

New onset and persistent symptoms of post-traumatic stress disorder self reported after deployment and combat exposures: prospective population based US military cohort study

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ABSTRACT

Objective To describe new onset and persistence of self reported post-traumatic stress disorder symptoms in a large population based military cohort, many of whom were deployed in support of the wars in Iraq and Afghanistan.

Design Prospective cohort analysis.

Setting and participants Survey enrolment data from the millennium cohort (July 2001 to June 2003) obtained before the wars in Iraq and Afghanistan. Follow-up (June 2004 to February 2006) data on health outcomes collected from 50 184 participants.

Main outcome measures Self reported post-traumatic stress disorder as measured by the posttraumatic stress disorder checklist—civilian version using *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition criteria.

Results More than 40% of the cohort were deployed between 2001 and 2006; between baseline and follow-up, 24% deployed for the first time in support of the wars in Iraq and Afghanistan. New incidence rates of 10-13 cases of post-traumatic stress disorder per 1000 person years occurred in the millennium cohort. New onset self reported post-traumatic stress disorder symptoms or diagnosis were identified in 7.6-8.7% of deployers who reported combat exposures, 1.4-2.1% of deployers who did not report combat exposures, and 2.3-3.0% of non-deployers. Among those with self reported symptoms of post-traumatic stress disorder at baseline, deployment did not affect persistence of symptoms.

Conclusions After adjustment for baseline characteristics, these prospective data indicate a threefold increase in new onset self reported post-traumatic stress disorder symptoms or diagnosis among deployed military personnel who reported combat exposures. The findings define the importance of post-traumatic stress disorder in this population and emphasise that specific combat exposures, rather than deployment itself, significantly affect the onset of symptoms of post-traumatic stress disorder after deployment.

INTRODUCTION

Concern is growing among the public and veterans that post-deployment health consequences among US military personnel deployed in Iraq, Afghanistan, and neighbouring countries may be considerable and lasting. A recent report suggested that US marine and army infantry units returning from duty in Iraq and Afghanistan have higher than expected proportions of mental disorders and that as many as 10% of personnel are returning home with symptoms of post-traumatic stress disorder.¹ Combat duty in Iraq has been associated with high use of mental health services and attrition from military service and possible alterations in neural functioning after deployment.^{2,3}

Symptoms of post-traumatic stress disorder have been reported in as many as 30% of veterans after service in Vietnam and in more than 10% of US military personnel returning from the 1991 Gulf war.^{1,2,4-9} Epidemiological studies to date have largely focused on retrospective data or select groups. Prospective investigation of the causes of the disorder in large, population based military cohorts has been limited. The objective of this study was to prospectively investigate the effect of military deployment and self reported exposure to combat on new onset and persistent symptoms of post-traumatic stress disorder in a large population based US military cohort.

METHODS

Study population

Between July 2001 and June 2003 the first panel of participants in the millennium cohort study, a population based US military cohort of 77 047 active military duty and Reserve/National Guard personnel, was enrolled in a 22 year longitudinal study of health.¹⁰ Between June 2004 and February 2006, 55 021 (71%) cohort members participated in the first three year follow-up questionnaire. After removing participants who were already deployed at baseline or first deployed at follow-up (n=4837), we analysed 50 184 participants. We linked demographic and military

personnel data to each participant at the time of baseline enrolment.

Deployment data

We categorised regular active duty and Reserve/National Guard personnel who had been deployed for one or more days in support of the wars in Iraq and Afghanistan between submission of their baseline and follow-up questionnaires as deployers. We categorised cohort members who had never been deployed before submission of their baseline and follow-up questionnaires as non-deployers.

Post-traumatic stress disorder assessment

We used the standardised posttraumatic stress disorder checklist—civilian version, with highly sensitive and specific criteria for symptoms of post-traumatic stress disorder. The sensitive definition of symptoms of post-traumatic stress disorder used the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV) criteria alone, whereas the specific definition of symptoms of post-traumatic stress disorder included the DSM-IV criteria and a requirement for a sum of 50 points for all of the questions in the checklist.¹¹⁻¹⁵ We also asked participants if they had ever been diagnosed with post-traumatic stress disorder.

We identified participants as having new onset self reported symptoms of post-traumatic stress disorder if they did not have symptoms or diagnosis at baseline but at follow-up met the criteria for the standardised checklist or reported a diagnosis of post-traumatic stress disorder within the previous three years. We identified participants as having persistent self reported symptoms of post-traumatic stress disorder if they were identified as having symptoms at baseline and at follow-up.

Other questionnaire information

We assessed cigarette smoking and problem alcohol drinking. We assessed combat exposures by asking about exposure during the previous three years to witnessing a person's death due to war, disaster, or tragic event and witnessing instances of physical abuse, dead or decomposing bodies, maimed soldiers or civilians, and prisoners of war or refugees.

Statistical analysis

We completed analyses of population characteristics by deployment status and new onset and persistent self reported symptoms or diagnosis of post-traumatic stress disorder. We compared the association between deployment in Iraq and Afghanistan and new onset self reported symptoms or diagnosis of post-traumatic stress disorder. We did secondary analyses of self reported persistence of post-traumatic stress disorder on a subpopulation of participants with symptoms at baseline.

RESULTS

Data were available for 50 128 (99.9%) of the 50 184 eligible cohort members. The mean elapsed time

between baseline and submission of follow-up questionnaire was 2.7 years (SD 0.5 years; median 2.8 years). Deployed cohort members were proportionately more likely than non-deployed cohort members to be male, born between 1970 and 1979, less educated, on active duty, and combat specialists.

We analysed data from 47 837 cohort members who had neither symptoms nor diagnosis of post-traumatic stress disorder at baseline. Applying the specific criteria, we found new onset symptoms in 4.3% of deployed cohort members and 2.3% of non-deployed cohort members. We found new onset symptoms in 7.6% of cohort members who were deployed and self reported combat exposures, 1.4% of cohort members who were deployed and did not self report combat exposures, and 2.3% of non-deployed cohort members. Applying the more sensitive DSM-IV criteria alone, we identified new onset self reported symptoms of post-traumatic stress disorder in 8.7%, 2.1%, and 3.0% of these categories of cohort members. These data correspond to new onset self reported symptoms or diagnosis of post-traumatic stress disorder in up to 21 per 1000 non-combat deployers and up to 87 per 1000 combat deployed military personnel.

At baseline, 995 cohort members self reported symptoms of post-traumatic stress disorder on the basis of the specific criteria and 1659 on the basis of the sensitive criteria. We found persistent self reported symptoms of post-traumatic stress disorder in 43.5% of cohort members who were deployed and reported combat exposures, 26.2% of cohort members who were deployed and did not report combat exposures, and 47.6% of non-deployed cohort members. Applying the more sensitive criteria alone, we identified persistent self reported symptoms of post-traumatic stress disorder in 47.9%, 22.4%, and 45.9% of these groups.

Tables 1 and 2 present logistic regression results for new onset self reported symptoms or diagnosis of post-traumatic stress disorder based on the more specific criteria, stratified by branch of service. Analyses included adjustment for baseline characteristics including sex, age, education, marital status, race/ethnicity, rank, service component, occupation, cigarette smoking, and problem alcohol drinking. Among all of the services, deployed personnel who reported combat exposures had significantly higher odds of post-deployment self reported post-traumatic stress disorder symptoms than did those who were not deployed (army odds ratio 3.59, 95% confidence interval 3.08 to 4.17; air force odds ratio 3.38, 2.29 to 4.98; navy/Coast Guard odds ratio 2.48, 1.48 to 4.14; Marine Corps odds ratio 2.78, 1.52 to 5.07). Being female, divorced, or enlisted and reporting problem alcohol drinking were also associated with increased odds of new onset self reported symptoms or diagnosis in at least three of the four service branches. We found no statistical difference between deployed army, navy/Coast Guard, and Marine Corps cohort members who did not report

Table 1 | Adjusted odds of new onset post-traumatic stress disorder*, stratified by US army and air force, among millennium cohort members without baseline post-traumatic stress disorder symptoms

Characteristic†	Army cohort members (n=22 959)		Air force cohort members (n=14 608)	
	Percentage	Odds ratio (95% CI)	Percentage	Odds ratio (95% CI)
Deployment‡				
Not deployed	3.0	1.00	1.2	1.00
Deployed without combat exposures	2.6	0.87 (0.64 to 1.18)	0.7	0.56 (0.35 to 0.89)
Deployed with combat exposures	9.3	3.59 (3.08 to 4.17)	3.5	3.38 (2.29 to 4.98)
Sex				
Male	3.6	1.00	1.0	1.00
Female	4.9	1.70 (1.44 to 2.00)	2.0	2.00 (1.41 to 2.83)
Birth year				
Pre-1960	3.1	1.00	1.2	1.00
1960-9	3.5	0.90 (0.74 to 1.10)	1.0	0.84 (0.56 to 1.24)
1970-9	4.9	1.09 (0.88 to 1.36)	1.6	1.40 (0.89 to 2.21)
1980 and forward	6.0	1.17 (0.83 to 1.65)	2.5	1.72 (0.70 to 4.26)
Education				
High school or less diploma/equivalent	5.0	1.00	2.2	1.00
Some college or bachelor's degree	2.8	0.83 (0.69 to 1.00)	1.2	0.75 (0.50 to 1.14)
Advanced degree	1.9	0.80 (0.54 to 1.19)	0.6	0.82 (0.35 to 1.92)
Marital status				
Married	3.7	1.00	1.1	1.00
Never married	4.4	0.80 (0.67 to 0.96)	1.3	0.79 (0.51 to 1.23)
Divorced	4.7	1.09 (0.85 to 1.40)	2.7	1.85 (1.25 to 2.74)
Race/ethnicity				
White non-Hispanic	4.0	1.00	1.3	1.00
Black non-Hispanic	4.5	1.14 (0.93 to 1.38)	1.2	0.86 (0.51 to 1.47)
Other	3.5	1.37 (1.13 to 1.65)	1.4	1.06 (0.63 to 1.76)
Smoking				
Never smoker	3.2	1.00	1.1	1.00
Past smoker	4.1	1.21 (1.03 to 1.44)	1.3	1.05 (0.73 to 1.50)
Current smoker	6.4	1.69 (1.42 to 2.01)	2.1	1.40 (0.94 to 2.07)
Problem drinking				
No	3.6	1.00	1.2	1.00
Yes	5.4	1.47 (1.25 to 1.73)	1.9	1.69 (1.17 to 2.43)
Military rank				
Enlisted	4.8	2.20 (1.70 to 2.86)	1.5	2.31 (1.24 to 4.30)
Officer	1.9	1.00	0.6	1.00
Service component				
Reserve/National Guard	3.8	1.00	1.5	1.00
Active duty	4.1	0.88 (0.76 to 1.03)	1.1	0.79 (0.56 to 1.13)
Occupational category				
Other occupations	4.4	1.00	1.3	1.00
Combat specialists	3.3	0.91 (0.75 to 1.11)	0.7	0.71 (0.41 to 1.25)
Healthcare specialists	3.7	1.02 (0.81 to 1.29)	1.3	0.78 (0.46 to 1.33)
Service supply and functional	4.1	0.95 (0.80 to 1.12)	1.4	0.93 (0.65 to 1.33)

*Self reported post-traumatic stress disorder symptoms based on posttraumatic stress disorder patient checklist—civilian version with DSM-IV criteria and a sum of 50 points out of 85 points possible or diagnosis of post-traumatic stress disorder within previous three years.

†Characteristic taken at time of submission of baseline questionnaire among members who submitted questionnaires at baseline (July 2001-June 2003) and follow-up (July 2004-Jan 2006).

‡Deployment in support of wars in Iraq and Afghanistan considered if full deployment occurred between submission dates of baseline and follow-up questionnaires. Cohort members who were deployed after follow-up survey are included with non-deployers in these analyses.

combat exposures when compared with non-deployers.

DISCUSSION

We document increased risk of new onset self reported symptoms of post-traumatic stress disorder among cohort members who were female, divorced, or

enlisted, and in those who self reported being a current smoker or problem drinker at baseline. We report overall new incidence rates of 10-13 cases per 1000 person years and a threefold increase in new onset self reported symptoms of post-traumatic stress disorder in deployed personnel who reported combat exposures compared with non-deployers.

Table 2 | Adjusted odds of new onset post-traumatic stress disorder*, stratified by US navy/Coast Guard and Marine Corps, among millennium cohort members without baseline post-traumatic stress disorder symptoms

Characteristic†	Navy and Coast Guard cohort members (n=8655)		Marine cohort members (n=2077)	
	Percentage	Odds ratio (95% CI)	Percentage	Odds ratio (95% CI)
Deployment‡				
Not deployed	2.2	1.00	2.3	1.00
Deployed without combat exposures	1.4	0.60 (0.35 to 1.02)	2.8	1.42 (0.57 to 3.51)
Deployed with combat exposures	5.2	2.48 (1.48 to 4.14)	5.7	2.78 (1.52 to 5.07)
Sex				
Male	1.8	1.00	2.8	1.00
Female	3.4	1.73 (1.25 to 2.38)	4.4	1.92 (0.94 to 3.94)
Birth year				
Pre-1960	2.0	1.00	1.2	1.00
1960-9	2.1	0.99 (0.66 to 1.48)	1.4	0.71 (0.18 to 2.79)
1970-9	2.4	0.97 (0.60 to 1.56)	3.9	1.51 (0.40 to 5.70)
1980 and forward	5.2	1.73 (0.79 to 3.78)	6.8	2.00 (0.42 to 9.56)
Education				
High school or less diploma/equivalent	2.7	1.00	3.8	1.00
Some college or bachelor's degree	1.6	0.89 (0.57 to 1.39)	1.4	0.70 (0.22 to 2.20)
Advanced degree	1.6	1.31 (0.60 to 2.88)	0.7	0.57 (0.05 to 6.17)
Marital status				
Married	1.9	1.00	2.0	1.00
Never married	2.7	1.14 (0.81 to 1.61)	4.3	1.09 (0.56 to 2.10)
Divorced	4.9	2.53 (1.31 to 4.91)	5.7	2.75 (1.06 to 7.14)
Race/ethnicity				
White non-Hispanic	2.0	1.00	2.9	1.00
Black non-Hispanic	3.5	1.54 (1.02 to 2.34)	1.6	0.70 (0.21 to 2.36)
Other	2.6	1.22 (0.80 to 1.88)	4.3	1.53 (0.78 to 3.01)
Smoking				
Never smoker	1.8	1.00	2.1	1.00
Past smoker	2.5	1.33 (0.94 to 1.88)	3.6	1.55 (0.83 to 2.88)
Current smoker	3.4	1.59 (1.08 to 2.34)	5.7	1.84 (0.94 to 3.59)
Problem drinking				
No	2.0	1.00	2.4	1.00
Yes	3.1	1.59 (1.08 to 2.34)	4.7	1.73 (1.00 to 2.99)
Military rank				
Enlisted	2.7	2.14 (1.16 to 3.94)	3.7	1.92 (0.52 to 7.13)
Officer	1.3	1.00	1.1	1.00
Service component				
Reserve/National Guard	2.1	1.00	2.5	1.00
Active duty	2.3	1.24 (0.86 to 1.77)	3.1	1.24 (0.62 to 2.47)
Occupational category				
Other occupations	2.0	1.00	2.8	1.00
Combat specialists	1.7	1.14 (0.72 to 1.79)	3.7	1.63 (0.86 to 3.06)
Healthcare specialists	3.1	1.49 (0.96 to 2.32)	–	–
Service supply and functional	2.6	1.23 (0.85 to 1.79)	2.7	1.02 (0.52 to 1.99)

*Self reported post-traumatic stress disorder symptoms based on posttraumatic stress disorder patient checklist—civilian version with DSM-IV criteria and a sum of 50 points out of 85 points possible or diagnosis of post-traumatic stress disorder within previous 3 years.

†Taken at time of baseline questionnaire submission among members who submitted questionnaires at baseline (July 2001-June 2003) and follow-up (July 2004-Jan 2006).

‡Deployment in support of wars in Iraq and Afghanistan considered if full deployment occurred between submission dates of baseline and follow-up questionnaires. Cohort members who were deployed after follow-up survey are included with non-deployers in these analyses.

Limitations and strengths

The millennium cohort, by design, oversampled female, previously deployed, and Reserve/National Guard personnel and may not be representative of the military population in general or of all deployers. Although participants self selected in accepting the

invitation to become part of the millennium cohort study, reports of millennium cohort baseline data suggest a representative sample of military personnel.^{10 16-22} Studies have shown that increased reporting of exposure and symptoms occurs among personnel who seek medical compensation,²³ as well as

WHAT IS ALREADY KNOWN ON THIS TOPIC

Post-traumatic stress disorder is associated with comorbidities and independently with military combat deployments

No published data describe the incidence of post-traumatic stress disorder or the persistence of symptoms in a large population based cohort

WHAT THIS STUDY ADDS

Female, divorced, or enlisted personnel and those who self reported being a current smoker or problem drinker at baseline had an increased risk of new onset self reported symptoms of post-traumatic stress disorder

Deployed personnel who reported combat exposures had a threefold increase in new onset self reported symptoms of post-traumatic stress disorder compared with non-deployers

among those with symptoms of post-traumatic stress disorder.²⁴ If the onset of symptoms in this cohort caused an increase in reporting of exposure, or if significant exposures caused an artificial increase in reporting of symptoms, the results of this study would overestimate the true burden of the disease. We could not discern exposures that are truly unique to combat from those that might be encountered through other occupational or non-occupational activities. The use of a standardised instrument for self reported data along with no specific date of trauma as a surrogate for post-traumatic stress disorder diagnosis is imperfect. However, our measure has been found to correlate well with a physician's assessment of post-traumatic stress disorder symptoms,¹¹ and it is internally valid in millennium cohort members.¹⁶

Self reported data offer information not accessible elsewhere. Post-traumatic stress disorder is often under-reported in electronic healthcare databases among populations who do not readily present for care for mental disorders.²⁵

Implications

Early identification of personnel with symptoms of post-traumatic stress disorder may lead to a smaller burden of the disorder in the years to come if appropriate and timely treatments are provided. Differences between results from this study and previous studies may be due to our distinction between personnel with and without symptoms or diagnosis of post-traumatic stress disorder at baseline. In our analyses, the average time between baseline and follow-up was nearly three years, whereas the average time between the end of first deployment and follow-up was just over one year. A recent study reported that compared with 11.8% of US army personnel reporting post-traumatic stress disorder symptoms soon after combat deployment, 16.7% reported symptoms six months post-deployment.²⁶

Overall, the rate of new onset self reported symptoms of post-traumatic stress disorder in deployed personnel was 4.3%, a rate that is nearly twice that seen in non-deployed personnel (2.3%). This report documents a threefold adjusted increase in risk of new onset self reported symptoms of post-traumatic stress disorder among those who were deployed and

who also report combat exposures compared with non-deployed cohort members. Compared with non-deployed personnel, we found no significant difference in new onset self reported symptoms or diagnosis of post-traumatic stress disorder among deployers who did not report combat exposures. Deployment in itself may not lead to the onset of post-traumatic stress disorder symptoms; rather, exposures during deployment may contribute to the onset of symptoms.

We found persistent self reported symptoms of post-traumatic stress disorder at follow-up in 40-50% of the 2.4% of millennium cohort members who had symptoms at baseline.²⁶ This underscores a considerable burden of persistent symptoms of post-traumatic stress disorder among those with baseline self reported symptoms and suggests that resolution of post-traumatic stress disorder may not be expected for many years.

Future research should include efforts to better understand the resiliency and vulnerability to symptoms of post-traumatic stress disorder among subpopulations of combat deployers. Different types of research are also needed to investigate development of better validated and standardised screening and diagnostic approaches for post-traumatic stress disorder; population based controlled clinical trials on treatment strategies; and evaluations of how increased awareness, improved access to care, or both can reduce morbidity.

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Inequalities in mortality during and after restructuring of the New Zealand economy: repeated cohort studies

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ABSTRACT

Objectives To determine whether disparities between income and mortality changed during a period of major structural and macroeconomic reform and to estimate the changing contribution of different diseases to these disparities.

Design Repeated cohort studies.

Data sources 1981, 1986, 1991, 1996, and 2001 censuses linked to mortality data.

Population Total New Zealand population, ages 1-74 years.

Methods Mortality rates standardised for age and ethnicity were calculated for each census cohort by level of household income. Standardised rate differences and rate ratios, and slope and relative indices of inequality (SII and RII), were calculated to measure disparities on both absolute and relative scales.

Results All cause mortality rates declined over the 25 year study period in all groups stratified by sex, age, and income, except for 25-44 year olds of both sexes on low

incomes among whom there was little change. In all age groups pooled, relative inequalities increased from 1981-4 to 1996-9 (RIIs increased from 1.85 (95% confidence interval 1.67 to 2.04) to 2.54 (2.29 to 2.82) for males and from 1.54 (1.35 to 1.76) to 2.12 (1.88 to 2.39) for females), then stabilised in 2001-4 (RIIs of 2.60 (2.34 to 2.89) and 2.18 (1.93 to 2.45), respectively). Absolute inequalities were stable over time, with a possible fall from 1996-9 to 2001-4. Cardiovascular disease was the major contributor to the observed disparities between income and mortality but decreased in importance from 45% in 1981-4 to 33% in 2001-4 for males and from 50% to 29% for females. The corresponding contribution of cancer increased from 16% to 22% for males and from 12% to 25% for females.

Conclusions During and after restructuring of the economy disparities in mortality between income groups in New Zealand increased in relative terms (but not in absolute terms), but it is difficult to confidently draw a causal link with structural reforms. The contribution of different