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Complete List of Authors:	McBride, David; University of Otago Dunedin School of Medicine, Department of Preventive and Social Medicine Samaranayaka, Ariyapala; University of Otago Division of Health Sciences, Biostatistics Centre Richardson, Amy; University of Otago Dunedin School of Medicine, Preventive and Social Medicine Gardner, D; Massey University, Department of Psychology Shepherd, Daniel; Auckland University of Technology, Health Sciences Wyeth, Emma; University of Otago, Ngāi Tahu Māori Health Research Unit de Graaf, Brandon; University of Otago Dunedin School of Medicine, Injury Prevention Research Unit Derrett, Sarah; University of Otago Dunedin School of Medicine, Preventive and Social Medicine
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FACTORS ASSOCIATED WITH SELF-REPORTED HEALTH AMONG NEW ZEALAND MILITARY VETERANS: A CROSS-SECTIONAL STUDY

David McBride,[1] Ari Samaranayaka[2], Amy Richardson,[1] Dianne Gardner,[3] Daniel Shepherd,[4] Emma H. Wyeth[5], Brandon deGraaf,[6] Sarah Derrett.[1]

[1]Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[2]Biostatistics Centre, Division of Health Sciences, University of Otago, Dunedin, New Zealand.

[3]School of Psychology, Massey University, New Zealand.

[4]Department of Psychology, Auckland University of Technology, New Zealand.

[5]Ngāi Tahu Māori Health Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[6]Injury Prevention Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

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Corresponding Author:

David McBride, Department of Preventive and Social Medicine, Adams Building, 18 Frederick Street, Dunedin 9017, New Zealand.

Email: david.mcbride@otago.ac.nz

Phone: +64 3 479 7208

Fax: +64 3 479 7298

ABSTRACT

Objective

To identify factors associated with better or poorer self-reported health status in New Zealand military Veterans.

Design

An online cross-sectional survey.

Participants

The total number of eligible Veterans is unknown, but a total of 1,817 Veterans responded, including 1009 serving personnel, providing a 26% response rate from that group.

Study variables

Health status was self-reported using the EQ-5D-5L, which asks about problems across five dimensions (mobility, self-care, usual activities, pain or discomfort, and anxiety or depression), with five levels of severity (e.g. no, slight, moderate, severe or extreme problems). The EQ-5D-5L also contains a visual analogue scale (EQ-VAS), scaled from 0 (worst) to 100 (best) imagined health. Hypothetical relationships with better health were positive social support, sleep and psychological flexibility; with poorer health, exposure to psychological trauma, distress and hazardous drinking.

Results:

The proportion of Veterans reporting 'any problems' compared to 'no problems' with the five EQ-5D dimensions, was similar to those found in the general NZ population, although a higher proportion of Veterans reported problems with mobility, self-care, usual activities and pain or discomfort. Psychological flexibility and better sleep quality were associated with higher EQ-VAS scores; distress was associated with lower EQ-VAS scores.

Conclusion:

In this sample of New Zealand Veterans, psychological flexibility and good sleep are associated with better self-rated health, and distress and poor sleep with diminished health. These factors might be used as sentinel health indicators in assessing Veteran health status. As distress, psychological flexibility and sleep are closely related, cognitive behavioural therapy encompassing these domains may be useful in improving the health of New Zealand Veterans.

Keywords:

Self-rated health, EQ-5D, Veterans, deployment, military, risk factors.

Strengths and limitations of this study

- Many studies of Veterans have focused on adverse outcomes, but we have been able to focus on a holistic measure of 'health'.

- The study was sufficiently powered to detect important relationships indicating opportunities for intervention.
- The exact response rate is unknown, and possible bias may be a limitation.
- The cross-sectional design means that we cannot explore cause and effect relationships.

INTRODUCTION

The three major events in the military life course are entry to military service, deployment on active service and transition back to civilian life. On entry, soldiers, sailors and air personnel are subject to a selection process to ensure, as far as possible, good physical and mental health, giving rise to the 'healthy soldier effect', with service personnel being, on average, healthier than the general population.[1] However, the physical and psychological stressors of military service have been found to erode this effect.[2]

The physical stressors have a particular impact on the lower limb, with load carriage, high intensity training and the design of footwear being implicated in injury causation.[3] A military career increases opportunities for psychological trauma, and post-traumatic stress disorder (PTSD) has been identified as the 'signature injury' of United States service men and women deployed to Afghanistan and Iraq.[4]

A focus on adverse health events in the literature[5] means that wellbeing is relatively overlooked. In the long run, military service has been found to have positive effects.[6,7] Good health after service does, however, depend on the success of the 'military civilian transition', a complex process for which models have been developed.[8] Health problems developed in service, difficulty in assuming a post-service identity and many other factors contribute to health and wellbeing outcomes.[8] In New Zealand, military Veterans can only access assistance from New Zealand Veteran's Affairs (NZVA) if they have undertaken 'qualifying operational service' as defined by the Veteran Support Act 2014,[9] and are Veterans in a legal sense. NZVA support some 12,000 Veterans, with an average age of 80 years, 5000 being actively case managed.[10] The majority will have seen operational service in Korea, Borneo, Malaya and Vietnam. Post-Vietnam, smaller numbers deployed on United Nations and other missions, but the tempo of operations rose with the deployment to Bosnia in 1992, and some 9,000-10,000 'legal' Veterans deployed between then and the withdrawal of New Zealand troops from Afghanistan in 2021. The Ministerial Veteran's Health Advisory Panel, established

under the Veteran Support Act, are specifically charged with funding research on this 'contemporary Veteran' group.

The aims of this study were to describe self-reported health among these younger Veterans, and identify factors associated with better or poorer health.

Veteran and public involvement

The Ministerial Veterans Health Advisory Panel, who fund research into contemporary Veterans health,[10] commissioned the study and advised on the design. We also formed a steering group with representatives from the New Zealand Defence Force, New Zealand Veterans Affairs, the Royal New Zealand Returned and Services Association (RSA)[11] and No Duff,[12] a charity providing first response support to Veterans and their families. We also consulted with the Ngāi Tahu Research Consultation Committee in order to assess the importance of the project to Māori, New Zealand's indigenous population. We undertook to inform the Veteran community before releasing the results, also to give all Veterans, defined as anyone who had served in the military, an opportunity to participate.

METHODS

Participants

Data were collected via an online survey, a postal version was also available on request. There is no comprehensive Veteran registry, however In June 2018, a link to the online questionnaire was sent by email to all currently serving regular and reserve New Zealand Defence Force (NZDF) members registered on the NZDF email system who were 'legal Veterans', as indicated by holding the New Zealand Operational Service Medal, numbering 3,874 personnel at that time. An introductory message and link to the questionnaire were also presented on the NZDF 'intranet landing page', a secure internal webpage from which all regular force personnel can access relevant work-related content, tools, and resources. Retired military personnel were invited to participate through posters distributed to reserve units and the 43 local social clubs identified by the RSA national office to be 'Veteran active.' Paper questionnaires with return postage envelopes were made available at these sites. 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 website. The questionnaire was available for completion from June to December 2018. Ethics approval for the study was obtained from the Northern B Health and Disability Ethics Committee, reference 17NTB118.

Questionnaire

Criterion variable

Self-rated health status was assessed using the EQ-5D-5L,[13] a short questionnaire asking about the respondent's health across five dimensions: mobility, self-care, usual activities, pain or discomfort and anxiety or depression, with response options ranging from (e.g.) 'no problems', to 'extreme problems'. For each dimension, participants were categorised as having 'any problems' if they selected any response other than 'no problems'.

Additionally, the EQ-5D-5L visual analogue scale (EQ-VAS) asks the respondent to mark on a vertical visual analogue scale (VAS) how good or bad their health is today, where the endpoints are labelled 'the best health you can imagine' (score of 100) and 'the worst health you can imagine' (score of 0).

Independent variables

Demographic characteristics included age, sex, ethnicity, service years, and past deployment on operational service (yes/no). Ethnicity prioritisation was adopted,[14] whereby participants with multiple responses were assigned to one of the categories, in the order of Māori, Pacific Peoples, Other and European.

General psychiatric morbidity was assessed using the 12-item General Health Questionnaire (GHQ-12),[15] scored using a four point scale (0-3) and summing the 12 items to give a total score, with higher scores indicating elevated distress.

Social support was measured using the Social Provisions Scale,[16] with responses made on a four-point Likert-type scale ranging from 1 'strongly disagree' to 4 'strongly agree'. The 24 items can be reduced to six subscales (attachment, social integration, reassurance of worth, reliable alliance, social guidance, opportunity for nurturance) or summed to create a total score, with greater scores indicating greater social support.

Alcohol use was measured using the AUDIT-C,[17] scaled from 0-12. A score of 3+ for women and 4+ for men indicated potentially hazardous drinking behaviour.

Sleep quality was assessed with the Sleep Condition Indicator (SCI), [18] assessing insomnia as described in the Diagnostic and Statistical Manual of Mental Disorders version 5 (DSM-V).[19] The SCI consists of eight items rated from 0-4, the total scores being scaled to a range of 0 to 10, where higher scores represent better sleep.

Trauma exposure was assessed with the Brief Trauma Scale (BTS),[20] which captures past exposure to situations that were life threating or capable of producing serious injury.

Psychological flexibility was measured with the 10-item AAQ-II, designed as a measure of effectiveness in a particular mode of behavioural intervention, Action and Commitment Therapy (ACT).[21] Items were answered on a 7-point scale, with options ranging from 'never true' to 'always true'. The items were summed to obtain a total score (possible range 10 to 70), with higher scores indicative of greater psychological flexibility.

Statistical analyses

With respect to the calculation of summed scores, if only one item was missing for a particular measure then this was imputed with the mean of the remaining items; if more than one item was missing then the score was set to missing for that participant. Complete case analysis was used in the remaining analyses. The five dimensions of the EQ-5D-5L were compared to the NZ population normative values.[22]

Univariate ordinary least-squares linear regression analyses assessed the strength of relationships between each independent variable and EQ-VAS scores, using robust standard errors to account for heteroscedasticity and calculating 95% confidence intervals (95% CIs). Multivariable linear regression was then used to identify the role of the independent variables while adjusting for each other. None of the social support sub-scales were used in this multivariable model, instead using the social support total score. The model was built using backward variable selection with $p<0.10$ for variable retention, with the exceptions of age, sex, service years, and deployment status which were retained as adjusting variables irrespective of p-values.

RESULTS

When the survey went online, invitations were emailed to the 3784 serving Veterans in the NZDF, resulting in 1009 responses, 26% of that group, added to by 449 retired and 288 non-deployed Veterans, a total of 1817, 90 of whom completed a paper questionnaire. A total of 1767 (97%) completed the EQ-VAS and were thus included in all the analyses.

A supplementary table presents the EQ-VAS score according to the sample characteristics.

Figure 1 shows the proportion of EQ-5D-5L dimension responses reporting 'any problem' severity level other than 'no problems' in comparison to the New Zealand population normative values.[22]

Figure 1 about here

The results of the univariate analysis are displayed in Table 1. Here, for continuous characteristics, the regression coefficient (β) represents the change in the mean EQ-VAS

associated with one unit increase in the characteristic. For categorical characteristics, *ß* is the change in mean EQ-VAS scores compared to the referent category.

Table 1: Univariate cross-sectional associations between variables and mean EQ-VAS scores for New Zealand Veterans (N=1,762)

Characteristic	*n*	*ß*	95% CIs	*p*-value
Age*	1762	-0.19	[-0.24, -0.13]	<.01
Sex				
Female	220	Reference	-	
Male	1520	-0.65	[-3.04, 1.73]	.59
Ethnicity				
NZ European	1382	Reference	-	
Māori	245	1.21	[-1.00, 3.42]	
Other	140	-2.95	[-6.26, 0.36]	0.10
Service years*	1670	0.19	[0.11, 0.27]	<.01
Deployment status				
Not deployed	288	Reference	-	
Deployed	1458	5.80	[3.35, 8.25]	<.01
GHQ-12 score*	1765	-1.63	[-1.79, -1.47]	<.01
Social support*				
Attachment	1760	2.02	[1.69, 2.34]	<.01
Social integration	1758	2.45	[2.06, 2.88]	<.01
Reassurance of worth	1756	2.48	[2.11, 2.85]	<.01
Reliable alliance	1760	2.30	[1.91, 2.70]	<.01
Social guidance	1760	2.00	[1.65, 2.35]	<.01
Opportunity for nurturance	1758	0.85	[0.47, 1.23]	<.01
Social support total score	1753	0.52	[0.44, 0.59]	<.01
Psychological flexibility*	1750	0.79	[0.71, 0.87]	<.01
Sleep score*	1747	3.47	[3.11, 3.83]	<.01
AUDIT-C	1691			
Non-hazardous		Reference	-	
Hazardous		0.62	[-1.03, 2.26]	0.46
Exposure to traumatic events	1754			
Not exposed		Reference	-	
Exposed		-5.72	[-7.34, -4.11]	<.01

*Scored as continuous variables, coefficient is per unit increase.

Of the demographic variables, age was associated with lower EQ-VAS scores, length of service with higher scores. No relationships were apparent for sex or ethnicity. Positive coefficients, indicating better health with presence of the characteristic, were present for dichotomous variables of deployment, where the mean EQ-VAS score for deployed Veterans was 5.8 VAS units higher (better) than for non-deployed. The largest negative associations

were for exposure to traumatic events, with a mean EQ-VAS score 5.7, lower for those exposed compared to those not exposed. Distress, as measured by the GHQ-12, had a negative association with health state. Positive associations with health state were found for psychological flexibility as measured by the AAQ-II, better sleep scores, and most of the dimensions of social support, barring 'opportunity for nurturance'.

Table 2 shows the results from two models. The first model is adjusted for the other characteristics, with 11 variables and 1,557 people providing valid responses for all factors included in the model. All effect sizes were reduced, and the social support and AUDIT-C scores were no longer associated, with 11 variables explaining 35% of the variability in the EQ-VAS.

The final model involved backward variable selection setting a p-value of 0.10, identifying a smaller subset of variables. Age, sex, service years, and deployment status were retained in the model irrespective of their p-values, thus adjusting for those variables, using 1,600 complete responses. Social support and AUDIT-C hazardous drinking were not retained in this final model; other coefficients remaining essentially the same, with a minimal effect on the overall R^2.

Table 2. Multivariable models of associations between variables and mean EQ-VAS scores for New Zealand Veterans

	Adjusted model, N used =1,557			Final model, N used =1,600		
Characteristic	***β***	**95% CI**	***p*-value**	***β***	**95% CI**	***p*-value**
Age (years)*	0.17	[-0.23, 1.11]	<0.01	-0.17	[-0.23, -0.12]	<0.01
Sex						
Female	**Ref**	-	-	**Ref**	-	
Male	0.24	[-2.52, 2.03]	0.84	-0.60	[-2.82, 1.63]	0.60
Ethnicity						
NZ European	**Ref**	-	-	**Ref**	-	
Māori	0.29	[-1.70, 2.27]	0.07	0.19	[-1.77, 2.14]	
Other	-3.58	[-6.66, -0.51]		-2.91	[-5.88, 0.06]	0.15
Service years*	0.17	[0.10, 0.25]	<0.01	0.17	[0.10, 0.25]	<0.01
Deployment status						
Not deployed	**Ref**			**Ref**	-	
Deployed	2.91	[0.64, 5.18]	<0.05	2.90	[0.65, 5.15]	0.01
GHQ12 score*	-0.87	[-1.09, -0.65]	<0.01	-0.92	[-1.13, -0.71]	<0.01
Social support (SPS score)*	0.01	[-0.07, 0.10]	0.76	-	-	-
Psychological flexibility score (AAQii)*	0.26	[0.15, 0.37]	<0.01	0.24	[0.14, 0.35]	<0.01
Sleep score (SCI), Range 0-10*	1.60	[1.18, 2.02]	<0.01	1.63	[1.22, 2.05]	<0.01
AUDIT_C score						
Non hazardous	**Ref**			-	-	-
Hazardous	0.41	[-1.00, 1.81]	0.57	-	-	-
Exposure to traumatic events (BTQ)						
Not exposed	**Ref**			**Ref**	-	-
Exposed	-1.77	[-3.30, -0.24]	<0.05	-1.81	[-3.32, 0.30]	0.02
			$R^2 = 0.35$			$R^2 = 0.36$

*Scored as continuous variables, coefficient is per unit increase.

DISCUSSION

Principal findings

In general, Veterans had a similar proportion of 'any problem' responses in the EQ-5D dimensions as the general population of New Zealand, with evidence of more problems in the physical domains of mobility, usual activities and pain or discomfort, but no difference in the psychological domain.

Mutual adjustment, with 11 variables in the model, reduced all the effect sizes and explained 35% of the variance, thus leaving 65% which cannot be explained. The final model had 9 variables, explaining 36% of the variance. The results make conceptual sense in that distress is associated with reduced EQ-VAS, while psychological flexibility is associated with a modest protective effect. Surprisingly, social support was not identified as an associated factor, however we may not have measured some support domains valued by Veterans. There are

known to be many other influences on health, including 'social wellbeing',[5] financial status, personality and non-deployment related stressors,[23] which we have not measured.

Strengths and weaknesses

Strengths of our study were the relatively large sample size, the inclusion of all Veterans, the assessment of 'health', infrequently investigated in Veteran populations, and the inclusion of New Zealand Veterans with a range of characteristics, including 'deployed' and 'non-deployed' Veterans. As a measure of health, the EQ-5D-5L dimensions and EQ-VAS ask about health on the day that respondents complete the questionnaire, the EQ-VAS end points being, respectively, the 'best' and 'worst' health they can imagine, so it is a holistic measure of health state.[24]

The response rate of 27% from serving Veterans, along with the unknown total number of Veterans, raises the question of bias, the direction of which is difficult to assess, as responses may be more likely from either Veterans with good or poor health. We do know that New Veterans tend to be stoic, so they might underestimate their health concerns.[25] There are also likely to be other personal characteristics that we have not measured. We were however able to adjust for deployment status, which did have a positive association with health state. The cross-sectional design also means that we cannot explore cause and effect, so recommendations for future interventions require additional support from longitudinal studies.

Comparison with other studies

We have previously reported factors associated with post-traumatic stress in this group,[26] using the Military Post Traumatic Stress Checklist (PCL-M). Factors associated with higher PCL-M scores were trauma exposure, older age, male gender, and being of Māori ethnicity. Factors associated with lower PCL-M scores were greater length of service, psychological flexibility, and better quality sleep. Using health as the outcome disclosed that Māori did not have poorer self-reported health compared to non-Māori, that deployment had a positive effect, and in the univariate models, all of the dimensions of social support were associated with improved health. The final model also included good sleep and psychological flexibility, providing most of the explanatory power in the model.

No other studies appear to have used the EQ-VAS as an outcome measure for Veteran health. Boehmer et al.[27] examined wellbeing among participants in the 2000 Behavioural Risk Factor Surveillance System describing health-related quality of life (HRQoL) by sex and military status, active duty, reservists Veterans, or no military service. Participants were asked to rate

recent physical health, mental health, and activity limitation. Active duty men were more likely than men without military service to report 14 or more days of activity limitation, pain, and not enough rest in the past 30 days. Reserve personnel reported better overall HRQoL than non-military participants, and no difference was observed between Veterans and persons with no military service. There are also reports indicating that non-deployed personnel retain better health than those who have been deployed.[28] Notably, the predominant reason for medical discharge from the British Armed Forces was musculoskeletal problems.[29]

Diaz Santana et al.[30] carried out a cross-sectional survey of 60,000 U.S. Veterans of Afghanistan and Iraq, with 20,563 responses. Mental quality of life scores were higher among the non-deployed group compared to the deployed group, though the deployed group reported higher physical quality of life scores compared to the non-deployed. Both mental and physical quality of life were lower among Veterans compared to U.S. population norms.

Both positive and negative consequences of deployment have been described.[7,30] In a study of Dutch Veterans,[7] two out of three reported a positive effect of deployment on their quality of life at the time of the survey, this being related to positive feelings such as satisfaction or comradeship, but a few having emotions such as frustration or shame. As regards tangible effects,[31] negative consequences included the military 'chain of command', being away from home, and deterioration of marital/significant other relationships. Positive influences include improved financial security, self-improvement, and time to reflect.

Sleep difficulties are a common symptom for those with PTSD. McCarthy et al.[32] reported on the 3,157 U.S. military Veterans enrolled in the National Health and Resilience in Veterans Study, in which 27.6% reported poor sleep quality. Path analyses revealed significant associations between poor sleep, severity of PTSD, poorer mental and physical health functioning and lower overall quality of life.

Most Veterans do cope well with a military career, and service has a positive effect on wellbeing. However, Oster et al.[5] emphasise that when things do not go well for Veterans, their mental, physical and social health is interconnected, so their needs can be complex, and management requires an integrated approach.

Future directions

The results suggest that distress, psychological flexibility, and sleep have an important relationship with self-rated health among Veterans in this study.

Reducing distress through the promotion of psychological flexibility might be possible, although our finding here must be subject to caution as several researchers argue that the

AAQ-II may be measuring psychological distress and affect rather than psychological inflexibility.[33] Psychological flexibility is specifically targeted by ACT, a psychological intervention described as being in the 'third wave' of behaviour change strategies.[34] The six core processes of ACT (acceptance, cognitive defusion, being present, self as context, values, and committed action) aim to increase psychological flexibility, the goal being "to have clients experience the world more directly so that their behavior is more flexible and thus their actions more consistent with the values that they hold."[34] Approaches such as ACT may therefore improve health state in appropriate subjects. Lang et al. carried out a randomised clinical trial (RCT), comparing ACT with person-centred therapy,[35] showing a general improvement in symptoms of distress across both treatment arms, ACT providing superior improvement in insomnia. The drop-out rate for both therapies was however high, and the two groups did not exhibit any change in psychological flexibility. The authors proposed that future studies should include additional measures of ACT processes to determine which are actually affected by ACT.

Sleep in military personnel has been recognised as a 'vital health behaviour' for which policies and guidelines must be developed.[36] Cognitive behavioural therapy for insomnia (CBT-I) is regarded as an effective 'first line' treatment, and a brief intervention has been described for use in Australian general practice.[37] The Lang et al. trial[35] showed CBT-I to be effective, however future studies should include outcome measures that include ACT processes. Our final model showed that distress had a negative association with health, and psychological flexibility had a positive relationship, with sleep most likely related to both of these variables. It would seem important to screen for these conditions prior to transition from the military, as well as among retired Veterans, in order to provide targeted support. Further research is needed to examine the potential of ACT to improve Veterans' wellbeing.

Figure 1 Caption.

The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions

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DATA SHARING STATEMENT

Data from this study is unsuitable for public deposition due to the privacy of participant data. Data are anonymised, but contain information on deployments (including location and duration), which could lead to some participants being identified. Furthermore, the participant information sheet, as required by the Southern Health and Disability Ethics Committee specifically contains the statement that 'all study data would be kept strictly confidential to the research team.' Qualified researchers may apply for data access with the research team at veterans.health@otago.ac.nz and/or hdecs@moh.govt.nz.

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COMPETING INTERESTS

None declared.

CONTRIBUTION

Investigation: Amy Richardson, Emma H. Wyeth, Sarah Derrett, Daniel Shepherd, David McBride.

Methodology: Amy Richardson, Ari Samaranayaka, Dianne Gardner, Emma H. Wyeth, Sarah Derrett, David McBride. Daniel Shepherd

Project administration: Amy Richardson

Resources: Brandon de Graaf

Software: Brandon de Graaf

Supervision: Ari Samaranayaka

Validation: Amy Richardson

Visualization: Amy Richardson

Writing – original draft: David McBride. AS, DG, EHW, SD and DS contributed to the re-writes and final draft

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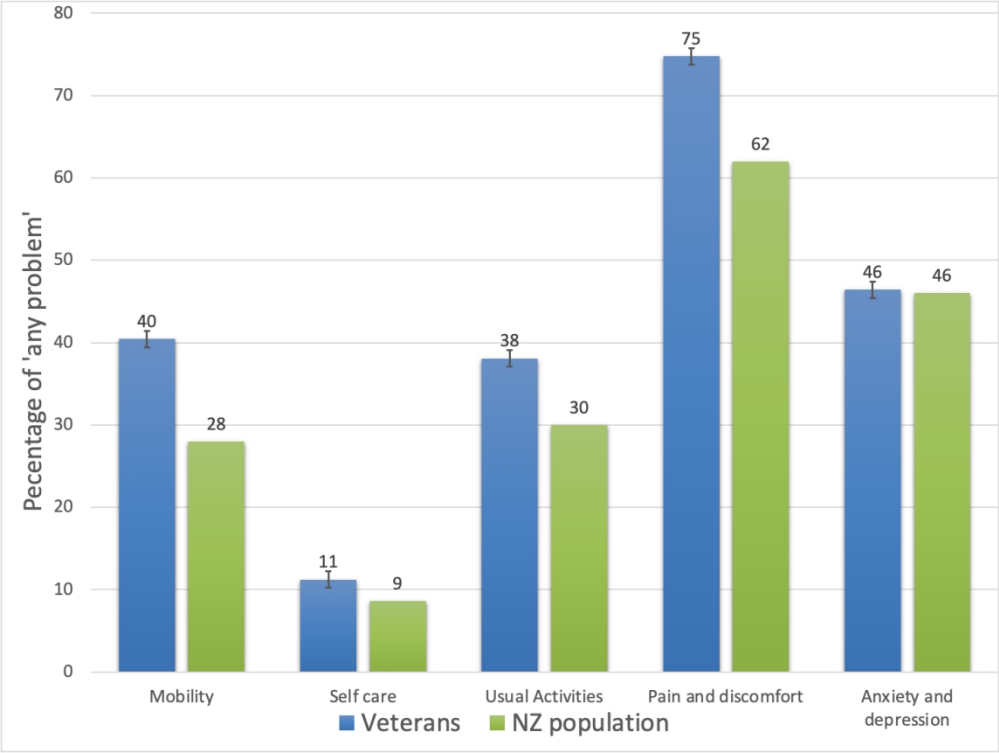
Finally, a thank you to the New Zealand Veterans who took the time and effort to complete a rather tedious questionnaire. Kia Kaha.



The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions

123x93mm (300 x 300 DPI)

Supplementary Table: Number of participants and EQ-VAS scores according to sample characteristics

Exposure variable	N(%)		Mean (SD)
All	1767		74.4 (17.1)
Age group (years)			
20-29	136	(7.7)	77.7 (14.4)
30-39	328	(18.6)	77.0 (16.2)
40-49	438	(24.8)	76.1 (14.6)
50-59	350	(19.8)	74.8 (16.6)
60-69	285	(16.1)	71.4 (19.8)
70-79	175	(9.9)	69.4 (19.4)
80+	50	(2.8)	66.2 (20.3)
Missing	5	(0.3)	61.2 (22.1)
Gender			
Female	220	(12.5)	70.3 (17.2)
Male	1520	(86.0)	74.4 (17.2)
Missing	27	(1.5)	75.0 (55.0)
Ethnicity (prioritised)			
NZ European	1382	(78.2)	74.4 (17.1)
Māori	245	(13.9)	75.6 (16.1)
Other	140	(7.9)	71.5 (19.3)
Service years			
0-9	339	(19.2)	69.9 (19.7)
10-19	478	(27.1)	74.5 (17.9)
20-29	530	(30.0)	75.3 (15.9)
30-39	254	(14.4)	76.3 (14.6)
40+	69	(3.9)	75.4 (16.4)
Missing	97	(5.5)	78.8 (14.2)
Deployment (ever)			
No	288	(16.3)	69.5 (19.9)
Yes	1458	(82.5)	75.3 (16.4)
Missing	21	(1.2)	75.6 (14.6)
GHQ12 Score			
0-9	652	(36.9)	82.0 (12.6)
10-19	972	(55.0)	72.3 (16.0)
20-29	123	(7.0)	54.3 (20.3)
30+	18	(1.0)	46.2 (24.4)
Missing	2	(0.1)	-

*sub-scores not used in multivariable models.

Supplementary table contd.

Social support full score			
24-29	0	0	-
30-39	3	(0.2)	66.7 (15.3)
40-49	15	(0.8)	44.5 (22.5)
50-59	97	(5.5)	62.4 (21.8)
60-69	351	(19.9)	69.0 (18.2)
70-79	643	(36.4)	75.1 (15.0)
80-89	409	(23.1)	78.0 (15.0)
90-96	235	(13.3)	81.9 (13.9)
Missing	14	(0.8)	58.1 (25.6)
Social support sub-scores			
Attachment*			
4-7	51	(3.5)	61.4 (23.4)
8-11	516	(29.2)	68.7 (18.0)
12-16	1193	(67.5)	77.5 (15.5)
Missing	7	(0.4)	61.0 (19.7)
Social integration*			
4-7	20	(1.1)	56.2 (25.1)
8-11	429	(24.3)	67.1 (19.4)
12-16	1309	(74.8)	77.1 (15.2)
Missing	9	(0.5)	58.7 (21.5)
Reassurance of worth*			
4-7	37	(2.1)	59.1 (19.5)
8-11	504	(28.5)	69.0 (19.1)
12-16	1215	(68.8)	77.2 (15.2)
Missing	11	(0.6)	62.0 (24.9)
Reliable Alliance*			
4-7	20	(1.1)	49.6 (22.2)
8-11	251	(14.2)	66.9 (20.1)
12-16	1489	(84.3)	76.0 (15.9)
Missing	7	(0.4)	61.0 (19.7)
Guidance sub-score*			
4-7	36	(2.0)	59.2 (22.2)
8-11	387	(21.9)	68.7 (18.9)
12-16	1337	(75.7)	76.6 (15.7)
Missing	7	(0.4)	54.6 (21.6)
Opportunity for nurturance*			
4-7	29	(1.6)	69.3 (18.9)
8-11	413	(23.4)	71.9 (18.8)
12-16	1316	(74.5)	75.4 (16.4)
Missing	9	(0.5)	58.7 (21.5)

Supplementary table, contd.

Psychological flexibility score (AAQii score).			
10-19	5	(0.3)	23.2 (13.8)
20-29	40	(2.3)	49.1 (22.1)
30-39	147	(8.3)	63.0 (18.6)
40-49	43	(24.7)	68.5 (16.8)
50-59	664	(37.6)	77.1 (13.9)
60-70	457	(25.9)	82.5 (13.5)
Missing	1	(1.0)	69.6 (20.5)
Sleep Condition Indicator (SCI score			
0 to <2	67	(3.8)	51.2 (22.3)
2 to <4	264	(14.9)	62.2 (19.5)
4 to <6	646	(36.6)	74.3 (14.6)
6 to <8	384	(21.7)	77.6 (14.2)
8 to 10	386	(21.8)	83.5 (12.2)
Missing	20	(1.1)	77.3 (12.8)
AUDIT-C score			
Non-hazardous	776	(43.9)	74.0 (17.4)
Hazardous	915	(51.8)	74.6 (16.9)
Missing	76	(4.3)	75.0 (17.0)
Brief Trauma Questionnaire (DSM-IV criteria)			
Not exposed	544	(30.8)	78.3 (15.1)
Exposed	1210	(68.5)	72.5 (17.8)
Missing	13	(0.7)	80.6 (8.1)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	Indicate the study's design with a commonly used term in the title or the abstract. **Yes, a cross sectional study, p1 title.**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **Background, results and conclusions, p 1**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **Introduction p2.**
Objectives	3	State specific objectives, including any prespecified hypotheses **p2, lines 59 and 60**
Methods		
Study design	4	Present key elements of study design early in the paper p**2 line 62 to page 5 line 145**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **Participants, page2 line 63-page 3 line 83.**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants **page 2 line 64 to page 3, line 68.**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **Questionnaire, pp 3-5.**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group **as above**
Bias	9	Describe any efforts to address potential sources of bias **Methods, page 3. Lines 76-83.**
Study size	10	Explain how the study size was arrived at **p5 line 137**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Cases defined through the **Multivariable logistic regression with the EQ-Visual analogue scale as the outcome measure, p5 lines 131-136**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **Backward elimination process p5 lines 134-135**
		(*b*) Describe any methods used to examine subgroups and interactions **By multivariable logistic regression, p5 as above**
		(*c*) Explain how missing data were addressed **p4 lines 122-125**
		(*d*) If applicable, describe analytical methods taking account of sampling strategy N/A
		(*e*) Describe any sensitivity analyses N/A
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **Potentially eligible lines 68-73 p 3**
		(b) Give reasons for non-participation at each stage N/A
		(c) Consider use of a flow diagram N/A

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders **page 5 et seq, table 1**
		(b) Indicate number of participants with missing data for each variable of interest '**n used' columns tables 2 and 3.**
Outcome data	15*	Report numbers of outcome events or summary measures **as per tables**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **Tables, adjusted for age, sex, service years and deployment status.**
		(*b*) Report category boundaries when continuous variables were categorized. **Independent variables, p 3 and 4, EQ-VAS is a continuous scale**.
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period **N/A**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **N/A**
Discussion		
Key results	18	Summarise key results with reference to study objectives **Discussion, p11 first para**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias **Discussion lines 215 et seq.**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence **Discussion, p12 lines 230 et seq.**
Generalisability	21	Discuss the generalisability (external validity) of the study results **p17, line 215 et seq.**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **Funding, p18**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Factors associated with self-reported health among New Zealand military Veterans: A cross-sectional study

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FACTORS ASSOCIATED WITH SELF-REPORTED HEALTH AMONG NEW ZEALAND MILITARY VETERANS: A CROSS-SECTIONAL STUDY

David McBride,[1] Ari Samaranayaka[2], Amy Richardson,[1] Dianne Gardner,[3] Daniel Shepherd,[4] Emma H. Wyeth[5], Brandon deGraaf,[6] Sarah Derrett.[1]

[1]Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[2]Biostatistics Centre, Division of Health Sciences, University of Otago, Dunedin, New Zealand.

[3]School of Psychology, Massey University, New Zealand.

[4]Department of Psychology, Auckland University of Technology, New Zealand.

[5]Ngāi Tahu Māori Health Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[6]Injury Prevention Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

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Corresponding Author:

David McBride, Department of Preventive and Social Medicine, Adams Building, 18 Frederick Street, Dunedin 9017, New Zealand.

Email: david.mcbride@otago.ac.nz

Phone: +64 3 479 7208

Fax: +64 3 479 7298

ABSTRACT

Objective

To identify factors associated with better or poorer self-reported health status in New Zealand military Veterans.

Design

An online cross-sectional survey.

Participants

The participants of interest were the 3,874 currently serving Veterans who had been deployed to a conflict zone, but all Veterans were eligible to participate.

Study variables

Health status was self-reported using the EQ-5D-5L, which asks about problems across five dimensions (mobility, self-care, usual activities, pain or discomfort, and anxiety or depression), with five levels of severity (e.g. no, slight, moderate, severe or extreme problems), also containing a visual analogue scale (EQ-VAS), scaled from 0 (worst) to 100 (best) imagined health. Hypothetical relationships with better health were positive social support, sleep and psychological flexibility; with poorer health, exposure to psychological trauma, distress and hazardous drinking.

Results:

The EQ5-D was completed by 1767 Veterans, 1009 serving, a response rate of 26% from that group, with 1767 completing the EQ5-D and entering the analysis, comprising 1458 who had deployed, 288 who had not, and the 21 who did not provide deployment data.

A significantly higher proportion of Veterans reported 'any problems' rather than 'no problems' with four EQ-5D dimensions: mobility, self-care, usual activities and pain or discomfort, but no difference in anxiety or depression. Age, length of service, deployment, psychological flexibility and better sleep quality were associated with higher EQ-VAS scores; distress with lower EQ-VAS scores.

Conclusion:

In this sample of New Zealand Veterans, psychological flexibility and good sleep are associated with better self-rated health, and distress and poor sleep with diminished health. These factors might be used as sentinel health indicators in assessing Veteran health status. As distress, psychological flexibility and sleep are closely related, cognitive behavioural therapy encompassing these domains may be useful in improving the health of New Zealand Veterans.

Keywords:

Self-rated health, wellbeing, EQ-5D, Veterans, deployment, military, risk factors.

Strengths and limitations of this study

- Many studies of Veterans have focused on adverse outcomes, but we have been able to focus on a holistic measure of 'health'.
- The study was sufficiently powered to detect important relationships indicating opportunities for intervention.
- The exact response rate is unknown, and bias may be a limitation.
- The cross-sectional design means that we cannot explore cause and effect relationships.

INTRODUCTION

The three major events in the military life course are entry to military service, deployment on active service and transition back to civilian life. On entry, soldiers, sailors and air personnel are subject to a selection process to ensure, as far as possible, good physical and mental health, giving rise to the 'healthy soldier effect,' with service personnel being, on average, healthier than the general population.[1] However, the physical and psychological stressors of military service have been found to erode this effect.[2]

The physical stressors have a particular impact on the lower limb, with load carriage, high intensity training and the design of footwear being implicated in injury causation.[3] A military career also increases opportunities for psychological trauma, and post-traumatic stress disorder (PTSD) has been identified as the 'signature injury' of United States service men and women deployed to Afghanistan and Iraq.[4]

A focus on adverse health events in the literature[5] means that wellbeing is relatively overlooked. In the long run, military service has been found to have positive effects.[6,7] Good health after service does, however, depend on the success of the 'military civilian transition', a complex process for which models have been developed.[8] Health problems developed in service, difficulty in assuming a post-service identity and many other factors contribute to health and wellbeing outcomes.[8] In New Zealand, military Veterans can only access assistance from New Zealand Veteran's Affairs (NZVA) if they have undertaken 'qualifying operational service' as defined by the Veteran Support Act 2014,[9] thus being Veterans in a legal sense. NZVA support some 12,000 Veterans, with an average age of 80 years, 5000 being actively case managed.[10] The majority will have seen operational service in Korea, Borneo, Malaya and Vietnam. Post-Vietnam, smaller numbers deployed on United Nations and other missions, but the tempo of operations rose with the deployment to Bosnia in 1992, and some 9,000-10,000 'legal' Veterans deployed between then and the

withdrawal of New Zealand troops from Afghanistan in 2021. The Ministerial Veteran's Health Advisory Panel, established under the Veteran Support Act, are specifically charged with funding research on this 'contemporary Veteran' group, NZVA acknowledging that they "have had different experiences, and have different needs, compared to the older veterans. They are likely to have served in a number of deployments during their career, and come to us with more complex health issues."[10]

The aims of this study were therefore to describe self-reported health among these Veterans, and identify factors associated with better or poorer health.

Veteran and public involvement

The Ministerial Veterans Health Advisory Panel,[10] commissioned the study and advised on the design. We also formed a steering group with representatives from the New Zealand Defence Force, New Zealand Veterans Affairs, the Royal New Zealand Returned and Services Association (RSA)[11] and No Duff,[12] a charity providing first response support to Veterans and their families. We also consulted with the Ngāi Tahu Research Consultation Committee in order to assess the importance of the project to Māori, New Zealand's indigenous population. We undertook to inform the Veteran community before releasing the results, to which end a link to the paper will be posted on the military social media sites where the study was advertised, and to give all Veterans, defined as anyone who had served in the military, an opportunity to participate. Participants were not recruited as patients.

METHODS

Participants

Data were collected via an online survey, a postal version being available on request. There is no comprehensive Veteran registry, however in July 2018, a link to the online questionnaire was sent by email to all currently serving regular and reserve New Zealand Defence Force (NZDF) members registered on the NZDF email system who were 'legal Veterans', as indicated by holding the New Zealand Operational Service Medal, numbering 3,874 personnel at that time. An introductory message and link to the questionnaire were also presented on the NZDF 'intranet landing page', a secure internal webpage from which all regular force personnel can access relevant work-related content, tools, and resources. Retired military personnel were invited to participate through posters distributed to reserve units and the 43 local social clubs identified by the RSA national office to be 'Veteran active.' Paper questionnaires with return postage envelopes were made available at these sites. 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 website. The questionnaire was available for completion from June to December 2018.

Ethics approval

Ethics approval for the study was obtained from the Northern B Health and Disability Ethics Committee, reference 17NTB118.

Questionnaire

Criterion variable

Self-rated health status was assessed using the EQ-5D-5L,[13] a short questionnaire asking about the respondent's health across five dimensions: mobility, self-care, usual activities, pain or discomfort and anxiety or depression, with response options ranging from (e.g.) 'no problems', to 'extreme problems'. For each dimension, participants were categorised as having 'any problems' if they selected any response other than 'no problems'.

Additionally, the EQ-5D-5L visual analogue scale (EQ-VAS) asks the respondent to mark on a vertical visual analogue scale (VAS) how good or bad their health is today, where the endpoints are labelled 'the best health you can imagine' (score of 100) and 'the worst health you can imagine' (score of 0).

Independent variables

Demographic characteristics included age, sex, ethnicity, service years, and past deployment on operational service (yes/no). Ethnicity prioritisation was adopted,[14] whereby participants with multiple responses were assigned to one of the categories, in the order of Māori, Pacific Peoples, Other and European.

General psychiatric morbidity was assessed using the 12-item General Health Questionnaire (GHQ-12),[15] scored using a four point scale (0-3) and summing the 12 items to give a total score, with higher scores indicating elevated distress.

Social support was measured using the Social Provisions Scale,[16] with responses made on a four-point Likert-type scale ranging from 1 'strongly disagree' to 4 'strongly agree'. The 24 items can be reduced to six subscales (attachment, social integration, reassurance of worth, reliable alliance, social guidance, opportunity for nurturance) or summed to create a total score, with greater scores indicating greater social support.

Alcohol use was measured using the AUDIT-C,[17] scaled from 0-12. A score of 3+ for women and 4+ for men indicated potentially hazardous drinking behaviour.

Sleep quality was assessed with the Sleep Condition Indicator (SCI), [18] assessing insomnia as described in the Diagnostic and Statistical Manual of Mental Disorders version 5 (DSM-V).[19]

The SCI consists of eight items rated from 0-4, the total scores being scaled to a range of 0 to 10, where higher scores represent better sleep.

Trauma exposure was assessed with the Brief Trauma Scale (BTS),[20] which captures past exposure to situations that were life threating or capable of producing serious injury.

Psychological flexibility was measured with the 10-item AAQ-II, designed as a measure of effectiveness in a particular mode of behavioural intervention, Acceptance and Commitment Therapy (ACT).[21] Items were answered on a 7-point scale, with options ranging from 'never true' to 'always true'. The items were summed to obtain a total score (possible range 10 to 70), with higher scores indicative of greater psychological flexibility. The questionnaire is available as supplementary material.

Statistical analyses

With respect to the calculation of summed scores, if only one item was missing for a particular measure then this was imputed with the mean of the remaining items; if more than one item was missing then the score was set to missing for that participant. Complete case analysis was used in the remaining analyses. The five dimensions of the EQ-5D-5L were compared to the NZ population normative values.[22]

Z tests were used to compare the EQ5D dimension scores with those of the New Zealand general population.[22] Univariate ordinary least-squares linear regression analyses assessed the strength of relationships between each independent variable and EQ-VAS scores, using robust standard errors to account for heteroscedasticity and calculating 95% confidence intervals (95% CIs). Multivariable linear regression was then used to identify the role of the independent variables while adjusting for each other. None of the social support sub-scales were used in this multivariable model, instead using the social support total score. The model was built using backward variable selection with $p<0.10$ for variable retention, with the exceptions of age, sex, service years, and deployment status which were retained as adjusting variables irrespective of p-values.

RESULTS

The EQ-5D was completed by 1767 Veterans, 1009 who were serving (26% of that group), 458 who had retired, 288 who had not deployed, and 21 who did not provide deployment data. There are no reliable denominator data on retired and non-deployed Veterans in New Zealand.

A supplementary table presents the EQ-VAS score according to the sample characteristics.

Figure 1 shows the proportion of EQ-5D-5L dimension responses reporting 'any problem' severity level other than 'no problems' in comparison to the New Zealand population normative values,[22] with table 1 showing the 95% CI's and Z values.

Figure 1 about here

Table 1, Proportion of 'any problem' in EQ-5D domains

Domain	**Veterans**	**NZ population**	**Z value (p)**
	Proportion (95% CI)	**Proportion (95% CI)**	
Mobility	0.40 (0.38-0.42)	0.28 (0.26-0.30)	8.5 (<.0001)
Self-care	0.11 (0.10-0.12)	0.09 (0.07-0.10)	2.8 (0.03)
Usual activities	0.38 (0.36-0.40)	0.30 (0.28-0.31)	5.6 (<.001)
Pain/discomfort	0.75 (0.73-0.76)	0.62 (0.60-0.63)	9.0 (<.0001)
Anxiety/depression	0.46 (0.44-0.48)	0.46 (0.44-0.48)	0 (1)

The results of the univariate analysis are displayed in Table 2. Here, for continuous characteristics, the regression coefficient (*ß*) represents the change in the mean EQ-VAS associated with one unit increase in the characteristic. For categorical characteristics, *ß* is the change in mean EQ-VAS scores compared to the referent category.

Table 2: Univariate cross-sectional associations between variables and mean EQ-VAS scores for New Zealand Veterans (N=1,762)

Characteristic	*n*	*ß*	95% CIs	*p*-value
Age*	1762	-0.19	[-0.24, -0.13]	<.01
Sex				
Female	220	Reference	-	
Male	1520	-0.65	[-3.04, 1.73]	.59
Ethnicity				
NZ European	1382	Reference	-	
Māori	245	1.21	[-1.00, 3.42]	
Other	140	-2.95	[-6.26, 0.36]	0.10
Service years*	1670	0.19	[0.11, 0.27]	<.01
Deployment status				
Not deployed	288	Reference	-	
Deployed	1458	5.80	[3.35, 8.25]	<.01
GHQ-12 score*	1765	-1.63	[-1.79, -1.47]	<.01
Social support*				
Attachment	1760	2.02	[1.69, 2.34]	<.01
Social integration	1758	2.45	[2.06, 2.88]	<.01
Reassurance of worth	1756	2.48	[2.11, 2.85]	<.01
Reliable alliance	1760	2.30	[1.91, 2.70]	<.01
Social guidance	1760	2.00	[1.65, 2.35]	<.01
Opportunity for nurturance	1758	0.85	[0.47, 1.23]	<.01
Social support total score	1753	0.52	[0.44, 0.59]	<.01
Psychological flexibility*	1750	0.79	[0.71, 0.87]	<.01
Sleep score*	1747	3.47	[3.11, 3.83]	<.01
AUDIT-C	1691			
Non-hazardous		Reference	-	
Hazardous		0.62	[-1.03, 2.26]	0.46
Exposure to traumatic events	1754			
Not exposed		Reference	-	
Exposed		-5.72	[-7.34, -4.11]	<.01

*Scored as continuous variables, coefficient is per unit increase.

Of the demographic variables, age was associated with lower EQ-VAS scores, length of service with higher scores. No relationships were apparent for sex or ethnicity. Positive coefficients, indicating better health with presence of the characteristic, were present for dichotomous variables of deployment, where the mean EQ-VAS score for deployed Veterans was 5.8 VAS units higher (better) than for non-deployed. The largest negative associations were for exposure to traumatic events, with a mean EQ-VAS score 5.7 lower for those exposed compared to those not exposed. Distress, as measured by the GHQ-12, had a negative association with health state. Positive associations with health state were found for

psychological flexibility as measured by the AAQ-II, better sleep scores, the total support scores and the individual dimensions.

Table 3 shows the results from two models. The first model is adjusted for the other characteristics, with 11 variables and 1,557 people providing valid responses for all factors included in the model. All effect sizes were reduced, and the social support and AUDIT-C scores were no longer associated, with 11 variables explaining 35% of the variability in the EQ-VAS.

The final model involved backward variable selection setting a p-value of 0.10, identifying a smaller subset of variables. Age, sex, service years, and deployment status were retained in the model irrespective of their p-values, thus adjusting for those variables, using 1,600 complete responses. Social support and AUDIT-C hazardous drinking were not retained in this final model; other coefficients remaining essentially the same, with a minimal effect on the overall R^2.

Table 3. Multivariable models of associations between variables and mean EQ-VAS scores for New Zealand Veterans

	Adjusted model, N used =1,557			Final model, N used =1,600		
Characteristic	***ß***	**95% CI**	***p*-value**	***ß***	**95% CI**	***p*-value**
Age (years)*	0.17	[-0.23, 1.11]	<0.01	-0.17	[-0.23, -0.12]	<0.01
Sex						
Female	**Ref**	-	-	**Ref**	-	-
Male	0.24	[-2.52, 2.03]	0.84	-0.60	[-2.82, 1.63]	0.60
Ethnicity						
NZ European	**Ref**	-	-	**Ref**	-	-
Māori	0.29	[-1.70, 2.27]	0.07	0.19	[-1.77, 2.14]	-
Other	-3.58	[-6.66, -0.51]		-2.91	[-5.88, 0.06]	0.15
Service years*	0.17	[0.10, 0.25]	<0.01	0.17	[0.10, 0.25]	<0.01
Deployment status						
Not deployed	**Ref**	-	-	**Ref**	-	
Deployed	2.91	[0.64, 5.18]	<0.05	2.90	[0.65, 5.15]	0.01
GHQ12 score*	-0.87	[-1.09, -0.65]	<0.01	-0.92	[-1.13, -0.71]	<0.01
Social support (SPS score)*	0.01	[-0.07, 0.10]	0.76	-	-	-
Psychological flexibility score (AAQii)*	0.26	[0.15, 0.37]	<0.01	0.24	[0.14, 0.35]	<0.01
Sleep score (SCI), Range 0-10*	1.60	[1.18, 2.02]	<0.01	1.63	[1.22, 2.05]	<0.01
AUDIT_C score						
Non hazardous	**Ref**	-	-	-	-	-
Hazardous	0.41	[-1.00, 1.81]	0.57	-	-	-
Exposure to traumatic events (BTQ)						
Not exposed	**Ref**	-	-	**Ref**	-	-
Exposed	-1.77	[-3.30, -0.24]	<0.05	-1.81	[-3.32, 0.30]	0.02
			$R^2 = 0.35$			$R^2 = 0.36$

*Scored as continuous variables, coefficient is per unit increase.

DISCUSSION

Principal findings

With the exception of anxiety or depression, Veterans had a significantly greater proportion of 'any problem' responses in the EQ-5D dimensions than the general population of New Zealand.

The final model identified variables independently associated with the EQ-VAS score: age, length of service, deployment, the GHQ score, psychological flexibility, the sleep score and exposure to traumatic events. The results make conceptual sense in that distress is associated with reduced EQ-VAS and psychological flexibility with a modest protective effect, however, and unusually, Social Support was dropped, however the SPS was found to have a significant correlation with distress, and collinearity was the problem. There are also known to be many

other influences on health, including 'social wellbeing',[5] financial status, personality and non-deployment related stressors,[23] which we have not measured.

Strengths and weaknesses

Strengths of our study were the relatively large sample size, the inclusion of all Veterans, the assessment of 'health', infrequently investigated in Veteran populations, and the inclusion of New Zealand Veterans with a range of characteristics, including 'deployed' and 'non-deployed' Veterans. As a measure of health, the EQ-5D-5L dimensions and EQ-VAS ask about health on the day that respondents complete the questionnaire, the EQ-VAS end points being, respectively, the 'best' and 'worst' health they can imagine, so it is a holistic measure of health state.[24]

The response rate of 26% from serving Veterans, along with the unknown total number of Veterans, raises the question of bias, the direction of which is difficult to assess, as responses may be more likely from either Veterans with good or poor health. The healthy soldier effect is well known, service having a positive effect on wellbeing, with serving NZ Veterans having good access to primary health care through the military system, but the public health care system is the primary pathway to care for all Veterans, who are also covered by the 'no fault' accident compensation scheme for accidental injuries and occupational diseases.[25] Deployed Veterans may be at an advantage, but are covered by NZVA only if their illness or injury is linked to a particular deployment, and the condition is listed on the 'Statements of Principle' of the Australian Repatriation Medical Authority.[26] We also know that New Veterans tend to be stoic, so they might underestimate their health concerns,[27] and there are likely to be other personal characteristics that we have not measured. We were however able to adjust for deployment status, which did have a positive association with health state. In the interest of minimising responder burden, we used brief scales, which might reduce construct validity. Distress, sleep, psychological flexibility and exposure to traumatic events are likely to be related, so collinearity was difficult to avoid. The confounding effect was greatest for social support, but our finding does not mean that social support is of no importance to Veterans. The precision of the other coefficients may also have been affected. Finally, the cross-sectional design means that we cannot explore cause and effect, so recommendations for future interventions require additional support from longitudinal studies.

Comparison with other studies

We have previously reported factors associated with post-traumatic stress in this group,[28] using the Military Post Traumatic Stress Checklist (PCL-M). Factors associated with higher PCL-M scores were trauma exposure, older age, male gender, and being of Māori ethnicity. Factors associated with lower PCL-M scores were greater length of service, psychological flexibility, and better quality sleep. Using health as the outcome disclosed that Māori did not have poorer self-reported health compared to non-Māori, that deployment had a positive effect, and in the univariate models, all of the dimensions of social support were associated with improved health. The final model also included good sleep and psychological flexibility, providing most of the explanatory power in the model.

No other studies appear to have used the EQ-VAS as an outcome measure for Veteran health. Boehmer et al.[29] examined wellbeing among participants in the 2000 Behavioural Risk Factor Surveillance System describing health-related quality of life (HRQoL) by sex and military status, active duty, reservists Veterans, or no military service. Participants were asked to rate recent physical health, mental health, and activity limitation. Active duty men were more likely than men without military service to report 14 or more days of activity limitation, pain, and not enough rest in the past 30 days, the mobility and pain findings being similar to our sample. Notably, the predominant reason for medical discharge from the British Armed Forces was musculoskeletal problems.[30]

Contrary to our finding on deployment, there are reports indicating that non-deployed personnel retain better health than those who have been deployed,[31] Diaz Santana et al. having carried out a cross-sectional survey of 60,000 U.S. Veterans of Afghanistan and Iraq, with 20,563 responses. In contrast to our finding, mental quality of life scores were higher among the non-deployed group compared to the deployed group, though the deployed group reported higher physical quality of life scores compared to the non-deployed. Again in contrast, both mental and physical quality of life were lower among Veterans compared to U.S. population norms.

Both positive and negative consequences of deployment have been described.[7,32] In a study of Dutch Veterans,[7] two out of three reported a positive effect of deployment on their quality of life at the time of the survey, this being related to positive feelings such as satisfaction or comradeship, but a few having emotions such as frustration or shame. As regards tangible effects,[32] negative consequences included the military 'chain of command', being away from home, and deterioration of marital/significant other relationships. Positive influences include improved financial security, self-improvement, and time to reflect.

We found sleep to be associated with better health, but sleep difficulties are a common symptom for those with PTSD. McCarthy et al.[33] reported on the 3,157 U.S. military Veterans enrolled in the National Health and Resilience in Veterans Study, in which 27.6% reported poor sleep quality. Path analyses revealed significant associations between poor sleep, severity of PTSD, poorer mental and physical health functioning and lower overall quality of life.

Future directions

The results suggest that distress, psychological flexibility, and sleep have an important relationship with self-rated health among Veterans in this study.

Reducing distress through the promotion of psychological flexibility might be possible, although our finding here must be subject to caution as several researchers argue that the AAQ-II may be measuring psychological distress and affect rather than psychological inflexibility.[34] Psychological flexibility is specifically targeted by ACT, a psychological intervention described as being in the 'third wave' of behaviour change strategies.[35] The six core processes of ACT (acceptance, cognitive defusion, being present, self as context, values, and committed action) aim to increase psychological flexibility, the goal being "to have clients experience the world more directly so that their behavior is more flexible and thus their actions more consistent with the values that they hold."[35] Approaches such as ACT may therefore improve health state and has been shown to improve pain acceptance and psychological flexibility [36]. Lang et al. carried out a randomised clinical trial (RCT), comparing ACT with person-centred therapy,[37] showing a general improvement in symptoms of distress across both treatment arms, ACT providing superior improvement in insomnia. The drop-out rate for both therapies was however high, and the two groups did not exhibit any change in psychological flexibility. The authors proposed that future studies should include additional measures of ACT processes to determine which are actually affected by ACT.

Sleep in military personnel has been recognised as a 'vital health behaviour' for which policies and guidelines must be developed.[38] Cognitive behavioural therapy for insomnia (CBT-I) is regarded as an effective 'first line' treatment, and a brief intervention has been described for use in Australian general practice.[39] The Lang et al. trial[37] showed CBT-I to be effective, however future studies should include outcome measures that include ACT processes. Our final model showed that distress had a negative association with health, and psychological flexibility had a positive relationship, with sleep most likely related to both of these variables. It would seem important to screen for these conditions prior to transition from the military,

as well as among retired Veterans, in order to provide targeted support. Further research is needed to examine the potential of CBT to improve Veterans' wellbeing.

Figure 1 Caption.

The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions

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DATA SHARING STATEMENT

Data from this study is unsuitable for public deposition due to the privacy of participant data. Data are anonymised, but contain information on deployments (including location and duration), which could lead to some participants being identified. Furthermore, the participant information sheet, as required by the Southern Health and Disability Ethics Committee specifically contains the statement that 'all study data would be kept strictly confidential to the research team.' Qualified researchers may apply for data access with the research team at veterans.health@otago.ac.nz and/or hdecs@moh.govt.nz.

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COMPETING INTERESTS

None declared.

CONTRIBUTION

Investigation: Amy Richardson, Emma H. Wyeth, Sarah Derrett, Daniel Shepherd, David McBride.

Methodology: Amy Richardson, Ari Samaranayaka, Dianne Gardner, Emma H. Wyeth, Sarah Derrett, David McBride, Daniel Shepherd.

Project administration: Amy Richardson.

Resources: Brandon de Graaf.

Software: Brandon de Graaf.

Supervision: Ari Samaranayaka.

Validation: Amy Richardson.

Visualization: Amy Richardson.

Writing – original draft: David McBride. AS, DG, EHW, SD and DS contributed to the re-writes and final draft.

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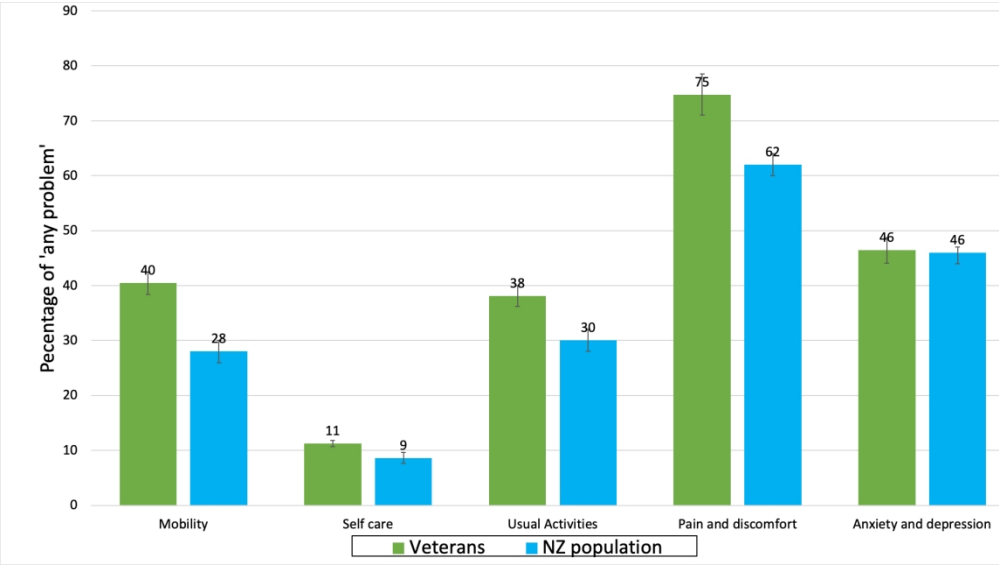

The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions

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FACTORS ASSOCIATED WITH SELF-REPORTED HEALTH AMONG NEW ZEALAND MILITARY VETERANS: A CROSS-SECTIONAL STUDY

David McBride,[1] Ari Samaranayaka[2], Amy Richardson,[1] Dianne Gardner,[3] Daniel Shepherd,[4] Emma H. Wyeth[5], Brandon deGraaf,[6] Sarah Derrett.[1]

[1]Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[2]Biostatistics Centre, Division of Health Sciences, University of Otago, Dunedin, New Zealand.

[3]School of Psychology, Massey University, New Zealand.

[4]Department of Psychology, Auckland University of Technology, New Zealand.

[5]Ngāi Tahu Māori Health Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[6]Injury Prevention Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

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Corresponding Author:

David McBride, Department of Preventive and Social Medicine, Adams Building, 18 Frederick Street, Dunedin 9017, New Zealand.

Email: david.mcbride@otago.ac.nz

Phone: +64 3 479 7208

Fax: +64 3 479 7298

ABSTRACT

Objective

To identify factors associated with better or poorer self-reported health status in New Zealand military Veterans.

Design

An online cross-sectional survey.

Participants

The participants of interest were the 3,874 currently serving Veterans who had been deployed to a conflict zone, but all Veterans were eligible to participate.

Study variables

Health status was self-reported using the EQ-5D-5L, which asks about problems across five dimensions (mobility, self-care, usual activities, pain or discomfort, and anxiety or depression), with five levels of severity (e.g. no, slight, moderate, severe or extreme problems), also containing a visual analogue scale (EQ-VAS), scaled from 0 (worst) to 100 (best) imagined health. Hypothetical relationships with better health were positive social support, sleep and psychological flexibility; with poorer health, exposure to psychological trauma, distress and hazardous drinking.

Results:

The EQ5-D was completed by 1767 Veterans, 1009 serving, a response rate of 26% from that group, with 1767 completing the EQ5-D and entering the analysis, comprising 1458 who had deployed, 288 who had not, and the 21 who did not provide deployment data.

A significantly higher proportion of Veterans reported 'any problems' rather than 'no problems' with four EQ-5D dimensions: mobility, self-care, usual activities and pain or discomfort, but no difference in anxiety or depression. Age, length of service, deployment, psychological flexibility and better sleep quality were associated with higher EQ-VAS scores; distress with lower EQ-VAS scores.

Conclusion:

In this sample of New Zealand Veterans, psychological flexibility and good sleep are associated with better self-rated health, and distress and poor sleep with diminished health. These factors might be used as sentinel health indicators in assessing Veteran health status. As distress, psychological flexibility and sleep are closely related, cognitive behavioural therapy encompassing these domains may be useful in improving the health of New Zealand Veterans.

Keywords:

Self-rated health, wellbeing, EQ-5D, Veterans, deployment, military, risk factors.

Strengths and limitations of this study

- Many studies of Veterans have focused on adverse outcomes, but we have been able to focus on a holistic measure of 'health'.
- The study was sufficiently powered to detect important relationships indicating opportunities for intervention.
- The exact response rate is unknown, and bias may be a limitation.
- The cross-sectional design means that we cannot explore cause and effect relationships.

INTRODUCTION

The three major events in the military life course are entry to military service, deployment on active service and transition back to civilian life. On entry, soldiers, sailors and air personnel are subject to a selection process to ensure, as far as possible, good physical and mental health, giving rise to the 'healthy soldier effect,' with service personnel being, on average, healthier than the general population.[1] However, the physical and psychological stressors of military service have been found to erode this effect.[2]

The physical stressors have a particular impact on the lower limb, with load carriage, high intensity training and the design of footwear being implicated in injury causation.[3] A military career also increases opportunities for psychological trauma, and post-traumatic stress disorder (PTSD) has been identified as the 'signature injury' of United States service men and women deployed to Afghanistan and Iraq.[4]

A focus on adverse health events in the literature[5] means that wellbeing is relatively overlooked. In the long run, military service has been found to have positive effects.[6,7] Good health after service does, however, depend on the success of the 'military civilian transition', a complex process for which models have been developed.[8] Health problems developed in service, difficulty in assuming a post-service identity and many other factors contribute to health and wellbeing outcomes.[8] In New Zealand, military Veterans can only access assistance from New Zealand Veteran's Affairs (NZVA) if they have undertaken 'qualifying operational service' as defined by the Veteran Support Act 2014,[9] thus being Veterans in a legal sense. NZVA support some 12,000 Veterans, with an average age of 80 years, 5000 being actively case managed.[10] The majority will have seen operational service in Korea, Borneo, Malaya and Vietnam. Post-Vietnam, smaller numbers deployed on United Nations and other missions, but the tempo of operations rose with the deployment to Bosnia in 1992, and some 9,000-10,000 'legal' Veterans deployed between then and the

withdrawal of New Zealand troops from Afghanistan in 2021. The Ministerial Veteran's Health Advisory Panel, established under the Veteran Support Act, are specifically charged with funding research on this 'contemporary Veteran' group, NZVA acknowledging that they "have had different experiences, and have different needs, compared to the older veterans. They are likely to have served in a number of deployments during their career, and come to us with more complex health issues."[10]

The aims of this study were therefore to describe self-reported health among these Veterans, and identify factors associated with better or poorer health.

Veteran and public involvement

The Ministerial Veterans Health Advisory Panel,[10] commissioned the study and advised on the design. We also formed a steering group with representatives from the New Zealand Defence Force, New Zealand Veterans Affairs, the Royal New Zealand Returned and Services Association (RSA)[11] and No Duff,[12] a charity providing first response support to Veterans and their families. We also consulted with the Ngāi Tahu Research Consultation Committee in order to assess the importance of the project to Māori, New Zealand's indigenous population. We undertook to inform the Veteran community before releasing the results, also to give all Veterans, defined as anyone who had served in the military, an opportunity to participate.

METHODS

Participants

Data were collected via an online survey, a postal version being available on request. There is no comprehensive Veteran registry, however in July 2018, a link to the online questionnaire was sent by email to all currently serving regular and reserve New Zealand Defence Force (NZDF) members registered on the NZDF email system who were 'legal Veterans', as indicated by holding the New Zealand Operational Service Medal, numbering 3,874 personnel at that time. An introductory message and link to the questionnaire were also presented on the NZDF 'intranet landing page', a secure internal webpage from which all regular force personnel can access relevant work-related content, tools, and resources. Retired military personnel were invited to participate through posters distributed to reserve units and the 43 local social clubs identified by the RSA national office to be 'Veteran active.' Paper questionnaires with return postage envelopes were made available at these sites. 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 website. The questionnaire was

available for completion from June to December 2018. Ethics approval for the study was obtained from the Northern B Health and Disability Ethics Committee, reference 17NTB118.

Questionnaire

Criterion variable

Self-rated health status was assessed using the EQ-5D-5L,[13] a short questionnaire asking about the respondent's health across five dimensions: mobility, self-care, usual activities, pain or discomfort and anxiety or depression, with response options ranging from (e.g.) 'no problems', to 'extreme problems'. For each dimension, participants were categorised as having 'any problems' if they selected any response other than 'no problems'.

Additionally, the EQ-5D-5L visual analogue scale (EQ-VAS) asks the respondent to mark on a vertical visual analogue scale (VAS) how good or bad their health is today, where the endpoints are labelled 'the best health you can imagine' (score of 100) and 'the worst health you can imagine' (score of 0).

Independent variables

Demographic characteristics included age, sex, ethnicity, service years, and past deployment on operational service (yes/no). Ethnicity prioritisation was adopted,[14] whereby participants with multiple responses were assigned to one of the categories, in the order of Māori, Pacific Peoples, Other and European.

General psychiatric morbidity was assessed using the 12-item General Health Questionnaire (GHQ-12),[15] scored using a four point scale (0-3) and summing the 12 items to give a total score, with higher scores indicating elevated distress.

Social support was measured using the Social Provisions Scale,[16] with responses made on a four-point Likert-type scale ranging from 1 'strongly disagree' to 4 'strongly agree'. The 24 items can be reduced to six subscales (attachment, social integration, reassurance of worth, reliable alliance, social guidance, opportunity for nurturance) or summed to create a total score, with greater scores indicating greater social support.

Alcohol use was measured using the AUDIT-C,[17] scaled from 0-12. A score of 3+ for women and 4+ for men indicated potentially hazardous drinking behaviour.

Sleep quality was assessed with the Sleep Condition Indicator (SCI), [18] assessing insomnia as described in the Diagnostic and Statistical Manual of Mental Disorders version 5 (DSM-V).[19] The SCI consists of eight items rated from 0-4, the total scores being scaled to a range of 0 to 10, where higher scores represent better sleep.

Trauma exposure was assessed with the Brief Trauma Scale (BTS),[20] which captures past exposure to situations that were life threating or capable of producing serious injury.

Psychological flexibility was measured with the 10-item AAQ-II, designed as a measure of effectiveness in a particular mode of behavioural intervention, Acceptance and Commitment Therapy (ACT).[21] Items were answered on a 7-point scale, with options ranging from 'never true' to 'always true'. The items were summed to obtain a total score (possible range 10 to 70), with higher scores indicative of greater psychological flexibility.

Statistical analyses

With respect to the calculation of summed scores, if only one item was missing for a particular measure then this was imputed with the mean of the remaining items; if more than one item was missing then the score was set to missing for that participant. Complete case analysis was used in the remaining analyses. The five dimensions of the EQ-5D-5L were compared to the NZ population normative values.[22]

Z tests were used to compare the EQ5D dimension scores with those of the New Zealand general population.[22] Univariate ordinary least-squares linear regression analyses assessed the strength of relationships between each independent variable and EQ-VAS scores, using robust standard errors to account for heteroscedasticity and calculating 95% confidence intervals (95% CIs). Multivariable linear regression was then used to identify the role of the independent variables while adjusting for each other. None of the social support sub-scales were used in this multivariable model, instead using the social support total score. The model was built using backward variable selection with $p<0.10$ for variable retention, with the exceptions of age, sex, service years, and deployment status which were retained as adjusting variables irrespective of p-values.

RESULTS

The EQ-5D was completed by 1767 Veterans, 1009 who were serving (26% of that group), 458 who had retired, 288 who had not deployed, and 21 who did not provide deployment data. There are no reliable denominator data on retired and non-deployed Veterans in New Zealand.

A supplementary table presents the EQ-VAS score according to the sample characteristics.

Figure 1 shows the proportion of EQ-5D-5L dimension responses reporting 'any problem' severity level other than 'no problems' in comparison to the New Zealand population normative values,[22] with table 1 showing the 95% CI's and Z values.

Figure 1 about here

Table 1, Proportion of 'any problem' in EQ-5D domains

Domain	Veterans	NZ population	Z value (p)
	Proportion (95% CI)	Proportion (95% CI)	
Mobility	0.40 (0.38-0.42)	0.28 (0.26-0.30)	8.5 (<.0001)
Self-care	0.11 (0.10-0.12)	0.09 (0.07-0.10)	2.8 (0.03)
Usual activities	0.38 (0.36-0.40)	0.30 (0.28-0.31)	5.6 (<.001)
Pain/discomfort	0.75 (0.73-0.76)	0.62 (0.60-0.63)	9.0 (<.0001)
Anxiety/depression	0.46 (0.44-0.48)	0.46 (0.44-0.48)	0 (1)

The results of the univariate analysis are displayed in Table 2. Here, for continuous characteristics, the regression coefficient (*ß*) represents the change in the mean EQ-VAS associated with one unit increase in the characteristic. For categorical characteristics, *ß* is the change in mean EQ-VAS scores compared to the referent category.

Table 2: Univariate cross-sectional associations between variables and mean EQ-VAS scores for New Zealand Veterans (N=1,762)

Characteristic	*n*	*ß*	95% CIs	*p*-value
Age*	1762	-0.19	[-0.24, -0.13]	<.01
Sex				
Female	220	Reference	-	
Male	1520	-0.65	[-3.04, 1.73]	.59
Ethnicity				
NZ European	1382	Reference	-	
Māori	245	1.21	[-1.00, 3.42]	
Other	140	-2.95	[-6.26, 0.36]	0.10
Service years*	1670	0.19	[0.11, 0.27]	<.01
Deployment status				
Not deployed	288	Reference	-	
Deployed	1458	5.80	[3.35, 8.25]	<.01
GHQ-12 score*	1765	-1.63	[-1.79, -1.47]	<.01
Social support*				
Attachment	1760	2.02	[1.69, 2.34]	<.01
Social integration	1758	2.45	[2.06, 2.88]	<.01
Reassurance of worth	1756	2.48	[2.11, 2.85]	<.01
Reliable alliance	1760	2.30	[1.91, 2.70]	<.01
Social guidance	1760	2.00	[1.65, 2.35]	<.01
Opportunity for nurturance	1758	0.85	[0.47, 1.23]	<.01
Social support total score	1753	0.52	[0.44, 0.59]	<.01
Psychological flexibility*	1750	0.79	[0.71, 0.87]	<.01
Sleep score*	1747	3.47	[3.11, 3.83]	<.01
AUDIT-C	1691			
Non-hazardous		Reference	-	
Hazardous		0.62	[-1.03, 2.26]	0.46
Exposure to traumatic events	1754			
Not exposed		Reference	-	
Exposed		-5.72	[-7.34, -4.11]	<.01

*Scored as continuous variables, coefficient is per unit increase.

Of the demographic variables, age was associated with lower EQ-VAS scores, length of service with higher scores. No relationships were apparent for sex or ethnicity. Positive coefficients, indicating better health with presence of the characteristic, were present for dichotomous variables of deployment, where the mean EQ-VAS score for deployed Veterans was 5.8 VAS units higher (better) than for non-deployed. The largest negative associations were for exposure to traumatic events, with a mean EQ-VAS score 5.7 lower for those exposed compared to those not exposed. Distress, as measured by the GHQ-12, had a negative association with health state. Positive associations with health state were found for

psychological flexibility as measured by the AAQ-II, better sleep scores, the total support scores and the individual dimensions.

Table 3 shows the results from two models. The first model is adjusted for the other characteristics, with 11 variables and 1,557 people providing valid responses for all factors included in the model. All effect sizes were reduced, and the social support and AUDIT-C scores were no longer associated, with 11 variables explaining 35% of the variability in the EQ-VAS.

The final model involved backward variable selection setting a p-value of 0.10, identifying a smaller subset of variables. Age, sex, service years, and deployment status were retained in the model irrespective of their p-values, thus adjusting for those variables, using 1,600 complete responses. Social support and AUDIT-C hazardous drinking were not retained in this final model; other coefficients remaining essentially the same, with a minimal effect on the overall R^2.

Table 3. Multivariable models of associations between variables and mean EQ-VAS scores for New Zealand Veterans

	Adjusted model, N used =1,557			Final model, N used =1,600		
Characteristic	**ß**	**95% CI**	***p*-value**	**ß**	**95% CI**	***p*-value**
Age (years)*	0.17	[-0.23, 1.11]	<0.01	-0.17	[-0.23, -0.12]	<0.01
Sex						
Female	**Ref**	-	-	**Ref**	-	-
Male	0.24	[-2.52, 2.03]	0.84	-0.60	[-2.82, 1.63]	0.60
Ethnicity						
NZ European	**Ref**	-	-	**Ref**	-	-
Māori	0.29	[-1.70, 2.27]	0.07	0.19	[-1.77, 2.14]	-
Other	-3.58	[-6.66, -0.51]		-2.91	[-5.88, 0.06]	0.15
Service years*	0.17	[0.10, 0.25]	<0.01	0.17	[0.10, 0.25]	<0.01
Deployment status						
Not deployed	**Ref**	-	-	**Ref**	-	
Deployed	2.91	[0.64, 5.18]	<0.05	2.90	[0.65, 5.15]	0.01
GHQ12 score*	-0.87	[-1.09, -0.65]	<0.01	-0.92	[-1.13, -0.71]	<0.01
Social support (SPS score)*	0.01	[-0.07, 0.10]	0.76	-	-	-
Psychological flexibility score (AAQii)*	0.26	[0.15, 0.37]	<0.01	0.24	[0.14, 0.35]	<0.01
Sleep score (SCI), Range 0-10*	1.60	[1.18, 2.02]	<0.01	1.63	[1.22, 2.05]	<0.01
AUDIT_C score						
Non hazardous	**Ref**	-	-	-	-	-
Hazardous	0.41	[-1.00, 1.81]	0.57	-	-	-
Exposure to traumatic events (BTQ)						
Not exposed	**Ref**	-	-	**Ref**	-	-
Exposed	-1.77	[-3.30, -0.24]	<0.05	-1.81	[-3.32, 0.30]	0.02
			$R^2 = 0.35$			$R^2 = 0.36$

*Scored as continuous variables, coefficient is per unit increase.

DISCUSSION

Principal findings

With the exception of anxiety or depression, Veterans had a significantly greater proportion of 'any problem' responses in the EQ-5D dimensions than the general population of New Zealand.

The final model identified variables independently associated with the EQ-VAS score: age, length of service, deployment, the GHQ score, psychological flexibility, the sleep score and exposure to traumatic events. The results make conceptual sense in that distress is associated with reduced EQ-VAS and psychological flexibility with a modest protective effect, however, and unusually, Social Support was dropped, however the SPS was found to have a significant correlation with distress, and collinearity was the problem. There are also known to be many

other influences on health, including 'social wellbeing',[5] financial status, personality and non-deployment related stressors,[23] which we have not measured.

Strengths and weaknesses

Strengths of our study were the relatively large sample size, the inclusion of all Veterans, the assessment of 'health', infrequently investigated in Veteran populations, and the inclusion of New Zealand Veterans with a range of characteristics, including 'deployed' and 'non-deployed' Veterans. As a measure of health, the EQ-5D-5L dimensions and EQ-VAS ask about health on the day that respondents complete the questionnaire, the EQ-VAS end points being, respectively, the 'best' and 'worst' health they can imagine, so it is a holistic measure of health state.[24]

The response rate of 26% from serving Veterans, along with the unknown total number of Veterans, raises the question of bias, the direction of which is difficult to assess, as responses may be more likely from either Veterans with good or poor health. The healthy soldier effect is well known, service having a positive effect on wellbeing, with serving NZ Veterans having good access to primary health care through the military system, but the public health care system is the primary pathway to care for all Veterans, who are also covered by the 'no fault' accident compensation scheme for accidental injuries and occupational diseases.[25] Deployed Veterans may be at an advantage, but are covered by NZVA only if their illness or injury is linked to a particular deployment, and the condition is listed on the 'Statements of Principle' of the Australian Repatriation Medical Authority.[26] We also know that New Veterans tend to be stoic, so they might underestimate their health concerns,[27] and there are likely to be other personal characteristics that we have not measured. We were however able to adjust for deployment status, which did have a positive association with health state. In the interest of minimising responder burden, we used brief scales, which might reduce construct validity. Distress, sleep, psychological flexibility and exposure to traumatic events are likely to be related, so collinearity was difficult to avoid. The confounding effect was greatest for social support, but our finding does not mean that social support is of no importance to Veterans. The precision of the other coefficients may also have been affected. Finally, the cross-sectional design means that we cannot explore cause and effect, so recommendations for future interventions require additional support from longitudinal studies.

Comparison with other studies

We have previously reported factors associated with post-traumatic stress in this group,[28] using the Military Post Traumatic Stress Checklist (PCL-M). Factors associated with higher PCL-M scores were trauma exposure, older age, male gender, and being of Māori ethnicity. Factors associated with lower PCL-M scores were greater length of service, psychological flexibility, and better quality sleep. Using health as the outcome disclosed that Māori did not have poorer self-reported health compared to non-Māori, that deployment had a positive effect, and in the univariate models, all of the dimensions of social support were associated with improved health. The final model also included good sleep and psychological flexibility, providing most of the explanatory power in the model.

No other studies appear to have used the EQ-VAS as an outcome measure for Veteran health. Boehmer et al.[29] examined wellbeing among participants in the 2000 Behavioural Risk Factor Surveillance System describing health-related quality of life (HRQoL) by sex and military status, active duty, reservists Veterans, or no military service. Participants were asked to rate recent physical health, mental health, and activity limitation. Active duty men were more likely than men without military service to report 14 or more days of activity limitation, pain, and not enough rest in the past 30 days, the mobility and pain findings being similar to our sample. Notably, the predominant reason for medical discharge from the British Armed Forces was musculoskeletal problems.[30]

Contrary to our finding on deployment, there are reports indicating that non-deployed personnel retain better health than those who have been deployed,[31] Diaz Santana et al. having carried out a cross-sectional survey of 60,000 U.S. Veterans of Afghanistan and Iraq, with 20,563 responses. In contrast to our finding, mental quality of life scores were higher among the non-deployed group compared to the deployed group, though the deployed group reported higher physical quality of life scores compared to the non-deployed. Again in contrast, both mental and physical quality of life were lower among Veterans compared to U.S. population norms.

Both positive and negative consequences of deployment have been described.[7,32] In a study of Dutch Veterans,[7] two out of three reported a positive effect of deployment on their quality of life at the time of the survey, this being related to positive feelings such as satisfaction or comradeship, but a few having emotions such as frustration or shame. As regards tangible effects,[32] negative consequences included the military 'chain of command', being away from home, and deterioration of marital/significant other relationships. Positive influences include improved financial security, self-improvement, and time to reflect.

We found sleep to be associated with better health, but sleep difficulties are a common symptom for those with PTSD. McCarthy et al.[33] reported on the 3,157 U.S. military Veterans enrolled in the National Health and Resilience in Veterans Study, in which 27.6% reported poor sleep quality. Path analyses revealed significant associations between poor sleep, severity of PTSD, poorer mental and physical health functioning and lower overall quality of life.

Future directions

The results suggest that distress, psychological flexibility, and sleep have an important relationship with self-rated health among Veterans in this study.

Reducing distress through the promotion of psychological flexibility might be possible, although our finding here must be subject to caution as several researchers argue that the AAQ-II may be measuring psychological distress and affect rather than psychological inflexibility.[34] Psychological flexibility is specifically targeted by ACT, a psychological intervention described as being in the 'third wave' of behaviour change strategies.[35] The six core processes of ACT (acceptance, cognitive defusion, being present, self as context, values, and committed action) aim to increase psychological flexibility, the goal being "to have clients experience the world more directly so that their behavior is more flexible and thus their actions more consistent with the values that they hold."[35] Approaches such as ACT may therefore improve health state and has been shown to improve pain acceptance and psychological flexibility [36]. Lang et al. carried out a randomised clinical trial (RCT), comparing ACT with person-centred therapy,[37] showing a general improvement in symptoms of distress across both treatment arms, ACT providing superior improvement in insomnia. The drop-out rate for both therapies was however high, and the two groups did not exhibit any change in psychological flexibility. The authors proposed that future studies should include additional measures of ACT processes to determine which are actually affected by ACT.

Sleep in military personnel has been recognised as a 'vital health behaviour' for which policies and guidelines must be developed.[38] Cognitive behavioural therapy for insomnia (CBT-I) is regarded as an effective 'first line' treatment, and a brief intervention has been described for use in Australian general practice.[39] The Lang et al. trial[37] showed CBT-I to be effective, however future studies should include outcome measures that include ACT processes. Our final model showed that distress had a negative association with health, and psychological flexibility had a positive relationship, with sleep most likely related to both of these variables. It would seem important to screen for these conditions prior to transition from the military,

as well as among retired Veterans, in order to provide targeted support. Further research is needed to examine the potential of CBT to improve Veterans' wellbeing.

Figure 1 Caption.

The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions

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DATA SHARING STATEMENT

Data from this study is unsuitable for public deposition due to the privacy of participant data. Data are anonymised, but contain information on deployments (including location and duration), which could lead to some participants being identified. Furthermore, the participant information sheet, as required by the Southern Health and Disability Ethics Committee specifically contains the statement that 'all study data would be kept strictly confidential to the research team.' Qualified researchers may apply for data access with the research team at veterans.health@otago.ac.nz and/or hdecs@moh.govt.nz.

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COMPETING INTERESTS

None declared.

CONTRIBUTION

Investigation: Amy Richardson, Emma H. Wyeth, Sarah Derrett, Daniel Shepherd, David McBride.

Methodology: Amy Richardson, Ari Samaranayaka, Dianne Gardner, Emma H. Wyeth, Sarah Derrett, David McBride. Daniel Shepherd

Project administration: Amy Richardson

Resources: Brandon de Graaf

Software: Brandon de Graaf

Supervision: Ari Samaranayaka

Validation: Amy Richardson

Visualization: Amy Richardson

Writing – original draft: David McBride. AS, DG, EHW, SD and DS contributed to the re-writes and final draft

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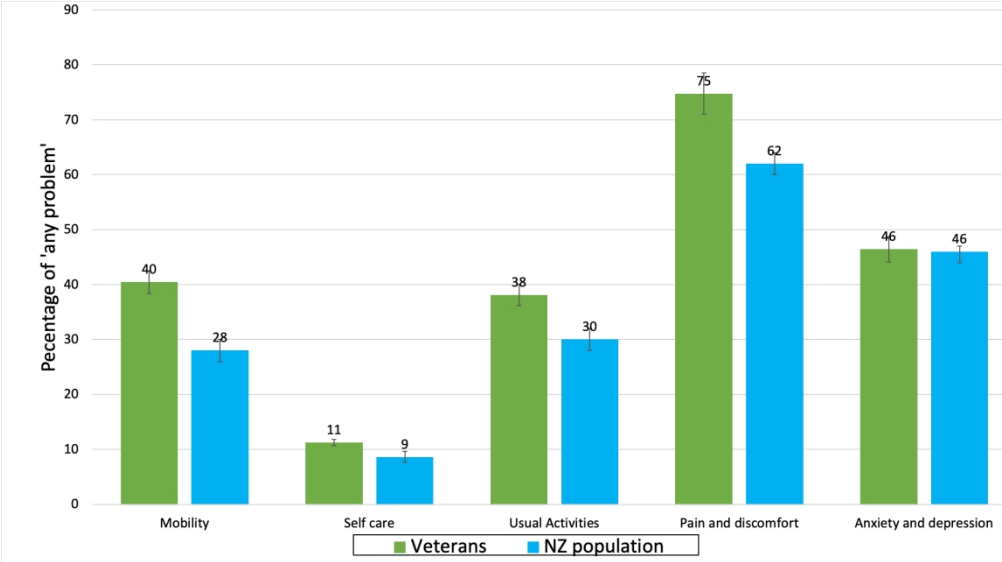
Finally, a thank you to the New Zealand Veterans who took the time and effort to complete a rather tedious questionnaire. Kia Kaha.



The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions

338x190mm (144 x 144 DPI)

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	Indicate the study's design with a commonly used term in the title or the abstract. **Yes, a cross sectional study, p1 title.**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **Background, results and conclusions, p 1**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **Introduction p2.**
Objectives	3	State specific objectives, including any prespecified hypotheses **p2, lines 59 and 60**
Methods		
Study design	4	Present key elements of study design early in the paper p**2 line 62 to page 5 line 145**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **Participants, page2 line 63-page 3 line 83.**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants **page 2 line 64 to page 3, line 68.**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **Questionnaire, pp 3-5.**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group **as above**
Bias	9	Describe any efforts to address potential sources of bias **Methods, page 3. Lines 76-83.**
Study size	10	Explain how the study size was arrived at **p5 line 137**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Cases defined through the **Multivariable logistic regression with the EQ-Visual analogue scale as the outcome measure, p5 lines 131-136**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **Backward elimination process p5 lines 134-135**
		(*b*) Describe any methods used to examine subgroups and interactions **By multivariable logistic regression, p5 as above**
		(*c*) Explain how missing data were addressed **p4 lines 122-125**
		(*d*) If applicable, describe analytical methods taking account of sampling strategy N/A
		(*e*) Describe any sensitivity analyses N/A
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **Potentially eligible lines 68-73 p 3**
		(b) Give reasons for non-participation at each stage N/A
		(c) Consider use of a flow diagram N/A

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders **page 5 et seq, table 1**
		(b) Indicate number of participants with missing data for each variable of interest '**n used' columns tables 2 and 3.**
Outcome data	15*	Report numbers of outcome events or summary measures **as per tables**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **Tables, adjusted for age, sex, service years and deployment status.**
		(*b*) Report category boundaries when continuous variables were categorized. **Independent variables, p 3 and 4, EQ-VAS is a continuous scale**.
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period **N/A**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **N/A**
Discussion		
Key results	18	Summarise key results with reference to study objectives **Discussion, p11 first para**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias **Discussion lines 215 et seq.**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence **Discussion, p12 lines 230 et seq.**
Generalisability	21	Discuss the generalisability (external validity) of the study results **p17, line 215 et seq.**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **Funding, p18**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Supplementary Table: Number of participants and EQ-VAS scores according to sample characteristics

Exposure variable	N (%)		Mean (SD)
All	1767		74.4 (17.1)
Age group (years)			
20-29	136	(7.7)	77.7 (14.4)
30-39	328	(18.6)	77.0 (16.2)
40-49	438	(24.8)	76.1 (14.6)
50-59	350	(19.8)	74.8 (16.6)
60-69	285	(16.1)	71.4 (19.8)
70-79	175	(9.9)	69.4 (19.4)
80+	50	(2.8)	66.2 (20.3)
Missing	5	(0.3)	61.2 (22.1)
Gender			
Female	220	(12.5)	75.0 (16.9)
Male	1520	(86.0)	74.4 (17.2)
Missing	27	(1.5)	70.3 (17.2)
Ethnicity (prioritised)			
NZ European	1382	(78.2)	74.4 (17.1)
Māori	245	(13.9)	75.6 (16.1)
Other	140	(7.9)	71.5 (19.3)
Service years			
0-9	339	(19.2)	69.9 (19.7)
10-19	478	(27.1)	74.5 (17.9)
20-29	530	(30.0)	75.3 (15.9)
30-39	254	(14.4)	76.3 (14.6)
40+	69	(3.9)	75.4 (16.4)
Missing	97	(5.5)	78.8 (14.2)
Deployment (ever)			
No	288	(16.3)	69.5 (19.9)
Yes	1458	(82.5)	75.3 (16.4)
Missing	21	(1.2)	75.6 (14.6)
GHQ12 Score			
0-9	652	(36.9)	82.0 (12.6)
10-19	972	(55.0)	72.3 (16.0)
20-29	123	(7.0)	54.3 (20.3)
30+	18	(1.0)	46.2 (24.4)
Missing	2	(0.1)	-

*sub-scores not used in multivariable models.

Supplementary table contd.

Social support full score			
24-29	0	0	-
30-39	3	(0.2)	66.7 (15.3)
40-49	15	(0.8)	44.5 (22.5)
50-59	97	(5.5)	62.4 (21.8)
60-69	351	(19.9)	69.0 (18.2)
70-79	643	(36.4)	75.1 (15.0)
80-89	409	(23.1)	78.0 (15.0)
90-96	235	(13.3)	81.9 (13.9)
Missing	14	(0.8)	58.1 (25.6)
Social support sub-scores			
Attachment*			
4-7	51	(3.5)	61.4 (23.4)
8-11	516	(29.2)	68.7 (18.0)
12-16	1193	(67.5)	77.5 (15.5)
Missing	7	(0.4)	61.0 (19.7)
Social integration*			
4-7	20	(1.1)	56.2 (25.1)
8-11	429	(24.3)	67.1 (19.4)
12-16	1309	(74.8)	77.1 (15.2)
Missing	9	(0.5)	58.7 (21.5)
Reassurance of worth*			
4-7	37	(2.1)	59.1 (19.5)
8-11	504	(28.5)	69.0 (19.1)
12-16	1215	(68.8)	77.2 (15.2)
Missing	11	(0.6)	62.0 (24.9)
Reliable Alliance*			
4-7	20	(1.1)	49.6 (22.2)
8-11	251	(14.2)	66.9 (20.1)
12-16	1489	(84.3)	76.0 (15.9)
Missing	7	(0.4)	61.0 (19.7)
Guidance sub-score*			
4-7	36	(2.0)	59.2 (22.2)
8-11	387	(21.9)	68.7 (18.9)
12-16	1337	(75.7)	76.6 (15.7)
Missing	7	(0.4)	54.6 (21.6)
Opportunity for nurturance*			
4-7	29	(1.6)	69.3 (18.9)
8-11	413	(23.4)	71.9 (18.8)
12-16	1316	(74.5)	75.4 (16.4)
Missing	9	(0.5)	58.7 (21.5)

Supplementary table, contd.

Psychological flexibility score (AAQii score).			
10-19	5	(0.3)	23.2 (13.8)
20-29	40	(2.3)	49.1 (22.1)
30-39	147	(8.3)	63.0 (18.6)
40-49	43	(24.7)	68.5 (16.8)
50-59	664	(37.6)	77.1 (13.9)
60-70	457	(25.9)	82.5 (13.5)
Missing	1	(1.0)	69.6 (20.5)
Sleep Condition Indicator (SCI score			
0 to <2	67	(3.8)	51.2 (22.3)
2 to <4	264	(14.9)	62.2 (19.5)
4 to <6	646	(36.6)	74.3 (14.6)
6 to <8	384	(21.7)	77.6 (14.2)
8 to 10	386	(21.8)	83.5 (12.2)
Missing	20	(1.1)	77.3 (12.8)
AUDIT-C score			
Non-hazardous	776	(43.9)	74.0 (17.4)
Hazardous	915	(51.8)	74.6 (16.9)
Missing	76	(4.3)	75.0 (17.0)
Brief Trauma Questionnaire (DSM-IV criteria)			
Not exposed	544	(30.8)	78.3 (15.1)
Exposed	1210	(68.5)	72.5 (17.8)
Missing	13	(0.7)	80.6 (8.1)

FACTORS ASSOCIATED WITH SELF-REPORTED HEALTH AMONG NEW ZEALAND MILITARY VETERANS: A CROSS-SECTIONAL STUDY

David McBride,[1] Ari Samaranayaka[2], Amy Richardson,[1] Dianne Gardner,[3] Daniel Shepherd,[4] Emma H. Wyeth[5], Brandon deGraaf,[6] Sarah Derrett.[1]

[1]Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[2]Biostatistics Centre, Division of Health Sciences, University of Otago, Dunedin, New Zealand.

[3]School of Psychology, Massey University, New Zealand.

[4]Department of Psychology, Auckland University of Technology, New Zealand.

[5]Ngāi Tahu Māori Health Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[6]Injury Prevention Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

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Corresponding Author:

David McBride, Department of Preventive and Social Medicine, Adams Building, 18 Frederick Street, Dunedin 9017, New Zealand.

Email: david.mcbride@otago.ac.nz

Phone: +64 3 479 7208

Fax: +64 3 479 7298

ABSTRACT

Objective

To identify factors associated with better or poorer self-reported health status in New Zealand military Veterans.

Design

An online cross-sectional survey.

Participants

The participants of interest were the 3,874 currently serving Veterans who had been deployed to a conflict zone, but all Veterans were eligible to participate.

Study variables

Health status was self-reported using the EQ-5D-5L, which asks about problems across five dimensions (mobility, self-care, usual activities, pain or discomfort, and anxiety or depression), with five levels of severity (e.g. no, slight, moderate, severe or extreme problems), also containing a visual analogue scale (EQ-VAS), scaled from 0 (worst) to 100 (best) imagined health. Hypothetical relationships with better health were positive social support, sleep and psychological flexibility; with poorer health, exposure to psychological trauma, distress and hazardous drinking.

Results:

The EQ5-D was completed by 1767 Veterans, 1009 serving, a response rate of 26% from that group, with 1767 completing the EQ5-D and entering the analysis, comprising 1458 who had deployed, 288 who had not, and the 21 who did not provide deployment data.

A significantly higher proportion of Veterans reported 'any problems' rather than 'no problems' with four EQ-5D dimensions: mobility, self-care, usual activities and pain or discomfort, but no difference in anxiety or depression. Age, length of service, deployment, psychological flexibility and better sleep quality were associated with higher EQ-VAS scores; distress with lower EQ-VAS scores.

Conclusion:

In this sample of New Zealand Veterans, psychological flexibility and good sleep are associated with better self-rated health, and distress and poor sleep with diminished health. These factors might be used as sentinel health indicators in assessing Veteran health status. As distress, psychological flexibility and sleep are closely related, cognitive behavioural therapy encompassing these domains may be useful in improving the health of New Zealand Veterans.

Keywords:

Self-rated health, wellbeing, EQ-5D, Veterans, deployment, military, risk factors.

Strengths and limitations of this study

- Many studies of Veterans have focused on adverse outcomes, but we have been able to focus on a holistic measure of 'health'.
- The study was sufficiently powered to detect important relationships indicating opportunities for intervention.
- The exact response rate is unknown, and bias may be a limitation.
- The cross-sectional design means that we cannot explore cause and effect relationships.

INTRODUCTION

The three major events in the military life course are entry to military service, deployment on active service and transition back to civilian life. On entry, soldiers, sailors and air personnel are subject to a selection process to ensure, as far as possible, good physical and mental health, giving rise to the 'healthy soldier effect,' with service personnel being, on average, healthier than the general population.[1] However, the physical and psychological stressors of military service have been found to erode this effect.[2]

The physical stressors have a particular impact on the lower limb, with load carriage, high intensity training and the design of footwear being implicated in injury causation.[3] A military career also increases opportunities for psychological trauma, and post-traumatic stress disorder (PTSD) has been identified as the 'signature injury' of United States service men and women deployed to Afghanistan and Iraq.[4]

A focus on adverse health events in the literature[5] means that wellbeing is relatively overlooked. In the long run, military service has been found to have positive effects.[6,7] Good health after service does, however, depend on the success of the 'military civilian transition', a complex process for which models have been developed.[8] Health problems developed in service, difficulty in assuming a post-service identity and many other factors contribute to health and wellbeing outcomes.[8] In New Zealand, military Veterans can only access assistance from New Zealand Veteran's Affairs (NZVA) if they have undertaken 'qualifying operational service' as defined by the Veteran Support Act 2014,[9] thus being Veterans in a legal sense. NZVA support some 12,000 Veterans, with an average age of 80 years, 5000 being actively case managed.[10] The majority will have seen operational service in Korea, Borneo, Malaya and Vietnam. Post-Vietnam, smaller numbers deployed on United Nations and other missions, but the tempo of operations rose with the deployment to Bosnia in 1992, and some 9,000-10,000 'legal' Veterans deployed between then and the

withdrawal of New Zealand troops from Afghanistan in 2021. The Ministerial Veteran's Health Advisory Panel, established under the Veteran Support Act, are specifically charged with funding research on this 'contemporary Veteran' group, NZVA acknowledging that they "have had different experiences, and have different needs, compared to the older veterans. They are likely to have served in a number of deployments during their career, and come to us with more complex health issues."[10]

The aims of this study were therefore to describe self-reported health among these Veterans, and identify factors associated with better or poorer health.

Veteran and public involvement

The Ministerial Veterans Health Advisory Panel,[10] commissioned the study and advised on the design. We also formed a steering group with representatives from the New Zealand Defence Force, New Zealand Veterans Affairs, the Royal New Zealand Returned and Services Association (RSA)[11] and No Duff,[12] a charity providing first response support to Veterans and their families. We also consulted with the Ngāi Tahu Research Consultation Committee in order to assess the importance of the project to Māori, New Zealand's indigenous population. We undertook to inform the Veteran community before releasing the results, also to give all Veterans, defined as anyone who had served in the military, an opportunity to participate.

METHODS

Participants

Data were collected via an online survey, a postal version being available on request. There is no comprehensive Veteran registry, however in July 2018, a link to the online questionnaire was sent by email to all currently serving regular and reserve New Zealand Defence Force (NZDF) members registered on the NZDF email system who were 'legal Veterans', as indicated by holding the New Zealand Operational Service Medal, numbering 3,874 personnel at that time. An introductory message and link to the questionnaire were also presented on the NZDF 'intranet landing page', a secure internal webpage from which all regular force personnel can access relevant work-related content, tools, and resources. Retired military personnel were invited to participate through posters distributed to reserve units and the 43 local social clubs identified by the RSA national office to be 'Veteran active.' Paper questionnaires with return postage envelopes were made available at these sites. 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 website. The questionnaire was

available for completion from June to December 2018. Ethics approval for the study was obtained from the Northern B Health and Disability Ethics Committee, reference 17NTB118.

Questionnaire

Criterion variable

Self-rated health status was assessed using the EQ-5D-5L,[13] a short questionnaire asking about the respondent's health across five dimensions: mobility, self-care, usual activities, pain or discomfort and anxiety or depression, with response options ranging from (e.g.) 'no problems', to 'extreme problems'. For each dimension, participants were categorised as having 'any problems' if they selected any response other than 'no problems'.

Additionally, the EQ-5D-5L visual analogue scale (EQ-VAS) asks the respondent to mark on a vertical visual analogue scale (VAS) how good or bad their health is today, where the endpoints are labelled 'the best health you can imagine' (score of 100) and 'the worst health you can imagine' (score of 0).

Independent variables

Demographic characteristics included age, sex, ethnicity, service years, and past deployment on operational service (yes/no). Ethnicity prioritisation was adopted,[14] whereby participants with multiple responses were assigned to one of the categories, in the order of Māori, Pacific Peoples, Other and European.

General psychiatric morbidity was assessed using the 12-item General Health Questionnaire (GHQ-12),[15] scored using a four point scale (0-3) and summing the 12 items to give a total score, with higher scores indicating elevated distress.

Social support was measured using the Social Provisions Scale,[16] with responses made on a four-point Likert-type scale ranging from 1 'strongly disagree' to 4 'strongly agree'. The 24 items can be reduced to six subscales (attachment, social integration, reassurance of worth, reliable alliance, social guidance, opportunity for nurturance) or summed to create a total score, with greater scores indicating greater social support.

Alcohol use was measured using the AUDIT-C,[17] scaled from 0-12. A score of 3+ for women and 4+ for men indicated potentially hazardous drinking behaviour.

Sleep quality was assessed with the Sleep Condition Indicator (SCI), [18] assessing insomnia as described in the Diagnostic and Statistical Manual of Mental Disorders version 5 (DSM-V).[19] The SCI consists of eight items rated from 0-4, the total scores being scaled to a range of 0 to 10, where higher scores represent better sleep.

Trauma exposure was assessed with the Brief Trauma Scale (BTS),[20] which captures past exposure to situations that were life threating or capable of producing serious injury.

Psychological flexibility was measured with the 10-item AAQ-II, designed as a measure of effectiveness in a particular mode of behavioural intervention, Acceptance and Commitment Therapy (ACT).[21] Items were answered on a 7-point scale, with options ranging from 'never true' to 'always true'. The items were summed to obtain a total score (possible range 10 to 70), with higher scores indicative of greater psychological flexibility.

Statistical analyses

With respect to the calculation of summed scores, if only one item was missing for a particular measure then this was imputed with the mean of the remaining items; if more than one item was missing then the score was set to missing for that participant. Complete case analysis was used in the remaining analyses. The five dimensions of the EQ-5D-5L were compared to the NZ population normative values.[22]

Z tests were used to compare the EQ5D dimension scores with those of the New Zealand general population.[22] Univariate ordinary least-squares linear regression analyses assessed the strength of relationships between each independent variable and EQ-VAS scores, using robust standard errors to account for heteroscedasticity and calculating 95% confidence intervals (95% CIs). Multivariable linear regression was then used to identify the role of the independent variables while adjusting for each other. None of the social support sub-scales were used in this multivariable model, instead using the social support total score. The model was built using backward variable selection with $p<0.10$ for variable retention, with the exceptions of age, sex, service years, and deployment status which were retained as adjusting variables irrespective of p-values.

RESULTS

The EQ-5D was completed by 1767 Veterans, 1009 who were serving (26% of that group), 458 who had retired, 288 who had not deployed, and 21 who did not provide deployment data. There are no reliable denominator data on retired and non-deployed Veterans in New Zealand.

A supplementary table presents the EQ-VAS score according to the sample characteristics.

Figure 1 shows the proportion of EQ-5D-5L dimension responses reporting 'any problem' severity level other than 'no problems' in comparison to the New Zealand population normative values,[22] with table 1 showing the 95% CI's and Z values.

Figure 1 about here

Table 1, Proportion of 'any problem' in EQ-5D domains

Domain	Veterans	NZ population	Z value (p)
	Proportion (95% CI)	Proportion (95% CI)	
Mobility	0.40 (0.38-0.42)	0.28 (0.26-0.30)	8.5 (<.0001)
Self-care	0.11 (0.10-0.12)	0.09 (0.07-0.10)	2.8 (0.03)
Usual activities	0.38 (0.36-0.40)	0.30 (0.28-0.31)	5.6 (<.001)
Pain/discomfort	0.75 (0.73-0.76)	0.62 (0.60-0.63)	9.0 (<.0001)
Anxiety/depression	0.46 (0.44-0.48)	0.46 (0.44-0.48)	0 (1)

The results of the univariate analysis are displayed in Table 2. Here, for continuous characteristics, the regression coefficient (*ß*) represents the change in the mean EQ-VAS associated with one unit increase in the characteristic. For categorical characteristics, *ß* is the change in mean EQ-VAS scores compared to the referent category.

Table 2: Univariate cross-sectional associations between variables and mean EQ-VAS scores for New Zealand Veterans (N=1,762)

Characteristic	*n*	*ß*	95% CIs	*p*-value
Age*	1762	-0.19	[-0.24, -0.13]	<.01
Sex				
Female	220	Reference	-	
Male	1520	-0.65	[-3.04, 1.73]	.59
Ethnicity				
NZ European	1382	Reference	-	
Māori	245	1.21	[-1.00, 3.42]	
Other	140	-2.95	[-6.26, 0.36]	0.10
Service years*	1670	0.19	[0.11, 0.27]	<.01
Deployment status				
Not deployed	288	Reference	-	
Deployed	1458	5.80	[3.35, 8.25]	<.01
GHQ-12 score*	1765	-1.63	[-1.79, -1.47]	<.01
Social support*				
Attachment	1760	2.02	[1.69, 2.34]	<.01
Social integration	1758	2.45	[2.06, 2.88]	<.01
Reassurance of worth	1756	2.48	[2.11, 2.85]	<.01
Reliable alliance	1760	2.30	[1.91, 2.70]	<.01
Social guidance	1760	2.00	[1.65, 2.35]	<.01
Opportunity for nurturance	1758	0.85	[0.47, 1.23]	<.01
Social support total score	1753	0.52	[0.44, 0.59]	<.01
Psychological flexibility*	1750	0.79	[0.71, 0.87]	<.01
Sleep score*	1747	3.47	[3.11, 3.83]	<.01
AUDIT-C	1691			
Non-hazardous		Reference	-	
Hazardous		0.62	[-1.03, 2.26]	0.46
Exposure to traumatic events	1754			
Not exposed		Reference	-	
Exposed		-5.72	[-7.34, -4.11]	<.01

*Scored as continuous variables, coefficient is per unit increase.

Of the demographic variables, age was associated with lower EQ-VAS scores, length of service with higher scores. No relationships were apparent for sex or ethnicity. Positive coefficients, indicating better health with presence of the characteristic, were present for dichotomous variables of deployment, where the mean EQ-VAS score for deployed Veterans was 5.8 VAS units higher (better) than for non-deployed. The largest negative associations were for exposure to traumatic events, with a mean EQ-VAS score 5.7 lower for those exposed compared to those not exposed. Distress, as measured by the GHQ-12, had a negative association with health state. Positive associations with health state were found for

psychological flexibility as measured by the AAQ-II, better sleep scores, the total support scores and the individual dimensions.

Table 3 shows the results from two models. The first model is adjusted for the other characteristics, with 11 variables and 1,557 people providing valid responses for all factors included in the model. All effect sizes were reduced, and the social support and AUDIT-C scores were no longer associated, with 11 variables explaining 35% of the variability in the EQ-VAS.

The final model involved backward variable selection setting a p-value of 0.10, identifying a smaller subset of variables. Age, sex, service years, and deployment status were retained in the model irrespective of their p-values, thus adjusting for those variables, using 1,600 complete responses. Social support and AUDIT-C hazardous drinking were not retained in this final model; other coefficients remaining essentially the same, with a minimal effect on the overall R^2.

Table 3. Multivariable models of associations between variables and mean EQ-VAS scores for New Zealand Veterans

	Adjusted model, N used =1,557			Final model, N used =1,600		
Characteristic	**ß**	**95% CI**	***p*-value**	**ß**	**95% CI**	***p*-value**
Age (years)*	0.17	[-0.23, 1.11]	<0.01	-0.17	[-0.23, -0.12]	<0.01
Sex						
Female	**Ref**	-	-	**Ref**	-	-
Male	0.24	[-2.52, 2.03]	0.84	-0.60	[-2.82, 1.63]	0.60
Ethnicity						
NZ European	**Ref**	-	-	**Ref**	-	-
Māori	0.29	[-1.70, 2.27]	0.07	0.19	[-1.77, 2.14]	-
Other	-3.58	[-6.66, -0.51]		-2.91	[-5.88, 0.06]	0.15
Service years*	0.17	[0.10, 0.25]	<0.01	0.17	[0.10, 0.25]	<0.01
Deployment status						
Not deployed	**Ref**	-	-	**Ref**	-	
Deployed	2.91	[0.64, 5.18]	<0.05	2.90	[0.65, 5.15]	0.01
GHQ12 score*	-0.87	[-1.09, -0.65]	<0.01	-0.92	[-1.13, -0.71]	<0.01
Social support (SPS score)*	0.01	[-0.07, 0.10]	0.76	-	-	-
Psychological flexibility score (AAQii)*	0.26	[0.15, 0.37]	<0.01	0.24	[0.14, 0.35]	<0.01
Sleep score (SCI), Range 0-10*	1.60	[1.18, 2.02]	<0.01	1.63	[1.22, 2.05]	<0.01
AUDIT_C score						
Non hazardous	**Ref**	-	-	-	-	-
Hazardous	0.41	[-1.00, 1.81]	0.57	-	-	-
Exposure to traumatic events (BTQ)						
Not exposed	**Ref**	-	-	**Ref**	-	-
Exposed	-1.77	[-3.30, -0.24]	<0.05	-1.81	[-3.32, 0.30]	0.02
			$R^2 = 0.35$			$R^2 = 0.36$

*Scored as continuous variables, coefficient is per unit increase.

DISCUSSION

Principal findings

With the exception of anxiety or depression, Veterans had a significantly greater proportion of 'any problem' responses in the EQ-5D dimensions than the general population of New Zealand.

The final model identified variables independently associated with the EQ-VAS score: age, length of service, deployment, the GHQ score, psychological flexibility, the sleep score and exposure to traumatic events. The results make conceptual sense in that distress is associated with reduced EQ-VAS and psychological flexibility with a modest protective effect, however, and unusually, Social Support was dropped, however the SPS was found to have a significant correlation with distress, and collinearity was the problem. There are also known to be many

other influences on health, including 'social wellbeing',[5] financial status, personality and non-deployment related stressors,[23] which we have not measured.

Strengths and weaknesses

Strengths of our study were the relatively large sample size, the inclusion of all Veterans, the assessment of 'health', infrequently investigated in Veteran populations, and the inclusion of New Zealand Veterans with a range of characteristics, including 'deployed' and 'non-deployed' Veterans. As a measure of health, the EQ-5D-5L dimensions and EQ-VAS ask about health on the day that respondents complete the questionnaire, the EQ-VAS end points being, respectively, the 'best' and 'worst' health they can imagine, so it is a holistic measure of health state.[24]

The response rate of 26% from serving Veterans, along with the unknown total number of Veterans, raises the question of bias, the direction of which is difficult to assess, as responses may be more likely from either Veterans with good or poor health. The healthy soldier effect is well known, service having a positive effect on wellbeing, with serving NZ Veterans having good access to primary health care through the military system, but the public health care system is the primary pathway to care for all Veterans, who are also covered by the 'no fault' accident compensation scheme for accidental injuries and occupational diseases.[25] Deployed Veterans may be at an advantage, but are covered by NZVA only if their illness or injury is linked to a particular deployment, and the condition is listed on the 'Statements of Principle' of the Australian Repatriation Medical Authority.[26] We also know that New Veterans tend to be stoic, so they might underestimate their health concerns,[27] and there are likely to be other personal characteristics that we have not measured. We were however able to adjust for deployment status, which did have a positive association with health state. In the interest of minimising responder burden, we used brief scales, which might reduce construct validity. Distress, sleep, psychological flexibility and exposure to traumatic events are likely to be related, so collinearity was difficult to avoid. The confounding effect was greatest for social support, but our finding does not mean that social support is of no importance to Veterans. The precision of the other coefficients may also have been affected. Finally, the cross-sectional design means that we cannot explore cause and effect, so recommendations for future interventions require additional support from longitudinal studies.

Comparison with other studies

We have previously reported factors associated with post-traumatic stress in this group,[28] using the Military Post Traumatic Stress Checklist (PCL-M). Factors associated with higher PCL-M scores were trauma exposure, older age, male gender, and being of Māori ethnicity. Factors associated with lower PCL-M scores were greater length of service, psychological flexibility, and better quality sleep. Using health as the outcome disclosed that Māori did not have poorer self-reported health compared to non-Māori, that deployment had a positive effect, and in the univariate models, all of the dimensions of social support were associated with improved health. The final model also included good sleep and psychological flexibility, providing most of the explanatory power in the model.

No other studies appear to have used the EQ-VAS as an outcome measure for Veteran health. Boehmer et al.[29] examined wellbeing among participants in the 2000 Behavioural Risk Factor Surveillance System describing health-related quality of life (HRQoL) by sex and military status, active duty, reservists Veterans, or no military service. Participants were asked to rate recent physical health, mental health, and activity limitation. Active duty men were more likely than men without military service to report 14 or more days of activity limitation, pain, and not enough rest in the past 30 days, the mobility and pain findings being similar to our sample. Notably, the predominant reason for medical discharge from the British Armed Forces was musculoskeletal problems.[30]

Contrary to our finding on deployment, there are reports indicating that non-deployed personnel retain better health than those who have been deployed,[31] Diaz Santana et al. having carried out a cross-sectional survey of 60,000 U.S. Veterans of Afghanistan and Iraq, with 20,563 responses. In contrast to our finding, mental quality of life scores were higher among the non-deployed group compared to the deployed group, though the deployed group reported higher physical quality of life scores compared to the non-deployed. Again in contrast, both mental and physical quality of life were lower among Veterans compared to U.S. population norms.

Both positive and negative consequences of deployment have been described.[7,32] In a study of Dutch Veterans,[7] two out of three reported a positive effect of deployment on their quality of life at the time of the survey, this being related to positive feelings such as satisfaction or comradeship, but a few having emotions such as frustration or shame. As regards tangible effects,[32] negative consequences included the military 'chain of command', being away from home, and deterioration of marital/significant other relationships. Positive influences include improved financial security, self-improvement, and time to reflect.

We found sleep to be associated with better health, but sleep difficulties are a common symptom for those with PTSD. McCarthy et al.[33] reported on the 3,157 U.S. military Veterans enrolled in the National Health and Resilience in Veterans Study, in which 27.6% reported poor sleep quality. Path analyses revealed significant associations between poor sleep, severity of PTSD, poorer mental and physical health functioning and lower overall quality of life.

Future directions

The results suggest that distress, psychological flexibility, and sleep have an important relationship with self-rated health among Veterans in this study.

Reducing distress through the promotion of psychological flexibility might be possible, although our finding here must be subject to caution as several researchers argue that the AAQ-II may be measuring psychological distress and affect rather than psychological inflexibility.[34] Psychological flexibility is specifically targeted by ACT, a psychological intervention described as being in the 'third wave' of behaviour change strategies.[35] The six core processes of ACT (acceptance, cognitive defusion, being present, self as context, values, and committed action) aim to increase psychological flexibility, the goal being "to have clients experience the world more directly so that their behavior is more flexible and thus their actions more consistent with the values that they hold."[35] Approaches such as ACT may therefore improve health state and has been shown to improve pain acceptance and psychological flexibility [36]. Lang et al. carried out a randomised clinical trial (RCT), comparing ACT with person-centred therapy,[37] showing a general improvement in symptoms of distress across both treatment arms, ACT providing superior improvement in insomnia. The drop-out rate for both therapies was however high, and the two groups did not exhibit any change in psychological flexibility. The authors proposed that future studies should include additional measures of ACT processes to determine which are actually affected by ACT.

Sleep in military personnel has been recognised as a 'vital health behaviour' for which policies and guidelines must be developed.[38] Cognitive behavioural therapy for insomnia (CBT-I) is regarded as an effective 'first line' treatment, and a brief intervention has been described for use in Australian general practice.[39] The Lang et al. trial[37] showed CBT-I to be effective, however future studies should include outcome measures that include ACT processes. Our final model showed that distress had a negative association with health, and psychological flexibility had a positive relationship, with sleep most likely related to both of these variables. It would seem important to screen for these conditions prior to transition from the military,

as well as among retired Veterans, in order to provide targeted support. Further research is needed to examine the potential of CBT to improve Veterans' wellbeing.

Figure 1 Caption.

The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions

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DATA SHARING STATEMENT

Data from this study is unsuitable for public deposition due to the privacy of participant data. Data are anonymised, but contain information on deployments (including location and duration), which could lead to some participants being identified. Furthermore, the participant information sheet, as required by the Southern Health and Disability Ethics Committee specifically contains the statement that 'all study data would be kept strictly confidential to the research team.' Qualified researchers may apply for data access with the research team at veterans.health@otago.ac.nz and/or hdecs@moh.govt.nz.

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COMPETING INTERESTS

None declared.

CONTRIBUTION

Investigation: Amy Richardson, Emma H. Wyeth, Sarah Derrett, Daniel Shepherd, David McBride.

Methodology: Amy Richardson, Ari Samaranayaka, Dianne Gardner, Emma H. Wyeth, Sarah Derrett, David McBride. Daniel Shepherd

Project administration: Amy Richardson

Resources: Brandon de Graaf

Software: Brandon de Graaf

Supervision: Ari Samaranayaka

Validation: Amy Richardson

Visualization: Amy Richardson

Writing – original draft: David McBride. AS, DG, EHW, SD and DS contributed to the re-writes and final draft

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The Psychological and Physical Health and Wellbeing of New Zealand Current and Former Service Personnel

We are researchers from the University of Otago, Massey University and AUT, and we are interested in learning more about ways to help current and former New Zealand service personnel maintain their wellbeing. While many personnel do very well during and after their deployment experiences, some can struggle with physical and mental health problems. We would like to know more about how to help identify when personnel might need extra support.

For this study, we would like to invite you to fill out a questionnaire, which will take about 45 minutes. Participation is completely voluntary and you may withdraw from the study at any time without any risk or disadvantage to you. You are under no obligation to answer all questions presented in it. You may skip any questions that you do not want to answer. All information will be kept confidential, and no material that could identify you will be used in any report on this study.

Please note that the survey is unclassified, and that all information and any comments are at the unclassified level. This survey is being conducted in compliance with DFO 3.14[5] Authority to Conduct Personnel Research.

If you would like more information, please contact David McBride on either 03 479 7208 or 027 253 5451.

Associate Professor David McBride
Preventive and Social Medicine, University of Otago
Phone: 027 253 5451
Email: david.mcbride@otago.ac.nz

David is a LtCol in the RNZAMC and a reservist, but is carrying out this project in his University capacity. The NZDF will not have access to the data.

Other team members: Associate Professor Brian Cox, brian.cox@otago.ac.nz; Dr Emma Wyeth, emma.wyeth@otago.ac.nz; Professor Sarah Derrett, sarah.derrett@otago.ac.nz; Dr Gagan Gurung, gagan.gurung@otago.ac.nz; Dr Amy Richardson, amy.richardson@otago.ac.nz; Dr Dianne Gardner, D.H.Gardner@massey.ac.nz; Dr Shane Harvey, S.T.Harvey@massey.ac.nz; Dr Daniel Shepherd, Daniel.shepherd@aut.ac.nz; Brandon de Graaf, brandon.degraaf@otago.ac.nz

This study is being carried out with the support of Lottery Health and the War Pensions Medical Research Trust Fund. The study has received ethical approval from the Northern B Health and Disability Ethics Committee.

Instructions for completing this survey:

- Please use Black or Blue pen only to complete this survey
- When completing Alpha Numeric data collection boxes for optimum accuracy, please print in captial letters and use the number formats and avoid contact with the edge of the box.

A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

0	1	2	3	4	5	6	7	8	9

- When completing a choice question please colour-in the whole circle.

○ 1 ○ 2 ○ 3 ● 4

- If an error is found after a question has been answered please colour-in the correct answer and place a tick next to the correct answer circle.

○ 1 ● 2 ○ 3 ● 4 ✓

- The free text line is a single line for text entry only and will only accomodate text to the size of the line. Any other comments or written information placed anywhere else will be ignored and not captured

SECTION A: PERSONAL DETAILS

ID No ☐☐☐☐

1. Are you male or female? ○ Male ○ Female

2. What is your date of birth? ☐☐ / ☐☐ / ☐☐☐☐
day month year

3. Which ethnic group or groups do you belong to ?

○ New Zealand European

○ New Zealand Māori

○ Other (please specify) _____

4. What is your service number? ☐☐☐☐☐☐☐☐

SECTION B: JOB HISTORY

1. With which branch of the NZDF did you serve?

○ Navy

○ Army

○ Airforce

2. What year did you first join the NZDF? ☐☐☐☐
year

3. Are you still a serving member of the NZDF ? ○ Yes ○ No

4. How many years did you serve? ☐☐

5. What is your current rank or what was your rank when you left the NZDF?

_____

SECTION C: HEALTH AND WELLBEING

ID No

C1. HEALTH AND WELLBEING: RECENT HEALTH SYMPTOMS AND MULTI SYMPTOMS ILLNESS

We would like to know about your health in the last six months.

Please indicate whether or not you have suffered any of the following symptoms in the last six months, and if so, please indicate whether your symptoms were mild, moderate, or severe in nature.

Please don't spend too long thinking about each symptom, just provide the first response that comes to mind.

Symptoms: Have you experienced *Please colour in the circle if you have this symptom*	**Are the symptoms** *Choose one and colour the circle*	**How long have you had the symptom?** *Choose one and colour the circle*
Loss of concentration ○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Feeling distant from others ○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Unrefreshed after sleep ○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Forgetfulness ○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Loss of interest in sex ○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Problems with sexual functioning ○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Sleeping difficulties ○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Avoiding doing things or situations ○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months

ID No

Symptoms: Have you experienced *Please colour in the circle if you have this symptom*		**Are the symptoms** *Choose one and colour the circle*	**How long have you had the symptom?** *Choose one and colour the circle*
Fatigue	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Irritability / Outbursts of anger	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Distressing dreams	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Feeling jumpy / easily startled	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Difficulty finding the right word	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Increased sensitivity to noise	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Alcohol intolerance	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Passing urine more often	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Shaking	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Difficulty speaking	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months

ID No

Symptoms: Have you experienced *Please colour in the circle if you have this symptom*		Are the symptoms *Choose one and colour the circle*	How long have you had the symptom? *Choose one and colour the circle*
Night sweats	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Increased sensitivity to smell	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Loss of or decrease in appetite	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Headaches	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Dizziness or blackouts	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Increased sensitivity to light	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Loss of balance or coordination	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Ringing ears	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Flatulence or burping	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Itchy or painful eyes	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months

ID No

Symptoms: Have you experienced *Please colour in the circle if you have this symptom*		Are the symptoms *Choose one and colour the circle*	How long have you had the symptom? *Choose one and colour the circle*
Double vision	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Loss of sensation in hands / feet	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Constipation	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Persistent cough	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Unintended weight gain >4Kg	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Rapid or pounding heartbeat	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Tingling or burning sensation in hands / feet	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Dry mouth	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Pain in several joints (no swelling or redness)	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Rash or skin irritation	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months

ID No

Symptoms: Have you experienced *Please colour in the circle if you have this symptom*		Are the symptoms *Choose one and colour the circle*	How long have you had the symptom? *Choose one and colour the circle*
Diarrhoea	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Low back pain	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Skin infections	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Mouth ulcers	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Chest pain	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Toothache	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Stomach cramps	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Nausea	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Stiffness in several joints	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Indigestion	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months

ID No

Symptoms: Have you experienced *Please colour in the circle if you have this symptom*		**Are the symptoms** *Choose one and colour the circle*	**How long have you had the symptom?** *Choose one and colour the circle*
Muscle aches or pains	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Wheezing	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Feeling feverish	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Tender / Painful swelling of lymph glands	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Shortness of breath	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months
Sore throat	○	○ Mild ○ Moderate ○ Severe	○ Less than 6 months ○ More than 6 months

ID No

C2. HEALTH AND WELLBEING: POST-TRAUMATIC STRESS

Below is a list of problems and complaints that people sometimes have in response to stressful life experiences. Please read each one carefully, then colour in the circle that indicates how much you have been bothered by that problem in the past month.

	Not at all	A litle bit	Moderately	Quite a bit	Extremely
1. Repeated, disturbing memories, thoughts, or images of a stressful military experience?	○	○	○	○	○
2. Repeated, disturbing dreams of a stressful military experience?	○	○	○	○	○
3. Suddenly acting or feeling as if a stressful military experience were happening again (as if you were reliving it)?	○	○	○	○	○
4. Feeling very upset when something reminded you of a stressful military experience?	○	○	○	○	○
5. Having physical reactions (e.g., heart pounding, trouble breathing, or sweating) when something reminded you of a stressful military experience?	○	○	○	○	○
6. Avoiding thinking about or talking about a stressful military experience or avoiding having feelings related to it?	○	○	○	○	○
7. Avoiding activities or situations becuse they reminded you of a stressful military experience?	○	○	○	○	○
8. Trouble remembering important parts of a stressful military experience?	○	○	○	○	○
9. Loss of interest in things that you used to enjoy?	○	○	○	○	○
10. Feeling distant or cut off from other people?	○	○	○	○	○
11. Feeling emotionally numb or being unable to have loving feelings for those close to you?	○	○	○	○	○
12. Feeling as if your future will somehow be cut short?	○	○	○	○	○
13. Trouble falling or staying asleep?	○	○	○	○	○

ID No

	Not at all	A litle bit	Moderately	Quite a bit	Extremely
14. Feeling irritable or having angry outbursts?	○	○	○	○	○
15. Having difficulty concentrating?	○	○	○	○	○
16. Being "super alert" or watchful on guard?	○	○	○	○	○
17. Feeling jumpy or easily startled?	○	○	○	○	○

C3. HEALTH AND WELLBEING: SOCIAL SUPPORT

Please indicate to what extent each statement describes your current relationships with other people. So, for example, if you feel a statement is very true of your current relationships, you would respond with a strongly agree. If you feel a statement clearly does not describe your relationships, you would respond with a strongly disagree.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. There are people I can depend on to help me if I really need it.	○	○	○	○
2. I feel that I do not have close personal relationships with other people.	○	○	○	○
3. There is no one I can turn to for guidance in times of stress.	○	○	○	○
4. There are people who depend on me for help.	○	○	○	○
5. There are people who enjoy the same social activities I do.	○	○	○	○
6. Other people do not view me as competent.	○	○	○	○
7. I feel personally responsible for the well-being of another person.	○	○	○	○
8. I feel part of a group of people who share my attitudes and beliefs.	○	○	○	○
9. I do not think other people respect my skills and abilities.	○	○	○	○
10. If something went wrong, no one would come to my assistance.	○	○	○	○
11. I have close relationships that provide me with a sense of emotional security and well-being.	○	○	○	○

ID No

	Strongly Disagree	Disagre	Agree	Strongly Agree
12. There is someone I could talk to about important decisions in my life.	○	○	○	○
13. I have realationships where my competence and skill are recognized.	○	○	○	○
14. There is no one who shares my interests and concerns.	○	○	○	○
15. There is no one who really relies on me for their well-being.	○	○	○	○
16. There is a trustworthy person I could turn to for advice if I were having problems.	○	○	○	○
17. I feel a strong emotional bond with at least one other person.	○	○	○	○
18. There is no one I can depend on for aid if I really need it.	○	○	○	○
19. There is no one I feel comfortable talking about problems with.	○	○	○	○
20. There are people who admire my talents and abilities.	○	○	○	○
21. I lack a feeling of intimacy with another person.	○	○	○	○
22. There is no one who likes to do the things I do.	○	○	○	○
23. There are people who I can count on in an emergency.	○	○	○	○
24. No one needs me to care for them.	○	○	○	○

ID No

C4. HEALTH AND WELLBEING: PSYCHOLOGICAL FLEXIBILITY AND COPING

Below you will find a list of statements. Please rate how true each statement is for you by colouring the appropriate circle.

	Never True	Very Seldom True	Seldom True	Sometimes True	Frequently True	Almost Always True	Always True
1. It's OK if I remember something unpleasant.	○	○	○	○	○	○	○
2. My painful experiences and memories make it difficult for me to live a life that I would value.	○	○	○	○	○	○	○
3. I'm afraid of my feelings.	○	○	○	○	○	○	○
4. I worry about not being able to control my worries and feelings.	○	○	○	○	○	○	○
5. My painful memories prevent me from having a fulfilling life.	○	○	○	○	○	○	○
6. I am in control of my life.	○	○	○	○	○	○	○
7. Emotions cause problems in my life.	○	○	○	○	○	○	○
8. It sems like most people are handling their lives better than I am.	○	○	○	○	○	○	○
9. Worries get in the way of my success.	○	○	○	○	○	○	○
10. My thoughts and feelings get in the way of how I want to live my life.	○	○	○	○	○	○	○

ID No

C5. HEALTH AND WELLBEING: GENERAL HEALTH

We would like to know how you have been feeling over the past few weeks.

Please colour in the circle that most closely describes your experience in each question.

Have you recently?

	Better than usual	Same as usual	Less than usual	Much less than usual
1. Been able to concentrate on what you're doing?	○	○	○	○

	Not at all	No more than usual	Rather more than usual	Much more than usual
2. Lost much sleep over worry?	○	○	○	○

	More so than usual	Same as usual	Less useful than usual	Much less useful
3. Felt you were playing a useful part in things?	○	○	○	○

	More so than usual	Same as usual	Less so than usual	Much less capable
4. Felt capable of making decisions about things?	○	○	○	○

	Not at all	No more than usual	Rather more than usual	Much more than usual
5. Felt constantly under strain?	○	○	○	○

	Not at all	No more than usual	Rather more than usual	Much more than usual
6. Felt you couldn't overcome your difficulties?	○	○	○	○

	More so than usual	Same as usual	Less so than usual	Much less than usual
7. Been able to enjoy your normal day-to-day activities?	○	○	○	○

	More so than usual	Same as usual	Less so than usual	Much less able
8. Been able to face up to your problems?	○	○	○	○

ID No

	Not at all	No more than usual	Rather more than usual	Much more than usual
9. Been feeling unhappy and depressed?	○	○	○	○
10. Been losing confidence in yourself?	○	○	○	○
11. Been thinking of yourself as a worthless person?	○	○	○	○

	More so than usual	About same as usual	Less so than usual	Much less than usual
12. Been feeling reasonably happy, all things considered?	○	○	○	○

C6. HEALTH AND WELLBEING: GENERAL HEALTH

Under each heading, please colour in the **ONE** circle that best describes your health **TODAY.**

INTELLECTUAL ACTIVITIES

○ I have no problems with intellectual activities

○ I have slight problems with intellectual activities

○ I have moderate problems with intellectual activities

○ I have severe problems with intellectual activities

○ I am unable to perform intellectual activities

ID No

C6. HEALTH AND WELLBEING: GENERAL HEALTH

Under each heading, please colour in the **ONE** circle that best describes your health **TODAY.**

MOBILITY

- ○ I have no problems in walking about
- ○ I have slight problems in walking about
- ○ I have moderate problems in walking about
- ○ I have severe problems in walking about
- ○ I am unable to walk about

SELFT-CARE

- ○ I have no problems washing or dressing myself
- ○ I have slight problems washing or dressing myself
- ○ I have moderate problems washing or dressing myself
- ○ I have severe problems washing or dressing myself
- ○ I am unable to wash or dress myself

USUAL ACTIVITIES *(e.g. work, study, housework, family or leisure activites)*

- ○ I have no problems doing my usual activities
- ○ I have slight problems doing my usual activities
- ○ I have moderate problems doing my usual activities
- ○ I have severe problems doing my usual activites
- ○ I am unable to do my usual activities

ID No

PAIN / DISCOMFORT

- ○ I have no pain or discomfort
- ○ I have slight pain or discomfort
- ○ I have moderate pain or discomfort
- ○ I have severe pain or discomfort
- ○ I have extreme pain or discomfort

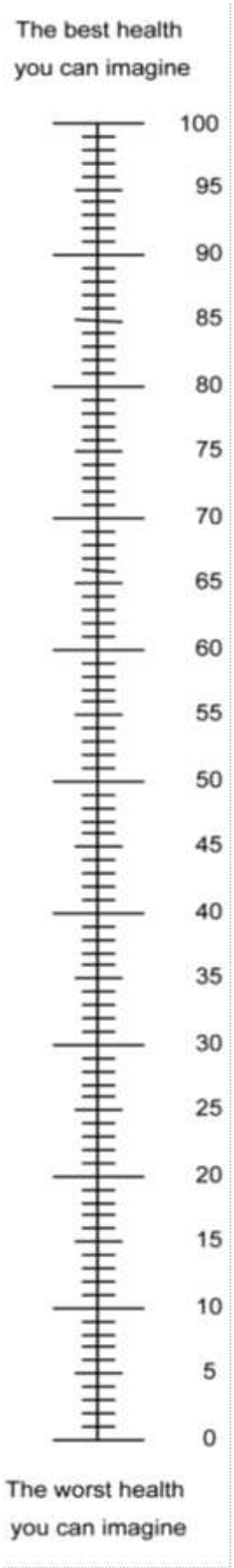
ANXIETY / DEPRESSION

- ○ I am not anxious or depressed
- ○ I am slightly anxious or depressed
- ○ I am moderately anxious or depressed
- ○ I am severely anxious or depressed
- ○ I am extremely anxious or depressed

ID No

- We would like to know how good or bad your health is TODAY.
- This scale is numbered from 0 to 100.
- 100 means the best health you can imagine.
- 0 means the worst health you can imagine.
- Mark an X on the scale to indicate how your health is TODAY.
- Now, please write the number you marked on the scale in the box below

YOUR HEALTH TODAY =



ID No

C7. HEALTH AND WELLBEING: SLEEP CONDITION

The following questions relate to your usual sleep condition during the past month only.
For each of the questions, colour in the one best response. Please answer all questions.

Thinking about a typical night in the last month ...

1. How long does it take you to fall asleep?

- ○ 0 - 15 minutes
- ○ 16 - 30 minutes
- ○ 31 - 45 minutes
- ○ 46 - 60 minutes
- ○ ≥ 61 minutes

2. If you then wake up during the night **...** how long are you awake for in total? (add all the wakenings up)

- ○ 0 - 15 minutes
- ○ 16 - 30 minutes
- ○ 31 - 45 minutes
- ○ 46 - 60 minutes
- ○ ≥ 61 minutes

3. How many nights a week do you have a problem with your sleep?

- ○ 0 - 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 - 7

4. How would you rate your sleep quality?

- ○ Very good
- ○ Good
- ○ Average
- ○ Poor
- ○ Very poor

ID No

Thinking about the past month, to what extent has poor sleep . . .

5. Affected your mood, energy, or relationships?

- ○ Not at all
- ○ A little
- ○ Somewhat
- ○ Much
- ○ Very much

6. Affected your concentration, productivity, or ability to stay awake?

- ○ Not at all
- ○ A little
- ○ Somewhat
- ○ Much
- ○ Very much

7. Troubles you in general?

- ○ Not at all
- ○ A little
- ○ Somewhat
- ○ Much
- ○ Very much

Finally . . .

8. How long have you had a problem with your sleep?

- ○ I don't have a problem / < 1 mo
- ○ 1 - 2 mo
- ○ 3 - 6 mo
- ○ 7 - 12 mo
- ○ > 1 year

ID No

C8. HEALTH AND WELLBEING: ALCOHOL AND DRUG USE

Because alcohol use can affect your health and can interfere with certain medications and treatments, it is important that we ask some questions about your use of alcohol. Your answers will remain confidential so please be honest.

Please colour in **one** circle that best describes your answer to each question.

1. How often do you have a drink containing alcohol?

- ○ Never
- ○ Monthly or less
- ○ 2 - 4 times a month
- ○ 2 - 3 times a week
- ○ 4 or more times a week

2. How many standard drinks containing alcohol do you have on a typical day?

- ○ 1 or 2
- ○ 3 or 4
- ○ 5 or 6
- ○ 7, 8 to 9
- ○ 10 or more

3. How often do you have six or more drinks on one occasion?

- ○ Never
- ○ Less than monthly
- ○ Monthly
- ○ Weekly
- ○ Daily or almost daily

ID No

C9. HEALTH AND WELLBEING: TRAUMATIC EXPOSURE

The following questions ask about events that may be extraordinarily stressful or disturbing for almost everyone. Please colour in the "Yes" or "No" circle to report what has happened to you.

If you answer "Yes" for an event, please answer any additional questions that are listed on the right side of the page to report: (1) whether you thought your life was in danger or you might be seriously injured; and (2) whether you were seriously injured.

If you answer "No" for an event, go on to the next event.

Event	Has this ever happened to you?	If the event happened, did you think your life was in danger or you might be seriously injured?	If the event happened, were you seriously injured?
1. Have you ever served in a war zone, or have you ever served in a noncombat job that exposed you to war-related casualties (for example, as a medic or on graves registration duty)?	○ No ○ Yes	If Yes, → ○ No ○ Yes	○ No ○ Yes
2. Have you ever been in a serious car accident, or a serious accident at work or somewhere else?	○ No ○ Yes	If Yes, → ○ No ○ Yes	○ No ○ Yes
3. Have you ever been in a major natural or technological disaster, such as fire, tornado, hurricane, flood, earthquake, or chemical spill?	○ No ○ Yes	If Yes, → ○ No ○ Yes	○ No ○ Yes
4. Have you ever had a life-threatening illness such as cancer, a heart attack, leukemia, AIDS, multiple sclerosis, etc?	○ No ○ Yes	If Yes, → ○ No ○ Yes	
5. Before age 18, were you ever physically punished or beaten by a parent, caretaker, or teacher so that: you were very frightened; or you thought you would be injured; or you received bruises, cuts, welts, lumps or other injuries?	○ No ○ Yes	If Yes, → ○ No ○ Yes	○ No ○ Yes
6. Not including any punishments or beatings you already reported in **Question 5**, have you ever been attacked, beaten or mugged by anyone, including friends, family members or strangers?	○ No ○ Yes	If Yes, → ○ No ○ Yes	○ No ○ Yes
7. Has anyone ever made or pressured you into having some type of unwanted sexual contact? **Note:** By sexual contact we mean any contact between someone else and your private parts or between you and someone else's private parts.	○ No ○ Yes	If Yes, → ○ No ○ Yes	○ No ○ Yes

ID No

The following questions ask about events that may be extraordinarily stressful or disturbing for almost everyone. Please colour in the "Yes" or "No" circle to report what has happened to you.

If you answer "Yes" for an event, please answer any additional questions that are listed on the right side of the page to report: (1) whether you thought your life was in danger or you might be seriously injured; and (2) whether you were seriously injured.

If you answer "No" for an event, go on to the next event.

Event	Has this ever happened to you?	If the event happened, did you think your life was in danger or you might be seriously injured?	If the event happened, were you seriously injured?
8. Have you ever been in any other situation in which you were seriously injured, or have you ever been in any other situation in which you feared you might be seriously injured or killed?	○ No ○ Yes	*If Yes,* →	○ No ○ Yes
9. Has a close family member or friend died violently, for example, in a serious car crash, mugging, or attack?	○ No ○ Yes	*If Yes,* →	○ No ○ Yes
10. Have you ever witnessed a situation in which someone was seriously injured or killed, or have you ever witnessed a situation in which you feared someone would be seriously injured or killed? **Note:** Do not answer "**YES**" for any event you already reported in **Questions 1-9**.	○ No ○ Yes		

ID No

SECTION D: DEPLOYMENTS

D1. Have you been on active deployment (war or peacekeeping)? This doesn't include training exercises or goodwill visits (flying the flag).

○ Yes

○ No ***If No, then GO TO SECTION E***

D2. In the table below please write where you were actively deployed and the year in which you were deployed. Remember that this doesn't include training exercises or goodwill visits (flying the flag).

	Deployment / mission:	**Year of Deployment:**
1.		
2.		
3.		
4.		
5.		
6.		
7.		

ID No

SECTION E: FINAL PERSONAL DETAILS

1. What is your current marital status?

- ○ Married
- ○ De facto relationship
- ○ Separated
- ○ Divorced
- ○ Widowed
- ○ Single, never married
- ○ Other (please specify)

2. Which category best describes the highest educational qualification you have completed?

- ○ No qualifications
- ○ Secondary school
- ○ University degree or equivalent
- ○ Other post-secondary school qualification

3. What is your current occupation?

- ○ Paid emplyment full-time
- ○ Paid employment part-time / casual
- ○ Volunteer / community work
- ○ Student
- ○ Home duties
- ○ Retired
- ○ Not working
- ○ Unemployed
- ○ Other (please specify)

4. What is your total annual income (before tax)?

- ○ $20,000 or less
- ○ $20,001 - $30,000
- ○ $30,001 - $50,000
- ○ $50,001 - $70,000
- ○ $70,001 - $100,000
- ○ $100,001 or more
- ○ Unsure

Supplementary Table: Number of participants and EQ-VAS scores according to sample characteristics

Exposure variable	N (%)		Mean (SD)
All	1767		74.4 (17.1)
Age group (years)			
20-29	136	(7.7)	77.7 (14.4)
30-39	328	(18.6)	77.0 (16.2)
40-49	438	(24.8)	76.1 (14.6)
50-59	350	(19.8)	74.8 (16.6)
60-69	285	(16.1)	71.4 (19.8)
70-79	175	(9.9)	69.4 (19.4)
80+	50	(2.8)	66.2 (20.3)
Missing	5	(0.3)	61.2 (22.1)
Gender			
Female	220	(12.5)	75.0 (16.9)
Male	1520	(86.0)	74.4 (17.2)
Missing	27	(1.5)	70.3 (17.2)
Ethnicity (prioritised)			
NZ European	1382	(78.2)	74.4 (17.1)
Māori	245	(13.9)	75.6 (16.1)
Other	140	(7.9)	71.5 (19.3)
Service years			
0-9	339	(19.2)	69.9 (19.7)
10-19	478	(27.1)	74.5 (17.9)
20-29	530	(30.0)	75.3 (15.9)
30-39	254	(14.4)	76.3 (14.6)
40+	69	(3.9)	75.4 (16.4)
Missing	97	(5.5)	78.8 (14.2)
Deployment (ever)			
No	288	(16.3)	69.5 (19.9)
Yes	1458	(82.5)	75.3 (16.4)
Missing	21	(1.2)	75.6 (14.6)
GHQ12 Score			
0-9	652	(36.9)	82.0 (12.6)
10-19	972	(55.0)	72.3 (16.0)
20-29	123	(7.0)	54.3 (20.3)
30+	18	(1.0)	46.2 (24.4)
Missing	2	(0.1)	-

*sub-scores not used in multivariable models.

Supplementary table contd.

Social support full score			
24-29	0	0	-
30-39	3	(0.2)	66.7 (15.3)
40-49	15	(0.8)	44.5 (22.5)
50-59	97	(5.5)	62.4 (21.8)
60-69	351	(19.9)	69.0 (18.2)
70-79	643	(36.4)	75.1 (15.0)
80-89	409	(23.1)	78.0 (15.0)
90-96	235	(13.3)	81.9 (13.9)
Missing	14	(0.8)	58.1 (25.6)
Social support sub-scores			
Attachment*			
4-7	51	(3.5)	61.4 (23.4)
8-11	516	(29.2)	68.7 (18.0)
12-16	1193	(67.5)	77.5 (15.5)
Missing	7	(0.4)	61.0 (19.7)
Social integration*			
4-7	20	(1.1)	56.2 (25.1)
8-11	429	(24.3)	67.1 (19.4)
12-16	1309	(74.8)	77.1 (15.2)
Missing	9	(0.5)	58.7 (21.5)
Reassurance of worth*			
4-7	37	(2.1)	59.1 (19.5)
8-11	504	(28.5)	69.0 (19.1)
12-16	1215	(68.8)	77.2 (15.2)
Missing	11	(0.6)	62.0 (24.9)
Reliable Alliance*			
4-7	20	(1.1)	49.6 (22.2)
8-11	251	(14.2)	66.9 (20.1)
12-16	1489	(84.3)	76.0 (15.9)
Missing	7	(0.4)	61.0 (19.7)
Guidance sub-score*			
4-7	36	(2.0)	59.2 (22.2)
8-11	387	(21.9)	68.7 (18.9)
12-16	1337	(75.7)	76.6 (15.7)
Missing	7	(0.4)	54.6 (21.6)
Opportunity for nurturance*			
4-7	29	(1.6)	69.3 (18.9)
8-11	413	(23.4)	71.9 (18.8)
12-16	1316	(74.5)	75.4 (16.4)
Missing	9	(0.5)	58.7 (21.5)

Supplementary table, contd.

Psychological flexibility score (AAQii score).			
10-19	5	(0.3)	23.2 (13.8)
20-29	40	(2.3)	49.1 (22.1)
30-39	147	(8.3)	63.0 (18.6)
40-49	43	(24.7)	68.5 (16.8)
50-59	664	(37.6)	77.1 (13.9)
60-70	457	(25.9)	82.5 (13.5)
Missing	1	(1.0)	69.6 (20.5)
Sleep Condition Indicator (SCI score			
0 to <2	67	(3.8)	51.2 (22.3)
2 to <4	264	(14.9)	62.2 (19.5)
4 to <6	646	(36.6)	74.3 (14.6)
6 to <8	384	(21.7)	77.6 (14.2)
8 to 10	386	(21.8)	83.5 (12.2)
Missing	20	(1.1)	77.3 (12.8)
AUDIT-C score			
Non-hazardous	776	(43.9)	74.0 (17.4)
Hazardous	915	(51.8)	74.6 (16.9)
Missing	76	(4.3)	75.0 (17.0)
Brief Trauma Questionnaire (DSM-IV criteria)			
Not exposed	544	(30.8)	78.3 (15.1)
Exposed	1210	(68.5)	72.5 (17.8)
Missing	13	(0.7)	80.6 (8.1)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	Indicate the study's design with a commonly used term in the title or the abstract. **Yes, a cross sectional study, p1 title.**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **Background, results and conclusions, p 1**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **Introduction p2.**
Objectives	3	State specific objectives, including any prespecified hypotheses **p2, lines 59 and 60**
Methods		
Study design	4	Present key elements of study design early in the paper p**2 line 62 to page 5 line 145**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **Participants, page2 line 63-page 3 line 83.**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants **page 2 line 64 to page 3, line 68.**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **Questionnaire, pp 3-5.**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group **as above**
Bias	9	Describe any efforts to address potential sources of bias **Methods, page 3. Lines 76-83.**
Study size	10	Explain how the study size was arrived at **p5 line 137**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Cases defined through the **Multivariable logistic regression with the EQ-Visual analogue scale as the outcome measure, p5 lines 131-136**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **Backward elimination process p5 lines 134-135**
		(*b*) Describe any methods used to examine subgroups and interactions **By multivariable logistic regression, p5 as above**
		(*c*) Explain how missing data were addressed **p4 lines 122-125**
		(*d*) If applicable, describe analytical methods taking account of sampling strategy N/A
		(*e*) Describe any sensitivity analyses N/A
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **Potentially eligible lines 68-73 p 3**
		(b) Give reasons for non-participation at each stage N/A
		(c) Consider use of a flow diagram N/A

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders **page 5 et seq, table 1**
		(b) Indicate number of participants with missing data for each variable of interest '**n used' columns tables 2 and 3.**
Outcome data	15*	Report numbers of outcome events or summary measures **as per tables**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **Tables, adjusted for age, sex, service years and deployment status.**
		(*b*) Report category boundaries when continuous variables were categorized. **Independent variables, p 3 and 4, EQ-VAS is a continuous scale**.
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period **N/A**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **N/A**
Discussion		
Key results	18	Summarise key results with reference to study objectives **Discussion, p11 first para**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias **Discussion lines 215 et seq.**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence **Discussion, p12 lines 230 et seq.**
Generalisability	21	Discuss the generalisability (external validity) of the study results **p17, line 215 et seq.**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **Funding, p18**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Factors associated with self-reported health among New Zealand military veterans: a cross-sectional study.

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FACTORS ASSOCIATED WITH SELF-REPORTED HEALTH AMONG NEW ZEALAND MILITARY VETERANS: A CROSS-SECTIONAL STUDY

David McBride,[1] Ari Samaranayaka[2], Amy Richardson,[1] Dianne Gardner,[3] Daniel Shepherd,[4] Emma H. Wyeth[5], Brandon deGraaf,[6] Sarah Derrett.[1]

[1]Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[2]Biostatistics Centre, Division of Health Sciences, University of Otago, Dunedin, New Zealand.

[3]School of Psychology, Massey University, New Zealand.

[4]Department of Psychology, Auckland University of Technology, New Zealand.

[5]Ngāi Tahu Māori Health Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[6]Injury Prevention Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

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Corresponding Author:

David McBride, Department of Preventive and Social Medicine, Adams Building, 18 Frederick Street, Dunedin 9017, New Zealand.

Email: david.mcbride@otago.ac.nz

Phone: +64 3 479 7208

Fax +64 3 479 7298

ABSTRACT

Objective

To identify factors associated with better or poorer self-reported health status in New Zealand military Veterans.

Design

A cross-sectional survey.

Participants

The participants of interest were the 3,874 currently serving Veterans who had been deployed to a conflict zone, but all Veterans were eligible to participate.

Study variables

The EQ-5D-5L, asking about problems across five dimensions (mobility, self-care, usual activities, pain or discomfort, and anxiety or depression), with five levels of severity (e.g. no, slight, moderate, severe or extreme problems), also containing a visual analogue scale (EQ-VAS), scaled from 0 (worst) to 100 (best) imagined health, assessed health status. Hypothetical relationships with better health were positive social support, sleep and psychological flexibility; with poorer health, post-traumatic stress, exposure to psychological trauma, distress and hazardous drinking.

Results:

The EQ5-D was completed by 1767 Veterans, 1009 serving, a response rate of 26% from that group, 1767 completing the EQ5-D, 1458 who had deployed, 288 who had not, and the 21 who did not provide deployment data. Of these 247 were not used in the analysis due to missing values in one or more variables, leaving 1,520 for analysis.

A significantly higher proportion of Veterans reported 'any problems' rather than 'no problems' with four EQ-5D dimensions: mobility, self-care, usual activities and pain or discomfort, but no difference in anxiety or depression. Age, length of service, deployment, psychological flexibility and better sleep quality were associated with higher EQ-VAS scores; distress with lower EQ-VAS scores.

Conclusion:

In this sample of New Zealand Veterans, psychological flexibility and good sleep are associated with better self-rated health, and distress and poor sleep with diminished health. These factors might be used as sentinel health indicators in assessing Veteran health status, and cognitive behavioural therapy encompassing these domains may be useful in improving the health of New Zealand Veterans.

Keywords:
Self-rated health, wellbeing, EQ-5D, Veterans, deployment, military, risk factors.

Strengths and limitations of this study

- Many studies of Veterans have focused on adverse outcomes, but we have been able to focus on a holistic measure of 'health'.
- The study was sufficiently powered to detect important relationships indicating opportunities for intervention.
- The exact response rate is unknown, and sampling bias may be a limitation.
- The cross-sectional design means that we cannot explore cause and effect relationships.

INTRODUCTION

The three major events in the military life course are entry to military service, deployment on active service and transition back to civilian life. On entry, soldiers, sailors and air personnel are subject to a selection process to ensure, as far as possible, good physical and mental health, giving rise to the 'healthy soldier effect,' with service personnel being, on average, healthier than the general population.[1] However, the physical and psychological stressors of military service have been found to erode this effect.[2]

The physical stressors have a particular impact on the lower limb, with load carriage, high intensity training and the design of footwear being implicated in injury causation.[3] A military career also increases opportunities for psychological trauma, and post-traumatic stress disorder (PTSD) has been identified as the 'signature injury' of United States service men and women deployed to Afghanistan and Iraq.[4]

A focus on adverse health events in the literature[5] means that wellbeing is relatively overlooked. In the long run, military service has been found to have positive effects.[6,7] Good health after service does, however, depend on the success of the 'military civilian transition', a complex process for which models have been developed.[8] Health problems developed in service, difficulty in assuming a post-service identity and many other factors contribute to health and wellbeing outcomes.[8] In New Zealand, military Veterans can only access assistance from New Zealand Veteran's Affairs (NZVA) if they have undertaken 'qualifying operational service' as defined by the Veteran Support Act 2014,[9] thus being Veterans in a legal sense. NZVA support some 12,000 Veterans, with an average age of 80 years, 5000 being actively case managed.[10] The majority will have seen operational service in Korea, Borneo, Malaya and Vietnam. Post-Vietnam, smaller numbers deployed on United

Nations and other missions, but the tempo of operations rose with the deployment to Bosnia in 1992, and some 9,000-10,000 'legal' Veterans deployed between then and the withdrawal of New Zealand troops from Afghanistan in 2021. The Ministerial Veteran's Health Advisory Panel, established under the Veteran Support Act, are specifically charged with funding research on this 'contemporary Veteran' group, NZVA acknowledging that they "have had different experiences, and have different needs, compared to the older veterans. They are likely to have served in a number of deployments during their career, and come to us with more complex health issues."[10]

The aims of this study were therefore to describe self-reported health among these Veterans, and identify factors associated with better or poorer health.

Veteran and public involvement

The Ministerial Veterans Health Advisory Panel,[10] commissioned the study and advised on the design. We also formed a steering group with representatives from the New Zealand Defence Force, New Zealand Veterans Affairs, the Royal New Zealand Returned and Services Association (RSA)[11] and No Duff,[12] a charity providing first response support to Veterans and their families. We also consulted with the Ngāi Tahu Research Consultation Committee in order to assess the importance of the project to Māori, New Zealand's indigenous population. During consultation we undertook to inform the Veteran community before releasing the results, to which end a link to the paper will be posted on the military social media sites where the study was advertised, and to give all NZ Veterans, defined as anyone who had served in the military, an opportunity to participate. Participants were not recruited as patients.

METHODS

Participants

Potential participants were currently serving Veterans, as indicated by holding the New Zealand Operational Service Medal at the time of the survey, a total of 3,874 personnel at that time; retired 'legal' Veterans in the community; and Veterans who had served, but had not deployed to a conflict. Data were collected via an online survey, a postal version being available on request. There is no comprehensive Veteran registry, however in July 2018, a link to the online questionnaire was sent by email to the 3,874 currently serving regular and reserve New Zealand Defence Force (NZDF) members registered on the NZDF email system who were 'legal Veterans', as indicated by holding the New Zealand Operational Service Medal. An introductory message and link to the questionnaire were also presented on the NZDF 'intranet landing page', a secure internal webpage from which all regular force

personnel can access relevant work-related content, tools, and resources. Retired military personnel were invited to participate through posters distributed to reserve units and the 43 local social clubs identified by the RSA national office to be 'Veteran active.' Paper questionnaires with return postage envelopes were made available at these sites. 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 website. The questionnaire was available for completion from June to December 2018.

Ethics approval

Ethics approval for the study was obtained from the Northern B Health and Disability Ethics Committee, reference 17NTB118.

Questionnaire

Criterion variable

Self-rated health status was assessed using the EQ-5D-5L,[13] a short questionnaire asking about the respondent's health across five dimensions: mobility, self-care, usual activities, pain or discomfort and anxiety or depression, with response options ranging from (e.g.) 'no problems', to 'extreme problems'. For each dimension, participants were categorised as having 'any problems' if they selected any response other than 'no problems'.

Additionally, the EQ-5D-5L visual analogue scale (EQ-VAS) asks the respondent to mark on a vertical visual analogue scale (VAS) how good or bad their health is today, where the endpoints are labelled 'the best health you can imagine' (score of 100) and 'the worst health you can imagine' (score of 0).

Independent variables

Demographic characteristics included age, sex, ethnicity, service years, and past deployment on operational service (yes/no). Ethnicity prioritisation was adopted,[14] whereby participants with multiple responses were assigned to one of the categories, in the order of Māori, Pacific Peoples, Other and European.

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 DSM-IV symptoms of PTS related to stressful military experiences, with response options ranging from 1 'Not at all' to 5 'Extremely' (33). A total symptom severity score is calculated by summing responses to each option (range = 17 – 85). While scores of 30-35 indicate significant PTS symptomology and probable cases of PTSD, scores of ≥45 indicate a presumptive PTSD diagnosis. [15]

General psychiatric morbidity was assessed using the 12-item General Health Questionnaire (GHQ-12),[16] scored using a four point scale (0-3) and summing the 12 items to give a total score, with higher scores indicating elevated distress.

Social support was measured using the Social Provisions Scale,[17] with responses made on a four-point Likert-type scale ranging from 1 'strongly disagree' to 4 'strongly agree'. The 24 items can be reduced to six subscales (attachment, social integration, reassurance of worth, reliable alliance, social guidance and opportunity for nurturance) or summed to create a total score, with greater scores indicating greater social support.

Alcohol use was measured using the AUDIT-C,[18] scaled from 0-12. A score of 3+ for women and 4+ for men indicated potentially hazardous drinking behaviour.

Sleep quality was assessed with the Sleep Condition Indicator (SCI), [19] assessing insomnia as described in the Diagnostic and Statistical Manual of Mental Disorders version 5 (DSM-V).[20] The SCI consists of eight items rated from 0-4, the total scores being scaled to a range of 0 to 10, where higher scores represent better sleep.

Trauma exposure was assessed with the Brief Trauma Scale (BTS),[21] which captures past exposure to situations that were life threating or capable of producing serious injury.

Psychological flexibility was measured with the 10-item AAQ-II, designed as a measure of effectiveness in a particular mode of behavioural intervention, Acceptance and Commitment Therapy (ACT).[22] Items were answered on a 7-point scale, with options ranging from 'never true' to 'always true'. The items were summed to obtain a total score (possible range 10 to 70), with higher scores indicative of greater psychological flexibility. The questionnaire is available as supplementary material.

Statistical analyses

With respect to the calculation of summed scores, if only one item was missing for a particular measure then this was imputed with the mean of the remaining items; if more than one item was missing then the score was set to missing for that participant. Complete case analysis was used in the remaining analyses. Z tests were used to compare the five dimensions of the EQ-5D-5L to the NZ population normative values.[23]

Univariate ordinary least-squares linear regression analyses assessed the strength of relationships between each independent variable and EQ-VAS scores, using robust standard errors to account for heteroscedasticity and calculating 95% confidence intervals (95% CIs). Multivariable linear regression was then used to identify the role of the independent variables while adjusting for each other. None of the social support sub-scales were used in this

multivariable model, instead using the social support total score. The model was built using backward variable selection with p<0.10 for variable retention, with the exceptions of age, sex, service years, and deployment status which were retained as adjusting variables irrespective of p-values. Cronbach's α, (C_α) reported in Table 2, was used to assess the internal consistency of the scales used.[24] A value of alpha greater than 0.7 is considered adequate.[25] Collinearity was assessed by calculating the Pearson correlation coefficient (*r*); if $0 < r < 1$ there is a positive linear trend.

RESULTS

The EQ-5D was completed by 1767 Veterans, 1009 who were serving (26% of that group), 458 who had retired, 288 who had not deployed, and 21 who did not provide deployment data. There are no reliable denominator data on retired and non-deployed Veterans in New Zealand.

To facilitate a complete case analysis, 247 replies were not used due to missing values in one or more variables, the final sample including 1520 individuals.

A supplementary table presents the EQ-VAS score according to the sample characteristics.

Figure 1 shows the proportion of EQ-5D-5L dimension responses reporting 'any problem' severity level other than 'no problems' in comparison to the New Zealand population normative values,[23] with Table 1 showing the 95% CI's and Z values.

Figure 1 about here

Table 1, Proportion of 'any problem' in EQ-5D domains

Domain	**Veterans**	**NZ population**	**Z value (p)**
	Proportion (95% CI)	**Proportion (95% CI)**	
Mobility	0.40 (0.38-0.43)	0.28 (0.26-0.30)	8.5 (<.0001)
Self-care	0.11 (0.10-0.13)	0.09 (0.07-0.10)	2.8 (0.03)
Usual activities	0.38 (0.35-0.40)	0.30 (0.28-0.31)	5.6 (<.001)
Pain/discomfort	0.75 (0.73-0.77)	0.62 (0.60-0.63)	9.0 (<.0001)
Anxiety/depression	0.47 (0.44-0.49)	0.46 (0.44-0.48)	0 (1.0)

The results of the univariate analysis are displayed in Table 2. Here, for continuous characteristics, the regression coefficient (*ß*) represents the change in the mean EQ-VAS associated with one unit increase in the characteristic. For categorical characteristics, *ß* is the change in mean EQ-VAS scores compared to the referent category.

Table 2: Univariate cross-sectional associations between variables and mean EQ-VAS scores for New Zealand Veterans (N=1,520)

Characteristic	C_α	*n*	*ß*	95% CIs		*p*-value
Age*	-	1520	-0.18	[-0.24,	-0.12]	<0.01
Sex						
Female	-	189	Ref			
Male	-	1331	-0.15	[-2.76,	2.46]	0.91
Ethnicity	-					
NZ European	-	1193	Ref			0.13
Māori	-	214	0.82	[-1.56,	3.19]	
Other	-	113	-3.55	[-7.33,	0.23]	
Service years*	-	1520	0.19	[0.11,	0.28]	<0.01
Deployment status	-					
Not deployed	-	242	ref			
Deployed	-	1278	6.56	[3.85,	9.26]	<0.01
GHQ-12 score*	0.89	1520	-1.63	[-1.81,	-1.46]	<0.01
Social support*		1520	2.05	[1.70,	2.41]	<0.01
Attachment	0.81	1520	2.47	[2.02,	2.92]	<0.01
Social integration	0.79	1520	2.49	[2.08,	2.91]	<0.01
Reassurance of worth	0.77	1520	2.39	[1.97,	2.82]	<0.01
Reliable alliance	0.81	1520	2.01	[1.63,	2.39]	<0.01
Social guidance	0.84	1520	0.83	[0.40,	1.25]	<0.01
Opportunity for nurturance	0.75	1520	0.53	[0.44,	0.61]	<0.01
Social support total score	-	1520	0.80	[0.71,	0.88]	<0.01
Psychological flexibility*	0.93	1520	3.56	[3.18,	3.95]	<0.01
Sleep score*	0.87					<0.01
AUDIT-C	0.67	707	Ref			
Non-hazardous		813	0.71	[-1.04,	2.45]	0.43
Hazardous						
Exposure to traumatic events	-					
Not exposed		454	Ref			
Exposed		1066	-5.62	[-7.39,	3.86]	<0.01
PTSD (PCL-M Score)*		1520	-0.67	[-0.75,	-0.60]	<0.01

*Scored as continuous variables, coefficient is per unit increase

Of the demographic variables, age was associated with lower EQ-VAS scores, length of service with higher scores. No relationships were apparent for sex or ethnicity. Positive coefficients, indicating better health with presence of the characteristic, were present for dichotomous variables of deployment, where the mean EQ-VAS score for deployed Veterans was 6.56 VAS units higher (better) than for non-deployed. The largest negative associations were for exposure to traumatic events, with a mean EQ-VAS score 5.62 lower for those exposed compared to those not exposed. Distress, as measured by the GHQ-12, had a negative association with health state, as did PTSD as measured by the PCL-M. Positive associations

with health state were found for psychological flexibility as measured by the AAQ-II, better sleep scores, the total support scores and the individual dimensions.

Table 3 shows the results from two multivariable models. The first model is adjusted for the other characteristics, with 12 variables included in the model. All effect sizes were reduced, and the social support and AUDIT-C scores were no longer associated.

The final model involved backward variable selection setting a p-value of 0.10, identifying a smaller subset of variables. Age, sex, service years, and deployment status were retained in the model irrespective of their p-values, thus adjusting for those variables. Social support and AUDIT-C hazardous drinking were not retained in this final model; other coefficients remaining essentially the same.

Table 3. Multivariable models of associations between variables and mean EQ-VAS scores for New Zealand Veterans

	Adjusted model, N =1,520			Final model, N =1,520		
Characteristic	***ß***	**95% CI**	***p*-value**	***ß***	**95% CI**	***p*-value**
Age (years)*	-0.15	[-0.21 -0.10]	<0.01	-0.16	[-0.22, -0.10]	<0.01
Sex						
Female	Ref			Ref		
Male	0.06	[-0.23, 2.35]	0.96	0.02	[-2.27, 2.30]	0.99
Ethnicity						
NZ European	Ref		0.03	Ref		0.03
Māori	0.53	[-1.46, 2.53]		0.55	[-1.44, 2.54]	
Other	-4.04	[-7.12, -0.95]		-4.07	[-7.16, -0.99]	
Service years*	0.16	[0.09, 0.24]	<0.01	0.17	[0.09, 0.24]	<0.01
Deployment status						
Not deployed	Ref			Ref		
Deployed	3.33	[1.00, 5.67]	0.01	3.36	[1.03, 5.70]	0.01
GHQ12 score*	-0.83	[-1.06, -0.61]	<0.01	-0.84	[-1.06, -0.62]	<0.01
Social support (SPS score)*	0.02	[-0.07, 0.11]	0.65	-	- -	-
Psychological flexibility score (AAQii)*	0.18	[0.06, 0.31]	0.01	0.19	[0.07, 0.31]	<0.01
Sleep score (SCI), Range 0-10*	1.41	[0.95, 1.88]	<0.01	1.41	[0.95, 1.87]	<0.01

Table 3, continued

AUDIT_C score								
Non hazardous	Ref							
Hazardous	0.37	[-1.05,	1.79]	0.61	-	-	-	-
Exposure to traumatic events (BTQ)								
Not exposed	Ref				Ref			
Exposed	-1.46	[-3.02,	0.11]	0.07	-1.45	[-3.02,	0.12]	0.07
PTSD (PCL-M Score)*	-0.14	[-0.25,	-0.04]	0.01	-0.15	[-0.25,	-0.04]	0.01

*Scored as continuous variables, coefficient is per unit increase.

DISCUSSION

Principal findings

With the exception of anxiety or depression, Veterans had a significantly greater proportion of 'any problem' responses in the EQ-5D dimensions than the general population of New Zealand.

The final model identified variables independently associated with the EQ-VAS score: age, length of service, deployment, the GHQ score, psychological flexibility, the sleep score and exposure to traumatic events. The results make conceptual sense in that distress is associated with reduced EQ-VAS, and psychological flexibility may have a modest protective effect. Age had a negative association, length of service being positive, most likely due to the 'healthy soldier' effect.[1] Unusually, Social Support was dropped, however the SPS was found to correlate significantly with GHQ12 (r=0.47), AAQii (r=0.56), and SCI scores (r=0.36), suggesting collinearity. There are known to be many other influences on health, including 'social wellbeing',[5] financial status, personality and non-deployment related stressors,[26] which we have not measured.

Strengths and weaknesses

Strengths of our study were the relatively large sample size, the inclusion of all Veterans, the assessment of 'health', infrequently investigated in Veteran populations, and the inclusion of New Zealand Veterans with a range of characteristics, including 'deployed' and 'non-deployed' Veterans. As a measure of health, the EQ-5D-5L dimensions and EQ-VAS ask about health on the day that respondents complete the questionnaire, the EQ-VAS end points being, respectively, the 'best' and 'worst' health they can imagine, so it is a holistic measure of health state.[27]

The response rate of 26% from serving Veterans, along with the unknown total number of Veterans, raises the question of bias, the direction of which is difficult to assess, as responses may be more likely from either Veterans with good or poor health. The healthy soldier effect is well known, service having a positive effect on wellbeing, with serving NZ Veterans having good access to primary health care through the military system, but the public health care system is the primary pathway to care for all Veterans, who are also covered by the 'no fault' accident compensation scheme for accidental injuries and occupational diseases.[28] Deployed Veterans may be at an advantage, but are covered by NZVA only if their illness or injury is linked to a particular deployment, and the condition is listed on the 'Statements of Principle' of the Australian Repatriation Medical Authority.[29]

We also know that New Veterans tend to be stoic, so they might underestimate their health concerns,[30] and there are likely to be other personal characteristics that we have not measured. We were however able to adjust for deployment status, which did have a positive association with health state. In the interest of minimising responder burden, we used brief scales, which might reduce construct validity. Distress, sleep, psychological flexibility and exposure to traumatic events are likely to be related, so collinearity was difficult to avoid. The confounding effect was greatest for social support, but our finding does not mean that social support is of no importance to Veterans. The precision of the other coefficients may also have been affected. Finally, the cross-sectional design means that we cannot explore cause and effect, so recommendations for future interventions require additional support from longitudinal studies.

Comparison with other studies

We have previously reported factors associated with post-traumatic stress in this group,[31] using the Military Post Traumatic Stress Checklist (PCL-M). Factors associated with higher PCL-M scores were trauma exposure, older age, male gender, and being of Māori ethnicity. Factors associated with lower PCL-M scores were greater length of service, psychological flexibility, and better quality sleep. Using health as the outcome disclosed that Māori did not have poorer self-reported health compared to non-Māori, that deployment had a positive effect, and in the univariate models, all of the dimensions of social support were associated with improved health. The final model also included good sleep and psychological flexibility, providing most of the explanatory power in the model.

No other studies appear to have used the EQ-VAS as an outcome measure for Veteran health. Boehmer et al.[32] examined wellbeing among participants in the 2000 Behavioural Risk Factor Surveillance System describing health-related quality of life (HRQoL) by sex and military status, active duty, reservists Veterans, or no military service. Participants were asked to rate recent physical health, mental health, and activity limitation. Active duty men were more likely than men without military service to report 14 or more days of activity limitation, pain, and not enough rest in the past 30 days, the mobility and pain findings being similar to our sample. Notably, the predominant reason for medical discharge from the British Armed Forces was musculoskeletal problems.[33]

Contrary to our finding on deployment, there are reports indicating that non-deployed personnel retain better health than those who have been deployed. Diaz Santana et al.[34] having carried out a cross-sectional survey of 60,000 U.S. Veterans of Afghanistan and Iraq,

with 20,563 responses. In contrast to our finding, mental quality of life scores were higher among the non-deployed group compared to the deployed group, though the deployed group reported higher physical quality of life scores compared to the non-deployed. Again in contrast, both mental and physical quality of life were lower among Veterans compared to U.S. population norms.

Both positive and negative consequences of deployment have been described.[7,35] In a study of Dutch Veterans,[7] two out of three reported a positive effect of deployment on their quality of life at the time of the survey, this being related to positive feelings such as satisfaction or comradeship, but a few having emotions such as frustration or shame. As regards tangible effects,[35] negative consequences included the military 'chain of command', being away from home, and deterioration of marital/significant other relationships. Positive influences include improved financial security, self-improvement, and time to reflect.

We found sleep to be associated with better health, but sleep difficulties are a common symptom for those with PTSD. McCarthy et al.[36] reported on the 3,157 U.S. military Veterans enrolled in the National Health and Resilience in Veterans Study, in which 27.6% reported poor sleep quality. Path analyses revealed significant associations between poor sleep, severity of PTSD, poorer mental and physical health functioning and lower overall quality of life.

Future directions

The results suggest that distress, psychological flexibility, and sleep have an important relationship with self-rated health among Veterans in this study.

Reducing distress through the promotion of psychological flexibility might be possible, although our finding here must be subject to caution as several researchers argue that the AAQ-II may be measuring psychological distress and affect rather than psychological inflexibility.[37]

Sleep in military personnel has been recognised as a 'vital health behaviour' for which policies and guidelines must be developed.[38] Cognitive behavioural therapy for insomnia (CBT-I) is regarded as an effective 'first line' treatment, and a brief intervention has been described for use in Australian general practice.[39]. Our final model showed that distress had a negative association with health, and psychological flexibility had a positive relationship, with sleep most likely related to both of these variables. It would seem important to screen for these conditions prior to transition from the military, as well as among retired Veterans, in order to

provide targeted support. Further research is needed to examine the potential of cognitive behavioural therapy to improve Veterans' wellbeing.

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DATA SHARING STATEMENT

Data from this study is unsuitable for public deposition due to the privacy of participant data. Data are anonymised, but contain information on deployments (including location and duration), which could lead to some participants being identified. Furthermore, the participant information sheet, as required by the Southern Health and Disability Ethics Committee specifically contains the statement that 'all study data would be kept strictly confidential to the research team.' Qualified researchers may apply for data access with the research team at veterans.health@otago.ac.nz and/or hdecs@moh.govt.nz.

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COMPETING INTERESTS

None declared.

CONTRIBUTION

All the authors have made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND

Drafting the work or revising it critically for important intellectual content; AND

Final approval of the version to be published; AND

Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Specific responsibilites

Investigation: Amy Richardson, Emma H. Wyeth, Sarah Derrett, Daniel Shepherd, David McBride.

Methodology: Amy Richardson, Ari Samaranayaka, Dianne Gardner, Emma H. Wyeth, Sarah Derrett, David McBride, Daniel Shepherd.

Project administration: Amy Richardson.

Resources: Brandon de Graaf.

Software: Brandon de Graaf.

Supervision: Ari Samaranayaka.

Validation: Amy Richardson.

Visualization: Amy Richardson.

Writing – original draft: David McBride. AS, DG, EHW, SD and DS contributed to the re-writes and final draft.

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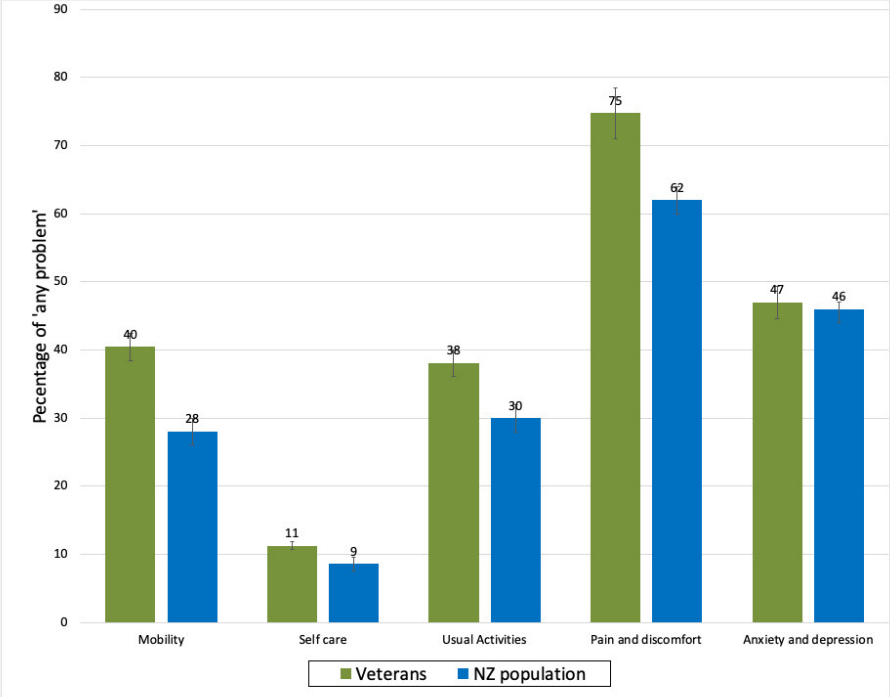
Finally, a thank you to the New Zealand Veterans who took the time and effort to complete a rather tedious questionnaire. Kia Kaha.

Figure 1 Caption.

The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions



The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions

86x65mm (300 x 300 DPI)

Supplementary Table: Number of participants and EQ-VAS scores according to sample characteristics

Exposure variable	N (%)		Mean (SD)
All	1767		74.4 (17.1)
Age group (years)			
20-29	136	(7.7)	77.7 (14.4)
30-39	328	(18.6)	77.0 (16.2)
40-49	438	(24.8)	76.1 (14.6)
50-59	350	(19.8)	74.8 (16.6)
60-69	285	(16.1)	71.4 (19.8)
70-79	175	(9.9)	69.4 (19.4)
80+	50	(2.8)	66.2 (20.3)
Missing	5	(0.3)	61.2 (22.1)
Gender			
Female	220	(12.5)	75.0 (16.9)
Male	1520	(86.0)	74.4 (17.2)
Missing	27	(1.5)	70.3 (17.2)
Ethnicity (prioritised)			
NZ European	1382	(78.2)	74.4 (17.1)
Māori	245	(13.9)	75.6 (16.1)
Other	140	(7.9)	71.5 (19.3)
Service years			
0-9	339	(19.2)	69.9 (19.7)
10-19	478	(27.1)	74.5 (17.9)
20-29	530	(30.0)	75.3 (15.9)
30-39	254	(14.4)	76.3 (14.6)
40+	69	(3.9)	75.4 (16.4)
Missing	97	(5.5)	78.8 (14.2)
Deployment (ever)			
No	288	(16.3)	69.5 (19.9)
Yes	1458	(82.5)	75.3 (16.4)
Missing	21	(1.2)	75.6 (14.6)
GHQ12 Score			
0-9	652	(36.9)	82.0 (12.6)
10-19	972	(55.0)	72.3 (16.0)
20-29	123	(7.0)	54.3 (20.3)
30+	18	(1.0)	46.2 (24.4)
Missing	2	(0.1)	-

*sub-scores not used in multivariable models.

Supplementary table contd.

Social support full score			
24-29	0	0	-
30-39	3	(0.2)	66.7 (15.3)
40-49	15	(0.8)	44.5 (22.5)
50-59	97	(5.5)	62.4 (21.8)
60-69	351	(19.9)	69.0 (18.2)
70-79	643	(36.4)	75.1 (15.0)
80-89	409	(23.1)	78.0 (15.0)
90-96	235	(13.3)	81.9 (13.9)
Missing	14	(0.8)	58.1 (25.6)
Social support sub-scores			
Attachment*			
4-7	51	(3.5)	61.4 (23.4)
8-11	516	(29.2)	68.7 (18.0)
12-16	1193	(67.5)	77.5 (15.5)
Missing	7	(0.4)	61.0 (19.7)
Social integration*			
4-7	20	(1.1)	56.2 (25.1)
8-11	429	(24.3)	67.1 (19.4)
12-16	1309	(74.8)	77.1 (15.2)
Missing	9	(0.5)	58.7 (21.5)
Reassurance of worth*			
4-7	37	(2.1)	59.1 (19.5)
8-11	504	(28.5)	69.0 (19.1)
12-16	1215	(68.8)	77.2 (15.2)
Missing	11	(0.6)	62.0 (24.9)
Reliable Alliance*			
4-7	20	(1.1)	49.6 (22.2)
8-11	251	(14.2)	66.9 (20.1)
12-16	1489	(84.3)	76.0 (15.9)
Missing	7	(0.4)	61.0 (19.7)
Guidance sub-score*			
4-7	36	(2.0)	59.2 (22.2)
8-11	387	(21.9)	68.7 (18.9)
12-16	1337	(75.7)	76.6 (15.7)
Missing	7	(0.4)	54.6 (21.6)
Opportunity for nurturance*			
4-7	29	(1.6)	69.3 (18.9)
8-11	413	(23.4)	71.9 (18.8)
12-16	1316	(74.5)	75.4 (16.4)
Missing	9	(0.5)	58.7 (21.5)

Supplementary table, contd.

Psychological flexibility score (AAQii score).			
10-19	5	(0.3)	23.2 (13.8)
20-29	40	(2.3)	49.1 (22.1)
30-39	147	(8.3)	63.0 (18.6)
40-49	43	(24.7)	68.5 (16.8)
50-59	664	(37.6)	77.1 (13.9)
60-70	457	(25.9)	82.5 (13.5)
Missing	1	(1.0)	69.6 (20.5)
Sleep Condition Indicator (SCI score			
0 to <2	67	(3.8)	51.2 (22.3)
2 to <4	264	(14.9)	62.2 (19.5)
4 to <6	646	(36.6)	74.3 (14.6)
6 to <8	384	(21.7)	77.6 (14.2)
8 to 10	386	(21.8)	83.5 (12.2)
Missing	20	(1.1)	77.3 (12.8)
AUDIT-C score			
Non-hazardous	776	(43.9)	74.0 (17.4)
Hazardous	915	(51.8)	74.6 (16.9)
Missing	76	(4.3)	75.0 (17.0)
Brief Trauma Questionnaire (DSM-IV criteria)			
Not exposed	544	(30.8)	78.3 (15.1)
Exposed	1210	(68.5)	72.5 (17.8)
Missing	13	(0.7)	80.6 (8.1)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	Indicate the study's design with a commonly used term in the title or the abstract. **Yes, a cross sectional study, p1 title.**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **Background, results and conclusions, p 1**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **Introduction p2.**
Objectives	3	State specific objectives, including any prespecified hypotheses **p2, lines 59 and 60**
Methods		
Study design	4	Present key elements of study design early in the paper p**2 line 62 to page 5 line 145**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **Participants, page2 line 63-page 3 line 83.**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants **page 2 line 64 to page 3, line 68.**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **Questionnaire, pp 3-5.**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group **as above**
Bias	9	Describe any efforts to address potential sources of bias **Methods, page 3. Lines 76-83.**
Study size	10	Explain how the study size was arrived at **p5 line 137**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Cases defined through the **Multivariable logistic regression with the EQ-Visual analogue scale as the outcome measure, p5 lines 131-136**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **Backward elimination process p5 lines 134-135**
		(*b*) Describe any methods used to examine subgroups and interactions **By multivariable logistic regression, p5 as above**
		(*c*) Explain how missing data were addressed **p4 lines 122-125**
		(*d*) If applicable, describe analytical methods taking account of sampling strategy N/A
		(*e*) Describe any sensitivity analyses N/A
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **Potentially eligible lines 68-73 p 3**
		(b) Give reasons for non-participation at each stage N/A
		(c) Consider use of a flow diagram N/A

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders **page 5 et seq, table 1**
		(b) Indicate number of participants with missing data for each variable of interest '**n used' columns tables 2 and 3.**
Outcome data	15*	Report numbers of outcome events or summary measures **as per tables**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **Tables, adjusted for age, sex, service years and deployment status.**
		(*b*) Report category boundaries when continuous variables were categorized. **Independent variables, p 3 and 4, EQ-VAS is a continuous scale**.
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period **N/A**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **N/A**
Discussion		
Key results	18	Summarise key results with reference to study objectives **Discussion, p11 first para**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias **Discussion lines 215 et seq.**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence **Discussion, p12 lines 230 et seq.**
Generalisability	21	Discuss the generalisability (external validity) of the study results **p17, line 215 et seq.**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **Funding, p18**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Factors associated with self-reported health among New Zealand military veterans: a cross-sectional study.

Journal:	*BMJ Open*
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FACTORS ASSOCIATED WITH SELF-REPORTED HEALTH AMONG NEW ZEALAND MILITARY VETERANS: A CROSS-SECTIONAL STUDY

David McBride,[1] Ari Samaranayaka[2], Amy Richardson,[1] Dianne Gardner,[3] Daniel Shepherd,[4] Emma H. Wyeth[5], Brandon deGraaf,[6] Sarah Derrett.[1]

[1]Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[2]Biostatistics Centre, Division of Health Sciences, University of Otago, Dunedin, New Zealand.

[3]School of Psychology, Massey University, New Zealand.

[4]Department of Psychology, Auckland University of Technology, New Zealand.

[5]Ngāi Tahu Māori Health Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

[6]Injury Prevention Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, New Zealand.

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Corresponding Author:

David McBride, Department of Preventive and Social Medicine, Adams Building, 18 Frederick Street, Dunedin 9017, New Zealand.

Email: david.mcbride@otago.ac.nz

Phone: +64 3 479 7208

Fax +64 3 479 7298

ABSTRACT

Objective

To identify factors associated with better or poorer self-reported health status in New Zealand military Veterans.

Design

A cross-sectional survey.

Participants

The participants of interest were the 3,874 currently serving Veterans who had been deployed to a conflict zone, but all Veterans were eligible to participate.

Study variables

The EQ-5D-5L, asking about problems across five dimensions (mobility, self-care, usual activities, pain or discomfort, and anxiety or depression), with five levels of severity (e.g. no, slight, moderate, severe or extreme problems), also containing a visual analogue scale (EQ-VAS), scaled from 0 (worst) to 100 (best) imagined health, assessed health status. Hypothetical relationships with better health were positive social support, sleep and psychological flexibility; with poorer health, post-traumatic stress, exposure to psychological trauma, distress and hazardous drinking.

Results:

The EQ5-D was completed by 1767 Veterans, 1009 serving, a response rate of 26% from that group, 1767 completing the EQ5-D, 1458 who had deployed, 288 who had not, and the 21 who did not provide deployment data. Of these 247 were not used in the analysis due to missing values in one or more variables, leaving 1,520 for analysis.

A significantly higher proportion of Veterans reported 'any problems' rather than 'no problems' with four EQ-5D dimensions: mobility, self-care, usual activities and pain or discomfort, but no difference in anxiety or depression. Age, length of service, deployment, psychological flexibility and better sleep quality were associated with higher EQ-VAS scores; distress with lower EQ-VAS scores.

Conclusion:

In this sample of New Zealand Veterans, psychological flexibility and good sleep are associated with better self-rated health, and distress and poor sleep with diminished health. These factors might be used as sentinel health indicators in assessing Veteran health status, and cognitive behavioural therapy encompassing these domains may be useful in improving the health of New Zealand Veterans.

Keywords:
Self-rated health, wellbeing, EQ-5D, Veterans, deployment, military, risk factors.

Strengths and limitations of this study

- Many studies of Veterans have focused on adverse outcomes, but we have been able to focus on a holistic measure of 'health'.
- The study was sufficiently powered to detect important relationships indicating opportunities for intervention.
- The exact response rate is unknown, and sampling bias may be a limitation.
- The cross-sectional design means that we cannot explore cause and effect relationships.

INTRODUCTION

The three major events in the military life course are entry to military service, deployment on active service and transition back to civilian life. On entry, soldiers, sailors and air personnel are subject to a selection process to ensure, as far as possible, good physical and mental health, giving rise to the 'healthy soldier effect,' with service personnel being, on average, healthier than the general population.[1] However, the physical and psychological stressors of military service have been found to erode this effect.[2]

The physical stressors have a particular impact on the lower limb, with load carriage, high intensity training and the design of footwear being implicated in injury causation.[3] A military career also increases opportunities for psychological trauma, and post-traumatic stress disorder (PTSD) has been identified as the 'signature injury' of United States service men and women deployed to Afghanistan and Iraq.[4]

A focus on adverse health events in the literature[5] means that wellbeing is relatively overlooked. In the long run, military service has been found to have positive effects.[6,7] Good health after service does, however, depend on the success of the 'military civilian transition', a complex process for which models have been developed.[8] Health problems developed in service, difficulty in assuming a post-service identity and many other factors contribute to health and wellbeing outcomes.[8] In New Zealand, military Veterans can only access assistance from New Zealand Veteran's Affairs (NZVA) if they have undertaken 'qualifying operational service' as defined by the Veteran Support Act 2014,[9] thus being Veterans in a legal sense. NZVA support some 12,000 Veterans, with an average age of 80 years, 5000 being actively case managed.[10] The majority will have seen operational service in Korea, Borneo, Malaya and Vietnam. Post-Vietnam, smaller numbers deployed on United

Nations and other missions, but the tempo of operations rose with the deployment to Bosnia in 1992, and some 9,000-10,000 'legal' Veterans deployed between then and the withdrawal of New Zealand troops from Afghanistan in 2021. The Ministerial Veteran's Health Advisory Panel, established under the Veteran Support Act, are specifically charged with funding research on this 'contemporary Veteran' group, NZVA acknowledging that they "have had different experiences, and have different needs, compared to the older veterans. They are likely to have served in a number of deployments during their career, and come to us with more complex health issues."[10]

The aims of this study were therefore to describe self-reported health among these Veterans, and identify factors associated with better or poorer health.

Veteran and public involvement

The Ministerial Veterans Health Advisory Panel,[10] commissioned the study and advised on the design. We also formed a steering group with representatives from the New Zealand Defence Force, New Zealand Veterans Affairs, the Royal New Zealand Returned and Services Association (RSA)[11] and No Duff,[12] a charity providing first response support to Veterans and their families. We also consulted with the Ngāi Tahu Research Consultation Committee in order to assess the importance of the project to Māori, New Zealand's indigenous population. During consultation we undertook to inform the Veteran community before releasing the results, to which end a link to the paper will be posted on the military social media sites where the study was advertised, and to give all NZ Veterans, defined as anyone who had served in the military, an opportunity to participate. Participants were not recruited as patients.

METHODS

Participants

Potential participants were currently serving Veterans, as indicated by holding the New Zealand Operational Service Medal at the time of the survey, a total of 3,874 personnel at that time; retired 'legal' Veterans in the community; and Veterans who had served, but had not deployed to a conflict. Data were collected via an online survey, a postal version being available on request. There is no comprehensive Veteran registry, however in July 2018, a link to the online questionnaire was sent by email to the 3,874 currently serving regular and reserve New Zealand Defence Force (NZDF) members registered on the NZDF email system who were 'legal Veterans', as indicated by holding the New Zealand Operational Service Medal. An introductory message and link to the questionnaire were also presented on the NZDF 'intranet landing page', a secure internal webpage from which all regular force

personnel can access relevant work-related content, tools, and resources. Retired military personnel were invited to participate through posters distributed to reserve units and the 43 local social clubs identified by the RSA national office to be 'Veteran active.' Paper questionnaires with return postage envelopes were made available at these sites. 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 website. The questionnaire was available for completion from June to December 2018.

Ethics approval

Ethics approval for the study was obtained from the Northern B Health and Disability Ethics Committee, reference 17NTB118.

Questionnaire

Criterion variable

Self-rated health status was assessed using the EQ-5D-5L,[13] a short questionnaire asking about the respondent's health across five dimensions: mobility, self-care, usual activities, pain or discomfort and anxiety or depression, with response options ranging from (e.g.) 'no problems', to 'extreme problems'. For each dimension, participants were categorised as having 'any problems' if they selected any response other than 'no problems'.

Additionally, the EQ-5D-5L visual analogue scale (EQ-VAS) asks the respondent to mark on a vertical visual analogue scale (VAS) how good or bad their health is today, where the endpoints are labelled 'the best health you can imagine' (score of 100) and 'the worst health you can imagine' (score of 0).

Independent variables

Demographic characteristics included age, sex, ethnicity, service years, and past deployment on operational service (yes/no). Ethnicity prioritisation was adopted,[14] whereby participants with multiple responses were assigned to one of the categories, in the order of Māori, Pacific Peoples, Other and European.

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 DSM-IV symptoms of PTS related to stressful military experiences, with response options ranging from 1 'Not at all' to 5 'Extremely' (33). A total symptom severity score is calculated by summing responses to each option (range = 17 – 85). While scores of 30-35 indicate significant PTS symptomology and probable cases of PTSD, scores of ≥45 indicate a presumptive PTSD diagnosis. [15]

General psychiatric morbidity was assessed using the 12-item General Health Questionnaire (GHQ-12),[16] scored using a four point scale (0-3) and summing the 12 items to give a total score, with higher scores indicating elevated distress.

Social support was measured using the Social Provisions Scale,[17] with responses made on a four-point Likert-type scale ranging from 1 'strongly disagree' to 4 'strongly agree'. The 24 items can be reduced to six subscales (attachment, social integration, reassurance of worth, reliable alliance, social guidance and opportunity for nurturance) or summed to create a total score, with greater scores indicating greater social support.

Alcohol use was measured using the AUDIT-C,[18] scaled from 0-12. A score of 3+ for women and 4+ for men indicated potentially hazardous drinking behaviour.

Sleep quality was assessed with the Sleep Condition Indicator (SCI), [19] assessing insomnia as described in the Diagnostic and Statistical Manual of Mental Disorders version 5 (DSM-V).[20] The SCI consists of eight items rated from 0-4, the total scores being scaled to a range of 0 to 10, where higher scores represent better sleep.

Trauma exposure was assessed with the Brief Trauma Scale (BTS),[21] which captures past exposure to situations that were life threating or capable of producing serious injury.

Psychological flexibility was measured with the 10-item AAQ-II, designed as a measure of effectiveness in a particular mode of behavioural intervention, Acceptance and Commitment Therapy (ACT).[22] Items were answered on a 7-point scale, with options ranging from 'never true' to 'always true'. The items were summed to obtain a total score (possible range 10 to 70), with higher scores indicative of greater psychological flexibility.

Statistical analyses

With respect to the calculation of summed scores, if only one item was missing for a particular measure then this was imputed with the mean of the remaining items; if more than one item was missing then the score was set to missing for that participant. Complete case analysis was used in the remaining analyses. Z tests were used to compare the five dimensions of the EQ-5D-5L to the NZ population normative values.[23]

Univariate ordinary least-squares linear regression analyses assessed the strength of relationships between each independent variable and EQ-VAS scores, using robust standard errors to account for heteroscedasticity and calculating 95% confidence intervals (95% CIs). Multivariable linear regression was then used to identify the role of the independent variables while adjusting for each other. None of the social support sub-scales were used in this multivariable model, instead using the social support total score. The model was built using

backward variable selection with p<0.10 for variable retention, with the exceptions of age, sex, service years, and deployment status which were retained as adjusting variables irrespective of p-values. Cronbach's α, (C_α) was used to assess the internal consistency of the scales used.[24] A value of alpha greater than 0.7 is considered adequate.[25] Collinearity was assessed by calculating the Pearson correlation coefficient (r); if $0 < r < 1$ there is a positive linear trend.

RESULTS

The EQ-5D was completed by 1767 Veterans, 1009 who were serving (26% of that group), 458 who had retired, 288 who had not deployed, and 21 who did not provide deployment data. There are no reliable denominator data on retired and non-deployed Veterans in New Zealand.

To facilitate a complete case analysis, 247 replies were not used due to missing values in one or more variables, the final sample including 1520 individuals.

A supplementary table presents the EQ-VAS score according to the sample characteristics.

Figure 1 shows the proportion of EQ-5D-5L dimension responses reporting 'any problem' severity level other than 'no problems' in comparison to the New Zealand population normative values,[23] with Table 1 showing the 95% CI's and Z values.

Figure 1 about here

Table 1, Proportion of 'any problem' in EQ-5D domains

Domain	**Veterans**	**NZ population**	**Z value (p)**
	Proportion (95% CI)	**Proportion (95% CI)**	
Mobility	0.40 (0.38-0.43)	0.28 (0.26-0.30)	8.5 (<.0001)
Self-care	0.11 (0.10-0.13)	0.09 (0.07-0.10)	2.8 (0.03)
Usual activities	0.38 (0.35-0.40)	0.30 (0.28-0.31)	5.6 (<.001)
Pain/discomfort	0.75 (0.73-0.77)	0.62 (0.60-0.63)	9.0 (<.0001)
Anxiety/depression	0.47 (0.44-0.49)	0.46 (0.44-0.48)	0 (1.0)

The results of the univariate analysis are displayed in Table 2. Here, for continuous characteristics, the regression coefficient (β) represents the change in the mean EQ-VAS associated with one unit increase in the characteristic. For categorical characteristics, β is the change in mean EQ-VAS scores compared to the referent category.

Table 2: Univariate cross-sectional associations between variables and mean EQ-VAS scores for New Zealand Veterans (N=1,520)

Characteristic	C_α*	*n*	*ß*	95% CIs		*p*-value
Age**	-	1520	-0.18	[-0.24,	-0.12]	<0.01
Sex						
Female	-	189	Ref			
Male	-	1331	-0.15	[-2.76,	2.46]	0.91
Ethnicity	-					
NZ European	-	1193	Ref			0.13
Māori	-	214	0.82	[-1.56,	3.19]	
Other	-	113	-3.55	[-7.33,	0.23]	
Service years*	-	1520	0.19	[0.11,	0.28]	<0.01
Deployment status	-					
Not deployed	-	242	ref			
Deployed	-	1278	6.56	[3.85,	9.26]	<0.01
GHQ-12 score*	0.89	1520	-1.63	[-1.81,	-1.46]	<0.01
Social support*		1520	2.05	[1.70,	2.41]	<0.01
Attachment	0.81	1520	2.47	[2.02,	2.92]	<0.01
Social integration	0.79	1520	2.49	[2.08,	2.91]	<0.01
Reassurance of worth	0.77	1520	2.39	[1.97,	2.82]	<0.01
Reliable alliance	0.81	1520	2.01	[1.63,	2.39]	<0.01
Social guidance	0.84	1520	0.83	[0.40,	1.25]	<0.01
Opportunity for nurturance	0.75	1520	0.53	[0.44,	0.61]	<0.01
Social support total score	-	1520	0.80	[0.71,	0.88]	<0.01
Psychological flexibility*	0.93	1520	3.56	[3.18,	3.95]	<0.01
Sleep score*	0.87					<0.01
AUDIT-C	0.67	707	Ref			
Non-hazardous		813	0.71	[-1.04,	2.45]	0.43
Hazardous						
Exposure to traumatic events	-					
Not exposed		454	Ref			
Exposed		1066	-5.62	[-7.39,	3.86]	<0.01
PTSD (PCL-M Score)*		1520	-0.67	[-0.75,	-0.60]	<0.01

*Cronbach's α

**Scored as continuous variables, coefficient is per unit increase

Of the demographic variables, age was associated with lower EQ-VAS scores, length of service with higher scores. No relationships were apparent for sex or ethnicity. Positive coefficients, indicating better health with presence of the characteristic, were present for dichotomous variables of deployment, where the mean EQ-VAS score for deployed Veterans was 6.56 VAS units higher (better) than for non-deployed. The largest negative associations were for exposure to traumatic events, with a mean EQ-VAS score 5.62 lower for those exposed compared to those not exposed. Distress, as measured by the GHQ-12, had a negative

association with health state, as did PTSD as measured by the PCL-M. Positive associations with health state were found for psychological flexibility as measured by the AAQ-II, better sleep scores, the total support scores and the individual dimensions.

Table 3 shows the results from two multivariable models. The first model is adjusted for the other characteristics, with 12 variables included in the model. All effect sizes were reduced, and the social support and AUDIT-C scores were no longer associated.

The final model involved backward variable selection setting a p-value of 0.10, identifying a smaller subset of variables. Age, sex, service years, and deployment status were retained in the model irrespective of their p-values, thus adjusting for those variables. Social support and AUDIT-C hazardous drinking were not retained in this final model; other coefficients remaining essentially the same.

Table 3. Multivariable models of associations between variables and mean EQ-VAS scores for New Zealand Veterans

	Adjusted model, N =1,520			Final model, N =1,520		
Characteristic	***ß***	**95% CI**	***p*-value**	***ß***	**95% CI**	***p*-value**
Age (years)*	-0.15	[-0.21 -0.10]	<0.01	-0.16	[-0.22, -0.10]	<0.01
Sex						
Female	Ref			Ref		
Male	0.06	[-0.23, 2.35]	0.96	0.02	[-2.27, 2.30]	0.99
Ethnicity						
NZ European	Ref		0.03	Ref		0.03
Māori	0.53	[-1.46, 2.53]		0.55	[-1.44, 2.54]	
Other	-4.04	[-7.12, -0.95]		-4.07	[-7.16, -0.99]	
Service years*	0.16	[0.09, 0.24]	<0.01	0.17	[0.09, 0.24]	<0.01
Deployment status						
Not deployed	Ref			Ref		
Deployed	3.33	[1.00, 5.67]	0.01	3.36	[1.03, 5.70]	0.01
GHQ12 score*	-0.83	[-1.06, -0.61]	<0.01	-0.84	[-1.06, -0.62]	<0.01
Social support (SPS score)*	0.02	[-0.07, 0.11]	0.65	-	- -	-
Psychological flexibility score (AAQii)*	0.18	[0.06, 0.31]	0.01	0.19	[0.07, 0.31]	<0.01
Sleep score (SCI), Range 0-10*	1.41	[0.95, 1.88]	<0.01	1.41	[0.95, 1.87]	<0.01

Table 3, continued

AUDIT_C score								
Non hazardous	Ref							
Hazardous	0.37	[-1.05,	1.79]	0.61	-	-	-	-
Exposure to traumatic events (BTQ)								
Not exposed	Ref				Ref			
Exposed	-1.46	[-3.02,	0.11]	0.07	-1.45	[-3.02,	0.12]	0.07
PTSD (PCL-M Score)*	-0.14	[-0.25,	-0.04]	0.01	-0.15	[-0.25,	-0.04]	0.01

*Scored as continuous variables, coefficient is per unit increase.

DISCUSSION

Principal findings

With the exception of anxiety or depression, Veterans had a significantly greater proportion of 'any problem' responses in the EQ-5D dimensions than the general population of New Zealand.

The final model identified variables independently associated with the EQ-VAS score: age, length of service, deployment, the GHQ score, psychological flexibility, the sleep score and exposure to traumatic events. The results make conceptual sense in that distress is associated with reduced EQ-VAS, and psychological flexibility may have a modest protective effect. Age had a negative association, length of service being positive, most likely due to the 'healthy soldier' effect.[1] Unusually, Social Support was dropped, however the SPS was found to correlate significantly with GHQ12 (r=0.47), AAQii (r=0.56), and SCI scores (r=0.36), suggesting collinearity. There are known to be many other influences on health, including 'social wellbeing',[5] financial status, personality and non-deployment related stressors,[26] which we have not measured.

Strengths and weaknesses

Strengths of our study were the relatively large sample size, the inclusion of all Veterans, the assessment of 'health', infrequently investigated in Veteran populations, and the inclusion of New Zealand Veterans with a range of characteristics, including 'deployed' and 'non-deployed' Veterans. As a measure of health, the EQ-5D-5L dimensions and EQ-VAS ask about health on the day that respondents complete the questionnaire, the EQ-VAS end points being, respectively, the 'best' and 'worst' health they can imagine, so it is a holistic measure of health state.[27]

The response rate of 26% from serving Veterans, along with the unknown total number of Veterans, raises the question of bias, the direction of which is difficult to assess, as responses may be more likely from either Veterans with good or poor health. The healthy soldier effect is well known, service having a positive effect on wellbeing, with serving NZ Veterans having good access to primary health care through the military system, but the public health care system is the primary pathway to care for all Veterans, who are also covered by the 'no fault' accident compensation scheme for accidental injuries and occupational diseases.[28] Deployed Veterans may be at an advantage, but are covered by NZVA only if their illness or injury is linked to a particular deployment, and the condition is listed on the 'Statements of Principle' of the Australian Repatriation Medical Authority.[29]

We also know that New Veterans tend to be stoic, so they might underestimate their health concerns,[30] and there are likely to be other personal characteristics that we have not measured. We were however able to adjust for deployment status, which did have a positive association with health state. In the interest of minimising responder burden, we used brief scales, which might reduce construct validity. Distress, sleep, psychological flexibility and exposure to traumatic events are likely to be related, so collinearity was difficult to avoid. The confounding effect was greatest for social support, but our finding does not mean that social support is of no importance to Veterans. The precision of the other coefficients may also have been affected. Finally, the cross-sectional design means that we cannot explore cause and effect, so recommendations for future interventions require additional support from longitudinal studies.

Comparison with other studies

We have previously reported factors associated with post-traumatic stress in this group,[31] using the Military Post Traumatic Stress Checklist (PCL-M). Factors associated with higher PCL-M scores were trauma exposure, older age, male gender, and being of Māori ethnicity. Factors associated with lower PCL-M scores were greater length of service, psychological flexibility, and better quality sleep. Using health as the outcome disclosed that Māori did not have poorer self-reported health compared to non-Māori, that deployment had a positive effect, and in the univariate models, all of the dimensions of social support were associated with improved health. The final model also included good sleep and psychological flexibility, providing most of the explanatory power in the model.

No other studies appear to have used the EQ-VAS as an outcome measure for Veteran health. Boehmer et al.[32] examined wellbeing among participants in the 2000 Behavioural Risk Factor Surveillance System describing health-related quality of life (HRQoL) by sex and military status, active duty, reservists Veterans, or no military service. Participants were asked to rate recent physical health, mental health, and activity limitation. Active duty men were more likely than men without military service to report 14 or more days of activity limitation, pain, and not enough rest in the past 30 days, the mobility and pain findings being similar to our sample. Notably, the predominant reason for medical discharge from the British Armed Forces was musculoskeletal problems.[33]

Contrary to our finding on deployment, there are reports indicating that non-deployed personnel retain better health than those who have been deployed. Diaz Santana et al.[34] having carried out a cross-sectional survey of 60,000 U.S. Veterans of Afghanistan and Iraq,

with 20,563 responses. In contrast to our finding, mental quality of life scores were higher among the non-deployed group compared to the deployed group, though the deployed group reported higher physical quality of life scores compared to the non-deployed. Again in contrast, both mental and physical quality of life were lower among Veterans compared to U.S. population norms.

Both positive and negative consequences of deployment have been described.[7,35] In a study of Dutch Veterans,[7] two out of three reported a positive effect of deployment on their quality of life at the time of the survey, this being related to positive feelings such as satisfaction or comradeship, but a few having emotions such as frustration or shame. As regards tangible effects,[35] negative consequences included the military 'chain of command', being away from home, and deterioration of marital/significant other relationships. Positive influences include improved financial security, self-improvement, and time to reflect.

We found sleep to be associated with better health, but sleep difficulties are a common symptom for those with PTSD. McCarthy et al.[36] reported on the 3,157 U.S. military Veterans enrolled in the National Health and Resilience in Veterans Study, in which 27.6% reported poor sleep quality. Path analyses revealed significant associations between poor sleep, severity of PTSD, poorer mental and physical health functioning and lower overall quality of life.

Future directions

The results suggest that distress, psychological flexibility, and sleep have an important relationship with self-rated health among Veterans in this study.

Reducing distress through the promotion of psychological flexibility might be possible, although our finding here must be subject to caution as several researchers argue that the AAQ-II may be measuring psychological distress and affect rather than psychological inflexibility.[37]

Sleep in military personnel has been recognised as a 'vital health behaviour' for which policies and guidelines must be developed.[38] Cognitive behavioural therapy for insomnia (CBT-I) is regarded as an effective 'first line' treatment, and a brief intervention has been described for use in Australian general practice.[39]. Our final model showed that distress had a negative association with health, and psychological flexibility had a positive relationship, with sleep most likely related to both of these variables. It would seem important to screen for these conditions prior to transition from the military, as well as among retired Veterans, in order to

provide targeted support. Further research is needed to examine the potential of cognitive behavioural therapy to improve Veterans' wellbeing.

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DATA SHARING STATEMENT

Data from this study is unsuitable for public deposition due to the privacy of participant data. Data are anonymised, but contain information on deployments (including location and duration), which could lead to some participants being identified. Furthermore, the participant information sheet, as required by the Southern Health and Disability Ethics Committee specifically contains the statement that 'all study data would be kept strictly confidential to the research team.' Some instruments used in the survey may be copyright. Qualified researchers may apply for data access and a copy of the survey by contacting the research team at veterans.health@otago.ac.nz and/or hdecs@moh.govt.nz.

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COMPETING INTERESTS

None declared.

CONTRIBUTION

All the authors have made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND

Drafting the work or revising it critically for important intellectual content; AND

Final approval of the version to be published; AND

Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Specific responsibilites

Investigation: Amy Richardson, Emma H. Wyeth, Sarah Derrett, Daniel Shepherd, David McBride.

Methodology: Amy Richardson, Ari Samaranayaka, Dianne Gardner, Emma H. Wyeth, Sarah Derrett, David McBride, Daniel Shepherd.

Project administration: Amy Richardson.

Resources: Brandon de Graaf.

Software: Brandon de Graaf.

Supervision: Ari Samaranayaka.

Validation: Amy Richardson.

Visualization: Amy Richardson.

Writing – original draft: David McBride. AS, DG, EHW, SD and DS contributed to the re-writes and final draft.

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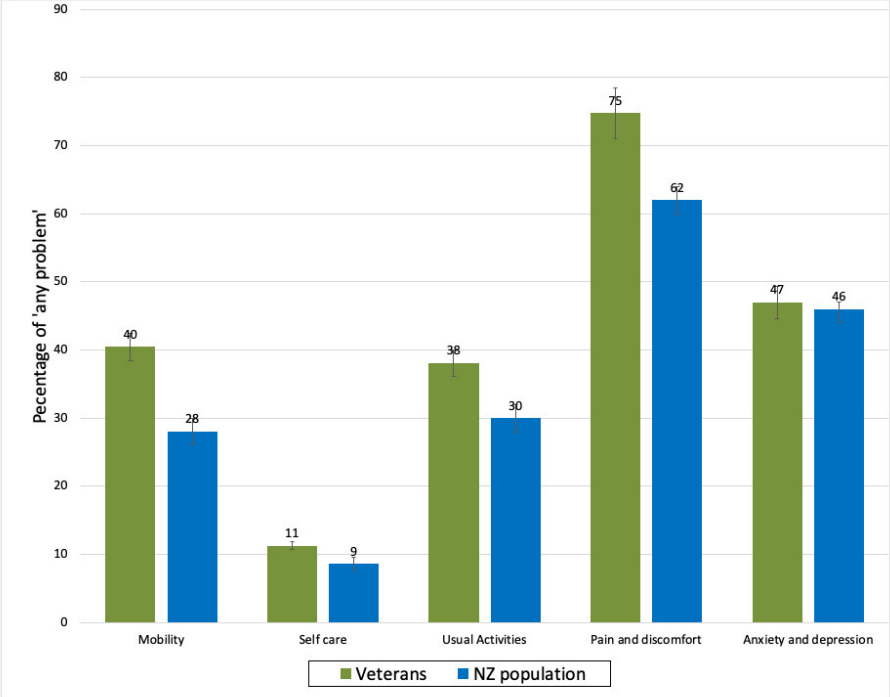
Finally, a thank you to the New Zealand Veterans who took the time and effort to complete a rather tedious questionnaire. Kia Kaha.

Figure 1 Caption.

The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions



The proportion of Veterans reporting 'any problem' with each of the EQ-5D-5L dimension scores compared to the NZ population normative proportions

86x65mm (300 x 300 DPI)

Supplementary Table: Number of participants and EQ-VAS scores according to sample characteristics

Exposure variable	N (%)		Mean (SD)
All	1767		74.4 (17.1)
Age group (years)			
20-29	136	(7.7)	77.7 (14.4)
30-39	328	(18.6)	77.0 (16.2)
40-49	438	(24.8)	76.1 (14.6)
50-59	350	(19.8)	74.8 (16.6)
60-69	285	(16.1)	71.4 (19.8)
70-79	175	(9.9)	69.4 (19.4)
80+	50	(2.8)	66.2 (20.3)
Missing	5	(0.3)	61.2 (22.1)
Gender			
Female	220	(12.5)	75.0 (16.9)
Male	1520	(86.0)	74.4 (17.2)
Missing	27	(1.5)	70.3 (17.2)
Ethnicity (prioritised)			
NZ European	1382	(78.2)	74.4 (17.1)
Māori	245	(13.9)	75.6 (16.1)
Other	140	(7.9)	71.5 (19.3)
Service years			
0-9	339	(19.2)	69.9 (19.7)
10-19	478	(27.1)	74.5 (17.9)
20-29	530	(30.0)	75.3 (15.9)
30-39	254	(14.4)	76.3 (14.6)
40+	69	(3.9)	75.4 (16.4)
Missing	97	(5.5)	78.8 (14.2)
Deployment (ever)			
No	288	(16.3)	69.5 (19.9)
Yes	1458	(82.5)	75.3 (16.4)
Missing	21	(1.2)	75.6 (14.6)
GHQ12 Score			
0-9	652	(36.9)	82.0 (12.6)
10-19	972	(55.0)	72.3 (16.0)
20-29	123	(7.0)	54.3 (20.3)
30+	18	(1.0)	46.2 (24.4)
Missing	2	(0.1)	-

*sub-scores not used in multivariable models.

Supplementary table contd.

Social support full score			
24-29	0	0	-
30-39	3	(0.2)	66.7 (15.3)
40-49	15	(0.8)	44.5 (22.5)
50-59	97	(5.5)	62.4 (21.8)
60-69	351	(19.9)	69.0 (18.2)
70-79	643	(36.4)	75.1 (15.0)
80-89	409	(23.1)	78.0 (15.0)
90-96	235	(13.3)	81.9 (13.9)
Missing	14	(0.8)	58.1 (25.6)
Social support sub-scores			
Attachment*			
4-7	51	(3.5)	61.4 (23.4)
8-11	516	(29.2)	68.7 (18.0)
12-16	1193	(67.5)	77.5 (15.5)
Missing	7	(0.4)	61.0 (19.7)
Social integration*			
4-7	20	(1.1)	56.2 (25.1)
8-11	429	(24.3)	67.1 (19.4)
12-16	1309	(74.8)	77.1 (15.2)
Missing	9	(0.5)	58.7 (21.5)
Reassurance of worth*			
4-7	37	(2.1)	59.1 (19.5)
8-11	504	(28.5)	69.0 (19.1)
12-16	1215	(68.8)	77.2 (15.2)
Missing	11	(0.6)	62.0 (24.9)
Reliable Alliance*			
4-7	20	(1.1)	49.6 (22.2)
8-11	251	(14.2)	66.9 (20.1)
12-16	1489	(84.3)	76.0 (15.9)
Missing	7	(0.4)	61.0 (19.7)
Guidance sub-score*			
4-7	36	(2.0)	59.2 (22.2)
8-11	387	(21.9)	68.7 (18.9)
12-16	1337	(75.7)	76.6 (15.7)
Missing	7	(0.4)	54.6 (21.6)
Opportunity for nurturance*			
4-7	29	(1.6)	69.3 (18.9)
8-11	413	(23.4)	71.9 (18.8)
12-16	1316	(74.5)	75.4 (16.4)
Missing	9	(0.5)	58.7 (21.5)

Supplementary table, contd.

Psychological flexibility score (AAQii score).			
10-19	5	(0.3)	23.2 (13.8)
20-29	40	(2.3)	49.1 (22.1)
30-39	147	(8.3)	63.0 (18.6)
40-49	43	(24.7)	68.5 (16.8)
50-59	664	(37.6)	77.1 (13.9)
60-70	457	(25.9)	82.5 (13.5)
Missing	1	(1.0)	69.6 (20.5)
Sleep Condition Indicator (SCI score			
0 to <2	67	(3.8)	51.2 (22.3)
2 to <4	264	(14.9)	62.2 (19.5)
4 to <6	646	(36.6)	74.3 (14.6)
6 to <8	384	(21.7)	77.6 (14.2)
8 to 10	386	(21.8)	83.5 (12.2)
Missing	20	(1.1)	77.3 (12.8)
AUDIT-C score			
Non-hazardous	776	(43.9)	74.0 (17.4)
Hazardous	915	(51.8)	74.6 (16.9)
Missing	76	(4.3)	75.0 (17.0)
Brief Trauma Questionnaire (DSM-IV criteria)			
Not exposed	544	(30.8)	78.3 (15.1)
Exposed	1210	(68.5)	72.5 (17.8)
Missing	13	(0.7)	80.6 (8.1)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation
Title and abstract	1	Indicate the study's design with a commonly used term in the title or the abstract. **Yes, a cross sectional study, p1 title.**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found **Background, results and conclusions, p 1**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported **Introduction p2.**
Objectives	3	State specific objectives, including any prespecified hypotheses **p2, lines 59 and 60**
Methods		
Study design	4	Present key elements of study design early in the paper p**2 line 62 to page 5 line 145**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection **Participants, page2 line 63-page 3 line 83.**
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants **page 2 line 64 to page 3, line 68.**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable **Questionnaire, pp 3-5.**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group **as above**
Bias	9	Describe any efforts to address potential sources of bias **Methods, page 3. Lines 76-83.**
Study size	10	Explain how the study size was arrived at **p5 line 137**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Cases defined through the **Multivariable logistic regression with the EQ-Visual analogue scale as the outcome measure, p5 lines 131-136**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding **Backward elimination process p5 lines 134-135**
		(*b*) Describe any methods used to examine subgroups and interactions **By multivariable logistic regression, p5 as above**
		(*c*) Explain how missing data were addressed **p4 lines 122-125**
		(*d*) If applicable, describe analytical methods taking account of sampling strategy N/A
		(*e*) Describe any sensitivity analyses N/A
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed **Potentially eligible lines 68-73 p 3**
		(b) Give reasons for non-participation at each stage N/A
		(c) Consider use of a flow diagram N/A

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders **page 5 et seq, table 1**
		(b) Indicate number of participants with missing data for each variable of interest '**n used' columns tables 2 and 3.**
Outcome data	15*	Report numbers of outcome events or summary measures **as per tables**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included **Tables, adjusted for age, sex, service years and deployment status.**
		(*b*) Report category boundaries when continuous variables were categorized. **Independent variables, p 3 and 4, EQ-VAS is a continuous scale**.
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period **N/A**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses **N/A**
Discussion		
Key results	18	Summarise key results with reference to study objectives **Discussion, p11 first para**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias **Discussion lines 215 et seq.**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence **Discussion, p12 lines 230 et seq.**
Generalisability	21	Discuss the generalisability (external validity) of the study results **p17, line 215 et seq.**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based **Funding, p18**

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.