

Original Contribution

The Physical and Mental Health of Australian Vietnam Veterans 3 Decades After the War and Its Relation to Military Service, Combat, and Post-Traumatic Stress Disorder

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The long-term health consequences of war service remain unclear, despite burgeoning scientific interest. A longitudinal cohort study of a random sample of Australian Vietnam veterans was designed to assess veterans' postwar physical and mental health 36 years after the war (2005–2006) and to examine its relation to Army service, combat, and post-traumatic stress disorder (PTSD) assessed 14 years previously (1990–1993). Prevalences in veterans ($n = 450$) were compared with those in the Australian general population. Veterans' Army service and data from the first assessments were evaluated using multivariate logistic regression prediction modeling. Veterans' general health and some health risk factors were poorer and medical consultation rates were higher than Australian population expectations. Of 67 long-term conditions, the prevalences of 47 were higher and the prevalences of 4 were lower when compared with population expectations. Half of all veterans took some form of medication for mental well-being. The prevalence of psychiatric diagnoses exceeded Australian population expectations. Military and war service characteristics and age were the most frequent predictors of physical health endpoints, while PTSD was most strongly associated with psychiatric diagnoses. Draftees had better physical health than regular enlistees but no better mental health. Army service and war-related PTSD are associated with risk of illness in later life among Australian Vietnam veterans.

combat disorders; health status; psychiatry; stress disorders, post-traumatic; veterans; Vietnam

Abbreviations: ABS, Australian Bureau of Statistics; CAPS, Clinician-Administered PTSD Scale; CI, confidence interval; CIDI, Composite International Diagnostic Interview; CURF(s), Confidentialised Unit Record File(s); DSM-III-R, *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition, Revised; OR, odds ratio; PTSD, post-traumatic stress disorder; SD, standard deviation.

Australian military forces were deployed to Vietnam from 1962 to 1972, making it the longest military conflict experienced by Australia to date. The conflict placed Australian men into longer periods of risk of contact with the enemy than at any time in Australia's history since the Gallipoli Campaign (1). More than 50,000 Australians saw service in Vietnam; over 500 lost their lives, and more than 2,500 sustained wounds.

Evidence that postwar survivors of combat continue to suffer ill health (2) has accumulated from postwar studies of military service members from World War II (3–7), the Vietnam War (8–18), the Middle East conflict (19–21), and

the Persian Gulf War (22–31). Cross-sectional epidemiologic studies have been conducted in Australian veterans of the Vietnam War (15–17), the Persian Gulf War (28, 29), and the Korean War (32). Each study showed that chronic mental health problems, particularly post-traumatic stress disorder (PTSD), anxiety, and depression, are prevalent in postwar military cohorts. This is broadly consistent with findings from studies carried out in other allied countries, including the United States (33) and the United Kingdom (26, 30). The recency of the Iraq and Afghanistan conflicts and the timing of earlier studies of the Vietnam conflict have constrained follow-up periods to relatively

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short durations, with only a few studies extending over more than 20 years—mostly retrospective studies of World War II and Korean War cohorts (3–7).

If combat soldiers are similar to their background general populations, it would be expected that the prevalence of most physical health disorders would increase with age while the prevalence of psychiatric disorders would decline (34–36). Given the chronic nature of PTSD (37, 38) and frequently observed comorbid conditions (39–43) and a possible link between PTSD and physical health (14, 44, 45), the question of aging veterans' health remains important.

We studied the self-reported physical and mental health of a cohort of Australian Vietnam veterans who were assessed approximately 20 years and 34 years after the war. We compared veterans' health with that of the Australian general population using official statistical data and examined the effect of relations between aspects of military and Vietnam service and PTSD on veterans' physical and mental health.

MATERIALS AND METHODS

Veterans were identified from a computer file developed during Australian Agent Orange studies (46–48) that holds the Army service numbers of all men who were posted to Vietnam. From the total of 57,643 postings, after removing duplicates, we selected a random sample of 1,000 numbers. The Army supplied the name and date of birth of each man for tracing and contact. Addresses for wave 1 were gathered through computerized searches of the Australian Electoral Roll (voting, and hence registration, is compulsory in Australia) and several government agencies and ex-service organizations. In wave 2, the Department of Veterans' Affairs distributed mail to veterans; nonresponders were sought through wave 1 addresses and addresses from the Australian Electoral Roll. Wave 1 interviews occurred between July 1990 and February 1993, and wave 2 interviews between April 2005 and November 2006. Wave 1 was conducted an average of 21.96 years (standard deviation (SD), 1.91) after the service member's first return to Australia and wave 2 an average of 36.10 years (SD, 1.92) afterward, with an average between-interview interval of 14.18 years (SD, 1.92). Deaths were identified through electronic searches of the National Death Index (Australian Institute of Health and Welfare).

Interview assessments comprised standardized questionnaires selected to permit direct comparison with national population statistics. The questionnaires were administered by trained clinical and research interviewers. In both waves, we relied on Australian Bureau of Statistics (ABS) data and methods used to gather national statistics on the health of the Australian population at approximately corresponding times.

The content of the interviews in both waves comprised: 1) the ABS National Health Survey, assessing physical health and associated risk factors, that was current at the time (the 1989–90 National Health Survey (49) in wave 1 and the 2004–05 National Health Survey (50) in wave 2); 2) a 21-item combat index (51); 3) assessment of combat-related PTSD (the Structured Clinical Interview for DSM-III-R

(52), which is based on the *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition, Revised (DSM-III-R), in wave 1 and the Clinician-Administered PTSD Scale (CAPS) (53) in wave 2); and 4) assessment of general psychiatric status (the Diagnostic Interview Schedule (54) in wave 1 and the Composite International Diagnostic Interview (CIDI) (55) in wave 2). For non-combat-related PTSD, the appropriate module of the Diagnostic Interview Schedule or CIDI was used. The version of the CIDI used was that used by the ABS in 1997 in the first Australian National Survey of Mental Health and Wellbeing (35, 56); these were the only population mental health data extant at the time of the wave 2 interviews.

The ABS 2004–05 National Health Survey included a question on a subjective overview of health (the first question in the SF-36 Health Survey (57)) and then proceeded to a set of questions on recent health actions, health risk factors, and specific conditions that were of target interest to the ABS: cancer, cardiovascular disease, asthma, arthritis, and diabetes. The National Health Survey also included categories for mental and behavioral problems, independently of CIDI diagnoses. "Gate" questions (typically "Have you ever been told by a doctor or nurse that you have had [condition]?") were followed by specific questions regarding age of onset, health actions taken, medications used, whether the condition was injury-related, and so forth. The survey then asked about long-term conditions that had lasted or were likely to last for 6 months or more; this was followed by a checklist of long-term or chronic conditions.

The ABS also provided the computerized Confidentialised Unit Record Files (CURFs) from the 2004–05 National Health Survey and the National Survey of Mental Health and Wellbeing for direct comparison with veteran data. This permitted us to compare the numbers of cases of particular illnesses (e.g., hypertension, depression) found among the veterans with the expected numbers of cases based on the Australian population for each age group. Physical and psychiatric conditions were coded according to the World Health Organization's *International Classification of Diseases*, Tenth Revision.

Prior to wave 1 fieldwork, with assistance from the Australian Army, data on the cohort were extracted from the Central Army Records Office and the Psychology Corps Records Office. Data gathered included type of enlistment (Regular enlistment vs. National Service conscription), service details (postings, dates, service milestones), conduct and casualty information, pre-enlistment education and employment, and the results of Army psychology classification tests. Included in these tests was the Army General Classification Test, a test of general intelligence that was found in earlier studies (58) to correlate highly ($r = 0.8$) with the Raven's Progressive Matrices (59) and which was periodically normed on Regular soldiers and scaled with a mean of 10.5 and a standard deviation of 4.

Combat was assessed in 2 ways: 1) from veterans' subjective reports, using a 21-item combat scale (51) that was administered at both waves, and 2) from Army records, based on the roles that individual units had played, as determined by military advisers to previous Australian studies of Vietnam veterans (46–48). The Army combat index

Table 1. Demographic and Lifestyle Characteristics and Use of Psychotropic Medications Among Wave 2 Respondents ($n = 450$) in a Study of Australian Vietnam Veterans and Associated Relative Prevalences of Those Factors in Comparison With Age- and Sex-Matched Data From the Australian General Population, 2005–2006

| | Prevalence, % | Relative Prevalence | 95% Confidence Interval |
|---|------------------|------------------------|----------------------------|
| Marital status | | | |
| Married | 78.2 | 0.94 | 0.85, 1.04 |
| Separated | 4.2 | 1.23 | 0.62, 1.84 |
| Divorced | 10.5 | 0.99 | 0.71, 1.27 |
| Widowed | 2.7 | 0.80 | 0.39, 1.19 |
| Never married | 4.5 | 0.80 | 0.48, 1.11 |
| Birthplace | | | |
| Australia | 93.3 | 1.42 | 1.26, 1.59 |
| Other Anglophone country | 4.2 | 0.26 | 0.20, 0.31 |
| Other country | 2.4 | 0.11 | 0.09, 1.34 |
| Highest level of education, years | | | |
| 12 | 26.4 | 0.82 | 0.69, 0.95 |
| 11 | 7.8 | 0.92 | 0.63, 1.21 |
| 10 | 39.6 | 1.30 | 1.01, 1.49 |
| 9 | 13.8 | 1.11 | 0.82, 1.40 |
| ≤8 | 12.4 | 0.62 | 0.49, 0.75 |
| Employment status | | | |
| Employed full-time | 21.9 | 0.43 | 0.37, 0.48 |
| Employed part-time | 8.3 | 0.71 | 0.52, 0.90 |
| Not in work force | 69.8 | 1.77 | 1.51, 2.03 |
| Housing tenure | | | |
| Owner | 86.4 | 0.99 | 0.89, 1.09 |
| Renter | 10.1 | 0.71 | 0.53, 0.88 |
| Other | 4.0 | 1.29 | 0.61, 1.98 |
| Hospital admission in past year | 27.8 | 1.42 | 1.12, 1.72 |
| Health action in past 2 weeks | | | |
| Visit to day clinic | 8.0 | 2.04 | 1.09, 2.99 |
| Visit to general practitioner | 36.9 | 1.44 | 1.18, 1.70 |
| Visit to medical specialist | 19.6 | 2.47 | 1.67, 3.28 |
| Visit to dentist | 11.8 | 1.65 | 1.08, 2.22 |
| Visit to other allied health professional | 33.3 | 2.37 | 1.78, 2.95 |

Table continues

grouped the units that had been present in Vietnam into 6 categories, depending on their role and presence in the field and thus their proximity to the “sharp end” of combat. These data were then weighted by the length of time each man had been posted to each unit, aggregated over all tours of duty, to produce a continuous scaled measure of exposure to combat that was independent of veterans’ self-reports. Each item on the self-reported combat exposure scale was coded according to the frequency of exposure to each event: never (0), once (0.25), 2–5 times (0.5), 6–10 times (0.75), or more than 10 times (1.0). Scales were computed with a range of 0 (no combat) to 21 (extreme combat). The correlations between the measures of combat exposure based on Army postings and those based on self-reports in waves 1 and 2

were only moderate, at 0.44 and 0.43, respectively, although they were statistically significant ($P < 0.001$); the correlation between wave 1 and wave 2 self-reported combat scores was 0.82 and statistically significant ($P < 0.0005$).

All interviews with veterans were conducted in wave 1 by then-current members of the research team, volunteer counselors from the Vietnam Veterans Counseling Service, or volunteer officers from the Australian Army Psychology Corps. In wave 2, interviews were conducted by 1 member of the research team (author A) and by independent clinician-counselors recruited via their then-affiliation with the Vietnam Veterans Counseling Service or the Australian Centre for Military and Veterans’ Health. Interviewers were trained to criterion in the assessment tools at residential training

Table 1. Continued

| | Prevalence, % | Relative Prevalence | 95% Confidence Interval |
|--|------------------|------------------------|----------------------------|
| Body mass index ^a category | | | |
| Grade 1 thin to lower normal (<19.99) | 2.4 | 2.77 | 0.55, 2.09 |
| Normal upper grade (20–24.99) | 21.1 | 0.74 | 0.61, 0.87 |
| Grade 1 obese (25–29.99) | 44.2 | 0.95 | 0.82, 1.08 |
| Grade 2 obese (30–39.99) | 29.8 | 1.40 | 1.12, 1.67 |
| Grade 3 obese (≥40) | 1.8 | 1.74 | 0.15, 3.32 |
| Unknown | 0.3 | 0.15 | 0.01, 0.22 |
| Smoking status | | | |
| Current regular smoker | 19.0 | 0.97 | 0.76, 1.17 |
| Current irregular smoker | 1.1 | 1.70 | 0.0, 3.65 |
| Ex-regular smoker | 56.6 | 1.27 | 1.09, 1.44 |
| Not current smoker, never smoked | 23.3 | 0.59 | 0.51, 0.68 |
| Alcohol consumption | | | |
| No alcohol consumption in past week | 18.7 | 0.64 | 0.53, 0.75 |
| Daily alcohol consumption | 40.9 | 1.35 | 1.12, 1.58 |
| Alcohol risk group ^b | | | |
| Low | 8.7 | 0.19 | 0.16, 0.21 |
| Medium | 11.6 | 0.85 | 0.64, 1.06 |
| High | 59.6 | 4.23 | 3.18, 5.27 |
| Use of psychotropic medication in past 2 weeks | | | |
| Any psychotropic medication | 50.0 | 3.06 | 2.78, 3.34 |
| Sleeping medication | 19.3 | 5.25 | 4.26, 6.24 |
| Anxiety medication | 16.9 | 6.19 | 4.92, 7.45 |
| Tranquillizer | 5.8 | 5.79 | 3.63, 7.95 |
| Antidepressant | 28.4 | 5.37 | 4.58, 6.15 |
| Mood stabilizer | 3.6 | 7.03 | 3.64, 10.42 |
| Other medication | 2.7 | 3.79 | 1.67, 5.91 |
| Vitamins/minerals for mental well-being | 12.7 | 1.63 | 1.23, 2.02 |

^a Weight (kg)/height (m)².

^b Alcohol risk categories of the 2000 Australian National Health and Medical Research Council guidelines (61).

sessions carried out in Sydney (wave 1) or interviewers' home states (wave 2). Ethics approvals were obtained in wave 1 from the Human Research Ethics Committees of the universities of Sydney and Queensland and in wave 2 from the Human Research Ethics Committees of the Repatriation General Hospital Concord in Sydney, the University of Sydney, the Australian Department of Veterans' Affairs, and the Australian Institute of Health and Welfare.

Data analysis

SPSS, version 14.0 (60), was used for statistical analysis; 2-sided statistical significance was set at $\alpha = 0.05$. For comparison with the Australian population, the expected number of cases in each diagnostic category was calculated by standardizing the male Australian population to the age distribution of the veterans in 5-year age bands. The ratios of the

observed and expected prevalences and their corresponding 95% confidence intervals were computed. We encountered a small problem in the ABS CURFs in the National Survey of Mental Health and Wellbeing, because the ABS structurally constrained the data file to return zeros in a number of age groups within certain diagnostic categories (for privacy and confidentiality reasons). To overcome this, we used the frequencies in each age group where data were present to compute a prevalence for these age groups combined, and then we applied this prevalence to the age groups with zero entries.

We constructed 2 logistic regression models for each health endpoint. Model 1 included the Army service data that were available for the whole wave 2 cohort of 450 veterans (type of enlistment, service details, conduct and casualty information, pre-enlistment education and employment, and the results of Army psychology classification

Table 2. Prevalence of *International Classification of Diseases*, Tenth Revision, Conditions Reported by Veterans in the Australian Bureau of Statistics 2004–05 National Health Survey Interview ($n = 450$) and Relative Prevalence in Comparison With Age- and Sex-Matched Data From the Australian General Population

| Condition | Prevalence, % | Relative Prevalence | 95% Confidence Interval |
|--|------------------|------------------------|----------------------------|
| Infectious and parasitic diseases | 3.6 | 2.41 | 1.25, 3.57 |
| Neoplasms | | | |
| Total | 13.4 | 2.91 | 2.22, 3.59 |
| Skin | 10.5 | 5.30 | 3.86, 6.73 |
| Melanoma | 1.6 | 4.73 | 1.25, 8.21 |
| Prostate | 1.6 | 1.29 | 0.34, 6.73 |
| Endocrine, nutritional, and metabolic diseases | | | |
| Disorders of the thyroid gland | 2.2 | 1.39 | 0.54, 2.24 |
| Diabetes mellitus type 2 | 12.3 | 1.01 | 0.76, 1.27 |
| High sugar levels in blood or urine | 7.6 | 7.59 | 5.14, 10.04 |
| High cholesterol levels | 41.8 | 1.71 | 1.52, 1.90 |
| Mental and behavioral problems | | | |
| Alcohol and drug problems | 15.7 | 8.75 | 6.86, 10.63 |
| Mood (affective) problems | 37.8 | 13.11 | 11.55, 14.68 |
| Anxiety and related problems | 52.3 | 6.54 | 5.96, 7.12 |
| Other psychological problems | 4.3 | 2.75 | 1.54, 4.00 |
| Diseases of the nervous system | | | |
| Migraine | 10.1 | 1.90 | 1.37, 2.43 |
| Other diseases of the nervous system | 2.5 | 0.93 | 0.39, 1.47 |
| Diseases of the eye and adnexa | | | |
| Cataract | 6.7 | 1.84 | 1.20, 2.47 |
| Glaucoma | 1.8 | 0.99 | 0.31, 1.66 |
| Other disorders of the choroid and retina | 2.5 | 0.60 | 0.25, 0.95 |
| Disorders of ocular muscles, movement, and accommodation | | | |
| Astigmatism | 3.6 | 0.48 | 0.25, 0.71 |
| Presbyopia | 45.0 | 3.05 | 2.73, 3.36 |
| Visual disturbance and blindness | | | |
| Complete or partial blindness | 1.1 | 0.53 | 0.07, 1.00 |
| Color blindness | 7.4 | 1.06 | 0.71, 1.41 |
| Other diseases of the eye and adnexa | 2.9 | 2.17 | 1.01, 3.34 |
| Diseases of the ear and mastoid | | | |
| Complete or partial deafness | 69.8 | 1.93 | 1.81, 2.05 |
| Tinnitus | 45.4 | 5.96 | 5.36, 6.57 |
| Diseases of the circulatory system | | | |
| Hypertensive disease | 42.7 | 1.13 | 1.01, 1.25 |
| Ischemic heart disease | | | |
| Angina | 9.8 | 2.34 | 1.68, 2.99 |
| Other ischemic heart disease | 13.2 | 4.07 | 3.11, 5.04 |
| Tachycardia | 10.3 | 2.42 | 1.76, 3.09 |
| Cerebrovascular disease | 2.6 | 2.39 | 1.24, 3.53 |
| Edema and heart failure | 4.5 | 1.76 | 1.01, 2.52 |
| Diseases of the arteries, arterioles, and capillaries | 6.3 | 1.31 | 0.84, 1.78 |
| Diseases of the veins and lymphatic vessels | | | |
| Hemorrhoids | 17.9 | 7.65 | 6.13, 9.17 |
| Varicose veins | 7.2 | 1.71 | 1.14, 2.28 |

Table continues

Table 2. Continued

| Condition | Prevalence, % | Relative Prevalence | 95% Confidence Interval |
|--|------------------|------------------------|----------------------------|
| Other diseases of the circulatory system | | | |
| Low blood pressure | 5.8 | 4.69 | 2.94, 6.44 |
| Other diseases of the circulatory system | 8.7 | 25.41 | 17.79, 33.03 |
| Symptoms and signs involving the circulatory system | | | |
| Cardiac murmurs and sounds | 8.1 | 3.19 | 2.19, 4.19 |
| Diseases of the respiratory system | | | |
| Chronic lower respiratory disease | | | |
| Bronchitis | 12.1 | 2.90 | 2.18, 3.63 |
| Emphysema | 6.5 | 2.03 | 1.32, 2.74 |
| Asthma | 13.4 | 1.33 | 1.01, 1.64 |
| Other diseases of the respiratory system | | | |
| Hay fever and allergic rhinitis | 22.4 | 1.16 | 0.96, 1.36 |
| Chronic sinusitis | 25.1 | 1.73 | 1.45, 2.01 |
| Other diseases of the respiratory system | 13.0 | 15.41 | 11.71, 19.11 |
| Diseases of the digestive system | | | |
| Diseases of the esophagus, stomach, and duodenum | | | |
| Diseases of the esophagus | 4.5 | 1.89 | 1.08, 2.69 |
| Stomach/duodenal/gastrointestinal ulcer | 11.0 | 1.61 | 1.18, 2.03 |
| Hernia | 15.2 | 2.11 | 1.65, 2.57 |
| Other diseases of the intestines | | | |
| Irritable bowel syndrome | 2.2 | 4.19 | 1.62, 6.76 |
| Gallstones | 2.2 | 1.19 | 0.74, 3.10 |
| Other diseases of the digestive system | 1.6 | 2.48 | 0.66, 4.31 |
| Diseases of the skin and subcutaneous tissue | | | |
| Dermatitis and eczema | 2.9 | 7.53 | 3.50, 11.57 |
| Psoriasis | 6.9 | 1.77 | 1.17, 2.36 |
| Other diseases of the skin and subcutaneous tissue | 6.5 | 6.18 | 4.00, 8.35 |
| Diseases of the musculoskeletal system and connective tissue | | | |
| Arthropies | | | |
| Gout | 23.0 | 3.72 | 3.09, 4.35 |
| Rheumatoid arthritis | 6.3 | 0.75 | 0.48, 1.02 |
| Osteoarthritis | 34.9 | 1.57 | 1.37, 1.77 |
| Arthritis, other and type unknown | 12.1 | 0.62 | 0.47, 0.78 |
| Other arthropies | 3.4 | 0.65 | 0.33, 0.98 |
| Soft tissue disorders | | | |
| Rheumatism | 5.8 | 1.43 | 0.90, 1.96 |
| Other soft tissue disorders | 1.3 | 0.42 | 0.90, 0.75 |
| Dorsopathies | | | |
| Disc disorders | 25.5 | 1.34 | 1.12, 1.55 |
| Back pain or back problems | 40.5 | 1.74 | 1.55, 1.94 |
| Diseases of the genitourinary system | | | |
| Urinary calculus | 6.0 | 1.57 | 1.00, 2.15 |
| Urinary incontinence | 3.8 | 4.00 | 2.14, 5.87 |
| Symptoms, signs, and conditions not elsewhere classified | | | |
| Speech difficulties | 1.6 | 1.00 | 0.27, 1.36 |
| Allergy (undefined) | 5.1 | 1.07 | 0.64, 1.50 |
| Injuries | 3.8 | 2.63 | 1.40, 3.85 |
| Other symptoms and signs not elsewhere classified | 8.5 | 3.34 | 2.32, 4.36 |

tests), and model 2 included the Army data plus wave 1 data that were available for the 391 veterans who responded during both waves. Wave 1 data included smoking and alcohol status, PTSD, and self-reported combat index, as well as the range of psychiatric diagnoses. At wave 1, 26.5% of veterans were current smokers, 54.5% were former smokers, and 18.1% had never smoked. Australian National Health and Medical Research Council guidelines on alcohol risk that were in operation at that time (61) put 76.5% of the veterans in the low-risk category, 13.2% in the medium-risk category, and 9.9% in the high-risk category (15). Wave 1 combat-related PTSD assessed using the Structured Clinical Interview for DSM-III-R yielded a DSM-III-R lifetime prevalence of 20.9% (16). In wave 2, the CAPS diagnosis was formulated according to the criteria of the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition, using the "SXCAL rule" contained in Weathers et al.'s (62) Table A3.

RESULTS

In wave 1, 641 veterans participated—87.0% of locatable veterans and 67.5% of those not known to have died ($n = 50$). In wave 2, 450 veterans participated—79.4% of locatable veterans and 51.4% of those not known to have died ($n = 125$). A total of 391 veterans participated in both waves. The age distribution of the veterans at wave 2 was different from the background population of the same ages (52–80 years); obtained and expected age bands were: 2.7% aged 52–54 years (expected, 9.9%); 53.2% aged 55–59 years (expected, 24.7%); 28.3% aged 60–64 years (expected, 18.8%); 7.6% aged 65–69 years (expected, 15.1%); 4.2% aged 70–74 years (expected, 11.9%); and 4.0% aged 75–80 years (expected, 19.6%).

A comparison of respondents with alive nonrespondents using the Army data revealed only 2 significant items in a final forward stepwise logistic regression model: the (intelligence) Army General Classification Test (for respondents, mean score = 13.86 (SD, 3.47), and for nonrespondents, mean score = 12.77 (SD, 3.51); odds ratio (OR) = 1.12, 95% confidence interval (CI): 1.06, 1.18) and having a charge of being absent without leave after return to Australia (OR = 1.52, 95% CI: 1.11, 2.09). A similar result was found for veterans who responded in both waves (Army General Classification Test: OR = 1.15, 95% CI: 1.09, 1.21; being absent without leave: OR = 1.93, 95% CI: 1.27, 2.93), indicating that respondents were generally more intelligent and more engaged than nonrespondents.

Table 1 shows the demographic characteristics, global assessment of health, recent health actions taken, and psychotropic medication use of the responding veterans: the obtained prevalence in the veterans and the relative prevalence comparing veterans with age- and sex-adjusted data from the Australian population. The majority of veterans (60.9%) were in receipt of a service pension, and 73.3% were in receipt of a disability pension paid by the Australian Department of Veterans' Affairs. The ABS CURFs do not contain these data for the Australian population. Veterans' overall current risk factor profile was similar to that of the Australian population but with higher alcohol consumption

and more former smokers. Almost all veterans reported having at least 1 long-term health condition, only slightly more than expected. However, most veterans (84.8%) reported 5 or more conditions, more than double the expected rate (relative prevalence = 2.08, 95% CI: 2.00, 2.17).

Table 2 shows the prevalence and relative prevalence of each condition for conditions assessed in the ABS National Health Survey interview that had prevalences higher than 1%. Of 67 long-term conditions shown, the relative prevalences of 16 did not carry 95% confidence intervals that excluded 1.00. The most prevalent conditions included deafness, tinnitus, hypertension, hypercholesterolemia, osteoarthritis, and back pain, while conditions with the highest relative prevalences included respiratory conditions, skin conditions (including skin cancer), tinnitus, hemorrhoids, and ischemic heart disease.

Table 3 shows the results for each CIDI psychiatric diagnosis. Only 3 of the 20 diagnoses for which comparative CURF data were available did *not* have significantly elevated prevalences in comparison with population data. More than 1 in 4 veterans had been diagnosed with an alcohol-related condition, more than 1 in 7 had been diagnosed with mild depression, and more than 1 in 10 had been diagnosed with severe recurrent depression. Since the CAPS does not currently have normative data for the Australian population, combat-related PTSD does not appear in the table; the wave 2 CAPS prevalence estimate of lifetime PTSD was 24.7%.

Thirty-one of the 67 physical health conditions were associated with various aspects of service; however, very few of the demographic factors, health actions, and psychiatric conditions bore such associations (results not shown). Specifically, age at first tour of duty in Vietnam was significantly associated with recurrent severe depression and generalized anxiety disorder, while the Army combat index was associated with alcohol abuse and dysthymia. Sustaining a combat casualty in Vietnam (prevalence = 5.1%) was not associated with wave 2 PTSD (OR = 1.36, 95% CI: 0.54, 3.38). Intelligence, as measured by the Army General Classification Test, was associated only with wave 2 diagnosis of PTSD, whether in the whole wave 2 cohort or in the veterans who responded during both waves. Twelve psychiatric diagnoses were not associated with either combat or PTSD (results not shown). Notably, non-combat-related PTSD was not significantly associated with wave 1 combat-related PTSD (OR = 1.90, 95% CI: 0.89, 4.08).

Results from logistic regression modeling are shown in Table 4 for physical health and in Table 5 for psychiatric diagnoses for which a significant association with any predictor variable was found. The dominant predictor of poorer physical health was age at wave 2. Regular enlistees were at higher risk of diabetes, cerebrovascular disease, ischemic heart disease, and disc disorders. Regular soldiers, who voluntarily enlisted for periods of 6 years, left school at younger ages, enlisted in earlier years at younger ages, had greater lengths of service before and after Vietnam, had higher ranks in Vietnam, and saw more combat than National Servicemen, who were conscripted for 2 years. However, the prevalences of PTSD and other mental

Table 3. Lifetime Prevalence of *International Classification of Diseases*, Tenth Revision, Psychiatric Diagnoses Assessed by the CIDI Among Australian Vietnam Veterans ($n = 450$) and Relative Prevalence in Comparison With Age- and Sex-Matched Data From the Australian General Population, 2005–2006

| Psychiatric Diagnosis | | Prevalence, % | Relative Prevalence | 95% Confidence Interval |
|-----------------------|--|------------------|------------------------|----------------------------|
| F10.1 | Alcohol use disorder | 9.4 | 3.25 | 2.32, 4.19 |
| F10.2 | Alcohol dependence | 18.9 | 9.47 | 7.65, 11.28 |
| F32.0 | Mild depressive disorder, single episode | 3.8 | 12.08 | 6.45, 17.72 |
| F32.1 | Moderate depressive disorder, single episode | 13.4 | 19.01 | 14.58, 23.57 |
| F32.2 | Severe depressive disorder, single episode | 10.2 | 6.06 | 4.40, 7.72 |
| F32.00 | Mild depression without somatic symptoms | 1.1 | 4.16 ^a | 0.53, 7.78 |
| F32.10 | Moderate depression without somatic symptoms | 1.6 | 4.82 ^b | 1.28, 8.36 |
| F32.11 | Moderate depression with somatic symptoms | 3.8 | 16.08 ^c | 8.58, 23.59 |
| F33.00 | Recurrent mild depression without somatic symptoms | 1.6 | 4.01 | 1.06, 6.59 |
| F33.10 | Recurrent moderate depression with somatic symptoms | 4.7 | 11.06 | 6.44, 15.67 |
| F33.11 | Recurrent moderate depression without somatic symptoms | 3.3 | NA ^d | NA |
| F33.2 | Recurrent severe depression without somatic symptoms | 11.4 | 42.95 ^e | 31.85, 54.05 |
| F34.1 | Dysthymia | 10.9 | 10.43 | 7.67, 13.19 |
| F41.0 | Panic disorder | 4.5 | 9.23 | 5.28, 13.19 |
| F40.00 | Agoraphobia without panic | 6.5 | 17.58 ^f | 11.39, 23.76 |
| F40.01 | Agoraphobia with panic | 2.2 | 5.31 ^g | 2.05, 8.56 |
| F40.1 | Social phobia | 6.5 | 3.65 | 2.36, 4.93 |
| F41.1 | Generalized anxiety disorder | 11.8 | 4.58 | 3.42, 5.74 |
| F42.0 | Obsessive compulsive disorder, obsessive type | 0.9 | 1.59 | 0.04, 3.14 |
| F42.1 | Obsessive compulsive disorder, compulsive type | 0.7 | 3.25 | 0.01, 6.92 |
| F43.1 | Post-traumatic stress disorder (non-combat-related) | 8.7 | 4.16 | 2.91, 5.40 |
| F40.21 | Specific phobia—animal | 2.0 | NA | NA |
| F40.22 | Specific phobia—natural phenomenon | 4.5 | NA | NA |
| F40.23 | Specific phobia—blood | 3.1 | NA | NA |
| F40.24 | Specific phobia—situational | 7.1 | NA | NA |
| F45.4 | Persistent pain disorder | 12.9 | NA | NA |
| F44.4 | Dissociative motor disorder | 2.7 | NA | NA |
| F44.6 | Dissociative anesthesia | 2.2 | NA | NA |

Abbreviations: ABS, Australian Bureau of Statistics; CIDI, Composite International Diagnostic Interview; NA, not available.

^a ABS data were restricted to the age groups 50–54 and 55–59 years.

^b ABS data were restricted to the age group 60–64 years.

^c ABS data were restricted to the age groups 60–64 and 65–69 years.

^d ABS data were not present in the Computerised Unit Record File.

^e ABS data were restricted to the age groups 50–54 and 60–64 years.

^f ABS data were restricted to the age groups 50–54, 55–59, 60–64, and 70–74 years.

^g ABS data were restricted to the age groups 50–54 and 55–59 years.

disorders were similar. Surprisingly, there was no difference in psychiatric conditions, except for alcohol and drug conditions assessed in the 2004–05 National Health Survey, between men who sustained casualties during the conflict and men who did not—possibly indicating that sustaining wounds per se does not necessarily imply poorer mental health in later life or that the attention given to wounded soldiers may aid resilience. Duration of Vietnam service was associated principally with deafness and PTSD, while lon-

ger periods in the Army were associated with musculoskeletal disorders and irritable bowel syndrome, underscoring the physical demands of active military service.

Combat exposure was linked with nonskin cancer, diabetes, gallstones, osteoarthritis, and urinary calculus among the physical health endpoints but only with alcohol misuse and dysthymia among the psychiatric endpoints. The finding that alcohol disorders were differentially associated with combat and PTSD indicates the importance of war sequelae

Table 4. Odds Ratios From Logistic Regression Prediction Models of the Relation Between Australian Bureau of Statistics Health Conditions and Army Service Exposures (Model 1) and Army Service Data and Age at Interview Plus Wave 1 Data (Model 2), 1990–1993 and 2005–2006

| Condition | Model 1 (n = 450) | | | Model 2 (n = 391) | | |
|---|--------------------------------------|------|-------------|--------------------------------------|------|-------------|
| | Item | OR | 95% CI | Item | OR | 95% CI |
| Cancer (nonskin) | Duration of pre-Vietnam service | 1.10 | 1.04, 1.16 | Age at wave 2 interview | 1.12 | 1.07, 1.18 |
| Diabetes mellitus type 2 | Regular enlistment | 2.25 | 1.21, 1.16 | Wave 1 combat index | 1.09 | 1.01, 1.18 |
| | | | | Duration of post-Vietnam service | 1.05 | 1.01, 1.10 |
| Alcohol and drug disorders | Rank in Vietnam | 1.36 | 1.03, 1.78 | Wave 1 combat index | 1.08 | 1.01, 1.16 |
| | | | | Casualty in Vietnam | 4.43 | 1.20, 16.32 |
| | | | | Wave 1 alcohol risk | 2.56 | 1.80, 3.65 |
| | | | | Wave 1 smoking status | 1.89 | 1.26, 2.85 |
| Mood disorders | Rank in Vietnam | 1.42 | 1.18, 1.72 | Wave 1 PTSD diagnosis | 3.79 | 2.21, 6.48 |
| | Casualty in Vietnam | 2.24 | 1.18, 4.25 | Corps group | 1.21 | 1.06, 1.38 |
| Anxiety disorders | Duration of pre-Vietnam service | 1.07 | 1.03, 1.13 | Age at wave 2 interview | 1.08 | 1.03, 1.14 |
| | | | | Age at wave 2 interview | 1.08 | 1.03, 1.13 |
| | | | | Wave 1 PTSD diagnosis | 3.59 | 2.02, 6.38 |
| | | | | Corps group | 1.14 | 1.01, 1.29 |
| Other psychological disorders | Duration of pre-Vietnam service | 1.59 | 1.04, 2.63 | >1 tour of duty in Vietnam | 2.67 | 1.16, 6.14 |
| Nervous system disorders | Army combat index | 1.68 | 1.05, 2.70 | Duration of Vietnam service | 5.05 | 1.11, 22.88 |
| Cataracts | Age at first tour of duty in Vietnam | 1.08 | 1.01, 1.14 | Age at wave 2 interview | 1.08 | 1.01, 1.14 |
| | Regular enlistment | 2.67 | 1.00, 7.12 | | | |
| Deafness | Duration of Vietnam service | 3.88 | 1.89, 7.95 | Duration of Vietnam service | 3.55 | 1.57, 8.03 |
| | | | | Corps group | 1.16 | 1.02, 1.33 |
| Angina | Regular enlistment | 1.97 | 1.01, 3.83 | Regular enlistment | 2.30 | 1.13, 4.70 |
| Cerebrovascular disease | Regular enlistment | 4.54 | 1.29, 15.29 | Regular enlistment | 4.02 | 1.12, 14.44 |
| | | | | Wave 1 smoking status | 2.21 | 1.01, 4.83 |
| “Other” ischemic heart disease | Age at first tour of duty in Vietnam | 1.15 | 1.07, 1.23 | Age at wave 2 interview | 1.08 | 1.03, 1.14 |
| | Rank in Vietnam | 1.63 | 1.16, 2.30 | | | |
| | Regular enlistment | 2.42 | 1.23, 4.75 | | | |
| “Other” circulatory conditions | Duration of Vietnam service | 8.40 | 1.13, 12.37 | — ^a | | |
| “Other” cardiovascular symptoms and signs | Enlistment age | 1.26 | 1.01, 1.06 | Enlistment age | 1.24 | 1.02, 1.59 |
| Asthma | Total duration of Army service | 1.03 | 1.01, 1.06 | Total duration of Army service | 1.03 | 1.01, 1.06 |
| | | | | Wave 1 PTSD diagnosis | 3.09 | 1.59, 5.99 |
| Ulcers | — | | | — | | |
| Irritable bowel syndrome | Total duration of Army service | 1.06 | 1.00, 1.14 | — | | |
| Gallstones | ≥2 tours of duty in Vietnam | 4.71 | 1.19, 19.37 | Wave 1 combat index | 1.19 | 1.05, 1.36 |
| Psoriasis | Duration of post-Vietnam service | 1.08 | 1.00, 1.17 | — | | |
| | | | | — | | |
| Gout | Duration of Vietnam service | 2.87 | 1.32, 6.29 | Duration of Vietnam service | 2.67 | 1.16, 6.13 |
| | Age at first tour of duty in Vietnam | 1.06 | 1.01, 1.10 | Age at first tour of duty in Vietnam | 1.05 | 1.01, 1.11 |
| Osteoarthritis | Regular enlistment | 1.74 | 1.17, 2.59 | Age at first tour of duty in Vietnam | 1.07 | 1.03, 1.11 |
| | | | | Wave 1 combat index | 1.09 | 1.03, 1.15 |
| | | | | Wave 1 smoking status | 1.36 | 1.01, 1.82 |
| Disc disorders | Duration of pre-Vietnam service | 1.11 | 1.03, 1.19 | Duration of pre-Vietnam service | 1.07 | 1.003, 1.15 |
| | Regular enlistment | 1.84 | 1.13, 3.00 | | | |
| Osteoporosis | Duration of post-Vietnam service | 1.09 | 1.01, 1.17 | Duration of post-Vietnam service | 1.10 | 1.01, 1.19 |
| | | | | Wave 1 smoking status | 3.65 | 1.23, 10.86 |
| Allergy | Casualty in Vietnam | 0.22 | 0.09, 0.56 | Casualty in Vietnam | 0.26 | 0.10, 0.73 |
| Joint injuries | Duration of post-Vietnam service | 1.11 | 1.00, 1.22 | — | | |

Abbreviations: CI, confidence interval; OR, odds ratio; PTSD, post-traumatic stress disorder.

^a No model.

Table 5. Odds Ratios From Logistic Regression Prediction Models of the Relation Between *International Classification of Diseases*, Tenth Revision, Psychiatric Diagnoses and Army Service Exposures (Model 1) and Army Service Data and Age at Interview Plus Wave 1 Data (Model 2), 1990–1993 and 2005–2006

| Psychiatric Diagnosis | Model 1 (n = 450) | | | Model 2 (n = 391) | | |
|--|--------------------------------------|------|------------|--------------------------------------|------|-------------|
| | Item | OR | 95% CI | Item | OR | 95% CI |
| F10.1 Alcohol use disorder | Army combat index | 1.16 | 1.01, 1.33 | Wave 1 combat index | 1.14 | 1.05, 1.23 |
| F10.2 Alcohol dependence | — ^a | | | Wave 1 PTSD diagnosis | 2.68 | 1.52, 4.71 |
| F32.0 Mild depressive disorder | Duration of Vietnam service | 5.61 | 1.26, 5.04 | — | | |
| F32.10 Moderate depression without somatic symptoms | — | | | Wave 1 PTSD diagnosis | 3.01 | 1.61, 5.61 |
| F32.11 Moderate depression with somatic symptoms | — | | | Wave 1 PTSD diagnosis | 1.18 | 1.06, 5.61 |
| F32.2 Severe depressive disorder | — | | | Wave 1 PTSD diagnosis | 2.92 | 1.49, 5.72 |
| F33.11 Recurrent moderate depression with somatic symptoms | — | | | Wave 1 PTSD diagnosis | 4.62 | 1.51, 14.14 |
| F33.2 Recurrent severe depression without somatic symptoms | Age at first tour of duty in Vietnam | 1.12 | 1.01, 1.24 | Duration of Vietnam service | 5.48 | 1.23, 24.32 |
| F34.1 Dysthymia | Army combat index | 1.14 | 1.01, 1.30 | Wave 1 PTSD diagnosis | 3.58 | 1.87, 6.86 |
| F40.1 Social phobia | — | | | Wave 1 PTSD diagnosis | 2.51 | 1.09, 5.76 |
| F41.0 Panic disorder | — | | | Wave 1 PTSD diagnosis | 5.14 | 1.96, 13.48 |
| F40.00 Agoraphobia without panic | — | | | Wave 1 PTSD diagnosis | 4.20 | 1.86, 9.48 |
| F40.01 Agoraphobia with panic | — | | | Wave 1 PTSD diagnosis | 9.37 | 2.37, 37.07 |
| F40.23 Specific phobia—blood | — | | | Wave 1 PTSD diagnosis | 4.88 | 1.28, 18.63 |
| F40.24 Specific phobia—situational | — | | | Wave 1 combat index | 1.10 | 1.01, 1.21 |
| F41.1 Generalized anxiety disorder | Age at first tour of duty in Vietnam | 1.13 | 1.02, 1.25 | Age at first tour of duty in Vietnam | 1.20 | 1.04, 1.38 |
| F45.4 Persistent pain disorder | — | | | Wave 1 PTSD diagnosis | 2.39 | 1.28, 4.46 |
| DSM-IV (CAPS) PTSD diagnosis | Army AGC score | 0.92 | 0.09, 0.98 | Army AGC score | 0.92 | 0.85, 0.998 |
| | Duration of Vietnam service | 3.59 | 1.48, 8.66 | Duration of Vietnam service | 3.17 | 1.20, 8.41 |
| | | | | Date of birth | 1.09 | 1.00, 1.18 |
| | | | | Wave 1 combat index | 1.08 | 1.004, 1.15 |
| | | | | Wave 1 PTSD diagnosis | 4.07 | 2.19, 7.58 |

Abbreviations: AGC, Army General Classification Test; CAPS, Clinician-Administered PTSD Scale; CI, confidence interval; DSM-IV, *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition; OR, odds ratio; PTSD, post-traumatic stress disorder.

^a No model.

in veterans' progressing from alcohol abuse to alcohol dependence. In multivariate models, PTSD assumed a position of paramount importance in many of the wave 2 psychiatric diagnoses, suggesting that PTSD may itself be a risk factor for depression and anxiety in later life and that this comorbidity may persist over many years. However, veteran age was also significant, with older veterans being more likely to have PTSD.

DISCUSSION

These results demonstrate that the physical and psychological health sequelae of military service and war zone experience, particularly after development of PTSD, endure into the later lives of former soldiers. The most prevalent psychiatric condition afflicting veterans was PTSD, with alcohol disorders following closely behind. Of the 67

long-term physical health conditions, the prevalences of 47 were in excess of those in the Australian general population and the prevalences of 4 were lower than those in the Australian population. Notably not in excess were potentially serious conditions such as prostate cancer and type 2 diabetes. The finding that psychological conditions assessed in the ABS 2004–05 National Health Survey bore significant bivariate relations with a number of Army service variables that were, except for mood disorders, reduced to significant associations with age is partly congruent with a US study which found that military service per se was not a risk factor for mental health disorders in later life (63).

An unexpected finding was that non-combat-related PTSD was also more prevalent than population expectations but was not associated with prior PTSD or any other aspect of military or war service. It is possible that veterans may, through various lifestyle characteristics that differentiate

them from the general population, put themselves in situations that other persons may avoid, such as providing assistance in road accidents or working as volunteer firefighters and emergency service workers, making them more likely to experience traumatic events. A younger age at first posting to the war zone was associated with combat-related PTSD, depression, dysthymia, panic, generalized anxiety, and blood phobias. It is possible that vulnerability to later mental ill health is increased when trauma exposure occurs at an age at which young men generally feel (in the words of many veterans) "bullet-proof."

Observational studies are the only feasible way of examining the long-term effects of exposure to environmental noxae. Nevertheless, biases arising from selection errors, measurement errors, or confounding are not always absent. In this study, selection of subjects was random, from a database that contained the entire company of male Australian Army Vietnam veterans, and included Regular enlistees as well as National Service conscripts, who were not included in previous epidemiologic studies of Australian Vietnam veterans (46–48, 64–66). We addressed measurement errors by using standardized assessment instruments in both waves of the study, by using data that had been collected by the Army and thus were not subject to self-report biases, and by using the same assessments or similar assessments in both waves. We addressed possible confounding by employing multivariate analysis using identified and measured confounders such as age at interview and smoking status. Nevertheless, comparisons of veterans' self-reported health conditions with self-reported Australian population ABS data may still be subject to interviewer effects or respondent bias. For example, all interviewers were master's-level clinicians or experienced doctoral-level researchers, which would not characterize ABS professional interviewers. The vast majority of veterans were already in receipt of government pensions, reducing the incentive for exaggeration of poor health. In addition, not all health endpoints had excess prevalences when compared with the ABS population data, making a universal tendency to overreport less likely. Moreover, it is possible that the Australian repatriation entitlements to free treatment for accepted war-caused conditions may have increased health service utilization, making a diagnosis more likely. In wave 1, adjustment for smoking status, alcohol status, perceived health, and physician consultations did not abolish the excess (67).

One limitation of our study was sample size: It is possible that the study did not have sufficient statistical power to detect small effects. Nevertheless, the finding that PTSD assessed in wave 1 was a significant and consistent predictor of morbidity at wave 2 demonstrates that sufficient statistical power was available to identify clinically interpretable and meaningful associations. There is also a possibility that some significant effects were obtained by chance, given the number of models fitted; however, more models were significant than would be predicted by chance alone.

These findings reinforce the view that there are indeed long-term mental health consequences of participation in war. Additionally, enduring ill health may be related to the

development of PTSD at younger ages. The findings indicate that military service may have severe consequences for soldiers' health that extend far into older age, with military service itself being a risk factor for later physical ill health and PTSD being a risk factor for later mental ill health.

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