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Post-Traumatic Stress among New Zealand military personnel: a cross sectional study

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Abstract:	Background Post-traumatic stress (PTS) is prevalent among military personnel. Knowledge of the protective and harmful factors associated with PTS in this population may assist with identifying personnel who would benefit from increased or targeted support. Aims To examine factors associated with PTS among New Zealand military personnel. Methods For this cross-sectional study, currently serving and retired military personnel were invited to complete a questionnaire. The questionnaire included a measure of PTS (the Military Post-traumatic Stress Disorder Checklist; PCL-M), where scores ≥30 indicate the experience of significant PTS symptoms and scores ≥45 indicate a presumptive clinical diagnosis of post-traumatic stress. Potentially protective and harmful factors associated with PTS were examined using logistic regression modelling. Results 1817 military personnel completed the questionnaire. PCL-M scores were ≥30 for 549 (30%) participants and ≥45 for 179 (10%) participants. Exposure to trauma was most strongly associated with PCL-M scores ≥45 (OR 3.34, 95% CI 1.54-7.27, p<0.01). Higher PCL-M scores were also associated with older age, male sex, and Māori ethnicity (New Zealand's indigenous population). Factors associated with lower PCL-M scores were greater length of service, psychological flexibility, and better quality sleep. Conclusions PTS was found to be prevalent among New Zealand military personnel. The experience of trauma was strongly associated with PTS. However, factors such as psychological flexibility (the ability to adapt to changes in circumstances) and good sleep were protective, suggesting that these factors could be key targets for interventions designed to reduce PTS among military personnel in New Zealand.
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Cover letter

UNIVERSITY of OTAGO

Te Whare Wānanga o Otāgo

22 August 2019.

Preventive and Social Medicine,

University of Otago.

Dear Editors,

Kia ora,

We are submitting this article to PLoS One because it highlights risk and protective factors for post-traumatic stress, an important condition worldwide, and prevalent in our veteran community. Non-deployed veterans were included, so the risk factors include not only deployment related trauma, but trauma from other life events in the military setting. We have found that good sleep and resilience are both protective, which facts will help with prevention and treatment.

Some previously published work has looked at these conditions but have not taken such a holistic view.

Coming from New Zealand, the population in this cross sectional study is small, but our response rate compares favourably with other veteran studies: they can be difficult to engage with. Our strength lies in having veterans on the team. We also include findings from our Māori indigenous population, relatively well represented in the sample.

We have not previously submitted it to PLOS or any other journal.

The appropriate Academic Editors would be:

Erin Bouldin

Ann Marie Cheney

Briony Hill or;

Tracey Weiland

We have no opposing reviewers.

Ngā mihi,

Dave McBride on behalf of the team

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Post-Traumatic Stress among New Zealand military personnel: a cross sectional study

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Abstract

Background: Post-traumatic stress (PTS) is prevalent among military personnel. Knowledge of the protective and harmful factors associated with PTS in this population may assist with identifying personnel who would benefit from increased or targeted support.

Aims: To examine factors associated with PTS among New Zealand military personnel.

Methods: For this cross-sectional study, currently serving and retired military personnel were invited to complete a questionnaire. The questionnaire included a measure of PTS (the Military Post-traumatic Stress Disorder Checklist; PCL-M), where scores ≥30 indicate the experience of significant PTS symptoms and scores ≥45 indicate a presumptive clinical diagnosis of post-traumatic stress. Potentially protective and harmful factors associated with PTS were examined using logistic regression modelling.

Results: 1817 military personnel completed the questionnaire. PCL-M scores were ≥30 for 549 (30%) participants and ≥45 for 179 (10%) participants. Exposure to trauma was most strongly associated with PCL-M scores ≥45 (OR 3.34, 95% CI 1.54-7.27, p<0.01). Higher PCL-M scores were also associated with older age, male sex, and Māori ethnicity (New Zealand's indigenous population). Factors associated with lower PCL-M scores were greater length of service, psychological flexibility, and better quality sleep.

Conclusions: PTS was found to be prevalent among New Zealand military personnel. The experience of trauma was strongly associated with PTS. However, factors such as psychological flexibility (the ability to adapt to changes in circumstances) and good sleep were protective, suggesting that these factors could be key targets for interventions designed to reduce PTS among military personnel in New Zealand.

Key words

Military Personnel, Post-Traumatic Stress (PTS), Psychological Flexibility, Sleep, Trauma

Introduction

In New Zealand, the Defence Force has three primary personnel groups: the Regular Force, Reserve Forces, and Civilians (including those employed by the Defence Force and working overseas) (1). These military personnel are responsible for contributing to the defence, security and wellbeing of the country. Research from other countries suggests that while many military personnel cope well with their roles (2) , they are exposed to higher rates of both military and non-military trauma compared to the general population (3-5) , and are at greater risk of experiencing post-traumatic stress (PTS) (6). An elevated risk has been identified among military personnel even during periods of low deployment activity (7-9).

Two critical events are commonly described in the military 'life course' – achievement of veteran status through operational deployment, and transition from military to civilian life. Operational deployment and witnessing atrocities has been associated with PTS (10, 11), while the period of transition from the military to civilian life has been found to confer an elevated risk of suicide, regardless of deployment history (12). A lack of support during this period (including social and family support) serves to amplify suicide risk, and has been found to contribute to the experience of PTS (13).

While the critical events described above have been identified across diverse military samples (13), estimates of the prevalence of PTS vary dramatically both across and within countries. For example, the prevalence of PTS identified within the United Kingdom Armed Forces is significantly lower than that reported for military personnel serving in the United States, Australia, and Canada (14). Although differences are partially attributable to variation in sampling strategies, research methods, and diagnostic thresholds, differences in exposure to risk factors are also likely to play a role (14). Research in veteran populations suggests that factors that can negatively affect adaptation to deployment and civilian transition include: female gender, ethnicity, high number of and longer duration deployments, prior adverse life events, pre-existing psychological disorders, trauma exposure, and alcohol misuse (13, 15-18). Conversely, sleep (19, 20), social support (21), and psychological flexibility (the ability to

fully experience thoughts and feelings and flexibly choose behaviour that is in line with personal goals and values) (22) have potential to protect against poor mental health outcomes, including PTS.

A significant number of New Zealand military personnel have been exposed to high levels of combat-related trauma and others have been deployed on peace-keeping missions (23). Moral injury is one stressor associated with peace-keeping missions, defined as "perpetrating, failing to prevent, bearing witness to, or learning about acts that transgress deeply held moral beliefs and expectations" (24). Other stressors include the restrictive rules of engagement (25), monotony and boredom, personnel encounter difficulties, and separation from family (26). Pre-deployment and follow-up stages are also important to consider; these were the most stressful periods, and had the greatest effect on mental and physical health, in a longitudinal study of 277 New Zealand military personnel deployed on peacekeeping duties (23).

While 10% of a community sample of New Zealand Vietnam War veterans were found to experience PTS (27), the prevalence of PTS among New Zealand military personnel more generally has not previously been reported. One reason for this is lower response rates to post-deployment screens for PTS (28). Research is also yet to identify the key harmful and protective factors associated with PTS in this population. This information is important to detect individuals who would benefit from targeted support following transition from the military, in order to reduce their risk of experiencing PTS. The aims of this cross-sectional study were to: 1) determine the prevalence of PTS (symptomology and presumptive cases), and 2) identify protective and harmful factors most strongly associated with PTS in New Zealand military personnel.

Materials and Methods

Sample

An online or paper questionnaire was available during June to December 2018 for completion by all currently serving and retired military personnel living in New Zealand. We attempted to minimise bias through an intensive recruitment campaign. In mid-June, a link to the online questionnaire was sent by email to all currently serving regular and reserve New Zealand Defence Force (NZDF) members who

were holders of the New Zealand Operational Service Medal (NZOSM), numbering 3874 individuals at that time. A global message and a link to the questionnaire was also presented on the NZDF 'intranet landing page', the webpage from which all currently serving personnel can access relevant work-related content, tools, and resources. Retired military personnel were recruited through paper questionnaires and posters distributed to the 43 local social clubs of the Royal New Zealand Returned and Services Association (RSA) identified by the RSA national office to be 'veteran active.' Announcements were also made on military social media pages, and both retired and currently serving personnel were invited to participate through an announcement on the No Duff Charitable Trust website; No Duff is a registered charity committed to providing confidential support for military personnel and their families in New Zealand (29).

Procedure

Military personnel interested in taking part in the study were directed to visit a website where they were required to enter their name and email address. This resulted in a personalised link being sent to their email address from which they could complete an online secure version of the questionnaire. All serving military personnel were informed that they could request a paper version of the survey if this was their personal preference. The study received approval from the Southern Health and Disability Ethics Committee of New Zealand (15/STH/40/AM02). We consulted with the Ngāi Tahu Research Consultation Committee in order to assess the importance of the project to Māori, New Zealand's indigenous population. For 6 predictor variables in a multivariate model, we needed at least 600 cases.

Measures

The questionnaire included standardised measures of PTS (outcome), and potentially harmful and protective exposures. Potentially adverse exposures examined included trauma, general distress, and hazardous drinking. Protective exposures included social support, sleep, and psychological flexibility.

Symptoms of PTS were assessed using the post-traumatic stress disorder (PTSD) checklist – military version (PCL-M). The PCL-M includes 17 items that ask about symptoms related to stressful military

experiences, with response options ranging from 1 ‘Not at all’ to 5 ‘Extremely’ (30). A total symptom severity score is calculated by summing responses to each option. While scores of 30-35 indicate significant PTS symptomology and probable cases of PTSD, scores of ≥45 indicate a presumptive PTSD diagnosis (30). The PCL-M has been identified as a widely used and well-validated measure (31).

The Brief Trauma Questionnaire (BTQ) was used to assess exposure to trauma. The BTQ consists of 10 items that screen for a range of different traumatic experiences [31]. Exposure to an event is scored as positive if a respondent says ‘yes’ to indicate life threat or serious injury from combat trauma, a serious car accident, a natural disaster, life-threatening illness, and physical or sexual abuse, or to indicate exposure to violent death (32). The BTQ is considered a reliable and valid measure to assess trauma exposure in defence force personnel (33).

Symptoms of distress were screened for using the General Health Questionnaire 12 (GHQ-12). This measure includes 12 items with a four-point response scale (34). Items are summed to yield an overall total score, with higher scores indicating greater distress (34).

The AUDIT-C is a 3-item measure that was used to identify potentially hazardous drinking (35). Each item is answered using five response options, with possible total scores ranging from 0 to 12 (35). A total score of ≥3 for women, and ≥4 for men, was used to identify participants engaging in hazardous drinking. The AUDIT-C has been validated in veteran populations (36, 37).

The Social Provisions Scale (SPS) was used to examine participant perceptions of the availability of different dimensions of social support. This theory-based social support instrument includes 24 items distributed across six subscales: reliable alliance, attachment, nurturance, social integration, reassurance of worth, and guidance (38). Each item is rated on a 4-point Likert scale with responses ranging from ‘strongly disagree’ to ‘strongly agree’ (38). After reversal of negatively worded items a total score was computed by summing all items. Higher scores (including total scores and individual subscale scores) indicate higher levels of perceived social support. The construct validity, internal

consistency, and test-retest reliability of the measure has been established across diverse populations (38, 39).

To screen for insomnia disorder based on DSM-5 criteria we used the 8-item Sleep Condition Indicator (SCI) (40). All items were scored on a four point scale (0 to 4), with possible summed scores on this measure range from 0 to 32; scores were then re-scaled to a 0 to 10 scale (40). Higher scores are indicative of better sleep.

To evaluate psychological flexibility, the 10-item Acceptance and Action Questionnaire II (AAQ-II) was used (41). After reversing negatively worded items, the items of the scale were summed to obtain a total score (possible range 10 to 70), with higher scores indicative of greater psychological flexibility (less experiential avoidance) (41).

The questionnaire also included a series of sociodemographic questions (gender, ethnicity, marital status, education level, employment status) and questions about service history, rank, and deployments.

Analyses

Statistical analyses were completed using Stata 15 software (42). First, descriptive statistics were used to describe the demographic characteristics of participants. Next, exploratory analyses investigated univariate associations between demographic, hazardous and protective factors, and the PTS outcomes (PCL-M ≥30 and PCL-M ≥45), with odds ratios (ORs) and 95% confidence intervals (CIs) estimated using logistic regression. Following this, multivariable logistic regression (adjusted for age, sex, service years, and deployment status) was performed to identify exposures associated with PTS using a backward elimination process; variables with a *p*-value >0.10 were sequentially dropped from the model. Missing data was addressed using developer recommendations or previous approaches for each measure. For example, in instances where one item was missing from the PCL-M the mean score was imputed; if more than one item was missing on the PCL-M the case was excluded from analyses (43). Only participants with complete data were included in the multivariable analyses.

Results

A total of 1817 military personnel completed the questionnaire; 90 of the participants completed a paper version. Among participants, 549 (30%) reported PCL-M scores of ≥30 indicating significant PTS symptomology (probable PTSD), and 179 (10%) reported PCL-M scores of ≥45, indicative of presumptive clinical PTS.

The demographic characteristics of participants categorised according to the experience of probable PTS (scores ≥30) are presented in Table 1.

Table 1. Demographic characteristics of participants according to PCL-M scores.

Characteristic	Low PCL-M Score 17-29 (*n* = 1268)	High PCL-M Score ≥30 (*n* = 549)
Age (years)		
20-29	124 (84%)	24 (16%)
30-39	264 (75%)	86 (25%)
40-49	327 (71%)	134 (29%)
50-59	247 (69%)	111 (31%)
60-69	176 (63%)	103 (37%)
70+	127 (59%)	89 (41%)
missing	3 (60%)	2 (40%)
Sex		
Female	183 (77%)	54 (23%)
Male	1065 (69%)	488 (31%)
missing	20 (74%)	7 (26%)
Ethnicity		
NZ European	997 (70%)	418 (30%)
Māori	177 (69%)	79 (31%)
Other	94 (64%)	52 (36%)
Service Years		
0-9	213 (62%)	132 (38%)
10-19	350 (70%)	153 (30%)
20-29	390 (73%)	144 (27%)
30-39	181 (69%)	80 (31%)
40-49	43 (65%)	23 (35%)
missing	91 (84%)	17 (16%)
Deployed		
No	186 (67%)	92 (33%)
Yes	1012 (71%)	415 (29%)
missing	70 (63%)	42 (37%)

The median age of participants was 49.1 years (interquartile range = 38.7 – 61.1 years). The majority were male (87%) and were of New Zealand European ethnicity (78%); 14% of participants identified as Māori, similar to that of the NZDF as a whole, reported as 15%. Most participants had served in the military for at least 10 years (80%) and had been deployed at least once (84%).

Descriptive statistics for exposures (harmful and protective factors) treated as continuous variables in the analyses are presented in Table 2.

Table 2. Descriptive statistics for continuous variables used in logistic regression analyses.

Exposure	Mean	Standard Deviation	Median	Inter-quartile Range
Distress (GHQ-12) *n* = 1735	11.9	5.1	11	8 – 14
Social Support (SPS) *n* = 1778	75.8	10.8	75	40 – 96
Psychological Flexibility (AAQ-II) *n* = 1734	52.3	10.1	54	46 – 60
Sleep (SCI) *n* = 1711	5.9	2.2	5.6	4.4 – 7.8

Of the 1656 participants who completed the AUDIT-C, 898 (54%) reported hazardous drinking. Of the 1715 participants who completed the BTQ, the majority (*n* = 1187, 69%) had been exposed to trauma. 1006 (59%) had served in a war zone and 736 (73%) of these individuals reported that this presented a threat to life and/or a threat of serious injury. The proportion of participants experiencing other traumatic events, including childhood physical and sexual abuse, was also high (35% and 16% respectively).

Univariate Analyses

Results of univariate analyses describing associations between exposure variables (demographic, risk, and protective factors) and PTS are presented in Table 3, showing both the odds of experiencing symptoms of PTS (PCL-M scores ≥30) and the odds of experiencing clinically relevant PTS (scores ≥45). With respect to PTS symptomology, older age, male sex, higher distress, and exposure to trauma were significantly associated with increased likelihood of PTS symptoms. In contrast, increased number of years in service, social support, psychological flexibility, and sleep were significantly associated with lower odds of experiencing PTS symptoms. The same pattern of associations was also found for clinically relevant PTS, in addition to greater odds of clinical PTS among individuals identifying as Māori compared to those of NZ European ethnicity.

Table 3. Univariate associations between exposure variables and elevated PCL-M scores (≥30 and ≥45 respectively).

Characteristic	**PCL-M Score ≥30**				**PCL-M Score ≥45**			
	OR	**95% CI for OR**	***p***	***n***	**OR**	**95% CI for OR**	***p***	***n***
*Age (Years)**	1.02	1.01, 1.03	<0.01	1812	1.03	1.02, 1.05	<0.01	1812
Sex								
Female	Ref				Ref			
Male	1.55	1.13, 2.14	0.01	1790	2.03	1.14, 3.64	0.02	1790
Ethnicity								
NZ European	Ref				Ref			
Māori	1.06	0.80, 1.42	0.67		1.78	1.21, 2.63	<0.01	
Other	1.32	0.92, 1.89	0.13	1817	1.17	0.67, 2.06	0.58	1817
*Service Years**	0.99	0.98, 1.00	0.03	1709	0.97	0.96, 0.99	<0.01	1709
Deployed								
No	Ref				Ref			
Yes	0.83	0.63, 1.10	0.18	1705	0.76	0.50, 1.13	0.18	1705
*Distress**	1.27	1.23, 1.30	<0.01	1735	1.21	1.18, 1.25	<0.01	1735
*Social Support**	0.91	0.90, 0.93	<0.01	1778	0.91	0.90, 0.93	<0.01	1778
*Psychological Flexibility**	0.84	0.82, 0.85	<0.01	1734	0.84	0.82, 0.86	<0.01	1734
*Sleep**	0.53	0.49, 0.57	<0.01	1711	0.41	0.36, 0.46	<0.01	1711
Hazardous Drinking								
No	Ref				Ref			
Yes	1.06	0.86, 1.31	0.58	1656	0.81	0.58, 1.12	0.20	1656
Trauma Exposure								
No	Ref				Ref			
Yes	4.04	3.05, 5.35	<0.01	1715	7.11	3.82, 13.23	<0.01	1715

Note. *Continuous variable (no reference group).

Multivariate Analyses

Results of multivariate analyses describing associations between exposure variables and PTS, after adjustment for age, sex, service years and deployment status, are presented in Table 4, including for odds of experiencing PTS symptomology (PCL-M scores ≥30) and for odds of clinically relevant PTS (scores ≥45). With respect to PTS symptomology, older age, male sex, higher distress, and exposure to trauma were significantly associated with an increased likelihood of PTS. Increased number of years in service, psychological flexibility, and sleep were significantly associated with decreased odds of experiencing PTS symptoms; social support was no longer significantly associated with this outcome. A single unit increase in sleep score corresponded to a 30% reduction in odds of experiencing significant PTS symptoms. The same pattern of results was found for clinically-relevant PTS, with the exception of higher distress, which was not significantly associated. In addition, Māori participants were found to have greater odds of experiencing clinically relevant PTS when compared to New Zealand Europeans.

Table 4. Multivariate associations between exposure variables and elevated PTSD (scores ≥ 30 and scores ≥ 45).

Characteristic	PCL-M Score ≥30, n = 1532			PCL-M Score ≥45, n = 1567		
	OR	**95% CI for OR**	***p***	**OR**	**95% CI for OR**	***p***
*Age (Years)**	1.02	1.01, 1.03	<0.01	1.04	1.03, 1.06	<0.01
Sex						
Female	Ref			Ref		
Male	1.84	1.14, 2.98	0.01	1.69	0.74, 3.86	0.21
Ethnicity						
NZ European				Ref		
Māori				2.80	1.54, 5.10	<0.01
Other				0.97	0.40, 2.31	0.94
*Service Years**	0.98	0.97, 1.00	0.01	0.97	0.95, 0.99	<0.01
Deployed						
No	Ref			Ref		
Yes	1.31	0.85, 2.00	0.22	1.54	0.84, 2.81	0.16
*Distress**	1.07	1.03, 1.11	<0.01			
*Psychological Flexibility**	0.87	0.85, 0.89	<0.01	0.87	0.85, 0.90	<0.01
*Sleep**	0.70	0.64, 0.77	<0.01	0.56	0.49, 0.66	<0.01
Hazardous Drinking						
No	Ref					
Yes	1.11	0.96, 1.77	0.08			
Trauma Exposure						
No	Ref			Ref		
Yes	3.03	2.07, 4.41	<0.01	3.34	1.54, 7.27	<0.01

Note. Variables with a *p*-value less than 0.10 after adjustment for age, sex, service years, and deployment status are included in the model. *Continuous variable (no reference group).

Discussion

This cross-sectional study identified a high prevalence of PTS in a large sample of currently serving and retired New Zealand military personnel. Thirty percent of participants reported experiencing probable PTS and 10% were identified as having clinically relevant PTS. These findings are similar to those reported in an earlier study, which found evidence of PTS among 10% of New Zealand Vietnam war veterans (27), indicating that it is not only retired veterans who are at risk. Our results highlight that support to deal with PTS is needed for a large number of New Zealanders who are serving, or have served, in the military.

Strengths of this study include the large sample, and the inclusion of those who have never been deployed. Our study also serves to provide a snapshot of New Zealand military personnel, for which the total number of those who have served and who are currently serving is unknown. Although the number of individuals in the sample who had never been deployed was small, our findings suggest that these individuals are also at risk of PTS. Evidence that personnel who have never deployed are at greater risk of PTS than the general population is growing (9, 44). It is clear that factors other than deployment have an important role to play in the experience of PTS among military personnel.

At the time the questionnaire was distributed there were 4822 serving veterans in the NZDF, 1038 of whom were reservists and unlikely to receive the email invitation. As the majority of questionnaires were completed by currently serving personnel, the response rate would have been in the order of 30%. This gives rise to potential sampling bias. Military personnel with higher PTS may have been more likely to participate, giving rise to inflated estimates of PTS prevalence. Conversely, our findings may underestimate the prevalence of PTS in this population if those without PTS were more inclined to participate. Another limitation of the study is the cross-sectional design which precludes the identification of cause and effect relationships between exposures and PTS. Additionally, although we assessed and accounted for a range of known confounders, it is still possible some important

confounders were not assessed in the survey and may explain significant relationships between exposures and PTS.

It is unclear how generalisable the study findings are to countries outside of New Zealand, where the characteristics of military personnel, deployment experiences, and post-deployment support services are likely to differ (14). Nevertheless, health support for military personnel in New Zealand follows that provided by American, Canadian, British, and Australian Defence Forces. Scores on the PCL-M measure reported by our participants suggest that as many as 10% may have symptoms likely to result in a clinical diagnosis of PTSD. This is in line with point prevalence estimates of combat-related PTSD in US military veterans, ranging from approximately 2% to 17% (6). Summary estimates of PTSD prevalence for military personnel and veterans from a number of countries range from 1.1% to 34.8% (13). The prevalence of PTS identified in our study is higher than that documented among UK military personnel, although this may be attributable to variation in sampling strategies and measures used (45). Differences in PTS estimates may also be due to variation in socio-political and cultural factors that vary across nations (6).

Trauma exposure was most strongly associated with odds of experiencing PTS symptomology and clinically relevant PTS in the present study, and is a prerequisite for a DSM IV diagnosis of PTSD. General distress was significantly associated with increased odds of PTS symptoms, although was not significantly associated with odds of clinical PTS after adjustment for age, sex, service years, and deployment status. This is consistent with findings from a meta-analysis of risk factors for combat-related PTS among military personnel and veterans, which did not identify general distress to be a significant risk factor, although a history of prior psychological problems and trauma exposure were (13).

Māori participants had greater odds of reporting clinical PTS than their New Zealand European counterparts. Higher levels of PTS among Māori were also detected in a sample of 756 New Zealand Vietnam War veterans, however, the effect of ethnicity on PTS was mediated by higher levels of

combat stressors experienced by Māori, including stressors related to combat exposure, rank, and combat role (46).

Consistent with findings of a study examining predictors of persistent PTS in UK military personnel (47), older age was significantly associated with increased odds of experiencing PTS. However, in contrast to other studies examining PTS in military personnel, males were at greater risk of experiencing PTS than females. It is important to note that other studies identifying females to be at greater risk of PTS have focused on combat-related PTS (13), and our sample includes personnel who never deployed.

Despite older age being associated with increased odds of PTS, a greater number of service years was associated with reduced odds of PTS. This may reflect a resilience that develops over time among long-serving personnel, or may be due to individuals with PTS leaving military service earlier as has been reported among UK Armed Forces Personnel (48). Sleep was also found to be protective against PTS. Self-reported sleep problems have consistently been associated with the experience of PTS in veteran populations (49). Early intervention among military personnel experiencing sleep disturbance may help to reduce PTS symptoms. An investigation of 44 military personnel who received cognitive behavioural therapy for insomnia found that participants who experienced improved sleep quality from pre- to post-treatment (n=28) had significant declines in depression and PTS symptoms (20). In contrast, those whose sleep did not improve had no changes in their psychiatric symptoms, as well as a reduction in health-related quality of life.

In the present study, psychological flexibility was associated with reduced odds of reporting PTS. However, it is important to interpret our findings with caution as there have been criticisms of the AAQ-II, with several researchers arguing that it may be measuring psychological distress rather than psychological inflexibility (50). Furthermore, numerous versions of the AAQ-II exist which can make it difficult to compare findings across studies. Despite few studies examining psychological flexibility among military personnel, techniques designed to increase psychological flexibility (such as

acceptance and commitment therapy) are being investigated as potential treatments for PTS in this population (51-53), and evidence for their effectiveness is emerging (54).

Conclusions

Knowledge of the harmful and protective factors associated with PTS may allow for early identification of military personnel who would benefit from targeted support to promote their wellbeing. Our findings suggest that traumatic exposure is most strongly associated with high levels of PTS, while good sleep and psychological flexibility are protective. As these protective factors are amenable to standardised measurement and modification, early detection could facilitate intervention. Future research is needed to identify whether relationships can be found longitudinally, which would provide further evidence regarding New Zealand military personnel most at risk of experiencing PTS.

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References

1. New Zealand Defence Force. Personnel Summary: New Zealand Government; 2019. Available from: http://www.nzdf.mil.nz/personnel-records/personnel-branch/.

2. Hunt EJF, Wessely S, Jones N, Rona RJ, Greenberg N. The mental health of the UK Armed Forces: where facts meet fiction. Eur J Psychotraumatol. 2014;5(1): 23617.

3. Stretch RH, Knudson KH, Durand D. Effects of premilitary and military trauma on the development of post-traumatic stress disorder symptoms in female and male active duty soldiers. Mil Med. 1998;163(7): 466-470.

4. Durand D, Knudson KH, Stretch RH. Psychological Health and Trauma in Male and Female Soldiers. Mil Med. 1998;163(6): 363-367.

337 5. Afifi TO, Taillieu T, Zamorski MA, Turner S, Cheung K, Sareen J. Association of child abuse exposure
338 with suicidal ideation, suicide plans, and suicide attempts in military personnel and the general
339 population in Canada. JAMA Psychiatry. 2016;73(3): 229-238.
340 6. Richardson LK, Frueh BC, Acierno R. Prevalence estimates of combat-related post-traumatic stress
341 disorder: critical review. Aust N Z J Psychiatry. 2010;44(1): 4-19.
342 7. Roux Cl, Stein DJ, Seedat S. Prevalence and characteristics of trauma and post-traumatic stress
343 symptoms in operational members of the South African National Defence Force. Mil Med.
344 2003;168(1): 71-75.
345 8. Jones M, Rona RJ, Hooper R, Wesseley S. The burden of psychological symptoms in UK Armed
346 Forces. Occup Med. 2006;56(5): 322-328.
347 9. McKenzie DP, Ikin JF, McFarlane AC, Creamer M, Forbes AB, Kelsall HL, et al. Psychological health of
348 Australian veterans of the 1991 Gulf War: an assessment using the SF-12, GHQ-12 and PCL-S. Psychol
349 Med. 2004;34(8): 1419-1430.
350 10. Jones M, Sundin J, Goodwin L, Hull L, Fear NT, Wessely S, et al. What explains post-traumatic stress
351 disorder (PTSD) in UK service personnel: deployment or something else? Psychol Med. 2012;43(8):
352 1703-1712.
353 11. Sareen J, Cox BJ, Afifi TO, Stein MB, Belik S-L, Meadows G, et al. Combat and peacekeeping
354 operations in relation to prevalence of mental disorders and perceived need for mental health care:
355 findings from a large representative sample of military personnel. JAMA Psychiatry. 2007;64(7): 843-
356 852.
357 12. Pease JL, Billera M, Gerard G. Military culture and the transition to civilian life: suicide risk and
358 other considerations. Social Work. 2015;61(1): 83-86.
359 13. Xue C, Ge Y, Tang B, Liu Y, Kang P, Wang M, et al. A Meta-Analysis of Risk Factors for Combat-
360 Related PTSD among Military Personnel and Veterans. PLoS One. 2015;10(3): e0120270.

14. Yehuda R, Vermetten E, McFarlane AC, Lehrner A. PTSD in the military: special considerations for understanding prevalence, pathophysiology and treatment following deployment. Eur J Psychotraumatol. 2014;5(1): 25322.

15. Koenen KC, Stellman SD, Dohrenwend BP, Sommer Jr. JF, Stellman JM. The consistency of combat exposure reporting and course of PTSD in Vietnam War veterans. J Trauma Stress. 2007;20(1): 3-13.

16. Reger MA, Gahm GA, Swanson RD, Duma SJ. Association between number of deployments to Iraq and mental health screening outcomes in US Army soldiers. J Clin Psychiatry. 2009;70(9): 1266-1272.

17. Jakupcak M, Tull MT, McDermott MJ, Kaysen D, Hunt S, Simpson T. PTSD symptom clusters in relationship to alcohol misuse among Iraq and Afghanistan war veterans seeking post-deployment VA health care. Addict Behav. 2010;35(9): 840-843.

18. Iversen A, Waterdrinker A, Fear N, Greenberg N, Barker C, Hotopf M, et al. Factors associated with heavy alcohol consumption in the U.K. Armed Forces: data from a health survey of Gulf, Bosnia, and era Veterans. Mil Med. 2007;172(9): 956-961.

19. Wright KM, Britt TW, Bliese PD, Adler AB, Picchioni D, Moore D. Insomnia as predictor versus outcome of PTSD and depression among Iraq combat veterans. J Clin Psychol. 2011;67(12): 1240-1258.

20. Rusch HL, Guardado P, Baxter T, Mysliwiec V, Gill JM. Improved sleep quality is associated with reductions in depression and PTSD arousal symptoms and increases in IGF-1 concentrations. J Clin Sleep Med. 2015;11(6): 615-623.

21. Pietrzak RH, Johnson DC, Goldstein MB, Malley JC, Southwick SM. Psychological resilience and postdeployment social support protect against traumatic stress and depressive symptoms in soldiers returning from Operations Enduring Freedom and Iraqi Freedom. Depress Anxiety. 2009;26(8): 745-751.

22. Dutra SJ, Sadeh N. Psychological flexibility mitigates effects of PTSD symptoms and negative urgency on aggressive behavior in trauma-exposed veterans. Personality Disord. 2018;9(4): 315-23.

385 23. Chamberlain K, MacDonald C, Pereira-Laird J, Long N, Mirfin K. Mental health, physical health, and
386 stressors reported by New Zealand Defence Force peacekeepers: a longitudinal study. Mil Med.
387 1998;163(7): 477-481.
388 24. Litz BT, Stein N, Delaney E, Lebowitz L, Nash WP, Silva C, et al. Moral injury and moral repair in war
389 veterans: A preliminary model and intervention strategy. Clin Psychol Rev. 2009;29(8): 695-706.
390 25. Litz BT, Orsillo SM, Friedman M, Ehlich P, et al. Posttraumatic stress disorder associated with
391 peacekeeping duty in Somalia for U.S. military personnel. Am J Psychiatry. 1997;154(2): 178-184.
392 26. Ritchie EC, Ruck DC, Anderson MW. The 528th combat stress control unit in Somalia in support of
393 operation restore hope. Mil Med. 1994;159(5): 372-376.
394 27. Long N, MacDonald C, Chamberlain K. Prevalence of posttraumatic stress disorder, depression and
395 anxiety in a community sample of New Zealand Vietnam War veterans. Aust N Z J Psychiatry.
396 1996;30(2): 253-256.
397 28. Brounéus K, Wray M, Green P. Underestimating the burden for peacekeepers? Difficulty in
398 determining psychological well-being following operational deployment with low response rates from
399 NZDF personnel. J Mil Veterans Health. 2015;23(2): 7-13.
400 29. No Duff Charitable Trust. No Duff - Confidential help for veterans their families. 2019. Available
401 from: https://www.noduff.org/.
402 30. U.S. Department of Veterans Affairs. Using the PTSD Checklist (PCL). Veterans Affairs National
403 Center for PTSD; 2012.
404 31. Wilkins KC, Lang AJ, Norman SB. Synthesis of the psychometric properties of the PTSD checklist
405 (PCL) military, civilian, and specific versions. Depress Anxiety. 2011;28(7): 596-606.
406 32. Schnurr PP, Spiro A, Vielhauer MJ, Findler MN, Hamblen JL. Trauma in the lives of older men:
407 findings from the normative aging study. J Clin Geropsychol. 2002;8(3): 175-187.
408 33. Whealin JM, Batzer WB, Morgan CA, III, Detwiler HF, Jr., Schnurr PP, Friedman MJ. Cohesion,
409 burnout, and past trauma in tri-service medical and support personnel. Mil Med. 2007;172(3): 266-
410 272.

411 34. Goldberg D, Williams P. A user's guide to the General Health Questionnaire. Windsor, United
412 Kingdom: NFER-Nelson; 1988.
413 35. Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA. The AUDIT alcohol consumption questions
414 (AUDIT-C): an effective brief screening test for problem drinking. JAMA Intern Med. 1998;158(16):
415 1789-1795.
416 36. Crawford EF, Fulton JJ, Swinkels CM, Beckham JC, Calhoun PS. Diagnostic efficiency of the AUDIT-
417 C in U.S. veterans with military service since September 11, 2001. Drug Alcohol Depend. 2013;132(1):
418 101-106.
419 37. Bradley KA, Bush KR, Epler AJ, Dobie DJ, Davis TM, Sporleder JL, et al. Two brief alcohol-screening
420 tests from the Alcohol Use Disorders Identification Test (AUDIT): validation in a female Veterans Affairs
421 patient population. JAMA Intern Med. 2003;163(7): 821-829.
422 38. Cutrona CE, Russell DW. The provisions of social relationships and adaptation to stress. Adv Pers
423 Rel. 1987;1: 37-67.
424 39. Mancini JA, Blieszner R. Social provisions in adulthood: concept and measurement in close
425 relationships. J Gerontol. 1992;47(1): P14-P20.
426 40. Espie CA, Kyle SD, Hames P, Gardani M, Fleming L, Cape J. The Sleep Condition Indicator: a clinical
427 screening tool to evaluate insomnia disorder. BMJ Open. 2014;4(3): e004183.
428 41. Bond FW, Hayes SC, Baer RA, Carpenter KM, Guenole N, Orcutt HK, et al. Preliminary psychometric
429 properties of the Acceptance and Action Questionnaire–II: a revised measure of psychological
430 inflexibility and experiential avoidance. Behav Therapy. 2011;42(4): 676-688.
431 42. StataCorp. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC; 2017.
432 43. Iwasa H, Suzuki Y, Shiga T, Maeda M, Yabe H, Yasumura S. Psychometric evaluation of the Japanese
433 version of the Posttraumatic Stress Disorder Checklist in community dwellers following the Fukushima
434 Daiichi nuclear power plant incident: the Fukushima health management survey. SAGE Open.
435 2016;6(2): 2158244016652444.

436 44. Hoge CW, Castro CA, Messer SC, McGurk D, Cotting DI, Koffman RL. Combat duty in Iraq and
437 Afghanistan, mental health problems, and barriers to care. New Eng J Med. 2004;351(1): 13-22.
438 45. Iversen AC, van Staden L, Hughes JH, Browne T, Hull L, Hall J, et al. The prevalence of common
439 mental disorders and PTSD in the UK military: using data from a clinical interview-based study. BMC
440 Psychiatry. 2009;9(1): 68.
441 46. MacDonald C, Chamberlain K, Long N. Race, combat, and PTSD in a community sample of New
442 Zealand Vietnam war veterans. J Traum Stress. 1997;10(1): 117-124.
443 47. Rona RJ, Jones M, Sundin J, Goodwin L, Hull L, Wessely S, et al. Predicting persistent posttraumatic
444 stress disorder (PTSD) in UK military personnel who served in Iraq: a longitudinal study. J Psychiat Res.
445 2012;46(9): 1191-1198.
446 48. Buckman JEJ, Forbes HJ, Clayton T, Jones M, Jones N, Greenberg N, et al. Early Service leavers: a
447 study of the factors associated with premature separation from the UK Armed Forces and the mental
448 health of those that leave early. Eur J Public Health. 2012;23(3): 410-415.
449 49. Baird T, McLeay S, Harvey W, Theal R, Law D, O'Sullivan R, et al. Sleep disturbances in Australian
450 Vietnam veterans with and without posttraumatic stress disorder. J Clin Sleep Med. 2018;14(5): 745-
451 752.
452 50. Wolgast M. What does the Acceptance and Action Questionnaire (AAQ-II) really measure? Behav
453 Ther. 2014;45(6): 831-839.
454 51. Vujanovic AA, Niles B, Pietrefesa A, Schmertz SK, Potter CM. Mindfulness in the treatment of
455 posttraumatic stress disorder among military veterans. Spiritual Clin Pract. 2013;1(S): 15-25.
456 52. King AP, Erickson TM, Giardino ND, Favorite T, Rauch SAM, Robinson E, et al. A pilot study of group
457 mindfulness-based cognitive therapy (MBCT) for combat veterans with posttraumatic stress disorder
458 (PTSD). Depress Anxiety. 2013;30(7): 638-645.
459 53. Casselman RB, Pemberton JR. ACT-based parenting group for veterans with PTSD: development
460 and preliminary outcomes. Am J Fam Ther. 2015;43(1): 57-66.

461 54. Boyd JE, Lanius RA, McKinnon MC. Mindfulness-based treatments for posttraumatic stress
462 disorder: a review of the treatment literature and neurobiological evidence. J Psychiatry Neurosci.
463 2018; 43(1): 7-25.

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