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Mental health in spouses of U.S. Gulf War veterans

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ABSTRACT

Veterans' spouses are at risk for mental distress and substance use. We examined long term psychological functioning in spouses from a national cohort of 1991 Gulf War era veterans. From clinical interviews, spouses of deployed veterans (n = 488) did not have a greater prevalence of post-war mental disorders compared to spouses of non-deployed veterans (n = 536); however, in couples that were living together since the war, there was an increased risk of anxiety disorders or any one disorder. On questionnaires, the impact varied but was most consistently observed in more severe depression and greater functional impairment in spouses of deployed compared to non-deployed veterans. If a veteran developed post-war anxious/depressive disorders or any one mental disorder, the matched spouse was more likely to develop post-war anxious/depressive disorders or any one mental disorder, respectively. Veteran combat exposure did not similarly increase the risk of spouse post-war mental disorders. Greater spouse self-reported symptomatology was observed in spouses of veterans with anxious/depressive disorders even when controlling for deployment. In summary, the war conferred greater risk for spouse mental disorders and distress for spouses of veterans with mental health disorders, with some increased risk for spouses of deployed veterans, especially in couples together since the war.

1. Introduction

The effect of military service on the psychological health of spouses has been of increasing interest since World War II. Initially, single males were the foundation of the American military and marriage and families were discouraged (Albano, 1994). Over time, the proportion of married service members in all military branches has increased. By the advent of the 1991 Gulf War (GW), a majority (54.7%) of the 1.5 million U.S. active duty, National Guard, and reserve troops were married, similar to the prevalence noted in 2015 (54.3 %) (U.S. Department of Defense, 2015). Studies of the effect of service on veteran's families have provided evidence of negative impacts on marital stress/adjustment (Jordan et al., 1993; Riggs et al., 1998), spouse abuse (Prigerson et al., 2002), aggression (McCarroll et al., 2010) violence in veteran and spouse (Jordan et al., 1993), caregiver burden and emotional distress of the partner (Beckham et al., 1996; Ben Arzi et al., 2000; Calhoun et al., 2002), and adverse effects on spouse mental health (Solomon et al., 1992), including depression or anxiety (Eaton et al., 2008).

Booth et al. (2007) reported increased psychological problems, including alcohol and drug use, among spouses over several years. Mansfield et al. (2010) found that deployment and its length were associated with spouse depression, sleep disorders, anxiety, acute stress reaction and adjustment disorders. Up to 40% of National Guard members deployed to Iraq/Afghanistan and 34% of their spouses screened positive for a mental health problem (Gorman et al., 2011). In a review of studies on Iraq/Afghanistan deployments, De Burgh et al. (2011) concluded that specific factors increased the risk for military spouses, such as veteran deployment length and mental health (especially PTSD), and spouse pregnancy and child care responsibilities. A recent meta-analysis showed that military related PTSD is reliably associated with partner psychological distress (Lambert et al., 2012). Increased PTSD rates in veterans related to intimacy problems, higher divorce rates, and more family violence (Jordan et al., 1993; McCarroll et al., 2010; Prigerson et al., 2002; Riggs et al., 1998; Solomon et al.,

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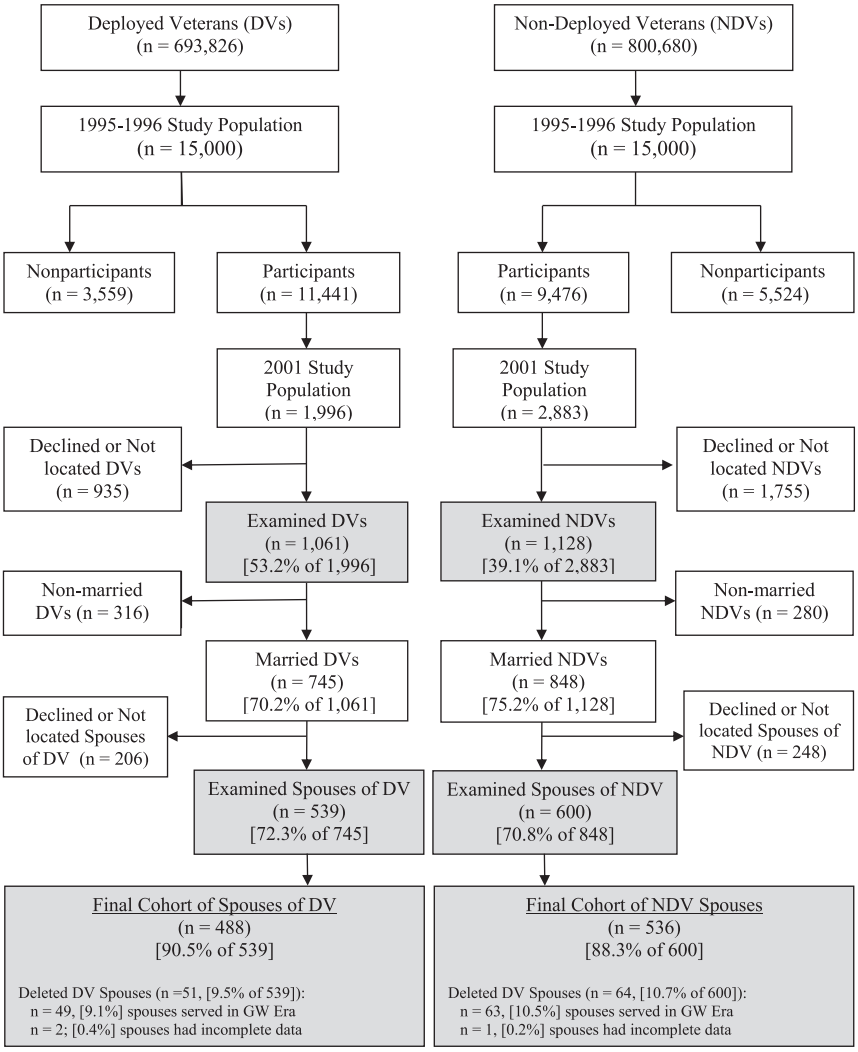

Fig. 1. Participation flow diagram in the 1995–1996 and 2001 phases of the National Health Survey Gulf War Era Veterans and their spouses, United States, 1999–2001.

1992). In a meta-analysis on the effects of deployment factors in predicting suicide related outcomes, Bryan et al. (2015) found that the relationship between predictors and outcomes was stronger and more consistent with certain traumatic exposures (killing and atrocities). Meadows et al. (2016) followed service members and their families regularly over three years. They found no significant effect of deployment on psychological functioning for spouses during a period with relatively low levels of deployment trauma, but for service personnel who experienced deployment trauma, there was an increase in spouse depression, PTSD, and anxiety symptoms. When the service member experienced physical trauma (i.e., injury) during deployment, their spouses also showed persistent increases in depression, PTSD, and anxiety symptoms and binge drinking.

Despite this accrual of evidence, there have been few population based studies of spouses of military personnel. The National Vietnam Veterans Readjustment Study (Kulka et al., 1990) asked veterans about their marital and family functioning, but did not collect data directly from spouses. The Millennium Cohort Family Study began a longitudinal assessment of service member and military spouse couples from all branches of service in 2011, but relies on paper or web-based self-report questionnaires (McMaster, LeardMann, Speigle, & Dillman, 2017; Corry, Williams, Battaglia, McMaster, & Stander 2017). Consistent with previous research, The Millennium Cohort Family Study found that while veteran deployment alone did not confer increased risk for spouse major depression in adjusted models, spouses of veterans with PTSD did have an increased risk of major depression (Donoho et al., 2018). Over a third (35.90%) of military spouses met criteria for at least one psychiatric condition, while PTSD, anxiety, depression, and panic were seen at rates of approximately 6–9%. Prevalence rates were similar in spouses whose partners did not deploy and spouses whose partners deployed, but did not see combat. Seeing combat increased pathology in service members and this drove higher rates of pathology in their spouses. The particular impact of deployment and combat depended on the specific psychiatric condition assessed (Steenkamp et al., 2018)

Although the GW involved a relatively short period of combat and a minimal number of combat deaths, deployed veterans (DV) were subjected to a wide variety of physical and psychological stressors (Presidential Advisory Committee on Gulf War Veterans' Illnesses, 1996). Subsequently, DV reported higher levels of cognitive and mental health symptoms, functional impairment, and poorer health related quality of life when compared to non-deployed veterans (NDV) (Fukuda et al., 1998; Iowa Persian Gulf Study Group, 1997; Ishoy et al., 1999; Kang et al., 2000; Southwick et al., 1995; Unwin et al., 1999). In response, a three-phase retrospective, population-based cohort study was implemented. In Phase I (mail) and II (telephone) interviews, DV reported a higher prevalence of symptoms, medical conditions, health care utilization, functional impairment and poorer health related

quality of life (Southwick et al., 1995).

In Phase III, the health of a subset of veterans who participated in Phases I/II was evaluated with a comprehensive face-to-face examination (Eisen et al., 2005; Toomey et al., 2007; Toomey et al., 2009). As compared to NDV, DV were more likely to develop any mental disorder and, more specifically, demonstrated a significantly higher incidence of post war onset PTSD, anxiety disorders and major depression (Toomey et al., 2007) and were more likely to report more severe psychiatric symptoms and a more impoverished quality of life.

In this study, we sought to determine whether spouses of DV, compared with spouses of NDV, experienced greater distress, poorer quality of life, and greater levels of diagnosable mental disorders. The examination of spouses mirrored the examination in veterans to address complaints from veteran families of similar symptomatology in spouses after the war. Furthermore, we explored the relationship of veteran mental health and combat exposure to spouse mental health. We hypothesized that mental disorders in veterans are associated with poorer psychological outcomes for spouses regardless of the veteran's GW deployment history, but that deployment would also exert an adverse effect on spouse mental health above and beyond veteran mental disorders.

Our study extends other population-based studies in three ways. First, it is important to capture the impact on spouses in different cohorts and our study examines a cohort between the Vietnam war and the later Gulf War. Second, our use of structured clinical interviews to assess mental disorders for both veterans and spouses is unique and represents the gold standard in diagnostic assessment. Third, we focus on long term outcomes for spouses.

2. Methods

2.1. Study population

Sampling and recruitment procedures for Phase III of the National Health Survey of Gulf War Era Veterans and Their Families are presented in more detail elsewhere (Eisen et al., 2006). In brief, the U.S. Department of Defense identified the entire cohort of 693,826 soldiers who were deployed to the first Persian Gulf War and approximately half (n = 800,680) of the NDVs who were in military service in 1990–1991 (Fig. 1). To ensure that women, reservists, and National Guard members were adequately represented, a stratified random sampling method was applied to each group of these two cohorts. A total of 15,000 deployed and 15,000 NDVs were selected, such that one-fifth (3000) of each sample were women, one-third (5000) were reservists, and approximately one-fourth (4000) were members of the National Guard. A total of 4879 (1996 DV and 2883 NDV) were randomly selected from 20,916 (11,441 DV and 9476 NDV) veterans who participated in the 1995 to 1996 study and were offered the opportunity to participate in Phase III of the National Survey, conducted between 1998 and 2001 (Eisen et al., 2005).

2.2. Participant recruitment

Study recruitment was conducted by a survey research organization that contacted veterans by mail and telephone. A spouse was defined as the person legally married to the veteran at the time the veteran was solicited to participate. Spouses were invited to participate only if the veteran participated. Examinations were performed at 16 Veterans Affairs (VA) Medical Centers dispersed geographically around the country in Albuquerque, Baltimore, Birmingham, Boston, Chicago, Cincinnati, Houston, Miami, Minneapolis, New Orleans, New York, Portland, Richmond, Salt Lake City, San Diego, and St. Louis. The protocol was approved by the Hines Cooperative Studies Program Human Rights Committee and the Institutional Review Board at the Brockton VA Medical Center (a co-investigator site) and at each individual site. All participants gave signed informed consent (Eisen et al., 2005).

2.3. Measures

Standardized, comprehensive medical and psychiatric examinations were performed between 1999 and 2001 on all participants. The descriptions of measures specifies when we are reporting on spouse and/or veteran data. Because the interviews often brought up war experiences and combat exposure, the examiners could not be blind to deployment status.

2.3.1. Mental disorders

Veterans and their spouses were interviewed separately and diagnosed using the Composite International Diagnostic Interview (CIDI) (Andrews and Peters, 1988), a computerized structured interview yielding diagnoses for mental disorders, including substance use disorders, according to criteria based on Diagnostic and Statistical Manual for Mental Disorders-IV (American Psychiatric Association, 1994). Included in the CIDI is self-report of the timing of disorder onset, which enabled a calculation of date of onset. For all disorders, we focused on onset following GW deployment (after 1/1/91), but also report the incidence of disorders with onset prior to 1/1/91. For veterans only, diagnoses of PTSD were made using the Clinician Administered PTSD Scale (CAPS) (Blake et al., 1995), instead of the CIDI.

2.3.2. Self-reported measures of current mental health

For spouses, we report on commonly used psychometric measures of psychological symptoms. The PTSD Checklist-Civilian version (Weathers et al., 1993), a 17-item scale based on DSM-IV symptom criteria, was used to assess the PTSD symptom severity in the past month using a 1–5 scale, yielding scores from 17 to 85. We report the mean total score as well as a categorical score representing “probable PTSD” as defined by a total score of 50 or more. This cutoff has yielded good sensitivity and specificity (Blanchard et al., 1996) and is commonly used in deployment research. We also use a more lenient cutoff score of 30 and only data with this cutoff is shown in the tables. A lower cut-point (30–35) is considered when screening for PTSD or when the goal is to maximize detection of possible cases (National Center for PTSD, 2014) and has been used to successfully screen female veterans in primary care settings (Lange et al., 2003) and a general military population (Searle et al., 2015). The Beck Depression Inventory-II (BDI-II) assessed depressive symptoms in the past two weeks using 21 items rated on a severity scale of 0–3 (minimal, mild, moderate, severe). We report the mean total score and the frequency of categories (Beck et al., 1996). The Beck Anxiety Inventory (BAI) assessed anxious symptoms in the past week using 21 items also rated on the same severity scale of 0–3. We report the mean total score and the frequency of cases categorized in the same way as the BDI-II (Beck and Steer, 1993).

2.3.3. General health status: mental and physical components

We report on spouse data from The Short Form Health Survey (SF-36) (Kazis et al., 1998; McHorney et al., 1993; Ware et al., 1993). This measure was utilized to give reliable, valid measurements of health-related quality of life in the four weeks preceding the evaluation. Items focus on current perception of health and normal daily functioning. There are 8 subscales: physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role-limitations due to emotional problems, and mental health. The subscales generate two summary scores that are standardized to a mean of 50 and standard deviation of 10: the physical component summary (PCS) and the mental component summary (MCS).

2.3.4. Quality of life

Spouses received The Quality of Life Inventory (QOLI) (Frisch, 1994), a non-pathology oriented measure of life satisfaction.

Table 1
Sociodemographic characteristics.[a]

	Deployed	Non-deployed	*p*-value[b]
Age (mean, se)	38.2(0.41)	40.5(0.45)	<0.001
	40.4 (0.51)	42.7(0.50)	<0.01
Gender (male vs female)	11.0%	12.3%	0.56
	9.2%	10.3%	0.70
Race (white vs other)	80.6%	83.3%	0.28
	79.8%	83.3%	0.27
Income (mean, se)	51,690.2 (1541.7)	55,740.4(1921.0)	0.10
	54,640.7(2074.0))	58,559.1(2471.1)	0.23
Vet Military Status at exam (%)			
Active duty	8.6%	8.7%	0.32
	9.9%	8.7%	0.45
Reserves	12.6%	12.7%	
	12.5%	13.0%	
National Guard	13.0%	9.3%	
	12.8%	9.3%	
No longer in military	65.9%	69.3%	
	64.8%	69.0%	
Did not report	2 DV	2 NDV	
	1 DV	2 NDV	

[a] Full sample = all spouses (480 deployed, 530 non-deployed). Restricted sample (second row of data per variable) = current spouses who were living together during the war (305 deployed, 379 non-deployed).
[b] Fisher's Exact Test.

Sixteen life areas (health, self-esteem, goals and values, money, work, play, learning, creativity, helping, love, friends, children, relatives, home, neighborhood, and community) are rated by participants on importance to their overall happiness (3-point rating scale) and satisfaction (6-point rating scale). Importance scores are multiplied by satisfaction scores for each life area and the final score is the sum of these 16 products.

2.3.5. Training and quality control

Dr. Robins, author of the Diagnostic Interview Schedule (DIS-IV; Robins et al., 1995), on which the CIDI is based, and her staff provided CIDI training. Dr. Weathers, one of the creators of the CAPS, provided CAPS training and independently rated 20 CAPS interviews. Inter-rater reliability was adequate, yielding kappa values of 0.77 for current PTSD and 0.79 for lifetime PTSD. Dr. Toomey managed quality through weekly calls and periodic reviews.

2.4. Statistical analyses

The original study sample of 1000 DV and 1000 NDV was determined *a priori to* provide 80% power to address the hypothesis of the original study's seven primary veteran outcome measures. The achieved spouse sample size provides 80% power to detect prevalence differences of 2.6% for PTSD (assuming a prevalence rate of 0.8% for spouses of NDV) and a mean difference of 1.75 for the mental component score of the SF-36.

To assess non-participation bias, we computed prevalence rates to compare self-reported mental health measures among the veterans of participating and non-participating spouses as a function of deployment. *p*-values generated from Fisher's Exact Test (or Mantel–Haenszel (MH) χ^2 test for linear trend) as well as odds ratios and confidence intervals were calculated to determine the strength of the association between groups. The Breslow Day test for the homogeneity of the odds ratios was used to compare odds ratios between the DV and NDV.

For continuous outcomes, two sample *t*-tests and generalized linear regression models (GLM) were used to compare mean responses between groups. In addition, GLM models with an interaction (veteran mental disorder and deployment) for mean comparisons of a mental disorder among spouses of DV and NDV were employed. Logistic regression models for dichotomous and polytomous outcomes were developed with and without covariate adjustments. Generalized linear mixed models with a random intercept were employed to account for correlated observations between the veteran and spouse. The covariates considered in the adjusted analysis were age, gender, race (white vs. other), years of education (less than 12 years vs. 12 or more), and duty type (regular active duty, activated Reserve/National Guard), service branch (Army/Marine, Navy/Air Force), rank (enlisted, officer) during the Gulf War and current military status of veteran (active duty, national guard/reserve, no longer in the military). Where appropriate odds ratios, 95 percent confidence intervals and *p*-values were calculated. Fisher's Exact Test was used for comparisons of categorical outcomes. Comparisons of categorical covariates with continuous outcomes were based on the F statistic from type III analysis of effects. For continuous data without adjustments, *p*-values are based on the two sample t-test. All analyses were completed using SAS Version 9.4 (SAS Institute Inc., Cary, NC).

3. Results

3.1. Participants

Of the 4879 (1996 DV, 2883 NDV) who were offered the opportunity to participate in Phase III of the National Survey, we enrolled 1061 DV (53.2%) and 1128 NDV (39.1%), while the remainder either declined participation or were not located. Of enrolled participants, 70% (n = 745) of DV and 75% (n = 848) of NDV were legally married (total n = 1594). Within this subset, spouses of 72.3% DV (n = 539) and of 70.8% NDV (n = 600) were examined (total n = 1139). We excluded spouses (n = 112) who had been in the military during or since the GW era (DV 6.6%, n = 49; NDV 7.4%, n = 63) to avoid potential confounding, leaving 490 spouses of DV and 537 of NDV (total n = 1027). Three spouses were missing mental health data and were excluded, yielding a final sample of 488 spouses of DV and 536 of NDV (total n = 1024) (Fig. 1). At the time of the examination, 692 veterans (67.8%) were no longer in the military (322 DV, 270 NDV), but 88 (8.6%) were on active duty (42 DV, 46 NDV), 129 (12.6%) were in the Reserves (61 DV, 68 NDV), 111 (10.9%) were in the National Guard (62 DV, 49 NDV) and 4 (.4%) did not report their current military status (1 DV, 3 NDV).

Spouses of DV were an average of 2.3 years younger than spouses of NDV [38.2 (s.d. 9.0) vs. 40.5 (s.d. 10.3)] years of age, respectively; p = 0.0002]. There were no group differences in gender, racial distribution, or mean income in spouses at the examination time. There was no group differences in veteran military status at the examination time (Table 1).

Of all spouse participants (n = 1024), 65.5% (n = 671) reported living with their spouse at the time of the war (7/1/91), 24.5% (n = 251) reported not living with their spouse at the time of the war, and 10% (n = 102) had this question missing. Of spouses of DV, 68.9% reported living with their spouse at the time of the war. Of spouses of NDV, 76.2% reported living with their spouse at the time of the war. Significantly fewer spouses of DV were living with their spouse during the war (Fisher's p value = 0.015, Odds Ratio (CI) = 0.69 (0.52, 0.93). We present data in the tables for both the full sample and the sample restricted to those also living together at the time of the war.

3.2. Non-participation bias

No information was available about non-examined eligible spouses. Data on both participating and non-participating veterans, however, were available from the Department of Defense Manpower Data Center (DMDC). Therefore, we evaluated participation bias by comparing *veterans* whose spouses participated with *veterans* whose spouses did not participate. NDV whose spouses participated were less likely to be members of the Reserves and more likely to be members of the National Guard compared with NDV whose spouses did not participate. Further

Table 2
Onset of mental disorders after 1/1/91[a].

Mental disorders (n = 1010)	Onset after 1/1/91 Unadjusted Deployed	Non-deployed	p-value[c]	Odds ratio (CI)[c]	Adjusted[b] p-value[c]	Odds ratio (CI)
PTSD	2.9%	2.1%	0.42	1.42 (0.64, 3.15)	0.30	1.55 (0.68, 3.56)
	3.0%	2.1%	0.62	1.41 (0.54, 3.70)	0.40	1.55(0.56, 4.28)
Anxiety disorders	4.6%	3.4%	0.34	1.37 (0.72, 2.58)	0.50	1.25 (0.66, 2.38)
	6.6%	2.9%	**0.03**	2.35 (1.11, 4.98)	**0.048**	2.17(1.01, 4.66)
Generalized anxiety disorder	0.2%	0.2%	1.0	1.10 (0.07, 17.71)	0.94	DNC
	0.3%	0.3%	1.0	1.24(0.08, 19.96)	0.93	DNC
Agoraphobia w/o panic	0.0%	0.2%	1.0	NA	NA	NA
	0.0%	0.3%	1.0	NA	NA	NA
Panic disorder	1.5%	0.6%	0.21	2.60 (0.67, 10.11)	0.21	2.46 (0.63, 9.64)
	2.0%	0.8%	0.20	2.52 (0.63, 10.14)	0.25	DNC
Specific phobia	1.9%	1.9%	1.0	0.99 (0.40, 2.47)	0.88	0.93(0.37, 2.34)
	2.6%	1.1%	0.15	2.53 (0.75, 8.47)	0.16	2.41 (0.70, 8.23)
Social phobia	0.2%	0.2%	1.0	1.10 (0.07, 17.71)	0.90	DNC
	0.3%	0.3%	1.0	1.24(0.08, 19.96)	0.87	DNC
Obsessive compulsive disorder	1.0%	0.4%	0.27	2.78 (0.54, 14.39)	0.23	DNC
	1.6%	0.3%	0.09	6.30(0.73, 54.21)	0.11	DNC
Substance dependence	9.8%	9.3%	0.83	1.07 (0.70, 1.62)	0.85	1.04 (0.68, 1.61)
	8.2%	7.9%	0.89	1.04 (0.60, 1.81)	0.99	1.00 (0.56, 1.79)
Nicotine dependence	8.8%	7.6%	0.49	1.17 (0.75, 1.85)	0.60	1.13 (0.71, 1.81)
	7.9%	6.9%	0.66	1.16 (0.65, 2.06)	0.70	1.12(0.62, 2.04)
Alcohol dependence	1.9%	1.9%	1.0	1.0 (0.40, 2.47)	0.90	0.94(0.37, 2.37)
	1.0%	0.8%	1.0	1.25 (0.25, 6.23)	0.84	1.21 (0.24, 6.14)
Illicit substance dependence	0.2%	1.1%	0.13	0.18 (0.02, 1.52)	0.13	DNC
	0.0%	0.53%	0.51	NA	NA	NA
Mood disorders	14.8%	12.6%	0.36	1.20 (0.84, 1.72)	0.27	1.23(0.85, 1.78)
	16.7%	12.7%	0.16	1.38 (0.90, 2.12)	0.15	1.38 (0.89, 2.14)
Major depression	14.6%	12.3%	0.31	1.22 (0.85, 1.76)	0.23	1.26(0.86, 1.83)
	16.4%	12.4%	0.15	1.39 (0.90, 2.13)	0.17	1.37(0.88, 2.13)
Dysthymia	0.4%	0.2%	0.61	2.21 (0.20, 24.49)	0.33	DNC
	0.7%	0.3%	0.59	2.50(0.23, 27.65)	0.32	DNC
Bipolar disorder	0.0%	0.2%	1.0	NA	NA	NA
	0.0%	0.0%	NA	NA	NA	NA
Somatic disorders	1.9%	1.7%	1.0	1.11 (0.44, 2.81)	0.93	1.05(0.40, 2.72)
	2.0%	1.3%	0.55	1.50 (0.45, 4.97)	0.59	DNC
Somatization disorder	0.2%	0.0%	0.48	NA	NA	NA
	0.3%	0.0%	0.45	NA	NA	NA
Conversion disorder	0.4%	0.2%	0.61	2.21 (0.20, 24.49)	0.55	DNC
	0.7%	0.0%	0.20	NA	NA	NA
Pain disorder	0.6%	0.4%	0.67	1.66 (0.28, 9.98)	0.52	1.77 (0.29, 10.97)
	0.7%	0.0%	0.20	NA	NA	NA
Body dysmorphic disorder	0.8%	1.1%	0.76	0.73 (0.21, 2.62)	0.54	DNC
	0.7%	1.3%	0.47	0.49 (0.10, 2.56)	0.36	DNC
Psychotic disorders [d]	0.8%	0.2%	0.20	4.45 (0.50, 39.91)	0.15	DNC
	0.7%	0.3%	0.59	2.5 (0.23, 27.65)	0.47	DNC
Delusional disorder	0.2%	0.0%	0.48	NA	NA	NA
	0.3%	0.0%	0.45	NA	NA	NA
Brief psychotic disorder	0.6%	0.2%	0.35	3.33 (0.35, 32.09)	0.27	DNC
	0.3%	0.3%	1.0	1.24(0.08, 19.96)	0.95	DNC
Eating disorder	0.0%	0.8%	0.13	NA	NA	NA
	0.0%	0.0%	NA	NA	NA	NA
Anorexia Nervosa	0.0%	0.2%	1.0	NA	NA	NA
	0.0%	0.0%	NA	NA	NA	NA
Bulimia Nervosa	0.0%	0.8%	0.13	NA	NA	NA
	0.0%	0.3%	1.0	NA	NA	NA
One or more mental disorder	22.5%	19.3%	0.21	1.22 (0.90, 1.65)	0.20	1.23(0.90, 1.68)
	24.6%	17.9%	**0.04**	1.49(1.03, 2.16)	**0.047**	1.4 (1.01, 2.16)

NA: Not Applicable, DNC: Does not converge.

[a] Full sample = all spouses, Restricted sample (second row of data per variable) = current spouses who were living together during the war.

[b] Adjusted for deployment, age, race(white vs other), gender(male vs female), education(<12 years vs >=12 years, rank(enlisted vs officer/warrant), branch (Army/Marine vs Air Force/Navy), type(active vs reserve/guard), and current military status (active duty, national guard/reserve, no longer in military).

[c] Fisher's Exact Test.

[d] No one had these disorders: schizophrenia, schizophreniform disorder, schizoaffective disorder.

details are reported in the paper on spouse's medical conditions (Eisen et al., 2006). There were no differences in the prevalence of mental disorders in the veterans whose spouses participated compared with veterans whose spouses did not participate.

3.3. Group comparisons: spouses of DV versus spouses of NDV

The groups did not differ significantly in the incidence of mental disorders that began prior to 1/1/91 (DV 35.2% vs. NDV 32.5%). When examining the onset of spouse mental disorders since the GW (Table 2), this also did not differ between groups in terms of any specific categories or the incidence of having any one mental disorder. However,

Table 3
Self-report measures of current mental health[a].

Self-report measures	Unadjusted Deployed	Non-deployed	*p*-value	Adjusted[b] *p*-value
SF-36 Mental component scale	50.30 (0.44)	52.64 (0.37)	<0.0001	<0.0001
Mean (s.e.)	50.27 (0.5)	52.53 (0.45)	0.0017	0.003
PTSD checklist	24.88 (0.47)	23.56 (0.42)	0.04	0.04
Mean total score (s.e.)	24.84 (0.57)	23.73(0.51)	0.15	0.15
PTSD checklist	20.82%	18.13%	0.30	0.31
Score ≥ 30 (%)[c]	21.22%	17.5%	0.24	0.24
Beck depression inventory	7.56 (0.38)	6.17 (0.33)	0.006	0.006
Mean total score (s.e.)	7.61 (0.47)	6.22 (0.38)	0.02	0.03
Beck depression inventory (%)				
Minimal	80.5%	86.3 %	0.09	0.01
	80.1%	86.2%	0.19	0.04
Mild	10.3%	6.9%		
	11.3%	7.6%		
Moderate	6.2%	4.5%		
	5.5%	3.7%		
Severe	3.1%	2.3%		
	3.2%	2.6%		
Beck anxiety inventory	4.86 (0.30)	4.18 (0.28)	0.10	0.09
Mean total score (s.e.)	4.99 (0.38)	4.33 (0.33)	0.19	0.19
Beck anxiety inventory (%)				
Minimal	78.6%	83.5%	0.27	0.04
	76.8%	82.9%	0.23	0.07
Mild	14.2%	10.9%		
	15.7%	11.0%		
Moderate	4.5%	3.6%		
	5.1%	3.9%		
Severe	2.7%	2.1%		
	2.3%	2.1%		
Quality of life inventory (%)				
Very low	10.7%	7.3%	0.03	0.12
	9.2%	6.9%	0.41	0.51
Low	8.2%	4.9%		
	6.9%	5.0%		
Average	49.8%	55.2%		
	51.6%	56.2%		
High	31.4%	32.6%		
	32.2%	31.9%		

[a] Full sample = all spouses, sample sizes from 478 to 488 for deployed and from 531 to 535 for non-deployed. Restricted sample (second row of data per variable) = current spouses who were living together during the war. Sample sizes from 304 to 312 for deployed and 381 to 383 for non-deployed.

[b] Adjusted for deployment, age, race(white vs other), gender(male vs female), education(<12 years vs >=12 years, rank(enlisted vs officer/warrant), branch(Army/Marine vs Air Force/Navy), type(active vs reserve/guard), and current military status (active duty, national guard/reserve, no longer in military).

[c] Full sample odds ratio (.95 CI) are 1.19 (0.87, 1.62) and 0.85 (0.62, 1.17) for unadjusted and adjusted analyses, respectively. Restricted sample odds ratio (.95 CI) 1.27 (0.87, 1.86) and 0.80 (0.54, 1.18) for unadjusted and adjusted analyses, respectively.

when we limited the sample to only those couples that were living together at the time of the war, two results became significant. There was a greater percentage of anxiety disorders in spouses of DV compared to spouses of NDV (full sample 4.6% vs 3.4%; restricted sample 6.6% vs. 3.0%, $p = 0.048$), and there was a greater percentage of having one or more mental disorders in spouses of DV compared to spouses of NDV (full sample 22.5% vs 19.3%; restricted sample 24.6% vs. 17.9%, $p = 0.0478$).

Regarding mental health symptoms and quality of life (Table 3), SF-36 MCS scores were significantly lower in spouses of DV than spouses of NDV [50.30 (0.44) vs. 52.6(0.37), $p < 0.0001$]. Spouses of DV reported greater mean levels of current PTSD symptom severity [24.88 (0.47) vs. 23.56 (0.42), $p = 0.046$] compared to spouses of NDV, but were not more likely to report symptoms indicating probable PTSD at the screening threshold of > 30 (20.82% vs. 18.13 $p = 0.30$). Of note (not in the table), there was no difference using the higher threshold of > 50 (3.7% vs. 3.0%, $p = 0.66$). Spouses of DV reported more depressive symptoms [7.56 (0.38) vs. 6.17 (0.33), $p = 0.006$] compared to spouses of NDV, and had significantly higher percentages of depressive symptoms in clinically impaired categories [moderate + severe 9.3% vs. 6.8%, $p = 0.01$]. Mean anxiety symptoms did not differ between groups [4.86 (0.30) vs. 4.18 (0.28), $p = 0.10$], but the percentage of anxiety symptoms in clinically impaired categories did differ significantly [moderate + severe 7.2% vs. 5.7%, $p = 0.04$]. There were no differences between groups on the levels of life satisfaction measured by the QOLI [average + high 81.2% vs. 87.8%, $p = 0.12$]. When we limited the sample to only those couples that were together at the time of the war, two results were no longer significant: the PTSD symptom checklist mean score comparison ($p = 0.12$) and the categories of anxiety severity ($p = 0.07$).

3.4. Association of spouse psychological distress or impaired functioning with veteran mental disorder

We examined whether onset of mental disorders in veterans after the war predicted the onset of comparable disorders in spouses, and whether this differed by deployment. We initially examined specific categories of mental disorders with logistic regression that matched data from spouse to veterans. There were too few cases for the models to work for several disorders/categories of disorders: anxiety, somatic, illicit substance dependence overall, alcohol dependence, bipolar and psychotic disorders. For the remaining (major depression, PTSD, nicotine dependence), only nicotine dependence was significant. Spouses of veterans diagnosed with post war nicotine dependence were significantly more likely to have post war nicotine dependence [spouses of DV 22.0% vs. 7.7%, Odds Ratio (CI) = 3.38 (1.49, 7.67); spouses of NDV 30.0% vs. 6.2%, Odds Ratio (CI) = 6.44 (2.72, 15.24)]. The odds ratios between DV and NDV did not differ significantly.

To achieve larger cell sizes, we looked at groupings of disorders with a post war onset: (1) anxious/depressive disorders (major depression, PTSD, anxiety disorders) and (2) one or more mental disorders. We previously reported that DV were characterized by increased incidence of post war onset of depression, PTSD, and anxiety disorders compared to NDV (Toomey et al. 2007), providing a rationale for this grouping. In logistic regression analyses, we examined whether spouses were more likely to have anxious/depressive disorders if the veteran had anxious/depressive disorders, stratified by deployment. Within both DV and NDV, spouses of veterans diagnosed with post war anxious/depressive disorders were significantly more likely to have post war anxious/depressive disorders [spouses of DV 28.2% vs. 17.7%, Odds Ratio (CI) = 1.83 (1.10, 3.03); spouses of NDV 28.4% vs. 14.1%, Odds Ratio (CI) = 2.41 (1.33, 4.35)]. Similarly, spouses of veterans diagnosed with post war onset of one or more mental disorders were significantly more likely to have post war onset of one or more mental disorders [spouses of DV 31.1% vs. 19.8%, Odds Ratio (CI) = 1.82 (1.16, 2.87); spouses of NDV 33.3% vs.16.6%. Odds Ratio (CI) = 2.51 (1.49, 4.25)]. The odds ratios between DV and NDV did not differ significantly.

We also examined whether spouses of veterans with trauma exposure had an increased risk of having anxious/depressive disorders. In neither the DV nor NDV was there a difference in the percentage of spouses having disorders depending on whether the veteran had trauma exposure for either anxious/depressive disorders [DV $p = 0.125$, Odds Ratio (CI) = 0.69 (0.43, 1.11); NDV $p = 0.914$, Odds Ratio (CI) = 0.98 (0.61, 1.56)] or one or more mental disorders [DV $p = 0.358$, Odds Ratio (CI) = 0.81 (0.51, 1.27); NDV $p = 0.884$, Odds Ratio (CI) = 0.97 (0.63, 1.50)].

Veterans having anxious/depressive disorders was also significantly associated with spouse self-reported number and severity of depression, anxiety and PTSD symptoms, as well as overall spouse quality of life, and there were no significant interaction effects with deployment. A

Table 4
Comparison of questionnaires among the spouses of deployed and non-deployed veterans who have or do not have anxious/depressive disorders with onset after 1/1/91[a].

Mental disorder	Deployed Percent of spouses with disorder Vet has anxious/ depressive disorder	 Vet does not have disorder	*p*-value	Non-deployed Percent of spouses with disorder Vet has anxious/ depressive disorder	 Vet does not have disorder	*p*-value	Vet disorder controlling for deployment *p*-value
Beck depression inventory mean total score (s.e.)	11.1(0.98)	6.5(0.4)	$p < 0.0001$	9.1(1.2)	5.7(0.3)	$p < 0.01$	$p < 0.0001$[b]
	$n = 106$	$n = 376$		$n = 67$	$n = 467$		
	11.7(1.3)	6.5(0.4)	$p < 0.001$	9.1(1.4)	5.9(0.4)	$p < 0.01$	$p < 0.0001$[b]
	$n = 69$	$n = 234$		$n = 41$	$n = 338$		
Beck depression inventory, %	$n = 106$	$n = 376$		$n = 67$	$n = 467$		
	$n = 69$	$n = 234$		$n = 41$	$n = 338$		
Minimal	65.1	84.9	$p < 0.0001$	76.1	87.9	$p = 0.03$	$p < 0.0001$[c]
	60.9	85.5		73.2	87.6		
Mild	14.2	9.5		13.4	5.8		
	15.9	9.8		17.1	6.5		
Moderate	15.1	3.2	$p < 0.0001$	6.0	4.3	$p = 0.05$	$p < 0.0001$[c]
	15.9	2.6		4.9	3.6		
Severe	5.7	2.4		4.5	1.9		
	7.3	2.1		4.9	2.4		
Beck anxiety inventory mean total score (s.e.)	6.5 (0.8)	4.3(0.3)	$p = 0.01$	6.4(1.1)	3.9(0.3)	$p = 0.03$	$p < 0.0001$[b]
	$n = 106$	$n = 377$		$n = 67$	$n = 466$		
	7.0(1.1)	4.5(0.4)	$p < 0.01$	6.1(1.2)	4.1 (1.1)	$p = 0.07$	$p < 0.001$[b]
	$n = 69$	$n = 234$		$n = 41$	$n = 336$		
Beck anxiety inventory, %	$n = 106$	$n = 377$		$n = 67$	$n = 466$		
	$n = 69$	$n = 234$		$n = 41$	$n = 336$		
Minimal	75.5	79.8	$p = 0.03$	74.6	84.8	$p < 0.01$	$p = 0.02$[c]
	72.5	77.4		75.6	83.9		
Mild	12.3	14.9		13.4	10.5		
	13.0	17.1		12.2	10.7		
Moderate	6.6	4.0	$p = 0.05$	6.0	3.2	$p = 0.08$	$p < 0.07$[c]
	8.7	4.3		7.3	3.6		
Severe	5.7	1.3		6.0	1.5		
	5.8	1.3		1.8	1.8		
PTSD checklist mean total score	28.4(1.3)	23.8(0.5)	$p < 0.001$	28.0(1.7)	22.9(0.4)	$p < 0.01$	$p < 0.0001$[b]
	$n = 105$	$n = 376$		$n = 67$	$n = 468$		
	28.5 (1.5)	23.9 (0.6)	$p < 0.01$	27.9 (2.4)	23.3 (0.5)	$p = 0.06$	$p < 0.0001$[b]
	$n = 69$	$n = 234$		$n = 41$	$n = 338$		
PTSD checklist Score ≥ 30, %	33.3	17.0	$p < 0.001$	25.4	17.1	$p = 0.13$	$p < 0.001$[c]
	$n = 105$	$n = 376$		$n = 67$	$n = 468$		
	36.2	17.1	$p < 0.01$	24.4	16.9	$p = 0.28$	$p < 0.001$[c]
	$n = 69$	$n = 234$		$n = 41$	$n = 338$		
SF-36 Mental component score, mean (s.e.)	46.6(1.0)	51.4(0.5)	$p < 0.0001$	50.3 (1.2)	53.0(0.4)	$p = 0.02$	$p < 0.0001$[b]
	$n = 107$	$n = 377$		$n = 67$	$n = 467$		
	46.6 (1.3)	51.2 (0.6)	$p < 0.001$	49.9 (1.6)	52.9 (0.5)	$p = 0.04$	$p < 0.0001$[b]
	$n = 70$	$n = 234$		$n = 41$	$n = 338$		
Quality of life inventory, %	$n = 107$	$n = 368$		$n = 67$	$n = 464$		
	$n = 70$	$n = 234$		$n = 41$	$n = 338$		
Very Low	16.8	8.4	$p < 0.001$	16.4	6.0	$p < 0.0001$	$p < 0.0001$[c]
	15.7	7.3		14.6	5.9		
Low	9.4	7.9		14.9	3.5		
	8.6	6.4		14.6	3.9		
Average	56.1	48.4	$p < 0.001$	55.2	55.2	$p < 0.001$	$p < 0.0001$[c]
	60.0	49.2		56.1	56.2		
High	17.8	35.3		13.4	35.3		
	15.7	37.2		14.6	34.0		

[a] Full sample = all spouses, Restricted sample (second row of data per variable) = current spouses who were living together during the war. Sample sizes listed in table.
[b] *p*-values from non-interaction GLM model.
[c] *p*-value from non-interaction logistic regression model.

few results turned to trends when we limited the sample to couples that were together at the time of the war (BAI severity level in DV and NDV, PCL mean in NDV, and PCL ≥ 50 in DV). For these measures, deployment was never significant when controlling for disorder, but disorder was always significant when controlling for deployment (*p*-values shown in table). Veteran diagnosis of anxious/depressive disorders was associated with lower spouse SF-36 mental component scores, interacting significantly with deployment, such that spouses of DV with anxious/depressive disorders had the lowest mean SF-36 MCS score (45.1 vs >48.9 in the three other groups); however, this interaction was no longer significant in the restricted sample. Deployment was significant when controlling for disorder, and disorder was significant

when controlling for deployment (*p*-values shown in table). On the Quality of Life Inventory, there was a significant interaction of disorder with deployment, but only in the restricted sample (where spouses of NDV had lower QOL than spouses of DV), not in the full sample. Deployment was not significant when controlling for disorder, but disorder was significant when controlling for deployment (*p*-values shown in table) (Table 4).

4. Discussion

Research on spouses of veterans demands rigorous empirical examination, including the use of gold standard measures such as structured clinical interviews, population based samples, assessment of different cohorts and measures of long term consequences. Our study is unique in having all these characteristics. Although we found that spouses of DV and NDV did not differ in the incidence of mental disorders with an onset after the Gulf War, when we limited the sample to those who reported that they were living with their current spouse at the time of the war, we found that spouses of DV were more likely to have anxiety disorders or any one mental disorder compared to spouses of NDV. Prior research shows that it may be specific deployment related factors rather than deployment alone that influences spouse mental health, yet with our unique ability to examine those couples together during the war and still together ten years later, we find that deployment alone has some negative effect on spouse mental health as measured by structured interview.

When we examined spouse self-report via questionnaires, we found that spouses of DV reported a comparable quality of life compared to spouses of NDV. Spouses of DV reported greater mental health-related functional impairment and a greater mean level of symptoms of PTSD and depression than did spouses of NDV, although these scores were not clinically significant. The mean PTSD score was no longer different when we limited the sample to those also together during the war and in neither the full nor restricted sample was the percentage of people significantly different for meeting the cutoff for probable PTSD. Nevertheless, in both the full and restricted samples, spouses of DV reported more depressive symptoms, both in terms of mean levels that were not clinically significant, but also in terms of clinically significant categorical severity levels.

We also show that the specific factor of veteran mental health influences spouse mental health. Having data on both veterans and spouses enabled us to uniquely control for the non-independence of members of a couple in the logistic regression. There were clinically meaningful findings in spouses of veterans suffering from disorders that we and others (Crum-Cianflone et al., 2016) observed more frequently after the war in DV: depression, PTSD and anxiety disorders (Toomey et al., 2007). There was an increased risk of spouse anxious/depressive disorders when the veteran was diagnosed with anxious/depressive disorders, although this did not vary by deployment. Multiple studies have documented that depression and anxiety disorders are comorbid (Kessler, 1995) and share genetic risk (Franz et al., 2011; Guffanti et al., 2016; Tsuang et al., 1980); thus, expression of these particular diagnoses (depression, anxiety, PTSD) may vary by individual. Examination of these disorders by themselves might limit our ability to detect the impact of living with someone with these disorders.

Although deployment generally did not confer direct additional risk to spouse mental health, veteran mental disorder was associated with greater spouse psychological distress, in the form of diagnosable disorders, distress, and sub-clinical symptoms. The GW was a relatively short war; nevertheless, our findings suggest that there was a long-term cost to military spouses, especially when their spouse suffered a post-deployment mental disorder. This was more critical for spouse risk than was combat exposure and this is in contrast with some other studies (Steenkamp et al., 2018). It is reasonable to speculate that longer conflicts and multiple deployments within a military career may take a greater toll on spouses. Indeed, the Institute of Medicine's review of the literature for veterans of Iraq and Afghanistan found that length of deployment and cumulative months of deployment were associated with spouse mental health problems (Institute of Medicine, 2013). Our results suggests that length of marriage may also play a role, or at least that new marriages beginning after a deployment may not bear the same risks as marriages that were present during deployment and continued many years after.

This study is the only published comprehensive psychological assessment of a population-based sample of spouses of GW era veterans. The strengths of this study are: (a) the 2189 participants in the *veteran* component of the study were selected from a population based representative samples of approximately 700,000 DV and 800,000 NDV; (b) subjects were selected independently of veteran medical or psychiatric illness or disability; (c) diagnoses were made using structured clinical interviews while self-report questionnaires were also included. The potential weaknesses of this study are: (a) data were not collected blindly, which may have introduced observer bias; (b) there may have been a negative response bias on the part of spouses of DV, or spouses of veterans with mental disorders; (c) the low study participation rate by veterans (53.2% of eligible DV and 39.1% of eligible NDV veterans) may have introduced participation bias, and (d) spouses of DV were less likely to have been with their spouse during the war compared to spouses of NDV and it is unknown if this reflects a greater likelihood of DV's marriages dissolving by 10 years after the war or a greater likelihood of new marriages post-war among the NDV. Participation bias characteristically over-estimates the impact of exposure on disease prevalence; therefore, the absence of an observed association between veteran deployment and spouse illness in the full sample suggests that participation bias is not an important issue. Norsdletten et al. (2016) identified patterns of non-random mating for psychiatric conditions whereby if a proband had a psychiatric condition, the spouse was more likely to have a psychiatric condition; however, this was less likely the case for mood/anxiety disorders and our analyses controlled for the non-independence of data from individuals that were married. Although we cannot rule out that non-random mating influenced our findings, our focus on the onset of disorders since the war reflects the development of disorders that presumably are related to war experiences.

In summary, despite its short duration, the GW resulted in increased mental health disorders in DV ten years after the war (Toomey et al., 2007.). In turn, these DV were more likely to have spouses with anxious/depressive disorders or one or more mental disorders, regardless of deployment. Deployment alone posed a risk for those couples together during the war and ten years later in terms of an increased risk for spouse anxiety disorders or any one mental disorder. Longer conflicts or greater combat exposure would be expected to further increase the risk for spouses, suggesting a need for further research to facilitate effective planning for preventing and managing the long-term family consequences of war.

Declarations of interest

None.

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Supplementary materials

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