completed the survey, 1532 reported being deployed to Iraq or Afghanistan for at least one month. Ten soldiers who reported moderate or severe traumatic brain injury (i.e., loss of consciousness >30 min) were excluded in order to isolate the specific contribution of mTBI as a correlate of physical health problems. Studies have identified mTBI/concussion as a potential correlate of post-deployment health problems (Fear et al., 2009; Hoge et al., 2008; Polusny et al., 2011). The final sample was 1522.

2.2. Measures

Independent variables examined in relation to physical health outcomes included combat experiences, injury, adverse childhood experiences (ACEs), alcohol misuse, depression, PTSD, and grief. There were 34 combat experience questions, which were dichotomized into "at least once" and "never", summed (range: 0–34), and divided into quartiles (Hoge et al., 2008). Combat injury was grouped into no injury, non-mTBI injury, mTBI with alteration of but no loss of consciousness (AOC), and mTBI with loss of consciousness (LOC) (Hoge et al., 2008). ACE scores were calculated using methods found in the literature (Cabrera et al., 2007; Felitti et al., 1998). Our questionnaire included four ACEs: growing up with a parent with alcohol problems, growing up with a parent with mental illness, experiencing emotional abuse, or experiencing physical abuse (range: 0–4). Alcohol misuse was defined using the Two-Item Conjoint Screen (TICS) (Brown et al., 2001; Santiago et al., 2010). Depression (i.e., major depressive disorder) and PTSD were defined using the Patient Health Questionnaire—9 (PHQ-9) and the PTSD Checklist (PCL), both using the strict cutoff criteria used in previous studies (Hoge et al., 2004, 2008; Thomas et al., 2010). The case definition for depression used current psychiatric diagnostic criteria and evidence of impairment in work, at home, or in interpersonal functioning that was categorized as at the "very difficult" level as measured by the PHQ. For the PCL, the total score also had to be at least 50 on a scale of 17 to 85 (with a higher number indicating a greater number of symptoms or greater severity), a well-established cutoff. Grief was assessed with an item that asked, "In the past month, how much have you experienced difficulty coping with grief over the death of someone close?" Responses were "not at all," "a little bit," "moderately," "quite a bit," and "extreme." Any positive response was categorized as evidence that the soldier was experiencing difficulty coping with grief.

The six study outcomes included past month physical/somatic symptoms, self-rated overall health, missed work days, medical utilization (i.e., number of "sick call" visits), and occupational impairment measured by difficulty carrying a heavy load and difficulty performing physical training (PT), important military requirements. Physical symptoms were measured with the Patient Health Questionnaire—15 (PHQ-15) (Hoge et al., 2007; Kroenke et al., 2002). The menstrual cramping item was excluded due to the low proportion of women taking the survey. Symptoms were scored on a three-point scale (0–2) using the response options "not bothered at all," "bothered a little," and "bothered a lot" (except for sleep problems and fatigue, which utilized the responses, "not at all," "few or several days", and "more than half the days"/"nearly every day"). A total score ≥ 15 (out of 28) indicated a high total score (Hoge et al., 2007; Kroenke et al., 2002). Individual symptoms were also dichotomized using "bothered a lot"/"more than half the days" as the cutoff. Other commonly reported post-deployment symptoms often attributed to mTBI (i.e., being easily annoyed or irritable, concentration problems, memory problems, balance problems, ringing in the ears, and sensitivity to light) were dichotomized using the same responses from the PHQ-15 (Hoge et al., 2008).

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The soldiers were also asked to rate their overall health ("excellent," to "poor") and the responses were dichotomized with "fair" and "poor" being considered worse health. The number of sick call visits and missed workdays in the past month were dichotomized at two or more (Hoge et al., 2008). Difficulty with "ability to do PT" and "ability to carry heavy loads" was measured using a 5-point Likert scale from "not at all" to "extreme"; "moderate" difficulty or higher was considered impaired given the face validity of these items and their importance to occupational functioning.

2.3. Analysis

We performed analyses using PASW, version 18.0 (SPSS, Chicago). We examined the prevalence of each of the six main outcomes, PHQ-15 symptoms, and the other post-deployment symptoms. We used prevalence rates, logistic regression, Kruskal–Wallis χ^2, and χ^2 tests for trend to examine the relationship of grief severity to outcome. We utilized multiple logistic regression to examine the unique contribution of grief to the six health outcomes, controlling for demographic variables, combat experiences, injuries, and mental health factors associated with physical health outcomes in the literature.

3. Results

The sample demographics were consistent with previous reports (Thomas et al., 2010); 92% were male, 73% under the age of 30, 56% married, 50% with a high school diploma or less, and 56% were junior enlisted (E1–E4). Overall, 63.4% of soldiers reported being "bothered a lot" by at least one PHQ-15 physical health symptom in the past month; 9.7% met criteria for a high total symptom score (Table 1). The PHQ-15 symptoms most commonly endorsed by soldiers were sleep problems (32.8%), musculoskeletal pain (32.7%), fatigue (32.3%), back pain (28.1%) and headaches (16.2%). Additionally, 37.7% and 16.3% of soldiers reported irritability and concentration problems, respectively. A large proportion of soldiers reported two or more past-month medical visits (30.0%), poor overall health (28.1%), difficulty performing PT (26.7%), or difficulty carrying a heavy load (24.1%) (Table 1).

Of the total sample of soldiers, 21.3% reported experiencing "difficulty coping with grief over the death of someone close." Overall, 77.3% of soldiers reported knowing someone injured or killed and 21.5% reported having a buddy shot or hit who was near them during their most recent deployment; 77.7% reported at least one of these experiences. Of soldiers who reported difficulty with grief, 87.3% reported knowing someone injured or killed during deployment, compared to 74.2% of those who did not report difficulty with grief ($\chi^2 = 23.3$, $p < .001$). Among soldiers reporting difficulty with grief, 34.5% reported that a buddy was shot or hit near them, compared to 17.5% of those who did not report difficulty ($\chi^2 = 42.4$, $p < .001$).

Soldiers reporting difficulty coping with grief were at least 2.4 times as likely to report all physical health symptoms and outcomes as soldiers who reported no difficulty with grief (Table 2). There were significant dose–response relationships between the level of difficulty coping with grief and all physical health symptoms, poor overall health, and the four occupational impairment outcomes ($p < .002$) (Table 2). The top five PHQ-15 symptoms for those reporting grief were: fatigue (58.1%), sleep problems (55.4%), musculoskeletal pain (49.7%), back pain (41.3%), and headaches (32.7%) with 49.7% also reporting poor overall health (Table 2).

Multiple logistic regression models were constructed to look at the factors correlated with the six principal health outcomes. Independent variables in the models included demographics (i.e., gender, age, education, marital status, rank), combat experiences, combat injury (including mTBI), depression, PTSD, alcohol misuse, ACEs, and difficulty coping with grief. The results demonstrated that after adjusting for these variables, grief remained significantly associated with all six physical health and occupational impairment outcomes: *high somatic symptom score* (adjusted odds ratio (AOR) = 3.6, 95% confidence interval (CI): 2.1–6.2), *poor overall health* (AOR = 2.0, 95% CI: 1.4–2.9), *missed work days* (AOR = 1.7, 95% CI: 1.03–3.0), *medical utilization* (AOR = 1.5, 95% CI: 1.04–2.1), *difficulty carrying a heavy load* (AOR = 1.7, 95% CI: 1.2–2.4), and *difficulty performing PT* (AOR = 1.6, 95% CI: 1.1–2.3) (Table 3).

Three sets of additional analyses were run to ensure the validity of the grief and physical health association. First, to

Table 1
Prevalence of post-deployment physical health outcomes.

	Total sample	
Physical health outcome during the past month	n/N[a]	(%)
PHQ-15 score ≥15[b]	138/1419	(9.7)
Physical symptoms included in PHQ-15[c]		
Stomach pain	78/1478	(5.3)
Back pain	415/1478	(28.1)
Arm, leg, or joint pain	482/1476	(32.7)
Headache	240/1480	(16.2)
Chest pain	78/1480	(5.3)
Dizziness	57/1479	(3.9)
Fainting spells	14/1476	(0.9)
Heart pounding or racing	104/1478	(7.0)
Shortness of breath	88/1479	(5.9)
Constipation, loose bowels, or diarrhea	133/1479	(9.0)
Nausea, gas, or indigestion	152/1478	(10.3)
Pain or problems during sexual intercourse	60/1478	(4.1)
Fatigue	479/1483	(32.3)
Sleep problems	488/1489	(32.8)
Other symptoms not included in PHQ-15[c]		
Concentration problems	243/1491	(16.3)
Memory problems	171/1481	(11.5)
Balance problems	53/1478	(3.6)
Ringing in the ears	138/1478	(9.3)
Sensitivity to light	104/1477	(7.0)
Easily annoyed or irritable	560/1486	(37.7)
Poor general health[d]	411/1462	(28.1)
Missed work days due to illness (≥2)	140/1446	(9.7)
Medical visits for physical condition (≥2)	437/1458	(30.0)
Difficulty with ability to carry heavy load[e]	351/1456	(24.1)
Difficulty with ability to do physical training[e]	390/1458	(26.7)

[a] Data are presented as numbers of individuals and valid percents that excluded missing values. Complete data regarding the physical health categories not available for all participants.
[b] PHQ-15 = Patient Health Questionnaire 15-Item somatic symptoms Scale (range: 0–28; higher numbers indicate a greater number and severity of symptoms).
[c] Symptoms were reported as "bothered a lot" or "more than half the days"/"nearly every day".
[d] Self-reported health was "fair" or "poor".
[e] Those reporting "moderate difficulty", "quite a bit of difficulty" or "extreme difficulty".

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Table 2
Prevalence of post-deployment physical health outcomes and combat experiences by grief severity.

	Crude odds ratios (95% CI)	Difficulty coping with grief[a]					
		Any difficulty n[b]	Not at all	A little bit	Moderately	Quite a bit	Extreme
Physical health outcome during the past month[c]							
PHQ-15 score ≥15[d]	8.2 (5.6–11.9)	85 (28.5%)	52 (4.7%)	27 (20.6%)	21 (29.2%)	13 (34.2%)	24 (42.1%)
Physical symptoms included in PHQ-15[e]							
Stomach pain	3.5 (2.7–4.5)	28 (9.1%)	49 (4.2%)	11 (8.2%)	8 (10.7%)	3 (7.3%)	6 (10.2%)
Back pain	2.9 (2.1–3.9)	128 (41.3%)	283 (24.5%)	53 (39.0%)	26 (34.7%)	21 (51.2%)	28 (48.3%)
Arm, leg, or joint pain	3.1 (2.3–4.2)	154 (49.7%)	324 (28.2%)	61 (45.2%)	34 (45.3%)	25 (61.0%)	34 (57.6%)
Headache	3.1 (2.4–4.0)	102 (32.7%)	136 (11.8%)	33 (24.1%)	23 (30.7%)	15 (36.6%)	31 (52.5%)
Chest pain	4.2 (3.2–5.6)	35 (11.3%)	42 (3.6%)	12 (8.8%)	9 (12.0%)	4 (9.8%)	10 (16.9%)
Dizziness	4.2 (3.2–5.6)	36 (11.6%)	21 (1.8%)	8 (5.9%)	7 (9.5%)	4 (9.8%)	17 (28.8%)
Fainting spells	12.4 (7.4–20.8)	11 (3.5%)	2 (0.2%)	5 (3.7%)	1 (1.3%)	1 (2.4%)	4 (6.9%)
Heart pounding or racing	5.8 (4.4–7.6)	60 (19.3%)	42 (3.6%)	17 (12.4%)	14 (18.7%)	7 (17.5%)	22 (37.3%)
Shortness of breath	4.7 (3.6–6.2)	46 (14.8%)	40 (3.5%)	12 (8.8%)	11 (14.7%)	6 (14.6%)	17 (28.8%)
Constipation, loose bowels, or diarrhea	2.6 (2.0–3.3)	46 (14.8%)	83 (7.2%)	13 (9.6%)	13 (17.3%)	7 (17.1%)	13 (22.0%)
Nausea, gas, or indigestion	3.5 (2.7–4.5)	58 (18.7%)	90 (7.8%)	18 (13.2%)	17 (23.0%)	9 (22.0%)	14 (23.7%)
Pain or problems during sexual intercourse	5.5 (4.0–7.6)	35 (11.3%)	24 (2.1%)	11 (8.1%)	7 (9.5%)	6 (14.6%)	11 (18.6%)
Fatigue	4.2 (3.2–5.5)	182 (58.1%)	285 (24.8%)	66 (47.8%)	43 (57.3%)	28 (70.0%)	45 (75.0%)
Sleep problems	3.5 (2.7–4.5)	173 (55.4%)	304 (26.3%)	62 (45.3%)	40 (53.3%)	25 (62.5%)	46 (76.7%)
Other symptoms not included in PHQ-15[e]							
Concentration problems	5.2 (3.9–7.0)	117 (37.3%)	118 (10.2%)	33 (23.9%)	27 (36.0%)	22 (53.7%)	35 (58.3%)
Memory problems	3.6 (2.6–5.0)	75 (24.0%)	93 (8.1%)	22 (16.1%)	16 (21.3%)	14 (34.1%)	23 (39.0%)
Balance problems	7.3 (4.1–13.0)	34 (10.9%)	19 (1.6%)	14 (10.3%)	5 (6.7%)	6 (14.6%)	9 (15.3%)
Ringing in the ears	3.1 (2.1–4.5)	57 (18.3%)	78 (6.8%)	16 (11.8%)	10 (13.3%)	13 (31.7%)	18 (30.5%)
Sensitivity to light	3.9 (2.6–5.8)	49 (15.8%)	53 (4.6%)	17 (12.4%)	11 (14.7%)	9 (22.5%)	12 (20.3%)
Easily annoyed or irritable	3.8 (2.9–4.9)	195 (62.3%)	351 (30.5%)	67 (48.6%)	45 (60.0%)	31 (77.5%)	52 (86.7%)
Poor general health[f]	3.4 (2.6–4.5)	150 (49.7%)	255 (22.3%)	58 (44.3%)	34 (45.9%)	24 (58.5%)	34 (60.7%)
Missed work days due to illness (≥2)	2.7 (1.9–4.0)	54 (18.0%)	84 (7.4%)	16 (12.2%)	19 (26.0%)	8 (19.5%)	11 (20.0%)
Medical visits for physical condition (≥2)	2.4 (1.8–3.1)	136 (45.0%)	293 (25.7%)	45 (34.4%)	38 (51.4%)	23 (56.1%)	30 (53.6%)
Difficulty with ability to carry heavy load[g]	2.7 (2.1–3.6)	121 (40.1%)	223 (19.6%)	38 (28.8%)	34 (45.9%)	21 (51.2%)	28 (50.9%)
Difficulty with ability to do physical training[g]	2.4 (1.8–3.1)	123 (40.7%)	256 (22.5%)	37 (28.0%)	36 (48.6%)	22 (55.0%)	28 (50.0%)
Combat experiences associated with injury or death of a fellow soldier[c]							
Had a buddy shot or hit who was near you	2.5 (1.9–3.3)	107 (34.5%)	201 (17.5%)	47 (34.6%)	29 (39.2%)	13 (32.5%)	18 (30.0%)
Knowing someone seriously injured or killed	2.4 (1.7–3.4)	268 (87.3%)	856 (74.2%)	116 (87.2%)	64 (87.7%)	37 (90.2%)	51 (85.0%)

CI = confidence interval.
[a] All Kruskal–Wallis χ^2 analyses for group differences are significant at the $p<0.001$ level; all Linear-by-Linear Association χ^2 tests for trend are significant at the $p\leq 0.002$ level.
[b] Percentage of those with each grief severity level reporting each physical health outcome and combat experience.
[c] Data are presented as numbers of individuals and valid percents that excluded missing values. Complete data regarding the physical health categories not available for all participants.
[d] PHQ-15 = Patient Health Questionnaire 15-Item somatic symptoms Scale (range: 0–28; higher numbers indicate a greater number and severity of symptoms).
[e] Symptoms were reported as "bothered a lot" or "more than half the days"/"nearly every day".
[f] Self-reported health was "fair" or "poor".
[g] Those reporting "moderate difficulty", "quite a bit of difficulty" or "extreme difficulty."

make certain that the grief variable was a unique correlate of physical health outcomes, we examined the models using a stricter cutoff for grief (i.e., "moderate" or higher). The pattern of findings did not change, and for four of the outcomes, the magnitude of the adjusted odds ratios became stronger.

Second, we wanted to determine if the grief variable was distinct from the combat experience measures of loss. We added the two combat loss variables ("knowing someone injured or killed," and "had a buddy shot or hit who was near you") to the final regression model with and without the grief coping variable. These two combat experiences were not associated with physical health outcomes and did not affect the strength of the association of the grief variable with physical health outcomes.

Finally, due to the overlapping items related to sleep and fatigue on the PHQ-9 and the PHQ-15, we ran the model without the PHQ-9 to ensure that collinearity did not affect the results; results were very similar indicating that having both scales in the model was acceptable.

4. Discussion

In this large survey of infantry soldiers following a combat deployment, physical health outcomes were prevalent. The most common symptoms were fatigue, sleep problems, musculoskeletal pain, back pain, and headaches. Additionally, almost 10% of the sample had a score at or above the cutoff of 15 on the generalized symptom scale (Hoge et al., 2007; Kroenke et al., 2002). Grief was identified as a significant correlate of post-deployment physical health. More than one in five soldiers reported difficulty coping with grief over the death of someone close to them. There was a strong dose–response relationship

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Table 3
Association of mental health symptoms and combat experiences with physical health outcomes following deployment.

Predictor	PHQ-15 severity ≥15 (9.7%)	Self-reported poor health[a] (28.1%)	≥2 Missed work (9.7%)	≥2 Medical visits (30.0%)	Difficulty carrying heavy load[b] (24.1%)	Difficulty performing PT[b] (26.7%)
Gender						
Male	Referent	Referent	Referent	Referent	Referent	Referent
Female	**3.0 (1.3–6.6)**[c]	1.1 (0.7–1.9)	1.8 (0.95–3.6)	**2.1 (1.4–3.4)**	**2.3 (1.4–3.7)**	1.0 (0.6–1.6)
Age						
18–24	Referent	Referent	Referent	Referent	Referent	Referent
25–29	0.9 (0.5–1.8)	1.1 (0.8–1.6)	1.1 (0.6–1.8)	1.0 (0.7–1.5)	1.3 (0.9–1.8)	**1.4 (1.01–2.1)**
30–39	0.8 (0.4–1.7)	1.2 (0.8–1.9)	0.7 (0.3–1.3)	1.4 (0.9–2.1)	1.5 (1.0–2.4)	**1.7 (1.1–2.6)**
40+	1.2 (0.4–4.3)	1.0 (0.5–2.2)	0.8 (0.2–2.3)	1.3 (0.7–2.6)	**3.4 (1.7–6.7)**	**2.5 (1.2–5.1)**
Education						
≤High school	Referent	Referent	Referent	Referent	Referent	Referent
Some college	**2.1 (1.2–3.6)**	1.1 (0.8–1.5)	1.4 (0.8–2.2)	1.2 (0.9–1.6)	1.0 (0.7–1.3)	0.7 (0.6–1.0)
Bachelor	0.8 (0.1–6.8)	0.4 (0.2–1.1)	1.9 (0.6–6.7)	1.3 (0.6–2.6)	0.6 (0.3–1.5)	0.5 (0.2–1.1)
Marital						
Single	Referent	Referent	Referent	Referent	Referent	Referent
Married	1.1 (0.6–2.0)	1.0 (0.7–1.4)	1.3 (0.7–2.2)	1.1 (0.8–1.5)	1.1 (0.8–1.6)	1.0 (0.7–1.4)
Other	1.5 (0.7–3.2)	1.0 (0.7–1.6)	**2.6 (1.4–4.9)**	**1.5 (1.01–2.3)**	1.0 (0.6–1.6)	1.1 (0.7–1.7)
Rank						
E1–E4	Referent	Referent	Referent	Referent	Referent	Referent
E5–E9	1.1 (0.6–2.0)	0.8 (0.6–1.1)	0.6 (0.4–1.1)	**0.7 (0.5–0.9)**	0.8 (0.5–1.1)	0.8 (0.6–1.1)
Officer/warrant	2.0 (0.3–13.7)	1.2 (0.4–3.5)	0.5 (0.1–2.3)	0.7 (0.3–1.6)	0.7 (0.3–2.0)	0.6 (0.2–1.8)
Combat experience						
Lowest 25%	Referent	Referent	Referent	Referent	Referent	Referent
Middle 50%	1.6 (0.8–3.4)	1.1 (0.8–1.6)	0.8 (0.4–1.3)	0.8 (0.6–1.2)	0.8 (0.6–1.2)	1.2 (0.9–1.7)
Highest 25%	2.0 (0.8–4.8)	1.2 (0.8–1.9)	0.7 (0.3–1.4)	0.8 (0.5–1.3)	0.8 (0.5–1.3)	1.1 (0.7–1.7)
Combat injury						
No injury	Referent	Referent	Referent	Referent	Referent	Referent
Other injury	0.6 (0.3–1.1)	**1.5 (1.05–2.0)**	1.6 (0.95–2.6)	**2.1 (1.6–2.9)**	**2.7 (1.9–3.7)**	**1.9 (1.4–2.6)**
mTBI with AOC	1.9 (0.9–3.8)	**1.6 (1.03–2.5)**	1.8 (0.9–3.5)	**2.0 (1.3–3.1)**	**2.2 (1.3–3.5)**	**1.9 (1.2–2.9)**
mTBI with LOC	1.5 (0.6–3.7)	**2.3 (1.2–4.5)**	1.4 (0.5–3.6)	**1.9 (1.04–3.6)**	**3.0 (1.5–5.7)**	1.6 (0.8–3.0)
PTSD						
No	Referent	Referent	Referent	Referent	Referent	Referent
Yes	**3.6 (2.0–6.7)**	**2.0 (1.3–3.1)**	**1.9 (1.03–3.6)**	**2.3 (1.5–3.4)**	**1.9 (1.2–3.0)**	1.3 (0.8–2.0)
Depression						
No	Referent	Referent	Referent	Referent	Referent	Referent
Yes	**4.5 (2.3–8.7)**	**4.3 (2.4–7.7)**	1.4 (0.7–3.0)	1.4 (0.8–2.4)	**2.2 (1.3–3.9)**	**2.9 (1.7–4.9)**
Alcohol misuse						
No	Referent	Referent	Referent	Referent	Referent	Referent
Yes	0.9 (0.4–1.5)	0.8 (0.6–1.1)	0.8 (0.5–1.3)	0.9 (0.7–1.3)	0.8 (0.6–1.1)	0.9 (0.7–1.3)
Number of ACE						
0	Referent	Referent	Referent	Referent	Referent	Referent
1	1.2 (0.6–2.4)	**1.6 (1.1–2.3)**	1.2 (0.7–2.0)	1.4 (1.0–1.9)	1.3 (0.9–1.9)	1.4 (1.03–2.0)
2	**2.1 (1.03–4.3)**	1.4 (0.9–2.2)	1.6 (0.8–3.0)	1.1 (0.8–1.8)	0.9 (0.6–1.5)	1.1 (0.7–1.7)
3	**2.7 (1.2–5.9)**	**2.2 (1.1–3.6)**	1.7 (0.8–3.4)	1.3 (0.8–2.1)	1.7 (1.04–2.9)	1.6 (1.0–2.7)
4	**3.8 (1.6–9.2)**	**2.0 (1.1–3.7)**	**2.3 (1.1–5.0)**	1.1 (0.6–2.0)	**2.0 (1.1–3.8)**	**2.4 (1.3–4.3)**
Grief						
No	Referent	Referent	Referent	Referent	Referent	Referent
Yes	**3.6 (2.1–6.2)**	**2.0 (1.4–2.9)**	**1.7 (1.03–3.0)**	**1.5 (1.04–2.1)**	**1.7 (1.2–2.4)**	**1.6 (1.1–2.3)**

ACE = adverse childhood experiences, AOC = alteration of consciousness, LOC = loss of consciousness, mTBI = mild traumatic brain injury/concussion, PHQ-15 = Patient Health Questionnaire 15-item somatic symptom scale, PT = physical training, PTSD = post-traumatic stress disorder.

[a] Those who self-reported that their health was fair or poor.

[b] As reported by those indicating "moderate difficulty", "quite a bit of difficulty" or "extreme difficulty".

[c] Adjusted odds ratios and 95% confidence intervals, adjusted for all other variables in the predictor column. Bold indicates statistical significance.

between severity of the grief response and all health and occupational impairment outcomes, with large differences observed between some of the severity levels. After controlling for demographics, combat experiences, injuries, and mental health variables, grief contributed significantly to all principal physical health and occupational impairment outcomes.

Characterizing the prevalence of generalized post-war physical health outcomes has not been a strong focus of research during the current wars, except in relation to PTSD or mTBI (Fear et al., 2009; Hoge et al., 2007, 2008; Polusny et al., 2011). Studies from previous US conflicts have demonstrated a strong association between combat deployments and adverse health outcomes similar to those reported here (Gray et al., 2002; Hyams et al., 1996; Jones et al., 2002), and there is a need for further research on the prevalence, impact, and correlates of combat-related physical health outcomes in this generation of military personnel.

Our finding that grief was associated with physical health symptoms in a military population is consistent with the literature from the civilian population (Neria et al., 2007;

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Stroebe et al., 2007), although the magnitude of differences appears to be larger in this military sample than some civilian samples. For instance, in one college population, 22% of the bereaved reported sleep problems compared to 17% of the non-bereaved (Hardison et al., 2005); in our study, 55% of bereaved soldiers reported sleep problems compared to 26% of the non-bereaved soldiers (Table 2).

Grief was significantly associated with all six principal physical health outcomes above and beyond the contribution of other health correlates (i.e., PTSD, depression, combat injuries and experiences, alcohol use, and ACEs). Clinically, the distinction between grief and depression or PTSD following loss, particularly traumatic loss, can be difficult, and it is important to understand the unique contribution of each (Boelen et al., 2011, Bonanno et al., 2007). While PTSD and depression were strongly related to most of the physical health outcomes, consistent with the literature (Committee on Gulf War and Health, 2010; Engel et al., 1999; Fear et al., 2009; Gray et al., 2002; Hoge et al., 2007, 2008; Polusny et al., 2011), the magnitudes of the associations between grief and physical health outcomes were comparable to those between physical health and both PTSD and depression. Grief and deployment-related physical injuries (including mTBI) also had similar levels of association with these outcomes. Taken together, difficulty coping with grief appears to play an important independent role in physical health outcomes. The war-zone context may contribute to the strong associations with physical health in this population, as traumatic experiences can complicate grief (Neria et al., 2007).

It should be noted that difficulty coping with grief was associated with physical health outcomes while the actual experiences of loss were not. This finding, coupled with the dose–response relationship between grief severity and health outcomes, suggests that the emotions linked with loss drive the association with physical health outcomes, rather than the loss itself. The clinical implication is that if interventions are applied to address grief among service members, they should be specifically directed toward those who are having trouble coping with grief, not everyone in the unit who experienced a loss.

There is dearth of information on how to address grief within military units. All military services have guidance for leaders on procedures required after the death of a service member, although military leaders have cited a need for more training (Adler et al., 2008). A recent meta-analysis suggests that interventions designed to prevent complicated grief do not show consistent effectiveness and rarely demonstrate change (Wittouck et al., 2011). The evidence also indicates that the majority of bereaved individuals will return to previous levels of functioning without specific intervention (Stroebe et al., 2007; Wittouck et al., 2011). For those who do develop complicated grief, clinical interventions may be of benefit in a group or individual format (Wittouck et al., 2011). Future research is needed to examine the impact of combat-related losses in military populations. A longitudinal design with more detailed assessments of complicated grief in military units that sustain combat-related losses would provide important data on prevalence, duration, and correlates of grief that might inform potential interventions.

This study has several limitations. First, grief was assessed using a single item; however, this item proved to be distinct in our models from the combat experience of loss. Other research has also found acceptable correlations between single items and longer grief scales (Maciejewski et al., 2007). The simplicity of a single item ("difficulty coping with grief") independently predicting important post-deployment health outcomes is remarkable. Second, it is unclear if the deceased were unit buddies or family/friends at home. However, as almost 90% of bereaved soldiers knew someone seriously injured or killed during the most recent deployment, it is likely that most deaths involved fellow soldiers. Although serious injury is likely to have a different impact on mental health and physical well-being than death, the questions that combined the two still showed strong correlations with the single grief item. Third, we could not determine the duration of the grief. The survey was administered six months post-deployment and one study found that negative grief indicators appear to peak at six months, suggesting that difficulty coping with grief beyond six months may indicate an abnormal response to loss (Maciejewski et al., 2007). However, there are virtually no data on "normative" grief in military personnel who experienced the loss of unit members or leaders during deployment. Fourth, although the demographics in the sample are comparable to other infantry brigades assessed in similar studies (Hoge et al., 2004; Thomas et al., 2010), it is important not to over-generalize the findings to soldiers and units who served outside of infantry brigades (i.e., the primary warfighting elements in the current wars). Finally, this study has a cross-sectional design based on self-reported data; thus, causality can only be inferred and recall bias is possible. The use of validated instruments, consistency in findings across outcomes, and the dose–response observed between grief and physical health help to support these methods.

In summary, these findings suggest that physical health and occupational impairment outcomes associated with combat are considerable, and that grief uniquely contributes to these outcomes. It is important for the military and VA to research how military training addresses grief and the availability of evidence-based clinical interventions for complicated grief. There may be aspects of the occupational context (e.g., leadership, unit cohesion, coping with mission-related losses) that can be included as part of effective intervention plans (Bartone and Wright, 1990), although caution is necessary, as this is a difficult and sensitive topic for service members and veterans who have lost team members in combat. It is ill-advised to implement well-intentioned interventions without fully understanding the cultural and occupational context.

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Conflict of interest

We have no conflicts of interest to report.

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