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The association of PTSD with physical and mental health functioning and disability (VA Cooperative Study #569: the course and consequences of posttraumatic stress disorder in Vietnam-era Veteran twins)

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Abstract

Purpose—To assess the relationship of posttraumatic stress disorder (PTSD) with health functioning and disability in Vietnamera Veterans.

Methods—A cross-sectional study of functioning and disability in male Vietnam-era Veteran twins. PTSD was measured by the Composite International Diagnostic Interview; health functioning and disability were assessed using the Veterans RAND 36-Item Health Survey (VR-36) and the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0). All data collection took place between 2010 and 2012.

Results—Average age of the 5,574 participating Veterans (2,102 Vietnam theater and 3,472 non-theater) was 61.0 years. Veterans with PTSD had poorer health functioning across all domains of VR-36 and increased disability for all subscales of WHODAS 2.0 (all $p < .001$) compared with Veterans without PTSD. Veterans with PTSD were in poorer overall health on the VR-36 physical composite summary (PCS) (effect size = 0.31 in theater and 0.47 in non-theater Veterans; $p < .001$ for both) and mental composite summary (MCS) (effect size = 0.99 in theater and 0.78 in non-theater Veterans; $p < .001$ for both) and had increased disability on the WHODAS 2.0 summary score (effect size = 1.02 in theater and 0.96 in non-theater Veterans; $p < .001$ for both). Combat exposure, independent of PTSD status, was associated with lower PCS and MCS scores and increased disability (all $p < .05$, for trend). Within-pair analyses in twins discordant for PTSD produced consistent findings.

Conclusions—Vietnam-era Veterans with PTSD have diminished functioning and increased disability. The poor functional status of aging combat-exposed Veterans is of particular concern.

Keywords

PTSD; Vietnam-era Veterans; VR-36; WHODAS 2.0

Introduction

Four decades after the war in Vietnam, the impact of that experience is still evident in the elevated prevalence of posttraumatic stress disorder (PTSD) among Veterans. While previous studies of Veterans have documented the negative influence of military service on various aspects of functioning and disability (including energy, fatigue, pain, and social and role functioning) [1, 2], most of these involved clinical samples and lacked data to adjust for the full complement of potential covariates. Additionally, they failed to distinguish the association of functioning with combat exposure and deployment from those of PTSD.

We collected data on functioning and disability from study participants in VA Cooperative Study #569, “The course and consequences of PTSD in Vietnam-era Veteran twins.” A key objective of this study is to evaluate the association between PTSD and two measures of health functioning and disability: the Veterans RAND-36 [3, 4] (VR-36) and the WHO Disability Assessment Schedule 2.0 (WHODAS 2.0) [5]. The aims of this paper are twofold: (1) to assess the association of PTSD with physical and mental health functioning and level of disability in Vietnam-era Veterans and (2) to examine the joint association of PTSD and combat exposure with health functioning and disability.

Methods

Setting

The Vietnam Era Twin (VET) Registry is the source of Veterans for this study. The Registry constitutes a national sample of twin pairs identified from military discharge records of males who served during the Vietnam era (1964–1975). VET Registry members were not selected based on VA care seeking and were not a clinically identified sample. More complete descriptions of the VET Registry have been previously published [6, 7].

Design

VA Cooperative Study #569, “The course and consequences of PTSD in Vietnam-era Veteran twins,” is a study of the long-term health of Vietnam-era Veterans. A mailed questionnaire obtained general health information including health functioning and disability. Psychiatric diagnoses, including PTSD, were obtained by a structured psychiatric telephone interview. Between 2010 and 2012, we mailed all eligible twins an initial contact letter on VA stationery describing the project and inviting them to participate in a mail survey and telephone interview. Participating twins were compensated \$75 each after completion of the mailed questionnaire and telephone psychiatric interview. Because of the size and scope of the study, all mail and telephone fieldwork was done under contract by Abt SRBI, Inc., a large survey research organization. Training for the telephone psychiatric interview was done by VA staff who were certified trainers, and the administration of the interviews was continuously monitored throughout the course of fieldwork.

Subjects

All members of the VET Registry who were alive and eligible at the start of the study were recruited to participate. The VA Central Institutional Review Board approved the study's protocol, and informed consent was obtained from participating VET Registry members.

Measures

PTSD diagnosis—We assessed psychiatric diagnoses, including PTSD, by telephone administration of the Composite International Diagnostic Interview (CIDI) according to the 4th edition of the DSM. The CIDI is a structured instrument designed for administration by trained non-clinical interviewers. The standard method of CIDI administration of the PTSD module was used, and we asked the symptom questions for up to two separate stressful traumatic events that were named by the respondent. If more than two events were identified, one of which was theater combat exposure, we always asked symptom questions for the combat exposure event.

We focus on current PTSD status according to full *diagnostic and statistical manual (DSM-IV)* [8] criteria which include history of a traumatic stressor (Criterion A), persistent re-experiencing of the traumatic event (Criterion B), persistent avoidance of stimuli associated with the trauma and numbing of general responsiveness (Criterion C), and persistent symptoms of increased arousal (Criterion D). To capture subsyndromal cases of PTSD, we also defined a measure of *subthreshold* PTSD based on fulfilling Criteria A and B and either Criterion C or D (but not both).

Functional health and disability outcomes—The VR-36 is a well-established, reliable, and valid instrument used to assess physical and mental health functioning [3, 4]. The VR-36 is a modification of the original medical outcomes study RAND SF-36 version 1 questionnaire and is a self-reported measure consisting of 36 items and includes questions about a broad array of physical and mental health functioning. The changes from the original SF-36 were done to improve psychometric performance of the instrument and primarily involved altering responses for role-physical and role-emotional items from a dichotomous yes/no to five-point-type Likert scales. The VR-36 questions are used to generate eight subscales that reflect distinct domains of functioning. Each of the eight subscales is based on a simple linear transformation from 0 to 100 with a higher score reflecting better functioning. The eight subscales can be further summarized into two global summary measures: the physical and mental component scores (PCS and MCS) that assess physical and mental functioning. The two component summary measures are calculated using a *t* score transformation that is normed to a general US population with a mean set to a score of 50 based on 1990 norms; PCS or MCS scores above 50 are an indication of better-than-average functioning, and scores below 50 represent diminished functioning. Based on the 2000–2002 medical expenditure panel survey, more contemporary norms of 51.4 (PCS) and 49.0 (MCS) have been published [9]. The VR-36 subscales demonstrate excellent reliability with intraclass correlations ranging from 0.86 to 0.96; the subscales have stable factor structures among different socio-demographic and clinical groups in VA populations [1, 3, 10]. The PCS and MCS have reliabilities of 0.95 and 0.96, respectively [4].

The World Health Organization Disability Assessment Schedule (WHODAS 2.0) was developed to assess disability using the framework provided by the International Classification of Functioning, Disability and Health (ICF) [11]. The WHODAS 2.0 includes 36 question items that cover 6 domains: (1) cognition, (2) mobility, (3) self-care, (4) getting along, (5) life activities, and (6) participation. Item responses range from “none” (1) to “extreme” (5) and are scored within domains by summing item scores and converting to a scale from 0 to 100 with 0 = no disability and 100 = full disability. An overall summary disability score is derived by summing across all 36 items. The WHODAS 2.0 has been used in a large number of multi-site field studies and has demonstrated excellent reliability and validity [5].

Demographic factors—Age, race (white versus non-white), Hispanic ethnicity, current marital status, years of education, employment status (full, part-time, retired, disabled, unemployed), and family income were obtained as part of the mailed questionnaire. Zygosity was assigned using an algorithm based on childhood similarity questions and shown to be more than 95 % accurate when compared with assignment based on DNA [12].

Military service factors—Service in Vietnam (theater of service) and combat exposure were collected from 1985 through 1990 by mailed questionnaire at the Registry’s inception; combat exposure during service in the Vietnam theater was based on the summation of 18 specific combat experiences [13]. Branch of service, enlistment year, and military rank at enlistment all were abstracted from military records at the time the VET Registry was constructed.

Lifestyle factors and clinical conditions—Cigarette smoking (never, former, current), alcohol consumption (never, former, currently drink <2 drinks per day or 2 or more per day), and current physical activity (minutes per week of moderate exercise) were all obtained by mailed questionnaire. Body mass index was collected from current self-report of height and weight. Self-reported physician diagnosis of common clinical conditions included hypertension, diabetes mellitus, pulmonary disease/disorder, and arthritis. Cardiovascular disease was a composite measure that included self-reported physician diagnosis including a history of cardiac revascularization or angina.

Psychiatric disorders—Current (within the past 12 months) depression, generalized anxiety disorder, and alcohol use disorders according to *DSM-IV* criteria were obtained by telephone using a structured psychiatric interview with the CIDI [14].

Statistical analysis

Descriptive analyses characterized differences in demographic, military service, lifestyle, clinical conditions, and psychiatric disorders according to current PTSD status. Formal testing for differences accounted for clustering by twin pair.

Mean estimates and effect sizes—The burden of PTSD on function and disability was estimated by the mean values for the VR-36 and WHODAS 2.0 summary scales and subscales according to current PTSD and service in the Vietnam theater of war. All estimates

were weighted for both non-response and the current population of living Vietnam-era Veterans as of 2010 [15] (see Online Resource Material for a description of the weighting procedure). Statistical testing was based on a two-degree-of-freedom Wald test to assess differences in VR-36 and WHODAS 2.0 scale mean values across the three levels of current PTSD status (no PTSD, subthreshold PTSD, and full PTSD diagnosis). Preliminary analysis indicated that the association of PTSD with health functioning and disability varied by theater of service, and we therefore conducted all analyses separately for theater and non-theater Veterans.

To evaluate the independent association of PTSD with functioning and disability, we focused on the mean values and effect size (mean difference divided by standard deviation) of the VR-36 PCS and MCS and the WHODAS 2.0 summary scale. Effect size is the standardized difference in scores and is widely used in studies of patient-reported outcomes and health functioning [16–18]. Effect sizes of 0.2 are deemed small, those of 0.5 are moderate and those of 0.8 are large [19]. For each of our summary outcomes, we estimated means and effect sizes from a series of least squares regression models (with the sandwich variance estimator) that cumulatively adjusted for the available demographic, military service, lifestyle, clinical conditions, and psychiatric disorders. This so-called chunk-wise approach to adjustment allowed us to assess the independent association of PTSD with functioning and disability by examining the change in the estimated PCS, MCS, and WHODAS 2.0 summary scale means and effect sizes as we included additional covariates [20]. Differences in the adjusted mean values for each scale across the three levels of current PTSD status (no PTSD, subthreshold PTSD, and full PTSD) within strata defined by Vietnam theater service were tested using a two-degree-of-freedom Wald test.

Further analysis focused on the PCS, MCS, and WHODAS 2.0 summary scales to explicitly examine the joint influence of PTSD status and combat exposure after adjustment for covariates. In these regression models, we estimated the adjusted mean and effect sizes after jointly stratifying on PTSD status and combat exposure in theater Veterans.

Within-pair analyses—To control for familial vulnerability to functioning and disability, we conducted a matched pair analysis that directly compared the PCS, MCS, and WHODAS 2.0 summary scales in twin pairs discordant for PTSD status—one twin did not have PTSD and his co-twin either had full or subthreshold PTSD. We followed our chunk-wise approach for adjustment using a least squares regression model for matched pairs that conditioned on the pair and cumulatively included demographic, military service, lifestyle, clinical conditions, and psychiatric disorders in the model. Statistical testing used a one-degree-of-freedom Wald test to examine the within-pair differences in the mean values for each summary scale.

All analyses used significance levels based on two-sided tests and nominally set $p = .05$ for statistical testing. Analyses accounted for the clustered data structure represented by twin pairs in the VET Registry using robust variance estimators. We did not adjust for multiple comparisons, following the suggestion of Rothman, that such adjustments are unwarranted when analyzing observational data [21]. Data analyses were performed with Stata 11.2 [22].

Results

Response

Of the 10,539 twins who were alive, locatable, and eligible to participate, 7,079 (67 %) returned the completed mailed questionnaire and 5,862 (56 %) completed the telephone psychiatric interviews. The analytic data set included only those 5,574 individuals who completed both the mailed questionnaire and telephone interview, had valid data to diagnosis PTSD, and had at least 1 summary measure of functioning and disability (2,102 Vietnam theater and 3,472 non-theater; mean age = 61 years).

Characteristics by PTSD status

PTSD status was associated with most of the demographic, military, lifestyle, clinical conditions, and psychiatric disorders (Table 1). Veterans with PTSD were younger and more likely to be non-white, divorced or never married, less educated, unemployed, and have less income than those without PTSD. Veterans with PTSD were also more likely to have served in the Army or Marines, enlisted after 1968, and served in the Vietnam theater than those without PTSD. The lifestyle characteristics of Veterans with PTSD were different from those without PTSD: they were more likely to be current smokers, more likely to be former alcohol drinkers, and less likely to engage in physical activity of more than 120 min per week. Clinically, those with PTSD weighed more and had a greater burden of chronic physical illness than those without PTSD. Finally, Veterans with PTSD were more likely to report current psychiatric comorbidity compared to those without PTSD.

Functional burden according to PTSD status

In both theater and non-theater Veterans, unadjusted and covariate-adjusted analyses of the three summary scales indicated that subthreshold and full PTSD are associated with worse physical health (VR-36 PCS), mental health (VR-36 MCS), and disability (WHODAS 2.0) compared with no PTSD ($p < .05$ for all models) (Table 2). (Detailed results from the analysis of the association of PTSD with individual subscales are provided in Online Resource Table S1.)

Physical health associations—Among theater Veterans, PCS effect size for those with PTSD were similar in all models ($p > .05$ in all models). Among Veterans who did not serve in-theater, there is a graded association between full, subthreshold and no PTSD and the PCS; in the unadjusted analysis, significant differences between subthreshold PTSD and full PTSD were observed, but after adjustment for all covariates, these differences were smaller and no longer significant ($p > .05$).

Mental health associations—In the unadjusted analysis, MCS effect size was in the large range and there were significant differences between subthreshold and full PTSD in theater (effect size = 0.80 for subthreshold and 1.51 for full PTSD; $p < .05$) and non-theater (effect size = 0.89 for subthreshold and 1.47 for full PTSD; $p < .05$) Veterans. In theater and non-theater Veterans the differences in MCS between subthreshold and full PTSD gradually become less pronounced with the addition of covariates into the model and in the final

model, with psychiatric disorders included, were no longer statistically significant ($p > .05$ for both theater and non-theater).

Disability associations—There were large effect sizes for the WHODAS 2.0 summary disability scale between those with subthreshold and full PTSD in the unadjusted analysis of both theater (effect size = 0.72 for subthreshold and 1.46 for full PTSD; $p < .05$) and non-theater (effect size = 0.97 for subthreshold and 1.64 for full PTSD; $p < .05$) Veterans. However, these differences between subthreshold and full PTSD became smaller and were no longer significant ($p > .05$ in both theater and non-theater Veterans) after adjustment for demographic characteristics, military service, lifestyle and clinical conditions, and psychiatric disorders.

Association of PTSD and combat with physical and mental health and disability—The joint association of PTSD and combat exposure with health functioning and disability adjusted for demographic characteristics, military service, lifestyle, clinical conditions, and psychiatric disorders is shown in Figs. 1 and 2. There are significant independent associations of both PTSD status and combat with PCS ($p < .001$ for a PTSD trend and $p = .045$ for a combat trend) and MCS ($p < .001$ for a PTSD trend; $p = .025$ for a combat trend) (Fig. 1). There were significant differences in MCS between subthreshold and full PTSD in Veterans exposed to low combat ($p < .001$) and high combat ($p = .026$). PTSD status and combat were independently and positively associated with the WHODAS 2.0 summary disability scale ($p = .01$ trend for both) (Fig. 2). Within each of the combat groups, there was no significant difference in the WHODAS 2.0 summary scale between the subthreshold and full PTSD diagnosis categories except for WHODAS 2.0 in Veterans exposed to low combat ($p = .031$). In general, subthreshold and full PTSD effect sizes at each level of combat were smaller for PCS than for the MCS and WHODAS 2.0 summary scale (Figure S1). Full PTSD and subthreshold PTSD effect sizes for PCS within levels of combat were very similar ranging from 0.3 to 0.6, except for the 0 effect size for subthreshold PTSD in the no combat group. Full and subthreshold PTSD effect sizes for MCS within each level of combat were highly variable, ranging from 0.3 for subthreshold PTSD in low combat to 1.4 for full PTSD in low combat. We found moderate to large effect sizes for WHODAS 2.0, from a low of 0.5 for subthreshold PTSD among theater Veterans who had no combat to 1.3 in Veterans with full PTSD in the low-and medium-combat exposure groups.

Within-pair association of PTSD with physical and mental health and disability—The analyses of differences in the PCS, MCS, and WHODAS 2.0 summary scales within-twin pairs discordant for PTSD status are presented in Table 3. In the unadjusted analysis, within-pair effect sizes were moderate for PCS between those without PTSD and those with either subthreshold or full PTSD (effect size = 0.49 for subthreshold and 0.52 for full PTSD; $p < .01$ for both). Adjustment for demographic characteristics, military service, lifestyle, clinical conditions, and psychiatric disorders slightly reduced the size of the within-pair differences, but the association remained significant ($p < .01$ for both subthreshold and full PTSD). There was no significant difference in effect size between subthreshold and full PTSD for PCS in the unadjusted and covariate-adjusted models. For both the MCS and

WHODAS 2.0 summary scales, there were significant within-pair differences associated with PTSD status in the unadjusted analysis that were only slightly diminished after regression adjustment ($p < .01$ in all models); in the unadjusted analysis, there was a significant difference in the WHODAS 2.0 summary scale between subthreshold and full PTSD, but after adjustment, this difference is no longer significant.

Discussion

PTSD was associated with diminished health functioning and increased disability in aging Vietnam-era Veterans. The reductions in function were seen across a broad set of functional domains that included aspects of physical and mental health. The relationship between PTSD with the PCS, MCS, and WHODAS 2.0 summary scales persists after adjustment for clinical conditions, psychiatric disorders, and familial vulnerability. Both PTSD and combat exposure were independently associated with diminished mental health functioning and disability, although differences were somewhat larger between the PTSD groups than for the combat exposure groups. These findings indicate that PTSD and combat exposure exact a toll on health functioning and disability.

For Veterans with full PTSD, the VR-36 unadjusted mean physical and mental summary scales were in the mid-30s, which indicates the substantial burden of PTSD on health; these values are far below the general US population average of 50, at least 1.5 standard deviations below this norm and fairly close to the same for the more contemporary norms [9]. To provide some context, summary scale scores this low are typically found for patients with chronic illnesses such as depression for MCS and unstable angina or moderate- to late-stage osteoarthritis for PCS [23, 24]. Similarly, average unadjusted WHODAS 2.0 summary scales for those with full PTSD were in the upper 30s, which puts these Veterans in the top (worst) decile for disability [5]. In general, scores were similar for those with subthreshold and full PTSD indicating that even at subthreshold levels, PTSD takes a toll on health functioning and disability.

Previous research in VA patients found an association between service in the Vietnam theater and decreased mental health functioning using the SF-36 instrument [1]. Other studies in clinical populations have also demonstrated the poor health of Veterans with PTSD across outcomes ranging from functional limitations to morbidity and mortality [25–28]. Both Boscarino et al. [29] and Schnurr et al. [30] found that PTSD is related to physical health independent from the influence of combat exposure. Others have emphasized behavioral factors as mediating the relationship between PTSD and physical health [31–33]. In yet other studies of Veterans using the Short Form 36 Item Health Survey, Vasterling et al. [34] and Schnurr et al. [35] reported a negative relationship between PTSD symptoms and health outcomes. In a longitudinal study of Veterans, Shiner et al. [36] found that when PTSD symptoms improved, there was a concomitant improvement in physical and mental function. While we are unable to comment on improvement over time, it is clear from the present report that a diagnosis of PTSD is the strongest factor influencing functioning and disability, with combat having a more modest association.

Limitations and strengths

There are a number of study limitations. First, the VET Registry is comprised of middle-aged male Veterans, and data on females are not available. The sample is based on twin pairs, who may be different from non-multiples, though data from Scandinavia suggest that there are few health differences between adult twins and non-multiples [37, 38]. Further, the Registry was constructed based on computerized military discharge records, which were missing records from the early years of the Vietnam era. In particular, the Registry did not include Veterans who enlisted prior to 1965; only 4–5 million discharge records were available in electronic format and could be used to identify potential twins from a total of nearly 9 million Vietnam-era Veterans. There is also the potential for non-response bias since just over half of the eligible VET Registry members completed the mailed questionnaire and telephone interview. It is possible that more functionally impaired Vietnam-era Veterans could not participate. If this was true, and in addition the missing Veterans were more likely to have PTSD than those that participated, then our findings would underestimate the true association of PTSD with functioning and disability. To minimize these sampling limitations, we reweighted our data for both non-response and to reflect the living population of Vietnam-era Veterans [15]. We diagnosed PTSD using the CIDI, which is widely used in psychiatric epidemiology but is not as definitive a measure of PTSD as either the Clinician-Administered PTSD Scale (CAPS) or the Structured Clinical Interview (SCID) for *DSM-IV* [39, 40]. However, with a large national sample of Veterans, it was not feasible to administer these clinical instruments. Research comparing the CIDI PTSD diagnosis to a clinical assessment using the SCID found a kappa of 0.49 and a sensitivity of 38.3 % [41]. We augmented the binary PTSD diagnosis with a measure of subthreshold PTSD. Regardless of how we measured PTSD, our results demonstrated a consistent association with functioning and disability. Another limitation is that Veterans' reporting of functional status may overestimate their limitations because of concern that their responses could impact their disability ratings for VA disability payments and service use. This could especially affect those Veterans with PTSD even though all participants were given explicit instructions that their responses would only be used for research purposes and would not be used for clinical care. Additionally, our analysis is cross-sectional, representing a single point in time between 2010 and 2012; we had no measures of functional status and disability at earlier time points, limiting our attributions of causality. Finally, the possibility of unmeasured determinants of functioning that may also be determinants of PTSD cannot be ruled out; however, we did account for a large number of covariates including clinical conditions and psychiatric disorders.

Strengths of our approach include the large, national, non-clinical community-based sample of Veterans. Additionally, we used a structured psychiatric telephone interview to measure PTSD and other psychiatric disorders. Our functional health outcomes, the VR-36 and the WHODAS 2.0, have excellent reliability and validity and are widely used. Our analytic approach included adjustment for numerous potential measured covariates; we also conducted a within-twin pair analysis to further account for unmeasured familial vulnerability.

Summary

We found that PTSD is strongly related to current functioning and disability in Vietnam-era Veterans even four decades after the war's end. Combat exposure was also associated with functioning independent of PTSD. These findings have important implications for physical and mental treatment programs that should consider both PTSD and combat experience.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Fig. 1.

The VR-36 physical component score (PCS) and mental component score (MCS) according to current PTSD diagnosis and combat exposure in theater Veterans. Full and subthreshold PTSD diagnoses are explained in the footnotes to Table 1^aAdjustment for demographic factors includes age, race, ethnicity, marital status, education, employment status, and family income; military service factors include branch of service, enlistment year, military rank at enlistment; lifestyle factors include smoking, alcohol consumption, and physical activity; clinical conditions include BMI, cardiovascular disease, hypertension, diabetes mellitus, pulmonary disease/disorder, and arthritis; psychiatric disorders include current depression, generalized anxiety disorder and alcohol use disorder^bWeighted for non-response and to the characteristics of the living male US population of Vietnam-era Veterans

Fig. 2.

The WHODAS 2.0 summary disability score according to current PTSD diagnosis and combat exposure in theater Veterans. Full and subthreshold PTSD diagnoses are explained in the footnotes to Table 1^aAdjustment for demographic, military service, lifestyle, clinical, and psychiatric factors is explained in the footnotes to Fig. 1^bWeighted for non-response and to the characteristics of the living male US population of Vietnam-era Veterans

Table 1

Distribution of demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders by full and subthreshold PTSD

Demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders	PTSD diagnosis			<i>p</i> value
	No PTSD ^b %	Subthreshold PTSD ^a %	Full PTSD ^a %	
<i>Demographic</i>				
Age				.021
<60	24.4	35.1	33.5	
60–61	17.3	18.6	19.4	
62–63	26.1	21.2	26.5	
64	32.2	25.1	20.6	
Race				<.001
White	88.9	76.9	76.0	
Non-White	11.1	23.1	24.0	
Ethnicity				.44
Hispanic	3.3	5.2	3.2	
Non-Hispanic	96.7	94.8	96.8	
Current marital status				<.001
Married/partnered/widowed	78.0	79.9	62.4	
Divorced/never married	22.0	20.1	37.6	
Education				.09
Less than high school graduate	5.5	5.2	9.8	
High school graduate	25.5	21.9	21.4	
Some college/vocational	36.5	43.1	38.9	
College graduate or more	32.4	29.8	29.9	
Employment status				<.001
Full time	44.0	39.1	27.8	
Part-time	11.7	9.6	6.1	
Retired	29.3	27.7	23.4	
Disabled	7.1	16.1	27.2	
Unemployed	7.9	7.5	15.4	
Family income				<.001
<\$15,000	9.1	7.9	20.4	
\$15,000–\$29,999	14.0	21.8	21.4	
\$30,000–\$49,999	22.3	29.7	22.3	
\$50,000–\$74,999	22.2	20.4	14.3	
\$75,000–\$99,999	14.8	9.0	7.4	
\$100,000–\$149,999	11.8	8.9	12.6	
\$150,000	5.7	2.3	1.4	
<i>Military service</i>				
Branch of service				<.001

Demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders	PTSD diagnosis			<i>p</i> value
	No PTSD ^b %	Subthreshold PTSD ^a %	Full PTSD ^a %	
Army	54.6	48.7	61.6	
Navy	22.5	22.4	11.4	
Air force	14.8	14.1	10.0	
Marines	8.1	14.8	17.0	
Enlistment year				.30
<1968	40.3	36.3	38.9	
1968–1969	28.0	25.3	25.2	
>1969	31.7	38.4	35.9	
Military rank at enlistment				.005
Enlisted	94.1	97.5	99.1	
Officer	5.9	2.5	0.9	
Service in Vietnam theater				<.001
No	64.1	56.9	41.7	
Yes	35.9	43.1	58.3	
<i>Lifestyle and clinical conditions</i>				
Cigarette smoking				<.001
Never	27.6	25.4	17.5	
Former	52.5	54.0	44.5	
Current	19.9	20.6	38.0	
Alcohol consumption				<.001
Never drinker	17.3	15.1	12.5	
Former drinker	31.2	32.0	50.5	
<2 drinks per day average	34.2	35.4	20.7	
2+ drinks per day average	17.3	17.6	16.3	
Physical activity				.002
<120 min per week	74.7	80.3	84.3	
120 min per week	25.3	19.7	15.7	
Body mass index				.18
<25	22.2	14.6	20.9	
25–30	46.3	45.6	43.8	
>30	31.5	39.9	35.3	
Hypertension				.023
No	47.0	37.4	37.6	
Yes	53.0	62.6	62.4	
Cardiovascular disease				.008
No	83.3	77.1	75.1	
Yes	16.8	22.9	24.9	
Diabetes mellitus				<.001
No	82.8	71.4	72.0	
Yes	17.2	28.6	28.0	

Demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders	PTSD diagnosis			<i>p</i> value
	No PTSD ^b %	Subthreshold PTSD ^a %	Full PTSD ^a %	
Pulmonary disease/disorder				<.001
No	82.7	75.4	69.8	
Yes	17.3	24.6	30.2	
Arthritis				<.001
No	65.3	57.1	49.4	
Yes	34.7	42.9	50.6	
<i>Psychiatric disorders</i>				
Current major depressive disorder				<.001
No	98.4	95.3	71.6	
Yes	1.6	4.7	28.4	
Current generalized anxiety disorder				<.001
No	98.9	96.1	86.1	
Yes	1.1	3.9	13.9	
Current alcohol use disorder				<.001
No	97.9	95.8	94.3	
Yes	2.2	4.2	5.7	

^aFull PTSD diagnosis defined according to *DSM-IV* criteria derived from the CIDI-IV. Subthreshold refers to having both Criterion A (history of a traumatic stressor) and Criterion B (persistent re-experiencing of the traumatic event) and either Criterion C (persistent avoidance of stimuli associated with the trauma and numbing of general responsiveness) or Criterion D (persistent symptoms of increased arousal). Full and subthreshold PTSD refers to an episode within 12 months prior to the interview; these definitions correspond to raw, unweighted counts as follows: no = 4,965, subthreshold = 170, full = 439

^bPercents and *p* values account for clustering by twin pair. Weighted for non-response and to the characteristics of the living male US population of Vietnam-era Veterans

Table 2

The association of current PTSD with VR-36 and WHODAS 2.0 summary scales unadjusted and adjusted for demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders

VR-36 and WHODAS 2.0 scales	Served in the Vietnam theater				Did not serve in the Vietnam theater					
	PTSD Diagnosis				PTSD Diagnosis					
	No PTSD	Subthreshold PTSD ^a	Full PTSD ^a	Effect size	No PTSD	Subthreshold PTSD ^a	Full PTSD ^a	Effect size		
	Mean	Mean	Mean	Effect size	Mean	Mean	Mean	Effect size		
<i>Physical component summary (PCS)</i>										
Unadjusted	44.0	39.2 ^f	0.43	38.2 ^f	0.52	45.7	39.8 ^f	0.53	33.7 ^{f,g}	1.08
Adjusted for demographic ^b and military service factors ^c	44.0	39.0 ^f	0.46	38.8 ^f	0.47	45.6	40.1 ^f	0.50	35.5 ^{f,g}	0.91
Adjusted for demographic, military service, lifestyle factors, and clinical conditions ^d	44.1	40.6	0.31	40.7 ^f	0.30	45.4	41.7 ^f	0.33	39.5 ^f	0.52
Adjusted for demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders ^e	44.1	40.7	0.31	40.6 ^f	0.31	45.3	41.7 ^f	0.32	40.1 ^f	0.47
<i>Mental component summary (MCS)</i>										
Unadjusted	53.1	43.3 ^f	0.80	34.5 ^g	1.51	54.3	44.5 ^f	0.89	38.0 ^{f,g}	1.47
Adjusted for demographic ^b and military service factors ^c	53.0	43.0 ^f	0.81	36.2 ^{f,g}	1.36	54.2	45.2 ^f	0.81	41.0 ^{f,g}	1.19
Adjusted for demographic, military service, lifestyle factors, and clinical conditions ^d	53.2	43.6 ^f	0.78	37.0 ^{f,g}	1.31	54.1	45.1 ^f	0.82	42.3 ^f	1.07
Adjusted for demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders ^e	52.7	43.7 ^f	0.73	40.5 ^f	0.99	54.0	45.9 ^f	0.73	45.3 ^f	0.78
<i>WHODAS 2.0 summary scale</i>										
Unadjusted	13.5	26.3 ^f	0.72	39.7 ^{f,g}	1.46	11.1	26.7 ^f	0.97	37.4 ^{f,g}	1.64
Adjusted for demographic ^b and military service factors ^c	13.5	26.6 ^f	0.73	37.5 ^{f,g}	1.34	11.3	25.1 ^f	0.86	33.6 ^{f,g}	1.39
Adjusted for demographic, military service, lifestyle factors, and clinical conditions ^d	13.3	24.2 ^f	0.61	35.9 ^{f,g}	1.26	11.5	23.6 ^f	0.75	29.8 ^{f,g}	1.14
Adjusted for demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders ^e	13.8	23.9 ^f	0.56	32.2 ^f	1.02	11.7	23.0 ^f	0.71	27.1 ^f	0.96

^a Full and subthreshold PTSD diagnoses are explained in the footnotes to Table 1

^b Demographic factors include age, race, ethnicity, marital status, education, employment status, and family income

^c Military service factors include branch of service, enlistment year, military rank at enlistment

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Lifestyle factors and clinical conditions include smoking, alcohol consumption, physical activity, BMI, cardiovascular disease, hypertension, diabetes mellitus, pulmonary disease/disorder, and arthritis

Psychiatric disorders include current depression, generalized anxiety disorder, and alcohol use disorder

Subthreshold or full PTSD mean functional values are significantly different at $p < .05$ compared with no PTSD; all tests account for clustering by twin pairs

Full PTSD values are significantly different at $p < .05$ compared with subthreshold PTSD; all tests account for clustering by twin pairs

Table 3

VR-36 health functioning and WHODAS 2.0 disability summary scales among twins discordant for subthreshold and full PTSD adjusted for demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders

VR-36 and WHODAS 2.0 scales	PTSD diagnosis					
	No PTSD	Subthreshold PTSD ^a	Within-pair mean (95 % CI)	Effect size	Full PTSD ^a	Within-pair mean (95 % CI)
	Mean	Mean			Mean	
<i>Physical component summary (PCS)</i>						
Unadjusted	43.0	39.2	-5.6 (-9.5, -1.6) ^f	0.49	36.0	-6.1 (-8.6, -3.5) ^f
Adjusted for demographic ^b and military service factors ^c	42.9	38.1	-6.3 (-10.4, -2.3) ^f	0.52	36.6	-5.9 (-8.3, -3.4) ^f
Adjusted for demographic, military service, lifestyle factors, and clinical conditions ^d	41.7	38.7	-5.3 (-8.7, -1.9) ^f	0.44	37.9	-4.9 (-7.1, -2.7) ^f
Adjusted for demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders ^e	41.9	38.8	-5.1 (-8.4, -1.7) ^f	0.44	37.8	-5.2 (-7.5, -3.0) ^f
<i>Mental component summary (MCS)</i>						
Unadjusted	48.8	43.2	-7.1 (-10.9, -3.4) ^f	0.57	39.5	-8.6 (-12.7, -4.4) ^f
Adjusted for demographic ^b and military service factors ^c	48.8	41.8	-7.9 (-11.9, -3.9) ^f	0.60	40.3	-8.4 (-12.6, -4.2) ^f
Adjusted for demographic, military service, lifestyle factors, and clinical conditions ^d	49.0	40.5	-8.2 (-12.5, -4.0) ^f	0.63	41.4	-7.4 (-11.6, -3.2) ^f
Adjusted for demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders ^e	48.2	39.9	-8.7 (-12.9, -4.4) ^f	0.61	42.9	-6.2 (-10.4, -2.0) ^f
<i>WHODAS 2.0 summary scale</i>						
Unadjusted	18.9	24.8	7.7 (1.5, 13.9) ^f	0.54	35.5	15.8 (11.0, 20.6) ^{f,g}
Adjusted for demographic ^b and military service factors ^c	18.9	25.9	9.7 (3.2, 16.2) ^f	0.59	34.9	15.3 (10.4, 20.2) ^f
Adjusted for demographic, military service, lifestyle factors, and clinical conditions ^d	19.3	25.6	8.0 (2.3, 13.6) ^f	0.54	33.7	14.7 (10.1, 19.3) ^f
Adjusted for demographic, military service, lifestyle factors, clinical conditions, and psychiatric disorders ^e	19.9	26.0	8.1 (2.4, 13.7) ^f	0.53	32.5	13.6 (9.0, 18.3) ^f

^aFull and subthreshold PTSD diagnoses are explained in the footnotes to Table 1

^bDemographic factors include age, race, ethnicity, marital status, education, employment status, and family income

^cMilitary service factors include branch of service, enlistment year, military rank at enlistment

^dLifestyle factors and clinical conditions include smoking, alcohol consumption, physical activity, BMI, cardiovascular disease, hypertension, diabetes mellitus, pulmonary disease/disorder, and arthritis

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Psychiatric disorders include current depression, generalized anxiety disorder, and alcohol use disorder
Subthreshold or full PTSD mean functional values are significantly different at $p < .05$ compared with no PTSD; all tests account for clustering by twin pairs
Full PTSD values are significantly different at $p < .05$ compared with subthreshold PTSD; all tests account for clustering by twin pairs