Published in final edited form as:

Am J Geriatr Psychiatry. 2016 March ; 24(3): 181–191. doi:10.1016/j.jagp.2015.05.004.

Prevalence of Post-Traumatic Stress Disorder in Aging Vietnam-Era Veterans: Veterans Administration Cooperative Study 569: Course and Consequences of Post-Traumatic Stress Disorder in Vietnam-Era Veteran Twins

Jack Goldberg, Ph.D., Kathryn M. Magruder, Ph.D., Christopher W. Forsberg, M.S., Matthew J. Friedman, M.D., Ph.D., Brett T. Litz, Ph.D., Viola Vaccarino, M.D., Ph.D., Patrick J. Heagerty, Ph.D., Theresa C. Gleason, Ph.D., Grant D. Huang, M.P.H., Ph.D., and Nicholas L. Smith, Ph.D.

Seattle Epidemiologic Research and Information Center (JG, CWS, NLS), VA Puget Sound Health Care System, Seattle, WA; Departments of Epidemiology (JG, NLS) and Biostatistics (PJH), University of Washington, Seattle, WA; Mental Health Service (KMM), Ralph H. Johnson VA Medical Center and Department of Psychiatry (KMM), Medical University of South Carolina, Charleston, SC; Department of Veterans Affairs (MJF), National Center for Posttraumatic Stress Disorder, White River Junction, VT; Departments of Psychiatry and Pharmacology & Toxicology (MJF), Geisel School of Medicine at Dartmouth, Hanover, NH; Massachusetts Epidemiological Research and Information Center (BTL), VA Boston Healthcare System and Boston University School of Medicine (BTL), Boston, MA; Departments of Epidemiology and Medicine (VV), Emory University, Atlanta, GA; and Cooperative Studies Program, Clinical Science Research and Development (TCG, GDH), VA Office of Research and Development, Washington, DC

Abstract

Objective—The prevalence of post-traumatic stress disorder (PTSD) among aging Vietnam-era veterans is not well characterized.

Methods—In a cross-sectional study, 5,598 male Vietnam-era veterans and members of the Vietnam Era Twin Registry were assessed for PTSD using the Composite International Diagnostic Interview. Current symptoms were measured with the PTSD Checklist (PCL). PTSD was estimated according to age (<60 or ≥60) and Vietnam theater service.

Results—The lifetime prevalence of PTSD in theater veterans aged at least 60 years was 16.9% (95% CI: 13.9%–20.5%) and higher than the 5.5% (95% CI: 4.3%–7.0%) among nontheater veterans. Among veterans younger than 60 years, the comparable prevalence was 22.0% for theater (95% CI: 16.7%–28.4%) and 15.7% for nontheater (95% CI: 13.4%–18.2%) veterans. Similar results were found for theater service and current PTSD prevalence (past 12 months). PCL scores were significantly higher in theater compared with nontheater veterans in both younger and

Send correspondence and reprint requests to Jack Goldberg, Ph.D., Seattle Epidemiologic Research and Information Center (S-152-E), VA Puget Sound Health Care System, 1600 South Columbian Way, Seattle, WA 98108. jack.goldberg@va.gov.

Supplemental digital content is available for this article in the HTML and PDF versions of this article on the journal's Web site (www.ajgp-online.org).

The authors have no disclosures of current or potential conflicts of interest to report.

older cohorts. In both the younger and older cohorts significant differences in lifetime and current PTSD prevalence and PCL scores persisted in theater service discordant twin pairs.

Conclusion—Vietnam service is related to elevated PTSD prevalence and current symptom burden in aging veterans. More than 30 years after the end of the Vietnam conflict, many veterans continue to suffer from PTSD, which highlights the need for continuing outreach throughout the life course.

Keywords

Epidemiology; geriatric/aging/elderly; PTSD/posttraumatic stress disorder; twin studies; trauma

INTRODUCTION

The Vietnam War impacted the lives of nearly 3 million U.S. veterans. A particularly insidious consequence of the war is post-traumatic stress disorder (PTSD).¹ In 1990, the National Vietnam Veterans Readjustment Study (NVVRS) estimated the prevalence of current and lifetime PTSD in Vietnam-era veterans.² These cross-sectional findings reflected the status of Vietnam-era veterans when they were in their thirties and forties. Now, more than 20 years later, Vietnam-era veterans are in late middle age, and the prevalence of PTSD in these veterans is not well characterized.

A study in the *American Journal of Geriatric Psychiatry* for the first time provided prevalence estimates for PTSD in the older (>60) U.S. population.³ For older men they estimated that 7.4% had a lifetime history of full or partial PTSD among individuals exposed to a traumatic event. PTSD continues to be a common diagnosis among Vietnam-era veterans within the Veterans Administration (VA) health system. From 2007 to 2009, 366,317 Vietnam-era veterans had a diagnosis of PTSD within the Department of Veterans Affairs health system⁴; this represents a treated prevalence of 15.8% of all Vietnam-era veterans seen in the system. However, there are currently no estimates of the prevalence in the larger community of aging Vietnam-era veterans. This is important because there may be veterans who are either not receiving treatment or receiving treatment outside the VA system.

The purpose of this study was to estimate the prevalence of PTSD in younger (<60) and older (≥ 60) Vietnam-era veterans. We evaluated PTSD in veterans in the Vietnam-Era Twin (VET) Registry, which was constructed from military discharge records in the mid-1980s.⁵ We assessed lifetime and current prevalence in 2011–2012 according to age cohort, service in the Vietnam theater of operations, and combat exposure.

METHODS

Setting

The VET Registry is the source of Vietnam-era veterans (military service between 1964 and 1975) for this study. The VET Registry is a national sample of male twins assembled in the 1980s and has been used as a platform for physical and mental health research.^{5–7} Members of the VET Registry were born from 1939 through 1957.

Design

The Course and Consequences of PTSD in Vietnam-Era Twins (VA Cooperative Study 569) is an observational study of PTSD among veterans. A mailed questionnaire obtained general health information and PTSD symptoms; a telephone interview used a structured psychiatric interview to diagnose PTSD.

Subjects

All members of the VET Registry who had entered military service in 1965 or later and who were known to be alive and had not withdrawn from the Registry were recruited to participate in this study. We used the enlistment year restriction because the Registry was assembled based on computerized military discharge records that did not become available until 1968. Study-specific informed consent was obtained from all participating VET Registry members, and the VA Central Institutional Review Board approved the study's protocol.

Data Collection

We mailed all eligible twins an initial contact letter describing the project and inviting participation. Twins were requested to complete and return a physical and mental health questionnaire by mail. For twins who did not send back a questionnaire, we attempted to call them directly. Because of the size and scope of the study, all mail and telephone fieldwork was done under contract by Abt SRBI, Inc., New York, NY, a large survey research organization.

Measures

PTSD Diagnosis—PTSD was assessed by a telephone administration of the Composite International Diagnostic Interview (CIDI) according to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV).¹ The CIDI is a structured instrument designed for administration by trained lay interviewers; it is the most widely used tool for the evaluation of psychiatric disorders in epidemiologic studies.⁸ A study demonstrated that relative to the Clinician Administered PTSD Scale,⁹ the CIDI had a sensitivity of 0.71 and a specificity of 0.85 for past-year PTSD and a sensitivity of 0.61 and a specificity of 0.91 for lifetime PTSD.¹⁰ Interview training was done by CIDI-certified trainers at the start of the study and continuously monitored during the course of data collection.

Assessment of PTSD Symptom Burden—As part of the mailed questionnaire, we included the PTSD Checklist (PCL), which includes a list of 17 PTSD items derived from the DSM-IV diagnostic criteria and is widely used in studies of traumatically exposed individuals.^{11,12} The psychometric properties of the scale are excellent, with a high internal consistency and criterion validity when compared with the formal diagnosis of PTSD.^{13,14}

Sociodemographic and Military Service Factors—Information about sociodemographic and military service factors was previously culled from military service records and interviews. These data include date of birth, race, zygosity, marital status at

enlistment, educational attainment in years at the time of enlistment, date of enlistment, branch of service, and rank at enlistment.

In most instances, we determined Vietnam theater service and combat exposure based on a response to a mailed questionnaire administered from 1985 through 1990. For less than 10% of the veterans who did not have this information, we used the military records to assign theater of service. We used a combat exposure index based on the sum of 18 specific combat experiences that has excellent reliability and validity.¹⁵ For the current analysis we grouped combat exposure among Vietnam theater veterans into two categories divided at the approximate median: no or low combat (combat score of 0–2) and medium to high combat (combat scores ≥ 2).

Statistical Analysis

Weighting—Descriptive analyses characterized the distribution of sociodemographic and military service factors among respondents to the mailed questionnaire and the telephone interview. We then used a model-based weighting procedure that adjusted prevalence estimates for both nonresponse and the current population of living Vietnam-era veterans.¹⁶ See Supplemental Material for further details about the weighting procedure.

Prevalence Estimates—We estimated the weighted lifetime and current (past 12 months) prevalence of PTSD in theater and nontheater veterans. Analysis stratified the sample into a younger (<60) and older (≥ 60) age cohort at the time of the survey. Statistical testing examined PTSD prevalence estimates for differences by theater service within the age cohort. Among those who served in Vietnam, we estimated adjusted odds ratios and mean differences in the PCL for combat exposure.

Within-pair Analyses—We used a matched-pair analysis that directly compared PTSD and PCL scores in twin pairs discordant for theater military service. In this co-twin control analysis one member of the pair did not serve in theater, whereas their co-twin served in theater. In this within-pair twin analysis we estimated the theater service–associated odds ratios and 95% confidence intervals (CIs) using matched-pair logistic regression; a parallel analysis was conducted using within-pair differences in PCL scores.¹⁷

In all analyses, significance levels were two-sided and set at $p = .05$. All statistical testing and CIs accounted for the clustered data structure represented by twin pairs in the VET Registry using robust variance estimators.¹⁸ Data analyses were performed with Stata 13.1.¹⁹

RESULTS

Sample Characteristics

From our original sample of 14,736 individuals in the VET Registry, 2,969 individuals (20%) had died or had withdrawn from the VET Registry at the time we initiated our study. An additional 925 individuals could not be located, and 303 individuals were excluded because they had enlisted before 1965 (Fig. 1). Of those who were alive and eligible ($N = 10,539$), we obtained completed mailed questionnaires from 7,079 veterans (67.2%) and

telephone psychiatric interviews from 5,862 veterans (55.6%). In total, our final analytic sample consisted of 1,534 veterans younger than age 60 and 4,064 age 60 or above who responded to both the mailed questionnaire and the telephone interview.

The distribution of military service and demographic characteristics is presented among respondents (unweighted) and then after weighting for nonresponse and population characteristics; the 2010 National Survey of Veterans population distributions are also presented (Supplemental Table 1). Weighting increased the percent of those who served in the Army and Marines and increased both early and late enlistment and discharge years. Demographic characteristics were also altered by the weighting with increases among the percent of those who were older, nonwhite, divorced or never married, obtained a high school degree or less, and had a lower income. One-fourth of the weighted sample were younger than age 60 at the time of interview. The weighted estimates for military service and demographic characteristics were similar to the population values for living Vietnam-era veterans derived from the 2010 National Survey of Veterans. Supplemental Table 2 displays the weighted distribution of demographic and military service factors according to age group and PTSD diagnosis. In general, within each age cohort those with a diagnosis of lifetime PTSD were more likely to have served in the Army or Marines, were younger at enlistment, were more likely to be nonwhite, and were less likely to have attended college.

PTSD Prevalence and Mean PCL

Theater Service—Overall, the lifetime prevalence of PTSD among theater veterans was 17.6% (95% CI: 14.8%–20.8%) and in nontheater veterans 8.9% (95% CI: 7.8%–10.2%) ($t(5,596) = 7.76, p < 0.001$); similarly, the current 12-month prevalence was greater in theater compared with nontheater veterans (12.8%, 95% CI: 10.2%–16.0% in theater versus 5.6%, 95% CI: 4.7%–6.8% in nontheater, ($t(5,591) = 7.98, p < 0.001$) (Table 1). The lifetime prevalence of PTSD differed by age at the time of interview. Among those younger than age 60 the lifetime PTSD prevalence was 22.0% (95% CI: 16.7%–28.4%) in theater veterans and 15.7% (95% CI: 13.4%–18.2%) among nontheater veterans ($t(1,532) = 2.12, p < 0.034$). For those age 60 and older, there were also differences in PTSD prevalence between theater and nontheater veterans (16.9% versus 5.5%, ($t(4,062) = 9.61, p < 0.001$). The differences in PTSD lifetime prevalence associated with theater service were significantly larger among the older than younger veterans ($t(5,594) = 3.24, p = 0.001$ interaction by age cohort). Similarly, there were differences in current PTSD prevalence associated with theater service in both younger and older cohorts ($t(5,589) = 3.56, p < 0.001$ interaction by age cohort). Mean PCL scores were significantly higher in theater veterans than in nontheater veterans ($t(5,570) = 8.77, p < 0.001$), and this was found for both age cohorts.

Combat Exposure—Combat exposure was strongly associated with the lifetime prevalence of PTSD in the younger and older cohorts ($t(274) = 4.18, p < 0.001$ for age < 60 and $t(1,834) = 7.34, p < 0.001$ for age ≥ 60) (Fig. 2). In the younger cohort (<60) the lifetime prevalence of PTSD was 12.1% in veterans with a history of no/low combat exposure and 37.8% for veterans with medium/high combat exposure. The comparable PTSD prevalences in older cohort (≥ 60) were 6.8% among those with no/low combat exposure and 25.6% in those with medium/high combat exposure. Similarly, medium/high combat exposure was

associated with a significant increase in the unadjusted current prevalence in both the younger ($t(273) = 3.60, p < 0.001$) and older ($t(1,831) = 6.92, p < 0.001$) cohorts. Adjusted logistic regression analysis found that medium/high combat exposed veterans were at four times the odds of lifetime PTSD in both the younger and older cohorts (Table 2). In the adjusted analysis medium/high combat was also associated with significantly increased mean PCL scores ($t(273) = 4.65, p < 0.001$ for age < 60 and $t(1,826) = 8.86, p < 0.001$ for age ≥ 60); the mean difference comparing no/low combat with medium/high combat was more than nine PCL points in the younger cohort and nearly seven PCL points in the old cohort.

Within-pair Analysis—In the younger cohort the lifetime prevalence of PTSD was 27.0% in theater twins compared with 13.1% in nontheater service co-twins ($t(180) = 2.27, p = 0.023$) (Table 3). Among veterans aged 60 and older, the lifetime prevalence of PTSD in nontheater twins was 6.9% compared with 13.8% in theater co-twins ($t(1,050) = 2.80, p = 0.005$). The results for the within-pair analysis of current PTSD prevalence were very similar, although of slightly smaller magnitude, to those observed for lifetime PTSD. The pattern of association of within-pair differences in PTSD prevalence by theater service was not significantly different by age cohort ($t(1,200) = 0.33, p = 0.74$ interaction by age cohort for lifetime and $t(1,194) = 0.55, p = 0.58$ interaction by age cohort for current). We found no evidence of differential theater service effects by zygosity for either current ($t(1,194) = 1.39, p = 0.16$ for zygosity interaction) or lifetime PTSD ($t(1,200) = 0.67, p = 0.50$ for zygosity interaction). Among theater service–discordant twin pairs, the within-pair analysis of mean PCL scores was significantly different in both age cohorts with higher scores in twins who served in theater ($t(178) = 2.78, p < 0.01$ for age < 60 and $t(1,010) = 7.45, p < 0.005$ for age ≥ 60). The association of theater service with PCL was larger but not significantly different in the younger compared with the older cohort ($t(1,188) = 0.68, p = 0.50$ for interaction by age cohort). Furthermore, there was no significant interaction by zygosity in either age cohort ($t(176) = 0.40, p = 0.69$ for age < 60 and $t(1,008) = 0.18, p = 0.86$ for age ≥ 60).

DISCUSSION

More than 35 years after the end of the Vietnam conflict, the prevalence of lifetime PTSD and current symptom burden is substantial in Vietnam-era veterans who served in the theater of operations. Consistent with prior research, the prevalence of PTSD was particularly marked among veterans with a history of combat exposure. For nontheater veterans, however, those younger than age 60 had a higher prevalence of PTSD compared with older veterans (age ≥ 60).

Comparison with Other Prevalence Estimates

There are no estimates of the current prevalence of PTSD among older Vietnam-era veterans, but there are estimates from 1985 to 1995 when these men—on average—were 40 years old. The NVVRS used a random probability sample of military records that identified Vietnam-era veterans and used a complex multistep process to make a diagnosis of PTSD according to *DSM, Third Edition Revised* (DSM-III-R) criteria.² The NVVRS reported that among theater veterans the 6-month (current) prevalence was 15.2% and the lifetime prevalence was 30.9%. A reanalysis of NVVRS primary data sources in 2007 reported lower

PTSD estimates: 9.1% for current and 18.7% for lifetime diagnoses.²⁰ Another estimate of PTSD prevalence in veterans was obtained from the Centers for Disease Control and Prevention (CDC) Vietnam Experience Study project published in 1989.²¹ This study included a sample of veterans who served one tour of duty in the Army derived from a random sample of military records. Based on in-person interviews using the Diagnostic Interview Schedule (DIS) with DSM-III criteria, the CDC estimated a lifetime PTSD prevalence of 14.7% and a 1-month prevalence of 2.2% among theater veterans; however, in the CDC study, a PTSD diagnosis required a specific war-related traumatic index event (Vietnam theater veterans only).²¹ Boscarino²² reanalyzed the CDC data and reported a 1-year prevalence of 12% for theater veterans. The prevalence estimate reported by Boscarino included both combat- and noncombat-related PTSD and a broadening of the diagnostic criterion for PTSD. In a previous psychiatric study of the VET Registry, based on a telephone administration of the DIS in 1992 with DSM-III-R criteria, the estimated prevalence of lifetime PTSD was 15.0% among theater veterans and 6.1% in nontheater veterans.²³ A study among Australian male Vietnam theater army veterans in 1990e1993 found a lifetime prevalence of PTSD of 18.7% using the DIS with DSM-III-R criteria.²⁴ Findings from the current study show that PTSD continues to be highly prevalent among those exposed to combat.

There are few studies of PTSD in the general population of older adults. A report by Pietrzak et al.³ represents the most detailed national assessment of PTSD in the older population using Wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions conducted between 2004 and 2005. A diagnosis of PTSD was based on an in-person fully structured instrument administered by lay interviewers.²⁵ Among men 60 years and older (range: 60–99) the lifetime prevalence of PTSD was 3.1%, which is smaller than the 5.5% prevalence we found in nontheater Vietnam-era veterans aged 60 and older (range: 60–71). An important difference between the two estimates is the definition of the denominator: In our study we included all participants in the denominator, whereas Pietrzak et al. only included individuals who reported experiencing a traumatic event. Had we restricted our denominator to only those with a history of a traumatic event, the prevalence among nontheater veterans would have been higher. Their national estimate is also lower than what we observed among Vietnam theater veterans, many of whom were exposed to combat trauma. Other potential reasons for the differences in prevalence estimates include the differences in age range, PTSD assessment instruments, and timing of measurement.

Public Health Implications

The results of this study show differences in PTSD prevalence by age cohort and theater service. It is interesting that there was an increase in PTSD among veterans who did not serve in theater in the younger versus older cohort. The reasons for this result are not obvious, although we can hypothesize that differences in exposure to noncombat traumatic exposures might play a role. Vietnam theater veterans carry a substantial burden of PTSD over the life course. The volume of care-seeking Vietnam-era veterans with a diagnosis of PTSD continues to increase within the VA and makes up an increasing proportion of the total VA caseload. For example, Vietnam-era veterans with a diagnosis of PTSD in the VA increased by 22.2% from 2004–2006 to 2007–2009.⁴ Although the VA has expanded its

outreach to war veterans and its PTSD treatment resources since the Vietnam War, our results suggest that it is important to find ways to continue to address PTSD across the lifespan. This might entail paying closer attention to the after-care challenges of veterans in therapy for PTSD, the reduction of relapse and recurrence, and shifting to a rehabilitation model of care for some. The impact of PTSD among aging veterans is complex, and recent articles point to the effects of the waxing and waning nature of PTSD on mental health across the life course²⁶ and the potential adverse impact that PTSD has on physical health.^{27,28} The VA should consider specialized outreach to Vietnam veterans suffering from PTSD that have never been treated.

Limitations and Strengths

Our study does have a number of limitations. The VET Registry is a sample of twin pairs, and it is possible that being a twin might influence the later-life prevalence of PTSD. Data from carefully done studies in Scandinavian twin registries, however, suggest that adult twins are at similar risk to the general population for most physical and mental health disorders.^{29,30} Our study did not include female veterans because the VET Registry was restricted to male twins when it was created.⁵ Our response rate of 53% is of concern. If the nonrespondents have a different PTSD prevalence than respondents, especially if this difference in nonrespondent prevalence is related to theater service, then our estimated prevalence might be biased. However, we used the extensive information on sociodemographic and military service from all VET Registry members to reweight our prevalence estimates. We further adjusted our final estimates to mirror the demographic and military service characteristics of Vietnam-era veterans using population-level data. The VET Registry was constructed using computerized military discharge records, and these records have known gaps during the Vietnam era. In particular, the Registry did not include individuals who were enlisted before 1965; we estimated that only 4 to 5 million records were available to construct the Registry, whereas the total number of Vietnam-era veterans is closer to 9 million.⁵ Thus, our prevalence estimates do not refer to the whole of the Vietnam-era veteran population.

Concerning our measure of PTSD, we used the CIDI, whereas the gold standard for PTSD assessment is the Clinician Administered PTSD Scale.³¹ However, the CIDI has been used extensively in large population studies of PTSD. The psychometric properties of the PTSD CIDI module were evaluated as part of the World Health Organization's World Mental Health surveys initiative.³² When compared with a clinical assessment using the Structured Clinical Interview for DSM-IV, the CIDI PTSD diagnosis had a kappa of 0.49 and a sensitivity of 38.3%.^{32,33} We also used the PCL to more broadly capture current symptom burden. Regardless of how we measured PTSD, our results were consistent with an elevation of PTSD associated with war-zone service. Another issue relates to how PTSD symptom reporting might vary across the life course. Our findings that younger veterans, even those who did not serve in theater, have an increased prevalence of PTSD may reflect differences in patterns of symptom reporting that vary inversely with age. Alternatively, current prevalence could in part reflect the effects of treatment on reducing symptoms. These topics need further investigation in longitudinal cohorts of individuals exposed to traumatic events and various PTSD treatment regimens. Finally, our analysis focuses on differences in PTSD

prevalence according to service in the Vietnam theater; in this study we do not examine the potential of non-war-zone traumatic events that might trigger PTSD.

A major strength of the current study is that it is based on the VET Registry sample, which is large, includes all branches and ranks, is national in scope, and is unselected with respect to treatment seeking. We diagnosed PTSD with the CIDI, which is widely used for studies of PTSD in the community.^{8,34} Furthermore, we capitalized on our twin sample to compare PTSD within pairs, which controls perfectly for age and numerous unmeasured familial and genetic factors.³⁵

In summary, PTSD is prevalent among aging Vietnam-era veterans who served in the Vietnam theater. The prevalence of PTSD among men who served in combat is of particular concern and points to the need for continuing outreach and intervention programs targeted to these aging Vietnam veterans.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Dr. Goldberg had full access to all data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. The funding source was involved in the design and conduct of the study and the interpretation, preparation, review, and approval of the manuscript. The authors were responsible for the collection, management, analysis, and interpretation of the data and for the preparation of the manuscript and its submission for publication. The authors gratefully acknowledge the continued cooperation and participation of the members of the VET Registry: Without their contribution this research would not have been possible. The authors also thank the members of the Department of Veterans Affairs Cooperative Study 569 Group (in addition to the authors): I. Curtis, A. Ali, B. Majerczyk, B. Harp, K. Moore, A. Fox, M. Tsai, A. Mori, J. Sporleder, P. Terry, Seattle, WA; D. Yeager, Charleston, SC. Executive Committee: S. Eisen, Washington, DC; A. Snodgrass, Albuquerque, NM. Data Monitoring Committee: J. Vasterling, Boston, MA; M. Stein, La Jolla, CA; B. Booth, Little Rock, AR; J. Westermeyer, Minneapolis, MN. Planning Committee: M. McFall, Seattle, WA; T. O'Leary, S. Eisen, Washington, DC; M. Smith, Palo Alto, CA; K. Swanson, Albuquerque, NM.

The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs or the U.S. Government.

The Cooperative Studies Program of the Office of Research and Development, Clinical Science Research and Development, of the U.S. Department of Veterans Affairs provided financial support for Cooperative Study 569 and the development and maintenance of the VET Registry. Dr. Viola Vaccarino was supported in part by a National Institutes of Health award (K24 HL077506).

References

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th. Washington, DC: American Psychiatric Association; 1994.
2. Kulka, RA., Schlenger, WE., Fairbanks, JA., et al. Trauma and the Vietnam War Generation: Report of Findings from the National Vietnam Veterans Readjustment Study. New York: Brunner Mazel; 1990.
3. Pietrzak RH, Goldstein RB, Southwick SM, et al. Psychiatric comorbidity of full and partial posttraumatic stress disorder among older adults in the United States: results from wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions. *Am J Geriatr Psychiatry*. 2012; 20:380–390. [PubMed: 22522959]
4. Hermes ED, Hoff R, Rosenheck RA. Sources of the increasing number of Vietnam era veterans with a diagnosis of PTSD using VHA services. *Psychiatr Serv*. 2014; 65:830–832. [PubMed: 24733559]

5. Eisen S, True W, Goldberg J, et al. The Vietnam Era Twin (VET) Registry: method of construction. *Acta Genet Med Gemellolog*. 1987; 36:61–66.
6. Goldberg J, Curran B, Vitek ME, et al. The Vietnam Era Twin Registry. *Twin Res*. 2002; 5:476–481. [PubMed: 12537880]
7. Tsai M, Mori AM, Forsberg CW, et al. The Vietnam Era Twin Registry: a quarter century of progress. *Twin Res Hum Genet*. 2013; 16:429–436. [PubMed: 23177374]
8. Kessler RC, Ustun TB. The World Mental Health (WMH) survey initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *Int J Methods Psychiatr Res*. 2004; 13:93–121. [PubMed: 15297906]
9. Blake DD, Weathers FW, Nagy LM, et al. The development of a Clinician-Administered PTSD Scale. *J Trauma Stress*. 1995; 8:75–90. [PubMed: 7712061]
10. Kimerling R, Serpi T, Weathers F, et al. Diagnostic accuracy of the Composite International Diagnostic Interview (CIDI 3.0) PTSD module among female Vietnam-era veterans. *J Trauma Stress*. 2014; 27:160–167. [PubMed: 24740869]
11. Weathers, FW., Litz, BT., Herman, DS., Huska, JA., Keane, TM. Annual Convention of the International Society for Traumatic Stress Studies. San Antonio: International Society for Traumatic Stress Studies; 1993 Oct. The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility.
12. Norris, FH., Hamblen, JL. Standardized self-report measures of civilian trauma and PTSD. In: Wilson, JP.Keane, TM., Martin, T., editors. *Assessing Psychological Trauma and PTSD*. New York: Guilford Press; 2004. p. 63-102.
13. Blanchard EB, Jones-Alexander J, Buckley TC, et al. Psychometric properties of the PTSD Checklist (PCL). *Behav Res Ther*. 1996; 34:669–673. [PubMed: 8870294]
14. Yeager DE, Magruder KM, Knapp RG, et al. Performance characteristics of the posttraumatic stress disorder checklist and SPAN in Veterans Affairs primary care settings. *Gen Hosp Psychiatry*. 2007; 29:294–301. [PubMed: 17591505]
15. Janes GR, Goldberg J, Eisen SA, et al. Reliability and validity of a combat exposure index for Vietnam era veterans. *J Clin Psychol*. 1991; 47:80–86. [PubMed: 2026782]
16. Rosenbaum PR. Model-based direct adjustment. *J Am Stat Assoc*. 1987; 82:387–394.
17. Carlin JB, Gurrin LC, Sterne JA, et al. Regression models for twin studies: a critical review. *Int J Epidemiol*. 2005; 34:1089–1099. [PubMed: 16087687]
18. Williams RL. A note on robust variance estimation for cluster-correlated data. *Biometrics*. 2000; 56:645–646. [PubMed: 10877330]
19. StataCorp. *Stata Statistical Software*, Release 13. College Station, TX: StataCorp; 2013.
20. Dohrenwend BP, Turner JB, Turse NA, et al. The psychological risks of Vietnam for U.S. veterans: a revisit with new data and methods. *Science*. 2006; 313:979–982. [PubMed: 16917066]
21. Vietnam Experience Study (Centers for Disease Control). Health status of Vietnam veterans. Atlanta, Ga: U.S Dept of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Environmental Health and Injury Control; 1989.
22. Boscarino JA. Post-traumatic stress and associated disorders among Vietnam veterans: the significance of combat exposure and social support. *J Trauma Stress*. 1995; 8:317–336. [PubMed: 7627446]
23. Eisen SA, Griffith KH, Xian H, et al. Lifetime and 12-month prevalence of psychiatric disorders in 8,169 male Vietnam War era veterans. *Mil Med*. 2004; 169:896–902. [PubMed: 15605939]
24. O'Toole BI, Marshall RP, Grayson DA, et al. The Australian Vietnam Veterans Health Study. III. Psychological health of Australian Vietnam veterans and its relationship to combat. *Int J Epidemiol*. 1996; 25:331–340. [PubMed: 9119558]
25. Grant, B., Dawson, D., Hasin, D. The Wave 2 National Epidemiologic Survey on Alcohol and Related Conditions Alcohol Use Disorder and Associated Disabilities Interview Schedule—DSM-IV Version. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism; 2004.
26. Chopra MP, Zhang H, Pless Kaiser A, et al. PTSD is a chronic, fluctuating disorder affecting the mental quality of life in older adults. *Am J Geriatr Psychiatry*. 2014; 22:86–97. [PubMed: 24314889]

27. Beristianos M, Yaffe K, Cohen B, et al. The impact of late-life PTSD on vascular-related disorders. *Am J Geriatr Psychiatry*. 2014; 22:S55.
28. Beristianos M, Yaffe K, Neylan T, et al. Late-life PTSD, comorbid psychiatric and behavioral disorders and risk of mortality among veterans. *Am J Geriatr Psychiatry*. 2013; 21:S89–S90.
29. Christensen K, Kyvik KO, Holm NV, et al. Register-based research on twins. *Scand J Public Health*. 2011; 39:185–190. [PubMed: 21775381]
30. Thorp, SR., Sones, HM., Cook, JM. Posttraumatic stress disorder among older adults. In: Sorocco, KH., Lauderdale, S., editors. *Cognitive Behavior Therapy with Older Adults: Innovations Across Care Settings*. New York: Springer; 2011. p. 189-217.
31. Weathers FW, Keane TM, Davidson JR. Clinician-administered PTSD scale: a review of the first ten years of research. *Depress Anxiety*. 2001; 13:132–156. [PubMed: 11387733]
32. Haro JM, Arbabzadeh-Bouchez S, Brugha TS, et al. Concordance of the Composite International Diagnostic Interview Version 3.0 (CIDI 3.0) with standardized clinical assessments in the WHO World Mental Health surveys. *Int J Methods Psychiatr Res*. 2006; 15:167–180. [PubMed: 17266013]
33. First, MB., Spitzer, RL., Miriam, G., et al. *Structured Clinical Interview for DSM-IV Axis I Disorders, Research Version, Non-Patient Edition (SCID-I/NP)*. New York: Biometrics Research, New York State Psychiatric Institute; 2002.
34. Norris FH, Murphy AD, Baker CK, et al. Postdisaster PTSD over four waves of a panel study of Mexico's 1999 flood. *J Trauma Stress*. 2004; 17:283–292. [PubMed: 15462535]
35. McGue M, Osler M, Christensen K. Causal inference and observational research: the utility of twins. *Perspect Psychol Sci*. 2010; 5:546–556. [PubMed: 21593989]

FIGURE 1.

Eligibility for Vietnam-era veteran PTSD prevalence study. Numbers in bold type indicate veterans age 60 and above; numbers in regular type indicate veterans younger than age 60.

FIGURE 2. Weighted prevalence of lifetime and current PTSD by combat exposure and age cohort

^a PTSD defined according to DSM-tV criteria derived from the CID1-IV.

^b Test statistics for combat exposure with lifetime PTSD prevalence: $t(274) = 4.18$, $p < 0.001$ for <60 age and $t(1834) = 7.34$, $p < 0.001$ for 60 age; combat by age cohort interaction $t(2108) = 0.17$, $p = 0.86$. Test statistics for combat exposure with current PTSD prevalence: $t(273) = 3.60$, $p < 0.001$ for <60 age and $t(1831) = 6.92$, $p < 0.001$ for 60 age; combat by age cohort interaction $t(2104) = 0.47$, $p = 0.64$.

^c Prevalence is estimated from theater service Veterans with valid responses. Error bars represent 95% confidence intervals that account for clustering by twin pairs. Weighted for non-response and to the characteristics of the living male US population of Vietnam-theater Veterans.

TABLE 1

Weighted Prevalence of Lifetime and Current PTSD and Mean PCL Scores According to Age Cohort and Vietnam Theater Service

PTSD	Service in Theater			Interaction by Age		
	Yes	No	Test Statistic	p	Test Statistic	p
Lifetime, ^a %	17.6 (14.8–20.8)	8.9 (7.8–10.2)	t(5,596) = 7.76	<0.001		
Age < 60	22.0 (16.7–28.4)	15.7 (13.4–18.2)	t(1,532) = 2.12	0.034	t(5,594) = 3.24	0.001
Age 60	16.9 (13.9–20.5)	5.5 (4.3–7.0)	t(4,062) = 9.61	<0.001		
Current, ^b %	12.8 (10.2–16.0)	5.6 (4.7–6.8)	t(5,591) = 7.98	<0.001		
Age < 60	14.7 (10.4–20.4)	10.2 (8.4–12.4)	t(1,530) = 2.04	0.041	t(5,589) = 3.56	<0.001
Age 60	12.5 (9.7–16.1)	3.3 (2.3–4.7)	t(4,062) = 9.40	<0.001		
PCL, mean	30.5 (29.4–31.5)	25.3 (24.7–25.8)	t(5,570) = 8.77	<0.001		
Age < 60	34.2 (31.7–36.8)	29.1 (28.1–30.1)	t(1,525) = 3.73	<0.001	t(5,568) = 0.92	0.36
Age 60	30.0 (28.8–31.1)	23.3 (22.7–23.9)	t(4,043) = 10.21	<0.001		

Notes: Values are percents or means, as indicated, with 95% CIs in parentheses. Prevalence and mean estimates, CIs, and p values account for clustering by twin pair. Weighted for nonresponse and to the characteristics of the living male U.S. population of Vietnam-era veterans; see also Supplemental Material.

^aDisorder classified according to DSM-IV criteria derived from the CID-IV.

^bCurrent refers to the last 12 months.

TABLE 2

Association of Combat Exposure with PTSD by Age Cohort Adjusted for Demographics and Military Service Factors

Combat Exposure ^a	Age < 60		Age 60		Interaction by Age	
	OR or Mean	(95% CI)	OR or Mean	(95% CI)	Test Statistic	p
Lifetime PTSD, OR						
Unadjusted					t(2,108) = 0.17	0.86
No/low combat	1.0 (ref)		1.0 (ref)			
Medium/high combat	4.4 (2.2–8.8)		4.7 (3.1–7.2)		t(2,070) = 0.16	0.87
Adjusted for demographics and military service factors ^b						
No/low combat	1.0 (ref)		1.0 (ref)			
Medium/high combat	4.1 (1.9–8.7)		4.0 (2.7–5.9)			
Current PTSD, OR						
Unadjusted					t(2,104) = 0.47	0.64
No/low combat	1.0 (ref)		1.0 (ref)			
Medium/high combat	4.5 (2.0–10.1)		5.6 (3.4–9.1)		t(2,066) = 0.20	0.84
Adjusted for demographics and military service factors ^b						
No/low combat	1.0 (ref)		1.0 (ref)			
Medium/high combat	5.1 (2.1–12.2)		3.9 (2.5–6.0)			
PCL, mean difference						
Unadjusted					t(2,099) = 1.22	0.22
No/low combat	0.0 (ref)		0.0 (ref)			
Medium/high combat	12.2 (7.1–17.4)		8.8 (6.9–10.8)		t(2,061) = 1.14	0.25
Adjusted for demographics and military service factors ^b						
No/low combat	0.0 (ref)		0.0 (ref)			
Medium/high combat	9.4 (4.6–14.3)		6.6 (4.7–8.5)			

Notes: OR: odds ratio.

^aCombat exposure measured by number of experiences endorsed on an 18-item combat index.

^bAdjusted for race, enlistment age, zygosity, marital status at enlistment, education at enlistment, calendar year of enlistment, and branch of service.

TABLE 3

Weighted Lifetime and Current PTSD Prevalence and Mean PCL Scores According to Age Cohort in Theater Service—Discordant Twin Pairs

PTSD	PTSD					
	Service in Theater			Interaction by Age		
	Yes	No	Test Statistic	p	Test Statistic	p
Lifetime, ^a %					t(1,200) = 0.33	0.74
Age < 60	27.0 (18.1–38.3)	13.1 (7.1–22.9)	t(180) = 2.27	0.023		
Age 60	13.8 (10.6–17.7)	6.9 (4.5–10.4)	t(1,022) = 2.69	0.007		
Current, ^b %					t(1,194) = 0.55	0.58
Age < 60	18.1 (10.8–28.4)	7.2 (3.0–13.1)	t(176) = 2.23	0.026		
Age 60	10.8 (7.9–14.5)	3.0 (1.6–5.3)	t(1,018) = 3.87	<0.001		
PCL, mean					t(1,188) = 0.68	0.50
Age < 60	36.3 (31.9–40.6)	29.8 (26.7–32.9)	t(178) = 2.78	0.005		
Age 60	27.7 (26.3–29.2)	23.1 (22.2–24.0)	t(1,010) = 7.45	<0.001		

Notes: Values are percents or means, as indicated, with 95% CIs in parentheses. Prevalence and mean estimates, CIs, and p values provided for 91 theater service–discordant pairs < 60 years of age and 526 pairs 60 years. Weighted for nonresponse and to the characteristics of the living male U.S. population of Vietnam-era veterans; see also Supplemental Material.

^aDisorder classified according to DSM-IV criteria derived from the CIDI-IV.

^bCurrent refers to the last 12 months.