

U.S. Department of Veterans Affairs

# National Vietnam Veterans Longitudinal Study

## Executive Summary

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## 1 History, Aims, Study Design, and Implementation

### 1.1 Purpose

This report describes the findings from the National Vietnam Veterans Longitudinal Study (NVVLS), a follow-up study of an existing cohort of Vietnam Veterans that was funded and overseen by the Office of Research and Development, Department of Veterans Affairs (VA). In Public Law 104-419, Congress asked the VA to “enter into a contract with an appropriate entity to carry out a study on post-traumatic stress disorder” (PTSD) by reassessing the cohort of Vietnam Veterans that was first assessed in 1986–88 in the National Vietnam Veterans Readjustment Study (NVVRS; Kulka et al., 1990), which was also funded and overseen by the VA in response to earlier legislation (Public Law 98-160).

The objectives of this follow-up study specified four important research questions, which frame the structure of this report. The questions are:

- What is the long-term course of PTSD among Vietnam Veterans?
- Are there long-term medical consequences of PTSD?
- Are there particular subgroups of Vietnam Veterans at greater risk of chronic or more severe problems with PTSD?
- What services have Vietnam Veterans with PTSD received, and what has been the effect of those services on the course of the disorder?

### 1.2 Brief History of the NVVRS and NVVLS

Per the legislation and the VA’s Request for Proposals, NVVLS is a follow-up study of two cohorts of Veterans who participated in the NVVRS: (1) service members who were deployed to the Vietnam War, and (2) a comparison group who served during the Vietnam War era, but were not deployed to the Vietnam theater. In the decade following the May 17, 1975 proclamation by President Gerald R. Ford that the “Vietnam Era” was over, controversy arose concerning the status and well-being of the men and women who served in the war and returned to civilian life. One faction believed that Vietnam Veterans had answered the Nation’s call, served honorably, and successfully adjusted to civilian life, while another faction believed that for a nontrivial number of Vietnam Veterans “the war was not yet over.” Because both beliefs were based primarily on anecdotal evidence, in 1983 Congress passed Public Law 98-60, which directed the VA to contract for an independent national study of “the prevalence, incidence, and effects of PTSD and related postwar psychological problems” among Vietnam Veterans. In February 1984, the VA issued an open, competitive Request for Proposals to design and implement what became known as the NVVRS, and in September 1984, awarded the contract to Research Triangle Institute.

The NVVRS research team designed and implemented a comprehensive, scientifically sound study that included probability samples, a quasi-experimental design with two comparison groups, survey and clinical interviews conducted in person with Veterans, and in-person interviews with Vietnam Veterans’ spouses. Because the primary study aims were focused on the relationships between warzone stress exposure and postwar readjustment problems, the research team created a detailed, hour-long interview-based assessment of warzone stress exposure. Multivariate statistical analyses of those data supported the creation of a gender-sensitive, multidimensional model of exposure to warzone stressors that produced

quantified, personalized ratings of Vietnam warzone stress exposure for every Vietnam Veteran enrolled in the study.

Study findings indicated that although the vast majority of Vietnam Veterans had readjusted to civilian life smoothly, 15.2% of the men and 8.5% of the women who served in the war had current PTSD 15 or more years after their service; that those with higher levels of exposure to combat and other warzone stressors were four times more likely to have PTSD than those with lesser exposure; and that PTSD from warzone trauma was often comorbid with major depression, heavy alcohol use, and many other postwar readjustment problems.

## 1.3 Overview of NVVLS Study Design

### 1.3.1 Study Groups

As with the NVVRS, the NVVLS was designed to be a community epidemiologic study using probability sampling, survey and clinical assessments, and a non-equivalent comparison group quasi-experimental design. The original NVVRS design included three groups:

- **Theater Veterans:** U.S. service members who served on active duty during the Vietnam era (August 5, 1964, through May 7, 1975) and were deployed to the warzone—Vietnam, Laos, Cambodia, or the waters or airspace surrounding these countries.
- **Era Veterans:** U.S. service members who served on active duty during the Vietnam era but were not deployed to the warzone.
- **Civilian Counterparts:** Americans who did not serve in the U.S. military during the Vietnam era, matched to the Theater Veterans on the basis of age, sex, race/ethnicity (for men only), and occupation (for women only).

The era Veteran sample was drawn to represent *all* era Veterans, but the primary role of the era cohort is for comparison with the theater cohort. To maximize the internal validity of theater versus era comparisons, statistical adjustments were made in the analyses to equalize important sociodemographic characteristics (e.g., age, sex, race). In the NVVRS, additional sampling weights were created to make the adjustments, and in the NVVLS the characteristics were added as covariates in the comparison regression models.

### 1.3.2 Study Sample

The legislation calling for the NVVLS described a follow-up study of the Veterans who participated in the NVVRS and consented to being contacted in the future about participation in additional studies. The NVVRS research team used military records to draw stratified random samples of the 8.3 million Veterans who (a) served in the active duty military during the Vietnam era and (b) were still alive in 1987. They then contacted and succeeded in enrolling 2,348 such Veterans in the NVVRS: 1,632 (83.4% response rate) from the sample of those who served in the war, and a comparison group of 716 (76.7% response rate) from the sample of those who served during the war era but were not deployed to the war. In both groups, some subgroups were purposefully oversampled (e.g., Black and Hispanic male Veterans, female Veterans, wounded Veterans) so that they could be studied in more detail, and analysis weights were developed to remove any bias introduced by the complex sample design and nonresponse. Together, these 2,348 Veterans who comprised the two Veteran groups who participated in

the NVVRS in the late 1980s comprise the sample of Veterans who were eligible to participate in the NVVLS.

### 1.3.3 Assessment Protocol

The NVVLS assessment protocol included three sequential components:

- **Phase 1:** A package containing (a) a letter describing the study and (b) a self-report survey booklet—referred to as the Health Questionnaire—was mailed to all eligible Veterans ( $n = 1,920$ ), requesting that they fill out the Health Questionnaire at home and return it in a pre-addressed, postage-paid envelope when completed.
- **Phase 2:** Upon receiving completed Health Questionnaires, study staff called the sender to schedule a computer-assisted telephone interview (CATI), entitled the Health Interview, which was conducted by an experienced survey interviewer for all participants after they completed Phase 1.
- **Phase 3:** For the subset of theater Veterans who were pre-selected for the (stratified random) clinical subsample, when they completed their Health Interview, they were asked to make an appointment for the Clinical Diagnostic Telephone Interview, conducted by an experienced mental health clinician.

### 1.3.4 Implementation

The collection of data from the study sample began on July 3, 2012, when the first batch of packets containing the advance letter and Health Questionnaire was mailed to 500 cohort members, and ended with the completion of the last four clinical interviews on May 17, 2013. Evidence from a comprehensive mortality assessment conducted prior to data collection indicated that 1,920 cohort members were still alive. Of these, 81 were found to be deceased during recruitment for the first two study phases. Of the remaining 1,839, a total of 1,450 (78.8%) participated in at least one of the first two study phases:

- 1,238 (67.3%) completed both Phases 1 and 2
- 171 (9.3%) completed Phase 1 only
- 41 (2.2%) completed Phase 2 only.

For the clinical interview (Phase 3), out of 767 in the clinical subsample and alive at the outset of the study, 36 were found to be deceased during recruitment for the first two study phases, and an additional 4 were found to be dead when contacted for the clinical interview. Of the remaining 727, 400 (55.0%) began the clinical interview, and 390 completed it.

## 2 Characteristics of Vietnam Veterans

At the time of the NVVRS, 8,269,882 Veterans who had served during the Vietnam War era were alive. Of these Veterans, 38% (an estimated 3,150,811) served in the Vietnam theater of operations, and the remaining 5,119,071 Veterans served in the United States, in Europe, in Korea, at sea, or elsewhere in the military during the Vietnam era. Among theater Veterans, an estimated 3,143,645 were men and 7,166 were women. These women represented a minority of women Veterans serving at the time (2.6% theater versus 97.4% era Veteran women).

An estimated 19.1% of Vietnam theater and era Veterans had died in the intervening 25 years between the NVVRS and the NVVLS (including cases identified during recruitment), and approximately 6,668,495 Veterans who served during the Vietnam War were living at the time of NVVLS implementation. The

vast majority (96.5%) of the living Veterans were men, accounting for 99.8% of the theater and 94.6% of the era Veterans. Conversely, 3.5% of the living Veterans were women, accounting for 0.2% of the theater and 5.4% of the era Veteran cohorts.

In order to develop a statistical profile of Veterans of the Vietnam era still living at the time of the NVVLS to inform interpretation of the study findings, several sociodemographic and Vietnam military service characteristics were examined among the living cohort of theater and era Veterans.

### 2.1 Background Characteristics

The average age of the living Vietnam Veteran cohort as of 2013 was 66.13 years (SE = .14). Nearly half of theater and era Vietnam Veterans were born between 1945 and 1949 (45.3%; current age 64 to 68), and over one-quarter were born in 1950 or later (29.3%; current age 63 and below); however, birth year varied significantly by group. For instance, theater Veteran women were more likely to be age 69 or older than theater Veteran men and era Veteran women. Eighty-six percent of all living theater and era Vietnam Veterans were White (86.2%), 8.9% were Black, and 4.9% were Hispanic. There were observable deviations from this pattern among women theater Veterans, 94.7% of whom were White and only 2.0% Black and 3.3% Hispanic.

### 2.2 Military Service Characteristics

The majority of male theater Veterans were enlisted personnel with pay grades of E4 or E5 at the time of discharge (34.3% and 30.7%, respectively), and nearly half of era Veteran men had a pay grade of E4 at discharge (48.1%). A notable majority of theater Veteran women were discharged as officers with a pay grade of O1-O3 (70.6%), and theater Veteran women achieved significantly higher pay grades at discharge than did era Veteran women. Among Vietnam theater Veterans, nearly one quarter experienced high levels of warzone stress exposure in contrast to low/moderate exposure. A greater portion of theater Veteran women experienced high levels of warzone stress compared to theater Veteran men (39.9% vs. 23.5%). Approximately 23% of theater Veterans were wounded/injured in or around Vietnam, and the majority of wounds/injuries occurred in combat. Vietnam theater Veteran men were far more likely to sustain a wound/injury in combat than theater Veteran women (17.8% vs. 1.6%).

### 2.3 Current Sociodemographic Characteristics

At the time of the NVVLS, the majority of all Vietnam Veterans were married or living as married (73.1%), and nearly 15% were separated or divorced. More theater Veteran men were married or living as married than theater Veteran women (76.3% vs. 47.7%), and six times as many theater Veteran women were never married (23.5% vs. 3.8%). Among era Veterans, men were also more likely to be married or living as married than women (72.7% vs. 44.9%), and women were more often separated or divorced (33.8% vs. 14.3%), widowed (11.4% vs. 6.1%), or never married (9.9% vs. 6.9%) than men.

Twenty-eight percent of all living theater and era Vietnam Veterans were high school graduates, 33.7% completed some college, and 30% completed college and/or graduate work. Among theater Veterans, more women than men completed college (31.9% vs. 15.3%) and graduate professional work (38.0% vs. 11.3%). Theater Veteran women also generally completed higher levels of education than did era Veteran women. Approximately half (49.8%) of all theater and era Vietnam Veterans living at the time of the NVVLS were retired, and more than one-third (35.9%) were currently working. Vietnam theater Veteran

women were more likely than era Veteran women to be retired (69.3% vs. 51.4%), whereas era Veteran women were more likely to be currently employed (41.2% vs. 23.1%).

At the time of the NVVLS, over one-third of all Vietnam theater and era Veterans reported an annual personal income less than \$25,000, 33% between \$25,000 and \$49,999, and nearly 33% \$50,000 or above. Over one-third of all theater and era Vietnam Veterans reported an annual *family* income of over \$75,999 and approximately 20% reported a family income of less than \$25,000. The household income of the majority of theater and era Vietnam Veterans supported two persons (63.9%), and a little more than one-fifth (22.3%) supported only one person. Compared to theater Veteran men, theater Veteran women were more likely to support only one person with their household income (40.5% vs 20.1%), while theater Veteran men were more likely to support two to four people.

## 2.4 Discussion

In summary, the statistical profile of the current, living cohort of Vietnam Veterans suggests that there is notable variation of sociodemographic characteristics across key subgroups, particularly between theater Veteran men and women and between theater and era Veteran women. Findings also indicate that there are important differences in Vietnam service characteristics between theater Veteran women and men.

## 3 Mortality among Vietnam Veterans circa 2011

Prior to implementing the three phases of data collection, the NVVLS research team conducted a comprehensive mortality search to determine vital status among the 2,348 NVVRS Veteran participants since they participated in NVVRS interviews from 1986 to 1988. It is important to note that the original NVVRS sample was explicitly drawn to represent Vietnam War Veterans (theater and era) who were alive at the time the baseline study was implemented; therefore, mortality estimates from the follow-up study may only be generalized to the population of Vietnam Veterans who were alive at the time of the NVVRS survey assessment (1986–88).

### 3.1 Description of All-Cause Mortality and Causes of Death among the NVVRS Cohort

Results indicate that, as of April 2011, 428 (18.2%) of the 2,348 NVVRS participants were deceased, and that the weighted mortality estimate among Vietnam War Veterans at that time was 16.0% (95% CI: 13.1–18.9). Thus, based on the proportion found to be deceased, an estimated 1,324,930 total deaths have occurred among the population of Vietnam Veterans alive during the mid-1980s. The leading causes of death among Vietnam War Veterans were chronic and non-communicable diseases (78.7%; 95% CI: 67.8–89.5), including most prominently neoplasms (30.0%; 95% CI: 21.6–38.4) and heart disease (18.5%; 95% CI: 11.4–25.6). Injuries/poisoning and communicable diseases accounted for 10.3% (95% CI: 1.3–19.3) and 6.1% (95% CI: 1.4–10.8) of population deaths, respectively.

### 3.2 Bivariate Relationships of Potential Risk Factors for All-Cause Mortality

The weighted mortality rate for male Vietnam Veterans (16.2%; 95% CI: 13.2–19.3) was substantially higher than for female Vietnam Veterans (9.7%; 95% CI: 5.4–14.1), with male Veterans having a 73% increased risk of death compared to female Veterans. Older age was predictably associated with greater

risk for mortality, with an 11% increase in risk per each additional year of age (HR = 1.11; 95% CI: 1.09–1.13,  $p < .0001$ ). Across ethnic groups, mortality was highest among Black Veterans (25%; 95% CI: 19.1–32.1), with Black Veterans having an 84% increased risk of death compared to White Veterans.

PTSD at the time of the NVVRS was associated with a threefold increased risk of death, as compared to the risk of death among Veterans who did not have PTSD at the time of the NVVRS; the risk of death increased by 1% for every 1% percent increase in probability of PTSD at the time of the NVVRS (HR = 1.01; CI: 1.00–1.02,  $p = .0037$ ). The number of serious post-service readjustment problems was also associated with increased risk for death, with a 20% increase in risk of death per each additional serious readjustment problem (HR = 1.20; 95% CI: 1.11–1.29,  $p < .0001$ ).

Surprisingly, the weighted mortality rate was only slightly (and not significantly) higher among theater Veterans (16.8%; 95% CI: 14.0–19.6) than era Veterans (15.5%; 95% CI: 11.1–20.0). There was *not* a statistically significant elevation of deaths among theater Veterans with high exposure to warzone stress (21.1%; 95% CI: 15.6–26.5) compared to those with low/moderate exposure (15.1%; 95% CI: 11.8–18.4).

### 3.3 Multivariate Risk Models of PTSD for All-Cause Mortality and Selected Specific Causes of Death

The association between PTSD at the time of the NVVRS and mortality from any cause was robust to covariate adjustment, with the hazard ratio remaining well over 2.0 for both theater and era Veterans, even after adjusting for demographic factors. These results indicate that there is a doubling of risk of death for theater Veterans with PTSD even after controlling for demographic variables (HR = 2.25; 95% CI: 1.29–3.92), as compared to the threefold increase in risk described earlier that did not account for increased risk associated with demographic variables, such as age, ethnicity, and sex. Furthermore, the association between PTSD and mortality remained significantly elevated among theater Veterans even after accounting for demographic factors and self-reported physical health comorbidities at the time of the NVVRS (HR = 1.90; 95% CI: 1.04–3.46). These associations between PTSD and all-cause mortality for both theater and era Veterans were maintained when follow-up was extended from the primary mortality assessment endpoint of April 2011 to May 2013, in order to include additional deaths ascertained during the NVVLS Implementation phase.

Among theater Veterans, PTSD at the time of NVVRS was strongly and significantly associated with external causes of death and cancer, but somewhat surprisingly not heart disease. The association between PTSD and external causes of death (i.e., injuries, poisoning, suicide, and homicide) among theater Veterans was robust to adjustments for demographics (HR = 14.36; 95% CI: 3.13–65.79). The relationship of PTSD and mortality due to cancer was also strong for theater Veterans and robust to adjustments for demographics (HR = 2.98; 95% CI: 1.41–6.30). The numbers of deaths due to specific causes among era Veterans were too small to draw meaningful conclusions; however, it does appear that PTSD was associated with greater mortality due to external causes among this group as well.

### 3.4 Discussion

Using conservative methods, results indicate that the weighted mortality rate estimates for theater and era cohorts were statistically equivalent (16.8% and 15.5%, respectively); the majority of deaths among Vietnam Veterans (78.7%) were caused by chronic diseases and 10.3% of deaths were caused by external causes, such as injuries, poisoning (including drug overdose), suicide, and homicide; and theater Veterans

who had PTSD were more than twice as likely to die during this interval than those who did not have PTSD even after accounting for demographic variables. Among theater Veterans, PTSD at the time of the NVVRS was also associated with an elevated risk of death due to external causes and cancer, even after adjusting for demographic variables. These and other findings in the mortality component of the study confirm and extend the findings from prior studies and add new empirical evidence suggesting that PTSD is associated with a greater risk of death among war Veterans.

## 4 PTSD: Prevalence, Psychiatric Comorbidities, and Risk Factors

### 4.1 Prevalence Estimates of Current Warzone-Related PTSD, Other PTSD, and Any PTSD (Survey Assessment)

The PTSD prevalence estimates were derived from survey interview assessments by applying decision rules from the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; APA, 2013) to the PTSD Checklist (PCL-5; Weathers, Litz, Herman, Huska, & Keane 1993) enriched with the addition of items to capture symptom duration and functioning disturbances, two additional DSM-5 criteria not captured by the PCL-5. Applying these criteria and weighting to the full population of living Vietnam theater Veterans, the estimated prevalence of current warzone-related PTSD was 11.2% (8.3%–14.2%), and an estimated 14.5% of Vietnam theater Veterans met criteria for full or subthreshold warzone-related PTSD. Among male theater Veterans, the rate of current warzone-related PTSD was 11.2% (8.3%–14.2%), and 14.5% met criteria for either full or subthreshold PTSD. Among female theater Veterans, the rate of current warzone-related PTSD was 6.6% (3.5%–9.6%), and 9.1% met criteria for full or subthreshold PTSD. These prevalence rates indicate that 282,724 male theater Veterans and 399 female theater Veterans have warzone-related PTSD today, 40 or more years after their exposure. Furthermore, an additional 83,569 male theater Veterans and 153 female theater Veterans report clinically significant symptoms and meet subthreshold criteria.

The estimated prevalence of combined *other-cause* (not warzone-related) PTSD among living Vietnam theater Veterans was 4.6% (2.6%–6.6%), and 6.5% met criteria for full or subthreshold PTSD. For male theater Veterans, the prevalence for current “other” PTSD was 4.6% (2.6%–6.6%), and 6.5% met criteria for full or subthreshold PTSD. For female theater Veterans, the prevalence for current “other” PTSD was 5.1% (2.3%–7.9%), and 7.8% met criteria for full or subthreshold PTSD. Based on the same survey interview assessments, the prevalence for current *other-cause* (not warzone-related) PTSD among era Veterans is 1.4% (0%–3.0%), with an estimated 7.1% of era Veterans meeting criteria for full or subthreshold current PTSD.

Applying DSM-5 criteria to survey interview assessments, the estimated current prevalence of any PTSD (warzone-related and not warzone-related) for theater Veterans was 12.2% (9.2%–15.3%), and for era Veterans 1.4% (0%–3.0%).

### 4.2 Prevalence Estimates of Current and Lifetime Warzone-Related PTSD (Clinical Assessment)

Taken together, based on the Clinician Administered PTSD Scale (CAPS-5; Blake, Weathers, Fagy, & Kaloupek, 1995) assessments in the clinical interview, the estimated rate of combined current warzone-

related PTSD and subthreshold PTSD in theater Veterans was 10.8% (6.5%–15.1%), and of combined lifetime warzone related PTSD and subthreshold PTSD was 26.2% (19.9%–32.4%).

### 4.3 PTSD Symptoms among Theater and Era Veterans across a 25-Year Time Period

Because the Mississippi Scale for Combat-Related PTSD (M-PTSD) was the best validated measure available at Time 1 and was the only PTSD measure replicated at Time 2, it was selected as the primary measure of symptom severity. Theater Veterans had significantly higher scores on the M-PTSD scale at Time 2 than Time 1 (73.5 versus 69.7), indicating an overall higher level of symptoms among the cohort. The self-reported, military service-related PTSD symptoms among era Veterans were stable across time and generally low (M-PTSD scores across time points: 65.3 at Time 1, 64.0 at Time 2). As a group, era Veterans had PTSD symptom levels that were low and stable, and theater Veterans' levels were more likely to be higher and rising.

To further explore the course of PTSD symptom levels, four classes of PTSD symptom course were created based on the established NVVRS cut score on the M-PTSD: (1) stable high, (2) increasing, (3) decreasing, and (4) stable low. As expected in a resilient population of Veterans, the majority of theater Veterans evidenced stable low levels of PTSD across the 25-year follow-up period, with 75.4% of theater Veterans reporting low levels of PTSD symptoms at both Time 1 and Time 2. Among the three other symptom trajectory groups, 7.0% were high on symptoms at both time points, 4.6% improved from Time 1 to Time 2, and 13.0% were substantially worse at Time 2. Thus, among the 17.6% of theater Veterans who changed, the proportion of those who got worse was nearly three times that of those who improved.

### 4.4 Current and Lifetime Rates of Other Psychiatric Disorders and Comorbidities in Vietnam Theater Veterans in the NVVLS

Among Vietnam theater Veterans, the current prevalence rates for anxiety and mood disorders, and alcohol and drug abuse and dependence, were low, while lifetime rates were 3 to 10 times higher. For example, current rates for major depressive disorder are estimated to be 4.3% (1.7–6.8) and lifetime 15.8% (10.5–21.0) among theater Veterans. For substance use disorders, the differences between current and lifetime rates were even greater. For current alcohol abuse, the rate is estimated to be 3.2% (0.2–6.2) and for lifetime 28.0% (21.0–35.1), and for current alcohol dependence the rate is 1.5% (0–2.9) compared with lifetime alcohol dependence rate of 17.3% (11.9–22.6). Rates of lifetime drug abuse are estimated to be 10 times the rate for current drug abuse (8.5% versus 0.8%), while the lifetime drug dependence rate is 5.9% compared with the current rate for drug dependence, 1.2%. Taken together these findings indicate a major reduction in the burden of these other psychiatric disorders for currently living Vietnam theater Veterans.

As expected, among theater Veterans with current warzone-related PTSD as determined by CAPS-5, there were substantially higher rates of current comorbid depression and substance use disorders, as assessed by the Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1996). As one example, among theater Veterans who were PTSD negative in the current study, the rates of comorbid SCID-based major depressive disorder were 0.7% (0%–1.4%), while rates of comorbid major depressive disorders were present in 30.9% (5.7%–56.2%) of those with subthreshold warzone-

related PTSD and a notable 36.7 % (6.2%–67.2%) of those with current full warzone-related PTSD. Rates of comorbid alcohol and drug abuse were also greater in those with warzone-related PTSD and subthreshold PTSD.

### 4.5 Subgroups at Risk for Current Warzone-Related PTSD

Five risk factors assessed at the time of the NVVRS were examined in relation to PTSD outcomes at follow-up (NVVLS), including age at entry into Vietnam, gender, ethnicity, warzone stress/trauma exposure, and war-related injury.

#### 4.5.1 Bivariate Relationships between Risk Factors and PTSD

In bivariate analyses, there were strikingly large effects for ethnicity, especially for Hispanic theater Veterans, who had 1.5 to 3 times the rates of current warzone-related PTSD, compared to Black and White/other theater Veterans, respectively. Theater Veterans with high warzone stressor exposure had nearly four times the rate of current PTSD compared with those having low/moderate warzone exposure, and theater Veterans who were injured or wounded in combat had more than four times the rate of current warzone-related PTSD as those who were not injured/wounded.

#### 4.5.2 Multivariate Relationships between Risk Factors and PTSD Outcomes

Using multiple logistic regression modeling, the relationship of the five risk factors to current warzone-related PTSD among theater Veterans was examined to identify which risk factors were robust to the adjustment of other Veteran characteristics. Black Veterans had nearly two and a half times the risk of developing warzone-related PTSD compared to White/other Veterans (odds ratio 2.46; 1.29–4.69); Hispanics had more than three times the risk compared to White/other Veterans (odds ratio 3.13; 1.62–6.05); and theater Veterans injured or wounded in combat had nearly four times the risk compared to those not injured/wounded (odds ratio 3.73; 1.75–7.96). Two of the other risk factors, warzone stress exposure and age at entry into Vietnam, were only marginally related to warzone-related PTSD when all five risk factors were included in the model, and gender was not significant in the model.

Multivariate modeling was also utilized to examine which of the five risk factors were associated with *high PTSD symptoms* at Time 2, as measured by continuous scores on the M-PTSD. Black and Hispanic race/ethnicity, high warzone exposure, and younger age entry into Vietnam all predicted higher levels of current PTSD symptoms among theater Veterans, even after controlling for the effects of all other predictors in the model.

#### 4.5.3 Multivariate Relationships between Risk Factors and Longitudinal Changes in PTSD Status and Symptom Severity

In multivariate tests of risk factors for *change in levels of PTSD symptoms* from Time 1 to Time 2, as assessed by the M-PTSD, ethnic minority status (Hispanic and Black), and being between 17 and 19 years of age at entry into Vietnam predicted increases in PTSD symptoms over time, while gender, warzone stress exposure, and being wounded or injured in combat did not.

Next, the analyses examined which of the five risk factors predicted significant differences in stability and change in PTSD symptoms, using the same four classes of symptom trajectories on the M-PTSD scale as defined earlier: stable high, increasing, decreasing, and stable low PTSD symptomatology. Compared to female theater Veterans, male theater Veterans were three times as likely to have stable high PTSD symptom trajectories and nearly twice as likely to have increasing symptom trajectories. Black theater

Veterans were nearly three times more likely to have stable high symptom trajectories when compared with White/other theater Veterans. Both Blacks and Hispanics were two and a half times more likely to have increasing symptom trajectories compared with Whites/others. Among Veterans evidencing substantial changes in PTSD symptoms between the two time points, the ratios of those with significant increasing symptoms to those with decreasing symptoms were nearly 10:1 among Hispanics and 5:1 among Blacks, as compared to only 2:1 among Whites/others.

Theater Veterans with high warzone exposure were more than five times as likely to have stable high symptom trajectories and nearly twice as likely to have increasing symptom trajectories when compared with theater Veterans with low/moderate warzone exposure. Similarly, theater Veterans injured or wounded in combat were nearly four times more likely to have stable high symptom trajectories and nearly twice as likely to have increasing symptoms compared to those not injured/wounded. Among those injured or wounded in combat who changed in symptom status, the ratio of those whose symptoms significantly increased to those whose symptoms decreased was nearly 5:1.

By comparison with theater Veterans who were 20 years of age or older at the time of entry into Vietnam, theater Veterans who were aged between 17 and 20 at entry into Vietnam were much more likely to be members of the stable high and increasing symptom trajectory groups.

### 4.6 Discussion

At Time 1 (NVVRS), an estimated 15.2% (12.65%–17.75%) of Vietnam theater Veterans met criteria for current PTSD. At Time 2 in the NVVLS, the enhanced PCL5-M was utilized in the survey sample as our primary measure to estimate that the rate of current warzone-related PTSD was 11.2% (8.3%–14.2%) in the full population of Vietnam theater Veterans living today. The estimated rate of any current PTSD, combining warzone-related and other-cause PTSD, was 12.2% (9.2%–15.3%) in Vietnam theater Veterans living today. Several factors may account for the changes in prevalence rates from Time 1 to Time 2, including mortality between assessments, aging, changes in diagnostic criteria, and changes in measurement instruments.

At the time of the NVVLS, PTSD estimates derived from CAPS-5 interviews in the clinical interview sample were substantially lower than estimates based on applying DSM-5 decision rules to the enhanced PCL-5 in the Phase 2 survey interview sample. A number of factors may contribute to this discrepancy, including differences in how participants perceive the meaning of symptoms with and without guidance from clinicians. Further, responses to survey interview questions on a standardized self-report questionnaire are more likely to be influenced by general emotional distress in comparison with clinical interviews, which more precisely delineate the symptoms of a given syndrome. The CAPS-5 protocol also includes a large number of new questions or probes to ascertain the clinical salience of symptoms, a factor that is inherently conservative with respect to scoring symptoms as meeting criteria for moderate or greater severity. Surprisingly, participants disclosed substantially higher levels of PTSD symptoms in the clinical interviews when asked about their worst *lifetime* versus *current* episode of distress.

Four decades or longer since their deployments, Vietnam theater Veterans with current PTSD continue to experience high levels of comorbid psychiatric disorders. Most notably, rates of comorbid depression are more than 50 times greater in theater Veterans with current PTSD compared to those who are PTSD negative. The substantial rate of current subthreshold PTSD also represents an important public health

concern, given the literature that suggests that subthreshold PTSD is associated with levels of functional impairment that are comparable to or approaching levels associated with full PTSD.

Several robust risk factors were identified that relate to the development and trajectory of warzone-related PTSD. When five risk factors assessed at the time of the NVVRS were accounted for (i.e., gender, age, warzone stress, wound history, age), Black and Hispanic ethnicity and a history of combat-related injury were significantly associated with elevated rates of warzone-related PTSD at the time of the NVVLS. With respect to predictions of current PTSD *symptom severity*, Black and Hispanic race/ethnicity, high warzone stress exposure, and being 17 to 19 years of age at the time of entry into Vietnam were associated with greater PTSD symptomatology in theater Veterans.

When examining *changes in PTSD symptoms*, Blacks and Hispanics were far less likely than Whites/others to have stable low symptom levels across the 25-year interval. Among those who changed in either direction, the ratios of those whose symptoms increased (who got worse) to those whose symptoms decreased (who got better) were 10:1 and 5:1 for Hispanics and Blacks, respectively, compared to only 2:1 among Whites/others. These ratios were also over 2:1 among those with high warzone stress exposure, nearly 5:1 among those injured in combat, and over 4:1 among those who were aged 17-19 when first exposed to combat. Thus, these five factors, to varying degrees, are not only associated with PTSD at each of the two time periods—one 15 years after the war and the other more than 25 years later, or 40 years after the war—but also with significant and important changes in the course of PTSD among the same Veterans over that time period, rather than simply average or mean changes in symptom levels over this period.

## 5 PTSD and Chronic Health Conditions in Vietnam Veterans

NVVLS findings concerning the relationships between (a) chronic physical health conditions and (b) warzone-related PTSD and its frequent comorbidities—major depression and alcohol use disorders—are summarized here. A growing body of literature links a diagnosis of PTSD with many physical health symptoms and comorbidities. Some studies have found an association between PTSD and multiple health conditions, while others have focused on specific conditions such as cardiovascular disease and chronic pain. Few studies have focused specifically on older adults.

### 5.1 Evidence from NVVLS Veteran Mortality Data

The all-cause weighted mortality estimates of the proportion of deceased theater Veterans were examined according to key cohort health characteristics, including the presence or absence of a select number of specific chronic health conditions. These analyses were adjusted for age, sex, and race/ethnicity. Compared to Veterans with no self-reported chronic health problems at the time of the NVVRS, Veterans with four or more of the 35 NHIS-listed chronic health problems were more than twice as likely to die than those with fewer or no such conditions (HR = 2.29, CI: 1.40–3.74). Theater Veterans with a history of high blood sugar or diabetes (HR = 3.96, CI: 2.38–6.59); high blood pressure or hypertension (HR = 2.18, CI: 1.51–3.16); myocardial infarction/heart attack (HR = 2.84, CI: 1.57–5.15); other heart trouble affecting circulation (HR = 2.36, CI: 1.39–3.99); and stroke/high blood pressure/heart disease (HR = 2.18, CI: 1.54–3.07) had a significantly increased (two to four times) risk of death. General indices of perceived health were also associated with mortality outcomes among theater Veterans. Theater Veterans who characterized their health status as “poor” at the time of the NVVRS had more than eight times the risk of

death as those who reported “excellent” health (HR = 8.53, CI: 3.79–19.17), and there was a monotonic increase in mortality risk across worsening health ratings or categories of self-rated health.

### 5.2 Evidence from Self-Reports of Chronic Physical Health Conditions by Living Veterans

Veterans in the NVVLS reported on both lifetime (i.e., had condition at some time, but not bothered by it in the past 12 months) and current (i.e., bothered by the condition in the past 12 months) chronic physical health conditions during the NVVLS Phase 2 telephone survey interview. Among male theater Veterans, 21.9% reported having had 0–2 lifetime conditions, but 55.6% reported having had 5 or more (range: 0–21), and among female theater Veterans, 22.2% reported having 0–3 lifetime conditions, but 57.9% reported having 6 conditions or more (range: 0–19). On average, males reported having had 5.4 lifetime conditions and females 6.6 (N.B.: four of the NHIS conditions apply only to women, so women have more conditions to potentially endorse than do men). For both males and females, the number of conditions endorsed by Veterans who had warzone-related PTSD was significantly higher than for those who did not.

Among males, the mean number of current conditions was 2.7, and the range was 0–16 conditions. Among females, the mean number of current conditions was 2.4, and the range 0–11. The numbers of conditions endorsed by males and females who had warzone-related PTSD were significantly higher than the numbers endorsed by those who did not have warzone-related PTSD.

These findings document that almost all theater Veterans alive today have had experience with important chronic physical health conditions in their lifetime, and most are living with one or more of these conditions today. They also indicate that there is a robust relationship for theater Veterans between warzone-related PTSD and the number of chronic physical health conditions that they have experienced both over their lifetime and in the current day.

The research team also examined the relationship between lifetime chronic conditions and Veterans’ rating of their health status, using a five-category rating scale: excellent, very good, good, fair, and poor. Among males, 83.4% of those who rated their health as excellent reported four or fewer lifetime conditions, but 91.7% of those rating their health as poor reported five or more conditions. Among females, 66.4% of those rating their health as excellent reported having five or fewer conditions, and 78.6% of those rating their health as poor reported 11 or more conditions. For both males and females, the correlation coefficient for chronic conditions and perceived health status was 0.51, indicating a strong relationship.

### 5.3 Discussion

The evidence provided indicates a robust relationship between warzone-related PTSD and self-reported chronic physical health conditions among male and female theater Veterans, and inconsistent with the recent literature—PTSD is correlated with many physical health problems. In addition, the lifetime prevalence among theater Veterans of many important conditions is substantial—e.g., hypertension, 61.0%; arthritis/rheumatism/gout, 54.9%; high sugar/diabetes, 31.7%; any cancer, 24.9%. Analyses of the mortality data are consistent with the survey findings, as those who reported four or more chronic conditions at baseline were more than twice as likely to be deceased at follow-up as those who reported three or fewer.

Findings also reveal a robust relationship between chronic physical health conditions and Veterans' self-ratings of their health status. For both genders, the number of conditions reported rose as the rating dropped. These findings are also confirmed by the mortality data, which show that Veterans who rated their health as poor at baseline were nearly nine times more likely to be deceased at follow-up as Veterans who had rated their health as excellent. Although these findings *do not* mean that PTSD creates chronic health conditions and/or lower self-rated health status—or vice versa—they do suggest that there may be information in the relationships that could be helpful in (a) identifying Veterans in need of healthcare, and (b) delivering services that address all of the Veteran's needs.

For example, the surprisingly robust correlations that both the chronic conditions assessment and the self-report of health status have with current warzone-related PTSD suggest that one or both of these health assessments could be used as screeners in the VA and other clinics to identify Veteran patients who should be assessed in more depth clinically. Doing so would reduce the likelihood of missing important comorbidities, reduce patient burden, and possibly reduce costs. Overall, the findings support the importance of providing healthcare for Veterans that is well integrated between health and mental health providers.

Finally, many of the findings reported here are based on participant self-reports given in surveys. Although useful and economical, self-reports have limitations, so future research should include biomarkers, medical records, and other more definitive data sources. Similarly, the conditions covered on the list are diverse in severity and do not span the entire range of chronic physical health conditions, both of which may limit the validity of the scale. More research is clearly needed.

## 6 Mental and Physical Health Service Use by Vietnam Veterans

The service utilization analyses compared health and mental health service use among Veterans by theater versus era status, as well as PTSD status, across multiple service use categories, including VA and non-VA inpatient and outpatient services. In particular, analyses addressed whether the same patterns from the NVVRS of higher prevalence of health service use among those with PTSD were evident in the current wave of data collection, given a much older cohort of Vietnam Veterans. In addition, analyses were conducted to identify differences in the patterns of health service use across groups of Veterans with different trajectories in PTSD symptomatology from the NVVRS to the NVVLS, as well as by other current co-occurring conditions and by racial/ethnic categories.

### 6.1 Relationship of Mental and Physical Health Service Use to Veteran Characteristics and Behavioral Health Conditions

In some service categories, male and female theater Veterans had higher utilization of health services compared to era Veterans. Both male and female theater Veterans had higher use of any VA outpatient services compared to male and female era Veterans, and female theater Veterans had higher rates of any VA inpatient services for physical or mental health compared to female era Veterans. Female theater Veterans with high warzone stress exposure also had significantly higher rates of inpatient mental health service utilization than era Veterans.

Male and female theater Veterans who had *any* current PTSD, warzone-related or from other causes, were more likely to use VA inpatient and outpatient services in their lifetime compared to those without PTSD, while male theater Veterans with PTSD were *less* likely to use non-VA services in their lifetime compared to those without PTSD. Similar patterns were observed looking at *frequency* of service use; theater Veterans with any PTSD (warzone- and not warzone-related) reported much higher overall yearly frequency of VA outpatient visits, and a marginally higher number of VA inpatient visits in the last year, compared to those without PTSD. Most striking, when examining the settings where Veterans reported receiving their outpatient care in the last 6 months, Veterans with any PTSD were far more likely to have received care only in a VA facility compared to those without PTSD. Males with any PTSD were also significantly more likely to talk about behavioral health concerns during a visit for a physical health condition compared to those without PTSD.

In general, higher rates of service utilization were evident for theater Veterans with high depressive symptomatology compared to those at lower levels across most service utilization outcomes. Prevalence of service use increased proportionately with higher numbers of chronic health conditions across most service use categories. No significant differences were found in service utilization between theater Veterans with and without harmful alcohol use.

### **6.2 Rates of Lifetime Service Use by Course of PTSD Symptomatology among Theater Veterans**

Looking at the service use patterns across different course of PTSD symptomatology categories, theater Veterans who had high symptomatology at both the NVVRS (Time 1) and the NVVLS (Time 2) or increasing PTSD symptomatology across the two time points had much higher lifetime VA service utilization rates for most service types compared to those with decreasing symptomatology or low PTSD symptomatology at Time 1 and Time 2. For example, rates of VA outpatient treatment were almost two times higher for those with in the stable high and increasing PTSD categories compared to those in the decreasing and stable low categories. Theater Veterans in the stable high and increasing PTSD symptomatology categories also had a greater proportion of Veterans who identified a VA facility as their source of usual care compared to those with decreasing and stable low PTSD symptomatology. Not surprisingly, in analyses conducted with the clinical subsample, those with stable high and increasing PTSD symptomatology also had extremely high rates of mental health service use across their lifetimes compared to those with decreasing or stable low PTSD symptomatology.

### **6.3 Rates of Service Use for Male Theater Veterans across Racial/Ethnic Categories**

Analyses of differences across race/ethnicity in use of services found higher rates of utilization for Blacks compared to Whites in many service use outcome categories, and particularly for VA services. Blacks and Hispanics were both significantly more likely to talk about behavioral health issues within the context of a physical health visit compared to Whites. In analyses using the clinical subsample, both Blacks and Hispanics reported significantly higher use of mental health services in their lifetime compared to Whites.

## 6.4 Discussion

In sum, although the current NVVLS cohort represents a population where physical health concerns due to aging are likely to be widespread, the associations between any PTSD (warzone- and not warzone-related) and increased use of healthcare services remain strong, as well as relationships between high depressive symptomatology and use of services. Analyses looking at the course of PTSD symptomatology suggest that certain Veterans who experienced high symptomatology between Time 1 and Time 2, or increasing symptomatology between the two time points are more highly represented in VA facilities than less symptomatic Veterans. Although this analysis presents information from only two time points, these differences in service utilization rates suggest high levels of need for healthcare and mental health services over many decades for this group of Veterans with high PTSD symptomatology.

## 7 NVVLS Strengths, Limitations, and Next Steps

### 7.1 Strengths and Limitations

As with all empirical research, the NVVLS has both strengths and limitations. The important strengths of the NVVLS include:

- Probability sampling, which provides strong external validity (i.e., generalizability of the findings);
- Comprehensive assessment with proven, multiple measures, including both self-report survey-based measures and semi-structured clinical diagnostic interviews;
- Quasi-experimental design with comparison groups, to support the ruling out of important competing hypotheses;
- A longitudinal design that allows for comparisons among the same subject at two points in time;
- Professional data collection at both time points; and
- A seasoned, multi-disciplinary team of investigators to analyze the data and report the findings.

The important limitations of the NVVLS derive largely from the nature of the study aims and the study design. The research questions involve important postwar outcomes, so the study focuses on prevalence estimates and changes from Time 1 to Time 2. Therefore, the design is best categorized as descriptive epidemiology—estimating the prevalence of each of the study outcomes, and exploring the relationships between outcomes and other variables of interest (e.g., potential risk factors). Because variable relationships are measured via correlation, the ability to make causal inferences from the findings is dampened, even with quasi-experimental comparisons. Definitive causal inference requires random assignment to specific conditions (e.g., drug or placebo). So, findings from the NVVLS tell us about relationships, but do not tell us what caused what—that must be studied in a different design.

NVVLS has other limitations as well. The lengthy interval between the two data collection points is not ideal, diluting our ability to establish course of illness in detail. Although participation levels were remarkably high given the long interval between the NVVRS and NVVLS, nearly 20% of the cases in the original cohort had died, and others could not be interviewed in the NVVLS for a number of reasons, thereby reducing the follow-up sample sizes and precision of estimates, as well as potentially subjecting

results to both known and unknown biases. The 25-year window between Time 1 and Time 2 also limits the ability to study course of illness: relying heavily on participant self-reports raises questions of validity, as does the lack of biomarkers, medical records, and other unbiased sources of information. Self-reporting is also not well suited to address many questions and hypotheses that have emerged as important issues in the military and among Veterans over this period, including for example, relationships between PTSD and traumatic brain injury (TBI) or more refined analyses of remission and relapsing of symptoms and diagnoses of PTSD and other disorders among those who served in the Vietnam War.

## 7.2 Suggested Next Steps for the NVVLS

Because the NVVLS employs assessment at two points in time and a registry that records the deaths in the only nationally representative sample of Vietnam Veteran cohorts, it is now more valuable than ever. This trove of information over time can support analyses that provide answers to many important but as-yet-unanswered questions about long-term outcomes among service members who serve in warzones. The following subsections describe some of the NVVLS team's suggestions for enhancing the ability of the NVVLS to inform policy decisions and clinical practice.

### 7.2.1 Maintain the Mortality Registry with Periodic Updates

Now that a 25-year death registry for NVVRS/NVVLS participants has been created, it should be updated periodically (e.g., every 3–5 years) until all of the participants are deceased. Although the current size of the living cohorts does not provide the statistical power that the study was designed for, the additional deaths raise the power of the mortality analyses, and the longer-term follow-up data can illuminate the impact of chronic conditions with late-life onset (e.g., dementia) on war-exposed service members, which could otherwise go undetected. Additionally, acquiring death information from national death registries is easier and much less expensive than conducting national surveys of the living, and may follow a nearly identical protocol to the one employed in the NVVLS.

### 7.2.2 Continue to Assess the Living Cohort in Much Shorter Intervals

Documentation of changes in health and mental health status across the life span is important in planning for and improving health service delivery. The cohorts should be assessed according to a regular schedule (e.g., every 3–5 years) until all cohort members are deceased. The NVVRS/NVVLS measures should be repeated in these assessments and a dementia component added, to further develop the longitudinal database and to address causal questions regarding the relationship of Vietnam military service to key physical and mental health outcomes across the cohorts' lifespan. Further, the incorporation of the clinical interview component will be essential in accurately capturing and accounting for the course of key mental health outcomes, including PTSD, and the influence of service utilization on these conditions.

### 7.2.3 Conduct Studies of Promising Biomarkers with Purposively Chosen Subsets of the Cohorts

Given the biases inherent in both self-report and clinical interview based diagnoses of PTSD, it is important to conduct imaging, genetic, multi-omic, and proteomic biomarker studies of current PTSD, subthreshold PTSD, and PTSD-negative participants from the clinical interview sample, enriched by sampling selected groups from the male and female survey samples, to include oversampling for women and minority Veterans.

### **7.2.4 Merge VA and Other Health Records (e.g., Medicare) to Improve Our Knowledge about Health and Mental Health Service Use and Costs**

Because self-reporting of health and mental health has been shown to be reliable only over short periods of time (e.g., 6 months for outpatient visits, 12 months for inpatient stays), medical records are both more accurate and much more comprehensive. Given the ages of the NVVLS cohort, the VA and Medicare together will become the important sources of the cohorts' medical records. Merging of health records and the rich NVVRS/NVVLS database would provide important service use and outcome estimates and would support examination of changes in health service usage and outcomes over time. More generally, by merging these data with other VA records, most notably an updated record of service-connected disabilities, both data from the NVVLS and NVVRS, as well as data from health records, could provide an even greater resource for understanding the history and continued course of health, well-being, and service needs of this very large component of the Veteran population.

### **7.2.5 Examine the Prevalence and Long-Term Consequences of TBI (Concussion) and Other Closed-Head Injuries in Vietnam Theater Veterans**

Head injury has long been a frequent and important outcome of war, and has become more prevalent in recent conflicts. Because only a few studies of the epidemiology of TBI and other head injuries in the Vietnam War have been conducted, it may be prudent to consider assessing head injury in the next wave of the NVVLS. Collaboration with existing studies (e.g., the Registry-based Vietnam Head Injury Study, which began in the 1970s) would be appropriate.