

Effects of deployment on mental health in modern military forces: A review of longitudinal studies

Eva Pietrzak, PhD†, Stephen Pullman, Cristina Cotea, BSc (Hons)†, Peter Nasveld, MBBS, FACTM

Abstract

Background. Earlier studies presenting evidence that operational deployment negatively affects mental health outcomes among military personnel and veterans generally have lacked conclusiveness, largely because of cross-sectional or retrospective design.

Purpose. To review longitudinal studies investigating mental health outcomes of military personnel deployed in recent conflicts.

Methods. MEDLINE database was searched using relevant keywords and MESH terms. The US Millennium Cohort study website was used to obtain the list of relevant publications. Only prospective longitudinal cohort studies investigating mental health outcomes in deployed post Vietnam era military or veteran populations of developed countries were included.

Results. Eighteen studies fulfilled the inclusion criteria. Adverse effects included the increased incidence of post-deployment PTSD and depression. Individuals with the lowest functional scores and those exposed to previous traumatic assault were particularly vulnerable to a new onset of PTSD after combat exposure. Factors influencing the incidence of post-deployment PTSD included depression symptoms present during deployment, the presence of stress reaction during combat exposure and reception of associated frontline treatment, and the number of negative life events experienced after the traumatic event. More mental health problems were reported in soldiers returning from Iraq on the second screening conducted several months after their return, compared with the first screening immediately upon their return. Some mental health symptoms (anxiety and depression) improved between deployments, while others (PTSD and panic attacks) did not improve.

Conclusion. The results indicate that combat exposure, not deployment in general, had an adverse effect on mental health.

Mental health indicators in personnel who were deployed but not exposed to combat were often better than those in non-deployed personnel. Health outcomes and health needs were affected both by individual characteristics and post-deployment life events and these changed over time.

Keywords: Military personnel, veterans, deployment, longitudinal study, mental health

Acknowledgements: This review was undertaken on behalf of the Longitudinal Health Surveillance Program, UQ Node, CMVH.

Conflict Of Interest: The authors declare no conflict of interest

Introduction

Negative effects of deployment on the mental health of Gulf War veterans have been identified in many studies. Systematic reviews of cross-sectional studies presented good evidence of an increased frequency of self-reported symptoms of post-traumatic stress disorder (PTSD) and other common mental disorders¹. Similar observations of negative health outcomes, including mental health, were found in a large sample of Australian veterans of the era².

Australian Gulf War veterans were at greater risk of developing post-Gulf War anxiety disorders including post-traumatic stress disorder, affective disorders and substance use disorders compared to non-deployed military personnel of the era. The prevalence of such disorders remained elevated a decade after deployment. The current PTSD rate assessed by structured clinical interviews 10 years after deployment was 5.4%³.

Although there were several longitudinal studies of varied quality made of the military that attempted to establish the causal relationship between deployment and other military-specific factors and various aspects of mental and physical health, they were rarely performed prospectively on a large cohort. After the 1991 Gulf War, the US Department of Defence recognised the need to collect prospective exposure and health information that may be associated with the long-term health of service members. Additionally, with a changed environment after the September 11 terrorist attack and with the deployment of an unprecedented number of troops to Iraq and Afghanistan, any negative health outcomes will affect a large segment of the population for years to come, increase the health needs of veterans and have a significant effect on medical and disability costs. Therefore, the accurate assessment of the effects of deployment on health becomes paramount.

To address this need, the US Millennium Cohort study was established⁴, with a goal to prospectively evaluate the long-term health of military service members and the potential influence of deployment and other military exposures on health.

Australian troops take part in conflicts in Iraq and Afghanistan and also play a significant peacekeeping role in the Pacific region. Any knowledge regarding the effects of military deployment and military specific exposures could therefore allow for better preparation for the ensuing consequences of deployment.

A systematic review of prospective longitudinal cohort studies performed in the military was undertaken to investigate the often raised question of whether military service, in particular operational deployment, results in a higher risk of chronic illness among military personnel and veterans. The current review article presents the findings on the effect of deployment on mental health outcomes.

Methods

The MEDLINE database was searched using relevant keywords and MESH terms for Military Personnel /

veterans, longitudinal study and health outcomes. Additionally, the US Millennium Cohort study website was used to obtain the complete list of relevant publications on the subject. The search was performed in July 2010.

To be included in the present review, studies had to be of prospective longitudinal cohort design and investigate mental health outcomes in military populations and veterans serving in post Vietnam War conflicts. Retrospective longitudinal studies and longitudinal panel studies were excluded.

The references found were downloaded to an EndNote library and assessed for relevance, based on the examination of titles and abstracts. There were 248 titles recovered, 49 were marked for inclusion, and after full text examination, 18 studies fulfilled the inclusion criteria and are reviewed here.

The quality of studies was assessed on criteria that included cohort size, sample selection, follow-up rate and duration, outcome and exposure measurement bias, type of analysis, clarity of the results and adjustment for confounders.

Results

Eighteen studies investigated mental health outcomes. PTSD was the main investigated outcome in 8 studies⁵⁻¹² and depression or stress in 10 studies¹³⁻²². Four studies resulted from the US Millennium Cohort study^{6, 9, 10, 22} and 14 studies investigated other military populations.

The main results of included papers are presented in the text below, while details of the studies are presented in Table 1.

Seven studies, including all of the US Millennium Cohort studies were of very good quality, eight studies were of good quality, and one each were of moderate and low quality (see Table 1).

Self-reported symptom measures of PTSD and depression, assessed using validated instruments, were used in all studies.

Table 1: Summary of characteristics and results of included studies

Study	Study characteristics	Results
PTSD		
US Millennium Cohort		
Smith 2008 ⁹	N= 50,184 OBJECTIVE: To describe new onset and persistence of self reported PTSD symptoms in military personnel before and after deployment in Iraq and Afghanistan. POPULATION: participants with pre and post-deployment data. More than 40% of the cohort was deployed between 2001 and 2006; 24% deployed for the first time, those deployed before or during submitting baseline questionnaire were excluded. Response rate: 70% of those who submitted a baseline questionnaire. OUTCOMES: New onset PTSD (self-reported symptoms measured by DSM-IV criteria using 17-item PTSD Checklist - civilian version, PCL-C). ANALYSIS: OR with 95% CI, Multivariable logistic regression analysis. APPRAISAL SCORE*=6	RESULTS: New onset PTSD was identified in: 2.3-3.0% of non-deployed. 1.4-2.1% of deployed without combat exposures, 7.6-8.7% of deployed with combat exposures, Compared to non-deployed personnel, new onset PTSD increases threefold in deployed military personnel with combat exposures, but was slightly lower in deployed personnel without combat exposure. There were differences between four arms of military. Female, divorced, enlisted personnel, and current smokers or problem drinkers at baseline had an increased risk of new onset PTSD. In those with PTSD present at baseline (2.4%), deployment did not affect persistence of symptoms, and 50-60% did not report symptoms at FU. This implies resiliency or recovery among more than half of the population between baseline and follow-up. CONCLUSIONS: New onset PTSD increases threefold in deployed military personnel with combat exposures. Combat exposures, not the deployment itself, affect the onset of PTSD.
Smith 2008 ¹⁰	N=5324, (881 women and 4443 men). OBJECTIVE: To investigate the relationship between prior assault and PTSD after combat deployment (Factors that make individuals vulnerable to or resilient against PTSD). POPULATION: eligible participants were those deployed in Iraq and Afghanistan, reported combat exposures and were free of PTSD at baseline. Assault defined as sexual or violent. OUTCOMES: Newly reported PTSD (self-reported symptoms measured by DSM-IV criteria using 17-item PTSD Checklist - civilian version) ANALYSIS: OR with 95% CI, adjusted and non-adjusted, Multivariable logistic regression analysis. APPRAISAL SCORE=6	RESULTS: The rates of newly reported PTSD for assaulted and non-assaulted individuals were, respectively, 22% and 10% in women and 12% and 6% in men. The odds of new-onset PTSD symptoms were more than 2-fold higher in both women and men who reported assault prior to deployment. CONCLUSIONS: Previous assault is a risk factor for newly reported PTSD: It appears to confer increased vulnerability for, rather than resilience against, PTSD symptoms among military professionals deployed to recent combat operations.
LeardMann 2009 ⁶	N=5410 OBJECTIVE: To determine if baseline functional health status, as measured by SF-36, predicts new onset of PTSD among deployed military personnel with combat exposure (factors that make individuals vulnerable to or resilient against PTSD). POPULATION: eligible participants were those deployed in Iraq and Afghanistan, reported combat exposures, and were free of PTSD at baseline. OUTCOMES: New onset PTSD (self-reported symptoms measured by DSM-IV criteria using 17-item PTSD Checklist - civilian version). ANALYSIS: Univariate regression for all variables and multivariate logistic regressions for independent variables. APPRAISAL SCORE=6	RESULTS: 7.3% of eligible participants had new onset PTSD. The risk of new onset of PTSD was 2-3 times higher in individuals with the SF-36 score below the 15th percentile compared to those with a score in the 15th to 85th percentile range. Over half (58%) of cases of new onset PTSD occurred among participants with scores below the 15th percentile at baseline. CONCLUSIONS: Low mental or physical health status before combat exposure significantly increases the risk of symptoms or diagnosis of PTSD after deployment. More vulnerable members of a population could be identified and benefit from interventions targeted to prevent new onset PTSD.

Other military		
Factors influencing post-deployment PTSD		
Britt 2007 ⁵	N=1,685	CONCLUSIONS: Depression was a predictor of PTSD and negative perceptions of deployment.
	OBJECTIVE: To examine predictors of PTSD and perception of deployment (longitudinal part of the study).	Morale during the deployment was a predictor of positive perception of deployment six months later.
	POPULATION: U.S. soldiers on a peacekeeping mission to Kosovo, sampled at middle-deployment and post-deployment, about 6 month later. 40% FU rate. Assessed at middle-deployment: morale, depression, deployment stressors. Assessed at post-deployment: benefits and costs of deployments, PTSD.	Consequences of morale during a military operation are different than the consequences of depression.
Rona 2006 ⁸	N=2,820	PRACTICAL IMPLICATIONS: Interventions designed to increase morale may not only prevent negative during deployment may positively affect re-deployability.
	OBJECTIVE: To assess whether pre-deployment screening for mental disorder predicts post-deployment PTSD or mental disorders.	
	POPULATION: UK armed forces, 2 sampling points, 2002 and 2004-6, 69% FU, entire group and those deployed to Iraq.	
Solomon 1992 ¹¹	OUTCOMES: PTSD (self-reported symptoms measured by DSM-IV criteria using 17-item PTSD Checklist), perception of deployment.	
	ANALYSIS: Correlations, Structural equation modelling.	
	APPRAISAL SCORE=5	
Solomon 1992 ¹¹	N=329	Screening before deployment had a low predictability for most common mental health conditions
	OBJECTIVE: To assess the effect of combat stress reaction (CSR) on PTSD and mental and somatic health of Israel veterans.	The predictability of screening for post-traumatic stress disorder was higher than for any other mental health problem
	POPULATION: Israeli veterans of Lebanon War with combat exposure (defined by participation in front-line battles) and with (n=213) and without CSR (n=116), assessed one, two and three years after the war.	As the prevalence of post-traumatic stress disorder was low before deployment, screening for the condition would be inappropriate despite a moderately high predictability.
Solomon 1992 ¹¹	OUTCOMES: PTSD (self-reported symptoms measured by DSM-III criteria using 13-item PTSD inventory), mental health, somatic symptoms and social functioning.	Results were the same for the analyses restricted to those who were deployed.
	ANALYSIS: ANOVA	CONCLUSIONS: Screening for common mental disorders before deployment in this cohort would not have reduced subsequent morbidity or predicted PTSD, but this may change if there is a considerable increase in the prevalence of the disorder.
	APPRAISAL SCORE=4	
Solomon 1992 ¹¹	N=329	Combat-related psychopathology was more prevalent among CSR casualties than among their matched controls at all assessment times, one, two and three years after war.
	OBJECTIVE: To assess the effect of combat stress reaction (CSR) on PTSD and mental and somatic health of Israel veterans.	Passage of time had no effect on the relative psychiatric symptomatology, social functioning, self-efficacy, and somatic complaints in either of the two study groups. Intensity of PTSD symptoms (avoidance and intrusion) declined in third year.
	POPULATION: Israeli veterans of Lebanon War with combat exposure (defined by participation in front-line battles) and with (n=213) and without CSR (n=116), assessed one, two and three years after the war.	CONCLUSIONS: Mental health status of the CSR casualties over the three years is worse than in veterans without CSR, but it remains stable, or improves slightly (results in contrast with cross-sectional studies).
Solomon 1992 ¹¹	OUTCOMES: PTSD (self-reported symptoms measured by DSM-III criteria using 13-item PTSD inventory), mental health, somatic symptoms and social functioning.	Limitations: self-reported symptoms, type of analysis.
	ANALYSIS: ANOVA	
	APPRAISAL SCORE=4	

Solomon 2005 ¹²	N=414 OBJECTIVE: To evaluate the long-term (20-year) effectiveness of frontline treatment for CSR. POPULATION: Israel soldiers from the 1982 Lebanon War with CSR who received frontline treatment (N=79), comparable CSR casualties who did not receive frontline treatment (N=156), and matched soldiers who did not experience CSR (N=194). Sampling points 20 years apart: 1982 and 2002. Longitudinal quasi-experimental design. OUTCOMES: PTSD (self-reported symptoms measured by DSM-III criteria using 13-item PTSD inventory), psychiatric symptoms, social functioning. ANALYSIS: Wald statistics and ANOVA APPRAISAL SCORE=4	Twenty years after the war, traumatised soldiers who received frontline treatment had lower rates of posttraumatic and psychiatric symptoms, experienced less loneliness, and reported better social functioning than similarly traumatised soldiers who did not receive frontline treatment. The more principles of frontline treatment were applied, the stronger the effect on psychiatric outcomes (cumulative effect). CONCLUSIONS: Frontline treatment is associated with improved outcomes even two decades after its application. Implications: Timely frontline application of treatment for combat stress reaction may improve post-deployment mental health outcomes
Marx 2009 ⁷	N=663 OBJECTIVE: To evaluate effect of pre-deployment neurocognitive performance and post-deployment PTSD symptoms POPULATION: active duty US Army soldiers deployed to Iraq who were enrolled in the Neurocognition Deployment Health Study. Tests of immediate and delayed verbal and visual memory, sustained attention, working memory and inhibitory functioning performed pre- and post-deployment. OUTCOMES: PTSD symptom severity (self-reported symptoms measured by DSM-IV criteria using 17-item PTSD Checklist). ANALYSIS: multiple regression analyses. APPRAISAL SCORE=4	Neurocognitive performance is an independent predictor of severity of PTSD symptoms. Pre-trauma immediate recall of visual (but not verbal-auditory) information was associated with post-deployment PTSD symptom severity. Correlation was controlled for pre-deployment PTSD symptom levels, combat intensity, and age, gender, and test-retest interval. CONCLUSIONS: Pre-trauma neurocognitive functioning may moderate the effects of trauma exposure on PTSD symptoms Limitation: sample <1000, all deployed, not stratified into those exposed to combat and not.
Depression and other mental health symptoms		
US Millennium cohort		
Wells 2010 ²²	N=40 219 OBJECTIVE: To investigate relations between deployment and new-onset depression among US service members recently deployed to the wars in Iraq and Afghanistan. POPULATION: Eligible participants completed baseline and follow-up questionnaires and did not have depression at baseline. OUTCOMES: A new onset of depression (self-reported symptoms measured by 9 items on Patient Health Questionnaire, PHQ, which corresponds to diagnosis by DSM-IV criteria. ANALYSIS: Multivariable logistic regression analysis model. APPRAISAL SCORE=6	RESULTS: Deployed men and women with combat exposures had the highest onset of depression, followed by those not deployed and those deployed without combat exposures. Combat-deployed men and women were at significantly increased risk for new-onset depression compared with non-deployed men and women: (adjusted) odds ratio =1.32 for men and 2.13 for women. Conversely, deployment without combat exposures led to significantly decreased risk for new onset depression compared with those who did not deploy (OR was 0.66 for men; and 0.65 for women). The following variables were correlated with significantly increased risk of new onset of depression: sex, and within both sexes: younger age, divorced, currently smoking, alcohol, baseline PTSD, rank of enlisted, active duty (vs. Reserve/National Guard), Army (vs. other arms). The Odds Ratios given above were adjusted for all those variables. CONCLUSIONS: It is combat exposure not the deployment itself that is a risk factor for new-onset depression among US service members. Post-deployment screening may be beneficial for US service members exposed to combat.

Other Military studies		
Effects of deployment to combat zones (Iraq and Afghanistan)		
Milliken 2007 ¹⁹	N=88,235 OBJECTIVE: To measure the mental health needs among soldiers returning from Iraq and the association of screening with mental health care utilization. POPULATION: US soldiers returning from Iraq who completed two Post-Deployment Health Assessments about 6 months between them. Stratified into those on active duty and reserve component, who returned to civilian life. OUTCOMES: Self-reported symptoms of PTSD (measured by the Primary Care 4-item PTSD screen, PC-PTSD), major depression (measured by 2-item depression instrument from the Patient Health Questionnaire), alcohol misuse, or other mental health problems; referral and mental health utilisation. ANALYSIS: At this sample size, almost all differences significant, so little analysis. APPRAISAL SCORE=6	Soldiers reported more mental health concerns and were referred at significantly higher rates at the second assessment. Based on the combined screening, about 20% of active and 42% of reserve component soldiers screened as requiring mental health treatment. Concerns about interpersonal conflict increased 4-fold. Soldiers frequently reported alcohol concerns, yet very few were referred to alcohol treatment. Most soldiers who used mental health services had not been referred, even though the majority accessed care within 30 days following the screening. Although soldiers were much more likely to report PTSD symptoms on the second than on first assessment, 49% to 59% of those who had PTSD symptoms identified on first assessment improved by the time they took the second assessment. There was no direct relationship of referral or treatment with symptom improvement. CONCLUSIONS: Rescreening soldiers several months after their return from Iraq identified a large cohort missed on initial screening. Increased relationship problems underscore shortcomings in services for family members. Practical implications: Large clinical burden among recently deployed veterans exists within months of returning home and highlights the need to enhance military mental health care during this period.
Duma 2010 ¹⁵	N=443 OBJECTIVE: To examine the longitudinal course of mental health symptoms among post-deployed soldiers preparing for another deployment. POPULATION: U.S. soldiers, post-deployed from Iraq or Afghanistan, preparing to deploy again. Mean period between screenings ~7 months. OUTCOMES: Self-reported symptoms of PTSD, depression, anxiety, panic, and alcohol overuse (measured by PC-PTSD, PHQ-9, PHQ-A, PHQ-P and AUDIT, respectively). ANALYSIS: MANOVA APPRAISAL SCORE=6	92 to 98% of the sample screened negative at both post-deployment and pre-deployment for all mental health measures. Initial rates of self-reported symptoms for PTSD, depression, anxiety, panic, and hazardous alcohol consumption were under 9% with most around 5%. Levels of reported depression, anxiety, and alcohol use decreased significantly between screening one and two, but levels of reported PTSD and panic symptoms did not change. CONCLUSIONS: Some mental health symptoms remain stable while others improve for soldiers repeating deployment. Panic and PTSD symptoms are less likely to spontaneously remit than other mental symptoms.
Campion 2006 ¹⁴	N=113 OBJECTIVE: To assess psychological morbidity during the 2002 deployment to Afghanistan. POPULATION: UK military personnel, members of Air Assault Brigade, who completed questionnaires on arrival in Afghanistan and then on departure OUTCOMES: Self-reported psychosomatic symptoms (GHQ28), alcohol use score (AUDIT). ANALYSIS: comparison of mean scores by ANOVA APPRAISAL SCORE=3	No significant change to alcohol use score at the end of deployment compared with pre-deployment (AUDIT score difference mean difference = -0.39, 95% CI = -1.25 - +0.47); No significant change to mental health (GHQ mean difference = 0.55, 95% CI = -0.07 - +1.17). An increase in psychosomatic symptoms (GHQ mean difference = 0.22, 95% CI = -0.03 - +0.47) is considered to result from the adverse conditions, but it is not supported by other mental ill health markers. The lack of visible negative effects may be related to shorter deployment durations adopted by British forces compared to US military. CONCLUSIONS: There appeared to be no negative effect on mental health from deployment to Afghanistan. LIMITATIONS: Small sample, short-term effects

Hughes 2005 ¹⁶	N=254 OBJECTIVE: To investigate mental health of UK personnel before and after deployment. POPULATION: members of the UK's Air Assault Brigade screened before enlisting and after about 4 months of service in Iraq. 35% of original sample filled up both questionnaires. OUTCOMES: Self-reported measures of general health (GHQ-28), trauma (TSQ). ANALYSIS: ANOVA APPRAISAL SCORE=2	Analysis of General Health Questionnaire (GHQ-28) scores before and after deployment revealed a lower score after deployment. The mean difference was slight, but significant =0.93, 95% CI 0.35-1.52 (cut-of score was >20), which indicates a significant relative improvement in mental health (P < 0.005). About 2% exceeded cut-off criteria on the trauma score. CONCLUSIONS: Deployment is not necessarily detrimental for psychological health. LIMITATIONS: Small non-representative sample, short-term effects, not clear whether participants exposed to direct combat, not stratification according to combat exposure.
Prorokovic 2005 ²⁰	N=286 OBJECTIVE: To evaluate psychosomatic and depressive symptoms among soldiers, refugees and civilians in the war and post-war period in Croatia. POPULATION: Croatian males, 128 civilians, 88 refugees, and 70 soldiers, who were interviewed at all four assessment time points, during the war and post-war period (1993, 1995, 2000, and 2004), 60% of initial sample. OUTCOMES: Self-reported psychosomatic complaints (measured by 25-item psychosomatic checklist) and depressive symptoms (Beck's Depression Inventory, BDI). ANALYSIS: ANOVA APPRAISAL SCORE=4	Levels of psychosomatic and depressive symptoms changed with time. Refugees showed the highest level of depressive symptoms, which eased up after the war. Civilians showed relatively high level of depressive symptoms during the war and soldiers just after the war. Psychosomatic complaints were dominant in soldiers and refugees at all assessment time points. Soldiers showed a significant increase in psychosomatic complaints with time, whereas refugees showed a decrease. Civilians showed relatively low level of psychosomatic complaints and did not show any significant changes with time. CONCLUSION: For refugees and soldiers, prolonged stressful situations appear to have long-term health implications primarily related to psychosomatic complaints. LIMITATIONS: Small sample
Effects of peacekeeping deployment (non-combat zones)		
McDonald 1998 ¹⁷	N=277 OBJECTIVE: To assess psychological effect of peacekeeping duties and to identify stressors encountered before, during and after deployment that would be related to the mental health state among the participants. POPULATION: New Zealand Defence Force personnel. Data collected in five stages: before, during and after deployment, to approximately 6 months after return. Different people of and different number filled questionnaires at any stage, 277 filled baseline and at least one FU questionnaire, 75 filled all five stages. OUTCOMES: Self-reported multiple measures of mental health (measured by Mental Health Inventory and BDI), physical health and stressors. ANALYSIS: ANOVA APPRAISAL SCORE=3	Pre-deployment and follow-up post-deployment stages appear to be the most stressful periods of the deployment, with the greatest effect on overall health and well-being. Highest levels of anxiety and psychological distress are seen at pre-deployment and 6 months after return. Practical implications: These findings demonstrate the need for effective pre-deployment training and post-deployment debriefing and support. Limitation: small and complex sample with different people and different number filling questionnaires at any stage, self-reported outcomes, type of analysis.

Michel 2003 ¹⁸	N=316 OBJECTIVE: To assess mental health of peacekeepers POPULATION: Swedish peacekeepers serving in Bosnia after 1993 (low-intensity conflict). Assessed 4 times: before deployment, immediately after deployment, 6 months after deployment, and 1 year after deployment. 61% response rate, >50% at 1 year FU. OUTCOMES: Self-reported measures of mental health (GHQ-28) ANALYSIS: Logistic regressions APPRAISAL SCORE=5	The participants were divided into four groups according to reported stressors: (1) no trauma in Bosnia or stressors post-deployment, (2) stressors only post-deployment, (3) trauma only in Bosnia, and (4) trauma in Bosnia and stressors post-deployment The general level of mental health problems among peacekeepers serving during a low-intensity conflict was low and no significant change of mental health over time was noted. The rank order between the groups in mean GHQ-28 score (lowest to highest) was as follows: 1) group without any stressor, 2) group with only traumatic experience in Bosnia, 3) the group with only post-deployment stressors, and 4) the group that experienced traumatic events in Bosnia as well as stressors back home. Post-deployment stressors made the strongest contribution to registering a poor mental health score after one year. CONCLUSIONS: Among peacekeeper serving during a low-intensity conflict, those that experienced traumatic events in Bosnia, as well as stressful life events post-deployment, reported the poorest mental health. LIMITATIONS: no control group, low-intensity conflict, no group with traumatic combat exposure, may not be generally applicable.
Effects of stress of training or work		
Robinson 2009 ²¹	N=3,792 OBJECTIVE: To examine mental health in soldiers undergoing combat medic training. POPULATION: US soldiers (first 18 companies) who entered the combat medic at Fort Sam Houston. Assessed at the beginning and 12 weeks later at the end of training. OUTCOMES: Self-reported symptoms of depression (BDI), anxiety (State Trait Anxiety Inventory, STAI) or suicidal ideation. ANALYSIS: ANOVA, Odds ratio, generalised linear mixed models. APPRAISAL SCORE=4	At the start of training, 10.4%, 15.5%, and 4.1% of soldiers had clinically significant depression, anxiety, or suicidal ideation, respectively. These percentages increased to 12.2%, 20.3%, and 5.7% at completion of training, respectively. Worsening of depression, anxiety, and suicidal ideation occurred for 7.7%, 11.4%, and 4% of soldiers. Higher percentages of symptoms were associated with females, lower education and lower income. Active duty personnel were more likely to worsen with respect to suicidal ideation (OR = 1.9, 95% CI = 1.2-2.9) compared to reservists. CONCLUSION: Study identified both demographic (i.e., age, sex) and military-specific predictors (i.e., duty status, history of military service) of psychological distress in soldiers undergoing combat medic training. Markers of distress increased as possible combat deployment became more imminent. Practical implications: The identification of significant predictors of mental health status may serve to identify individuals at risk.

Britt 2005 ¹³	N=176 OBJECTIVE: To examine whether self-engagement in a performance domain could buffer or exacerbate the consequences of different stressors on well-being. POPULATION: U.S. Army soldiers stationed in Europe. Assessed about 3 months apart. OUTCOMES: Self-reported measures of measures of well-being and physical symptoms (GHQ). Stressors assessed were work hours, days spent on training exercises, and subjective work overload. ANALYSIS: Moderated Multiple Regressions of relationship between stressors and outcomes. Outcomes at Time 2 were controlled for outcomes at Time 1. APPRAISAL SCORE=4	Soldiers highly engaged in their jobs were less likely to report negative consequences under high levels of training/work hours in comparison to soldiers disengaged from their jobs. However, engagement in work interacted with work overload in the opposite manner, with high levels of engagement potentiating the relationship between overload and reports of health symptoms. CONCLUSIONS: High levels of self-engagement in performance domains can buffer individuals from stressors that do not impede performance but may potentiate the effects of stressors that compromise performance. LIMITATIONS: Small sample, short-term effects
-----------------------------	--	--

*Each of the 7 appraisal questions was assigned a score of 1 or 0. Only cohorts above 1000 participants were assigned a point for the size. The max number of points in the appraisal score was 7. Studies with scores of 6-7, 4-5 and 3 were considered to be, respectively, of very good, good and moderate quality, and those below 3 points, of low quality.

PTSD

Millennium Cohort

Among military personnel recently deployed to Iraq and Afghanistan and who did not have PTSD at baseline, the new onset of self-reported PTSD symptoms increases threefold in deployed military personnel with combat exposures compared to those of non-deployed personnel⁹. Combat exposure in all Millennium Cohort studies was defined by being personally exposed to witnessing (i) violent death (ii) physical abuse (torture, beating, rape), (iii) dead and/or decomposing bodies, (iv) maimed soldiers or civilians, and (v) prisoners of war or refugees. Interestingly, the new onset of PTSD was less frequent in deployed personnel without combat exposure than in non-deployed personnel, indicating that combat exposures, not the deployment itself, affected the onset of PTSD. In those with PTSD present at baseline, deployment did not affect the persistence of symptoms. About 2.4% of Millennium Cohort members had self reported symptoms of PTSD at baseline. These symptoms were present in only 40-50% of the individuals at second assessment, which implies resiliency or recovery among more than half of the affected population between baseline and follow-up.

Although prior knowledge of post-deployment harmful effects is very useful, an understanding of the characteristics that confer particular vulnerabilities or resilience to new onset PTSD could be of utmost importance. The mechanism of resilience or vulnerability to PTSD symptoms in

individuals following overwhelming stress is not well understood. Some have suggested that repeated exposure to traumatic events makes people more resilient, others argue that it makes them more vulnerable. Although victims of prior assault and those with a history of mental illness have been shown to exhibit less optimal levels of mental health and higher risk for PTSD after a stressful experience, epidemiologic studies of PTSD in military members to date have been based largely on retrospective data, rendering investigation of etiologic pathways of PTSD inconclusive. Two papers investigated the factors contributing to vulnerability to PTSD in the US Millennium Cohort.^{6, 10}

One study investigated the effect of previous assault on the rates of new onset of PTSD¹⁰. Eligible participants who were deployed to Iraq and Afghanistan between baseline and follow up had no PTSD symptoms at baseline and reported combat exposure at follow up. Out of five thousand participants, 28% of the women and 9% of the men, reported a previous assault at baseline, mostly sexual for women and violent for men. The rates of new onset of PTSD for the assaulted versus non-assaulted groups were, respectively, 22% and 10% in women and 12% and 6% in men. Adjusting for baseline factors, the odds of new-onset PTSD symptoms was more than 2-fold higher in both women and men who reported an assault prior to deployment.¹⁰

The next study investigated whether baseline functional health status, as measured by SF-36

(Short Form-36), predicts new onset of PTSD among deployed military personnel with combat exposure.⁶ When over five thousand participants (eligibility criteria as in the previous study) were stratified according to their functional health measured by SF-36 score, 7.3% had new onset PTSD. Individuals with the lowest (<15th percentile) baseline mental or physical component summary scores of SF-36 had two to three times the risk of new onset of PTSD compared with those with higher scores (15th - 85th percentile). Of those with new onset PTSD, over half (58%) of cases occurred among 15% of participants with the lowest SF-36 scores.

Other Military Studies

Other military studies have investigated mainly the factors influencing the incidence of post-deployment PTSD.

In a large cohort of U.S. soldiers on a peacekeeping mission to Kosovo, depression symptoms present during deployment were a predictor of post-deployment PTSD.⁵ However, pre-deployment screening for common mental disorders had a low predictability and would not have reduced subsequent morbidity or predicted PTSD in UK forces deployed to Iraq.⁸

In Israeli veterans of the Lebanon War, the intensity of PTSD symptoms and mental health status assessed in three consecutive years after the war were worse in those who had a combat stress reaction (CSR) during the combat compared to those without CSR. However, the mental health status of the CSR casualties over the three years was stable or improved slightly.¹¹

In a similar group of veterans, twenty years after the war, traumatised soldiers who received frontline treatment for CSR had lower rates of posttraumatic and psychiatric symptoms, experienced less loneliness and reported better social functioning than similarly traumatised soldiers who did not receive frontline treatment.¹²

There are also individual-based predictors of post-deployment PTSD. In a group of active duty US Army soldiers deployed to Iraq, neurocognitive performance prior to deployment was an independent predictor of the severity of PTSD symptoms.⁷

DEPRESSION

Millennium Cohort

Male and female US service members who deployed and reported combat exposures were at an increased risk for depression compared with non-deployed service members, after adjustment for baseline PTSD symptoms and other potentially confounding

variables.²² Conversely, men and women who deployed and did not report combat exposures were at a lower risk for depression than non-deployed men and women. Thus, it is combat exposure not the deployment itself that is a risk factor for new-onset depression among US service members. In the absence of combat exposure, outcomes may be affected by selective deployment of service members who are at decreased risk for the development of depression in comparison with non-deployed men and women. The implications of these findings are that post-deployment screening for depression should be focused on US service members exposed to combat.

Other Military Studies

In a large population of US soldiers who were screened for common mental problems directly after returning from Iraq and then 6 months later, more mental health concerns were reported at the second assessment.¹⁹ Based on the combined screening, about 20% of active personnel and 42% of reserve component soldiers screened required mental health treatment. Reported concerns included PTSD symptoms, interpersonal conflict and alcohol overuse. Although up to 60% of soldiers with PTSD symptoms identified on the first assessment improved by the second assessment, soldiers were still much more likely to report PTSD symptoms on the second assessment. This suggests either a failure of the first screening or a delayed onset of symptoms.

A smaller group of US soldiers, post-deployed from Iraq or Afghanistan and preparing to deploy again, were screened for PTSD, depression, anxiety, panic and alcohol overuse directly after return and then before re-deployment (about 7 months later). Post-deployment rates for all mental health measures combined were under 9%, with most around 5%. Levels of reported depression, anxiety and alcohol use decreased significantly between screenings one and two, but levels of reported PTSD and panic symptoms did not change. Results indicated that symptoms of panic and PTSD are less likely to spontaneously remit than other mental symptoms.¹⁵

Two studies investigated the mental health of the UK Air Assault Brigade who were deployed to Afghanistan and Iraq with surprising results.

Those who completed questionnaires on arrival in Afghanistan and then on departure about 4 months later reported no significant change to mental health or alcohol use at the end of deployment compared with pre-deployment.¹⁴ Those screened before deployment and after about 4 months of service in Iraq reported slight but significant relative improvement in mental health.¹⁶ The result may reflect a limitation of these

two studies, which were small and measured short-term effects, and participants were not stratified according to combat exposure. However, it is also possible that the lack of visible negative effects may be related to shorter deployment durations adopted by British forces as compared with the US military.^{23, 24}

In a small cohort of Croatian soldiers assessed during the war and four times in the 10 years after the war, depressive and psychosomatic symptoms show different levels and trajectories. The level of psychosomatic complaints in soldiers was high during the war and increased steadily over time. Depressive symptoms were relatively low during the war but increased just afterwards.²⁰

For New Zealand peacekeepers deployed to low conflict zones, pre-deployment and follow-up post-deployment stages appear to be the most stressful periods of the deployment, with highest levels of anxiety and psychological distress seen at pre-deployment and 6 months after return.¹⁷

Among Swedish peacekeepers serving during a low-intensity conflict, those that experienced traumatic events in Bosnia, as well as stressful life events post-deployment, reported the poorest mental health, with post-deployment stressors making the strongest contribution to poor mental health after one year.¹⁸

A study of US soldiers undergoing the combat medic training, assessed at the beginning and the end of training 3 months later, found an increase in self-reported symptoms of depression, anxiety or suicidal ideation.²¹ Markers of distress increased as possible combat deployment became more imminent. Although this study was large, it investigated only short term effects and the further trajectory of these symptoms is unknown.

Discussion

The cross-sectional studies on the prevalence of PTSD reported different rates in the military personnel from different countries or from different military forces. For example, in the US, PTSD rates among veterans of the US Persian Gulf War and the current conflict in the Middle East varied between 2% and 17%.²⁵ In contrast, PTSD rates among British veterans were generally lower and were less varied, about 3-6% of returning UK Iraq War veterans.²⁵ PTSD rates found in different UK studies were 2.5% among a random sample of veterans from all branches deployed after 1999²⁶, 4.8% for regular UK army personnel²⁷, and 4% for regulars and 6% for army reservists deployed to Iraq in 2003.²⁸

In Australia, the prevalence of PTSD among younger

veterans was closer to that reported in veterans from the UK rather than the US. In Australian Gulf War veterans, the rate of PTSD assessed a decade after deployment was 5.4%.³ The estimates of PTSD in ground forces of the ADF serving in Iraq and Afghanistan are as yet unpublished, but in Royal Australian Navy sailors deployed to the Middle Eastern Area of Operations between 2001 and 2005, the rate of PTSD was 1.4% in total.²⁹ Usually, PTSD rates reported for military personnel deployed with the Navy and AF were lower than for the ground troops.

There are distinct benefits of prospective longitudinal cohort studies over cross-sectional and retrospective studies. Prospective longitudinal studies can distinguish between short-term and long-term phenomena, can contribute to establishing causative associations between exposure and disease, and minimise recall and selection biases that are often influenced by exposure and/or disease.

Longitudinal studies, such as the US Millennium Cohort, demonstrate that it was combat exposure, not deployment in general, that has adverse effects on health.⁹ Therefore, higher rates of PTSD are to be expected among troops with the greatest combat exposure (i.e. ground troops vs. Navy or Air Force, US troops versus Australian). The dose response between combat exposure and PTSD is not linear, but a relationship between the amount and intensity of combat exposure and PTSD prevalence has been indicated previously in cross-sectional studies.³⁰

Studies from the US Millennium Cohort demonstrate conclusively that previous life events and health factors may constitute risk factors for the development of combat-related PTSD. Non-military trauma such as sexual or violent assault is a risk factor for newly reported PTSD and it appears to confer increased vulnerability for the development of PTSD symptoms¹⁰. Low mental or physical health status before combat exposure significantly increases the risk of symptoms after deployment and a small proportion of individuals account for the majority of new cases of PTSD. The practical implications of these findings are that the more vulnerable members of a population could be identified by their health or life experience status and interventions and preventive measures could be focused on this group.

A very large US study demonstrated the importance of longitudinal screening for post-deployment mental health problems.¹⁹ Although the majority of soldiers with PTSD symptoms identified on first assessment improved by the second assessment, still more mental health concerns were reported at the second assessment 6 months after deployment

than directly after returning from Iraq. This suggests either a failure of the first screening or a delayed onset of symptoms, and confirms the importance of an effective mental health screening policy. These findings are in agreement with a study of Australian Gulf War veterans, which mapped the temporal progression and peak prevalence of the most common psychological disorders across each year of the post-Gulf War period.³¹ Psychological disorder rates peaked in the first 2 years, with alcohol use disorders the most likely to appear first. In veterans with two or more disorders, anxiety disorders and alcohol disorders tended to appear before affective disorders. The changing trajectory of mental health problems after deployment or between deployments has been confirmed by most of the other military studies included in this review. These studies support findings that mental health problems and needs change in time and may increase with the accumulation of stressful events in post-deployment life. There is also a suggestion that improved screening and timely medical intervention may have beneficial effects.

Limitations of the Review

With few notable exceptions, which included all of the US Millennium Cohort studies, longitudinal studies of mental health in the military were limited either by an insufficient sample size or by investigations of short term health outcomes, making it difficult to draw definitive conclusions from these studies.

Conclusion

The results and conclusions drawn from the US Millennium Cohort studies represent the best level of evidence in the military context that presently can be obtained from epidemiological observational trials. The key finding from these studies was that it was combat exposure, not deployment in general, that had adverse effects on health.

Another finding was that the mental and physical health indicators in deployed personnel were often better than those in non-deployed personnel, probably reflecting a selection of healthier individuals for deployment, while health outcomes and health needs change over time and are affected by individual characteristics and post-deployment life events.

As direct generalisation of results from the US Millennium Cohort and other studies are limited by differences in populations and different terms of deployment, longitudinal health surveillance of a large, representative sample of Australian Defence Forces should be considered.

Authors' affiliation: Centre for Military and Veterans' Health, Research Coordination Unit, The University of Queensland, Brisbane, 4000
Corresponding author: Steve Pullman
Email: : s.pullman@uq.edu.au

References

1. Stimpson NJ, Thomas HV, Weightman AL, et al. Psychiatric disorder in veterans of the Persian Gulf War of 1991. Systematic review. *Br J Psychiatry*, 2003, 182: 391-403.
2. Kelsall HL, Sim MR, Forbes AB, et al. Symptoms and medical conditions in Australian veterans of the 1991 Gulf War: relation to immunisations and other Gulf War exposures. *Occup Environ Med*, 2004, 61(12): 1006-13.
3. Ikin JF, Sim MR, Creamer MC, et al. War-related psychological stressors and risk of psychological disorders in Australian veterans of the 1991 Gulf War. *Br J Psychiatry*, 2004, 185: 116-26.
4. Gray GC, Chesbrough KB, Ryan MAK, et al. The millennium Cohort Study: a 21-year prospective cohort study of 140,000 military personnel. *Mil Med*, 2002, 167(6): 483-8.
5. Britt TW, Dickinson JM, Moore D, et al. Correlates and consequences of morale versus depression under stressful conditions. *J Occup Health Psychol*, 2007, 12(1): 34-47.
6. LeardMann CA, Smith TC, Smith B, et al. Baseline self reported functional health and vulnerability to post-traumatic stress disorder after combat deployment: prospective US military cohort study. *BMJ*, 2009, 338: b1273.
7. Marx BP, Doron-Lamarca S, Proctor SP, et al. The influence of pre-deployment neurocognitive functioning on post-deployment PTSD symptom outcomes among Iraq-deployed Army soldiers. *J Int Neuropsychol Soc*, 2009, 15(6): 840-52.
8. Rona RJ, Hooper R, Jones M, et al. Mental health screening in armed forces before the Iraq war and prevention of subsequent psychological morbidity: follow-up study. *BMJ*, 2006, 333(7576): 991.
9. Smith TC, Ryan MA, Wingard DL, et al. New onset and persistent symptoms of post-traumatic stress disorder self reported after deployment and combat exposures: prospective population based US military cohort study. *BMJ*, 2008, 336(7640): 366-71.

10. Smith TC, Wingard DL, Ryan MA, et al. Prior assault and posttraumatic stress disorder after combat deployment. *Epidemiology*, 2008, 19(3): 505-12.
11. Solomon Z, Mikulincer M. Aftermaths of combat stress reactions: a three-year study. *Br J Clin Psychol*, 1992, 31(Pt 1): 21-32.
12. Solomon Z, Shklar R, Mikulincer M. Frontline treatment of combat stress reaction: a 20-year longitudinal evaluation study. *Am J Psychiatry*, 2005, 162(12): 2309-14.
13. Britt TW, Castro CA, Adler AB. Self-engagement, stressors, and health: a longitudinal study. *Pers Soc Psychol Bull*, 2005, 31(11): 1475-86.
14. Champion BH, Hacker Hughes JGH, Devon M, et al. Psychological morbidity during the 2002 deployment to Afghanistan. *J R Army Med Corps*, 2006, 152(2): 91-3.
15. Duma SJ, Reger MA, Canning SS, et al. Longitudinal mental health screening results among postdeployed U.S. soldiers preparing to deploy again. *J Trauma Stress*, 2010, 23(1): 52-8.
16. Hughes JH, Cameron F, Eldridge R, et al. Going to war does not have to hurt: preliminary findings from the British deployment to Iraq. *Br J Psychiatry*, 2005, 186: 536-7.
17. MacDonald C, Chamberlain K, Long N, et al. Mental health, physical health, and stressors reported by New Zealand Defence Force peacekeepers: a longitudinal study. *Mil Med*, 1998, 163(7): 477-81.
18. Michel P-O, Lundin T, Larsson G. Stress reactions among Swedish peacekeeping soldiers serving in Bosnia: a longitudinal study. *J Trauma Stress*, 2003, 16(6): 589-93.
19. Milliken CS, Auchterlonie JL, Hoge CW. Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the Iraq war. *JAMA*, 2007, 298(18): 2141-8.
20. Prorokovic A, Cavka M, Cubela Adoric V. Psychosomatic and depressive symptoms in civilians, refugees, and soldiers: 1993-2004 longitudinal study in Croatia. *Croat Med J*, 2005, 46(2): 275-81.
21. Robinson ME, Teyhen DS, Wu SS, et al. Mental health symptoms in combat medic training: a longitudinal examination. *Mil Med*, 2009, 174(6): 572-7.
22. Wells TS, LeardMann CA, Fortuna SO, et al. A prospective study of depression following combat deployment in support of the wars in Iraq and Afghanistan. *Am J Public Health*, 2010, 100(1): 90-9.
23. Fear NT, Jones M, Murphy D, et al. What are the consequences of deployment to Iraq and Afghanistan on the mental health of the UK armed forces? A cohort study. *The Lancet*, 2010, 375(9728): 1783-97. <http://usmilitary.about.com/od/armyjoin/a/deployment.htm>.
25. Richardson LK, Frueh BC, Acierno R. Prevalence estimates of combat-related post-traumatic stress disorder: critical review. *Aust N Z J Psychiatry*, 2010, 44(1): 4-19.
26. Jones M, Rona R, Hooper R, et al. The burden of psychological symptoms in UK Armed Forces. *Occup Med*, 2006, 56(5): 322.
27. Iversen A, Fear N, Ehlers A, et al. Risk factors for post-traumatic stress disorder among UK Armed Forces personnel. *Psychol Med*, 2008, 38(04): 511-22.
28. Hotopf M, Hull L, Fear N, et al. The health of UK military personnel who deployed to the 2003 Iraq war: a cohort study. *The Lancet*, 2006, 367(9524): 1731-41.
29. Rayner S. Prevalence of psychological trauma in operationally deployed Navy personnel: a baseline surveillance report. *ADF Health* 2005, 6: 81-4.
30. Hoge CW, Castro CA, Messer SC, et al. Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care. *N Engl J Med*, 2004, 351(1): 13-22.
31. McKenzie DP, Creamer M, Kelsall HL, et al. Temporal relationships between Gulf War deployment and subsequent psychological disorders in Royal Australian Navy Gulf War veterans. *Soc Psychiatry Psychiatr Epidemiol*, 2010, 45(9): 843-52.