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Long-term mental health outcomes of military service: national linkage study of 57,000 veterans and 173,000 matched non-veterans.

Short running title: Long-term mental health and military service

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ABSTRACT

Objective

We used data from the Scottish Veterans Health Study to examine long-term mental health outcomes in a large cohort of veterans, with a focus on the impact of length of service.

Methods

We conducted a retrospective, 30-year cohort study of 56,205 veterans born 1945-1985, including 14,702 who left prematurely, and 172,741 people with no record of military service, using Cox proportional hazard models, to examine the association between veteran status, length of service and cumulative risk of mental health disorder. We stratified the veterans by common lengths of service, defining 'early service leavers' as those who had served for less than 2.5 years.

Results

There were 2,794 (4.97%) first episodes of any mental health disorder in veterans, compared with 7,779 (4.50%) in non-veterans. The difference was statistically significant for all veterans (adjusted HR 1.21, 95% CI 1.16-1.27, $P < 0.001$). Sub-group analysis showed the highest risk to be in early service leavers (adjusted HR 1.51, 95% CI 1.30-1.50, $P < 0.001$), including those who failed to complete initial training. The risk reduced with longer service; beyond nine years' service, it was comparable to or lower than non-veterans.

Conclusions

The veterans at highest risk of mental health disorder were those who did not complete training or minimum engagement, whilst those with longest service were at reduced risk, suggesting that military service was not causative. The high risk among the earliest leavers may reflect pre-service vulnerabilities not detected at recruitment, which become apparent during early training and lead to early discharge.

KEYWORDS

Military veterans

Mental health

Early Service Leavers

Healthy worker effect

Retrospective cohort studies

INTRODUCTION

In the UK Armed Forces, veteran status is conferred by a minimum of one day's service, requiring neither participation in operational service nor completion of initial training.

Currently around 22,000 people leave the Armed Forces each year, of whom about 15% fail to complete initial training¹, and others leave before completing their minimum term of engagement. Periods of service range from a single day to over 40 years. The majority of veterans do well after discharge, with only a minority developing mental health problems².

However, analysis of the 2007 Adult Psychiatric Morbidity Survey of England³ suggested that UK veterans who leave early (designated by the Ministry of Defence as Early Service Leavers, or ESL) may be at increased risk of poor mental health outcomes. The reasons for this are unclear and quantitative research remains limited; that study was based on only 98 ESL, while Buckman et al. examined 80 leavers identified as ESL⁴. Although low rank (which is generally associated with shorter service) has been shown to be a risk factor for adverse mental health outcomes⁵, we have not identified any studies which have specifically examined an association between length of service and veterans' long-term health.

The Scottish Veterans Health Study cohort includes over 14,000 ESL, recruited over a period of 50 years and followed up for up to 30 years. Comparison of their mental health with that of both longer-serving veterans and with non-veterans was used to explore possible explanations for their poorer outcomes.

METHODS

The Scottish Veterans Health Study is a retrospective cohort study of all 56,570 military veterans resident in Scotland who were born between 1945 and 1985 and who were registered with National Health Service (NHS) Scotland both before and after service, and a comparison group of 172,753 individuals with no record of service matched 3:1 for age, sex and postcode sector of residence (mean population 5,000). The study cohort and methods have been described in detail elsewhere⁶. Demographic data obtained from electronic NHS registration records were linked at an individual level to routine hospital admissions data (Scottish Morbidity Record SMR01), mental health inpatient and hospital day-case records (SMR04) and death certificates to provide information on the first episode of a wide range of physical and mental conditions and all-cause death. For the purposes of this study we have defined incidence of 'any mental health disorder' as day-cases (attending for treatment on a daily basis), in-patient hospitalisation or death, due to anxiety disorders, including PTSD (ICD-10 F40-F48 and ICD-9 300 & 308-309), mood disorders (ICD-10 F30-F39 and ICD-9 296), and psychosis (ICD-10 F20-F29 and ICD-9 295, 297 & 298). Quintiles of socio-economic status (SES) were assigned by postcode of residence, based on the Scottish Index of Multiple Deprivation (SIMD) (<http://www.scotland.gov.uk/Topics/Statistics/SIMD>). We obtained published data on recruit intake and outflow from Defence Health (Statistics), and obtained aggregated data on Army failures to complete initial training from the Army Medical Directorate.

The electronic NHS record provided dates of entering and leaving military service. The maximum period of follow-up was from 1 January 1981 (or date of leaving the Service, for veterans, if later) to 31 December 2012. The data extract was pseudo-anonymised and

approval for the study was granted by the Privacy Advisory Committee of the Information Services Division of NHS Scotland.

Definition of Early Service Leavers (ESL)

The minimum period of military service has changed over time, and also varies between Services (Naval Service, Army, Royal Air Force), but has never been less than 3 years during the period covered by our study. Therefore, we applied a cut-off of 2.5 years to define ESL strictly. We pragmatically defined failure to complete initial training as a period of service less than 0.4 years. We defined 'non-ESL' as serving for more than 3.5 years so as not to exclude all those who completed a nominal 4-year engagement whilst allowing for some variability in the dates of joining and leaving. A total of 38,321 veterans (68.2%) met this definition. We excluded 3,182 (5.7%) veterans with between 2.5 and 3.5 years' service from analyses requiring ESL status, as their ESL/non-ESL status could not be inferred with confidence.

Statistical analyses

Cox proportional hazard models were used to examine the association between veteran status and cumulative risk of mental health disorder, using age as the time dependent variable and age at first episode or death (if no mental health disorder) as the censor time. The models were run for each of the three mental health disorder groups separately and then for any mental health disorder. The *a priori* rejection level was set at 0.05. Cox proportionality assumptions were tested using methodology based on Schoenfeld residuals⁷. The models were run univariately and then repeated adjusting for the potential confounding

effect of socio-economic status. The analyses were repeated, for each disease group, stratifying by length of service in three subgroups to examine the effects of failure to complete initial training and failure to complete a minimum term of military engagement. A further analysis was performed for any mental health disorder by length of military service, categorised into the common terms of engagement. Mean age at entry for each length of service group was calculated, and compared using one-way ANOVA. All analyses were performed using Stata v12.1 (©1985-2011 StataCorp).

RESULTS

Main Findings

After data cleansing, 56,205 (99.3%) veterans and 172,741 (99.9%) non-veterans were included in the analysis. Of the veterans, 5,235 (9.3%) were women, reflecting the gender balance of the Service population. The mean period of follow-up was 29.3 years, with a total of 6.7 million person-years of follow-up among veterans and non-veterans combined. Among the veterans, there were 14,702 (26.2%) who met the definition of ESL. Of these, 5,854 (39.8%) did not complete initial training, comprising 10.4% of all veterans. The mean length of service of all ESL was 0.78 years (SE 0.006) and the median was 0.58 (IQR 0.16-1.33) years. Twenty-two percent of ESL, or 55% of those who failed to complete initial training, were discharged in the first few days of service. The mean age at recruitment for all ESL was 20.4 years (SE 0.05), whilst for those who left prior to completing initial training, it was 21.7 years (SE 0.08). Non-ESL had a mean age at entry of 19.1 years (SE 0.02), whilst for those with more than 12 years' service, it was 18.9 years (SE 0.04). The difference was highly significant, $P < 0.001$. ESL were more likely than either non-ESL or non-veterans to live in the most deprived areas (Table 1 and Figure 1).

Mental Health Outcomes

There were 2,794 (4.97%) first episodes of any mental health disorder recorded in veterans, compared with 7,779 (4.50%) in non-veterans. The difference was statistically significant (adjusted hazard ratio (HR) 1.21, 95% CI 1.16-1.27, $P < 0.001$). Sub-group analysis by ESL status showed the increased incidence to be confined to ESL, both for any mental health disorder and for the three diagnostic groups (Table 2). There was a strong association

between any mental health disorder, ESL status and deprivation (Figure 2). For all ESL, the adjusted HR for any mental health diagnosis was 1.51 (95% CI 1.30-1.50, $P < 0.001$) compared with all non-veterans, and for those who did not complete initial training, it was similar (Table 2). For all non-ESL analysed together, there was no increased risk of any mental health disorder (adjusted HR 1.03, 95% CI 0.97-1.09, $P = 0.277$) although sub-group analysis by length of service showed that those in the junior years of service exhibited a modest increase which had disappeared beyond 9 years of service. When stratified by length of service categorised by common terms of engagement, there was a decrease in risk of any mental health disorder with increasing length of service. Those with the longest service experienced a lower risk of mental health disorder than non-veterans (Figure 3). The Cox proportional hazard model demonstrated the decrease in hazard ratio with increasing length of service, those with the longest service showing a reduction in risk compared with non-veterans which was statistically significant for 10-12 years' service and for over 22 years' service (Table 3). When stratified by sex, the risk of any mental health disorder showed a similar pattern in men and women although the overall risk in non-ESL women was non-significantly lower than in all non-veteran women. The increase in risk was higher in ESL women who left before completion of initial training than in those who had completed training. There was a small overall increase in the risk of mental health disorder in non-ESL men compared with non-veteran men (adjusted HR 1.07, 95% CI 1.01-1.40, $P = 0.029$) (Table 4).

DISCUSSION

Using data from the Scottish Veterans Health Study, in a large sample of veterans spanning over 50 years of service and followed up for up to 30 years, we found that there was an overall increased risk of diagnosis of a mental health disorder, of sufficient severity to result in hospital day-care, hospitalisation or death, when compared with age, sex and geographically matched non-veterans. However, sub-group analysis of mental health disorders by length of service identified that premature leavers were at greatest risk. The risk decreased with increasing length of service and the longest-serving veterans had a lower risk than non-veterans. Those who left early were older at entry to the Armed Forces than those who had the longest careers; this may reflect differences in employment history and potential, although we had no data on pre-Service employment status.

When stratified by sex and ESL status, women who did not complete training had the greatest increase in risk of a mental health disorder. Overall however, women veterans had no increased risk of a mental health problem compared with non-veterans, as the increased risk seen in ESL women was balanced by the reduction in risk in women who had completed the minimum engagement. There was only a small overall increase in risk of a mental health disorder in non-ESL male veterans. The reasons for the gender differences are unclear, but may include differences in the proportion discharged for disciplinary reasons as some women would have been discharged as a result of pregnancy .

The UK definition of 'veteran' status, requiring only a single day's service and recognising the commitment to serve, is one of the most inclusive in the world⁸. There are many reasons for failure to complete training, or for leaving early, including personal choice,

family reasons, inadequate fitness, disciplinary problems, or temperamental unsuitability⁹. Around 25% of all failures to complete initial training are for medical reasons, and some 6% of those discharged during training (23% of all who leave for medical reasons) have been found to have failed to declare pertinent medical history which would have precluded enlistment, but which comes to light under the rigours of training. Injury or illness in training may also preclude completion. Not all premature discharges increase the risk of adverse long-term health outcomes. Those who did not complete training will never have deployed, although trained premature leavers may have done so.

'Healthy Workers' and 'Less Healthy Leavers'

The association between continued employment and reduced mortality has long been recognised, and has been termed the 'healthy worker effect'¹⁰. The healthy worker effect is strongest in those occupations which are the most physically demanding¹¹. Continued good health is a prerequisite to remaining in service; the term 'healthy warrior' acknowledges this as a potential source of bias in studies comparing military personnel who are deployed to a war zone and those who are not deployed for health reasons¹², although the 'healthy warrior effect' differs from the 'healthy worker effect' in that it is predominantly used to refer to psychiatric diagnoses. Larson et al. suggested that the initial months of training act as a *de facto* screening mechanism, whereby recruits with mental illness are least likely to continue in service^{13,14}. This suggestion is supported by our findings, that long-term mental health is poorest amongst those who leave the Armed Forces earliest, and that those who serve longest have a reduced risk of mental health conditions in comparison with members

of the wider community. In addition to carrying a greater burden of latent ill-health owing to pre-Service factors⁴, ESL have also served for too short a period to have benefited from in-service health promotion. Those who leave earliest therefore include a disproportionate number of 'less healthy leavers', whose long-term health experience we have shown to be less favourable.

The recruit selection process has changed over the long period encompassed by this study, from a relatively crude exclusion of those with gross problems in the 1960s through to the more recent scientifically validated battery of physical tests and medical examinations based on modern occupational health screening^{15,16}. The aim has been to minimise losses through injury¹⁷, although concealed conditions such as asthma remain common¹⁸. Effective screening for mental robustness has proved much more difficult to implement. Jones et al. conducted an historical review of screening for psychological disability or vulnerability from World War 1 onwards and found that the sensitivity and specificity of screening were low in relation to both future performance as a soldier and prediction of mental vulnerability¹⁹. In a questionnaire-based study of UK personnel deployed to the Iraq war, Rona et al. concluded there was little evidence to support pre-deployment psychological screening to prevent mental disorders, as both positive and negative predictive values were low²⁰.

It is therefore inevitable that each intake of recruits includes a number of people who have latent mental health conditions, or have concealed a mental health history. The stress of cultural readjustment which is an intrinsic concomitant of recruit training²¹ will inevitably cause some of these problems to become manifest, often resulting in early discharge. It is therefore plausible that latent or concealed mental health problems will be over-represented among ESL. Further selective discharge of those who are unsuited to service

takes place throughout this period, although skewed towards the early months of service. This 'multilayered selection process' has been described by Hyams²². Concurrently, the level of latent mental ill-health in the still-serving population reduces. Those discharged for disciplinary reasons may be especially likely to develop later mental health problems; in a follow-back of a longitudinal cohort, Kim-Cohen et al. found a history of juvenile conduct or behavioural disorder in 25%-60% of adults with mental health disorders²³.

We therefore postulate that the poorer long-term health of Early Service Leavers represents the inverse of the 'healthy worker effect' – a 'less healthy leaver effect' which arises from selectively following up a sub-group of whom many have left for health or behavioural reasons. This hypothesis is consistent with, and explains, the results of Jones et al.'s study of 8,261 UK military personnel which demonstrated, in a multiple logistic regression analysis, that having left service was the greatest contributor to risk of possible PTSD; other factors being low rank, a history of accident and major childhood adversity. The authors suggested that a possible reason may have been a greater willingness to seek care after discharge²⁴; however Brewin et al. have recently demonstrated that the majority (81%) of veterans who experienced PTSD symptoms during service had received medical care in-service²⁵, whilst we have shown that the health potential of ESL is influenced by selective discharge of those least suited to service. Status as a veteran means that these 'occupational leavers' are identifiable within the community and that their long-term health outcomes can be studied.

Strengths and limitations

The major strength of this present study is that it was based on a large cohort covering the whole of Scotland, giving unprecedented access to data on over 14,000 ESL, and almost

3,000 veterans with a mental health diagnosis, over a period of around 30 years follow-up. The veterans served over the period 1960-2012, encompassing a wide range of deployments in those who completed training. The ESL were able to be subdivided into those who did not complete initial training, and those who were trained but left before completion of the minimum engagement. The results were able to be matched or adjusted for confounders including sex and regional SES, and compared with non-veterans. It was possible to do subgroup analysis by sex, and length of service, greatly adding to the existing quantitative data on ESL. Consistency of the findings in respect of ESL with earlier small studies indicates that the results are unlikely to have arisen by chance. The overall reducing risk with increasing length of service indicates that the multiple comparisons problem should not be considered as explaining our findings.

Limitations of the study include possible loss to follow-up of subjects due to migration away from Scotland, for which no data are available, and the lack of any follow-up data prior to 1 January 1981. Mental health conditions diagnosed and treated solely in primary care could not be identified and were therefore not included; therefore, our data reflect the more severe end of the spectrum of mental health disorders. No information was available on mental health conditions occurring in service as we were unable to link to military health records; conditions persisting into the veteran period would not have been picked up until first presentation to the NHS. We used a cut-off of 2.5 years to define ESL. This is a tighter definition than many recent studies which have defined ESL as serving for less than 4 years, but this cut-off would have erroneously categorised many older veterans in our cohort who had completed the earlier 3-year minimum engagement. Some veterans whose ESL status

could not be determined with confidence have been omitted from the sub-group analysis. The 'best fit' definition of length of initial training as 0.4 years will have resulted in some people being incorrectly classified. Veterans with Reserve service only could not be identified from NHS records and would have been included amongst the non-veterans. Any effect would have been to under-estimate observed differences between veterans and non-veterans. Data on combat exposure in the veterans were not available. No information was available on the service to which a veteran had belonged (Army, Royal Navy or Royal Air Force), and rates of mental health disorders have been shown in other studies to differ between the three Services²⁶.

Summary

Our findings show that although overall, veterans are at higher risk of subsequent mental health disorders than the wider population, the increased risk occurs predominantly in veterans with the shortest service. Neither deployment nor combat can be causal in those who did not complete training. Early training acts to screen out recruits who have latent or concealed mental health problems. People who have longer service demonstrate better long-term mental health despite being more likely to have experienced multiple deployments. Older age at recruitment is a risk factor for leaving prematurely. Failure of some previous studies to differentiate between veterans according to length of service may have resulted in some mental ill-health in veterans being inappropriately ascribed to military service; this has implications for care.

CLINICAL POINTS

- It is widely believed that combat is the most important cause of mental health disorders in veterans.
- When treating veterans with mental health disorders, always explore pre-service factors, as mental health problems are most likely in veterans who left before completing training , who could not have been in combat.

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Table 1. Socioeconomic distribution of non-veterans, Early Service Leavers and other veterans

| SIMD quintile | Non-veterans n (%) | All veterans n (%) | Non-ESL veterans n (%) | ESL veterans n (%) | Failed initial training n (%) |
|--------------------|-----------------------|-----------------------|------------------------------|-----------------------|-------------------------------------|
| 1 (most deprived) | 34,116 (19.8) | 11,880 (21.3) | 7,328 (19.3) | 3,756 (25.7) | 1,433 (24.6) |
| 2 | 35,279 (20.5) | 12,228 (21.9) | 7,984 (21.0) | 3,492 (23.9) | 1,367 (23.5) |
| 3 | 36,454 (21.2) | 11,882 (21.3) | 8,330 (21.9) | 2,906 (19.9) | 1,147 (19.7) |
| 4 | 36,544 (21.2) | 11,373 (20.4) | 8,247 (21.7) | 2,574 (17.6) | 1,080 (18.6) |
| 5 (least deprived) | 29,971 (17.4) | 8,468 (15.2) | 6,163 (16.2) | 1,889 (12.9) | 796 (13.7) |

SIMD Scottish Index of Multiple Deprivation; ESL Early Service Leaver

Table 2. Incident mental health disorders among non-veterans, Early Service Leavers and other veterans

| Diagnosis | Non-veterans n=172,741 (100%) | All veterans n=56,205 (100%) | Non-ESL veterans n=38,321 (100%) | All ESL veterans n=14,702 (100%) | Failed initial training n=5,854 (100%) |
|----------------------------|-------------------------------------|---------------------------------|-------------------------------------|-------------------------------------|---|
| Any mental health disorder | 7,779 (4.50) | 2,794 (4.97) | 1,526 (3.38) | 1,063 (7.23) | 423 (7.23) |
| Anxiety | 3,512 (2.03) | 1,415 (2.52) | 765 (2.00) | 551 (3.75) | 215 (3.67) |
| Mood disorder | 4,371 (2.53) | 1,578 (2.81) | 874 (2.28) | 593 (4.03) | 242 (4.13) |
| Psychosis | 1,867 (1.08) | 537 (0.96) | 257 (0.67) | 225 (1.53) | 92 (1.57) |

ESL Early Service Leaver

Table 3. Cox proportional hazard model of the association between veteran status and length of service, and any mental health disorder

| Length of service ^a | Univariate | | | Multivariate ^b | | |
|--------------------------------|------------|-----------|----------------|---------------------------|-----------|----------------|
| | HR | 95% CI | <i>P</i> value | HR | 95% CI | <i>P</i> value |
| Basic training only | 1.63 | 1.47-1.80 | <0.001 | 1.51 | 1.37-1.67 | <0.001 |
| Up to 3 years | 1.62 | 1.51-1.74 | <0.001 | 1.48 | 1.37-1.59 | <0.001 |
| 4-6 years | 1.30 | 1.19-1.42 | <0.001 | 1.21 | 1.11-1.32 | <0.001 |
| 7-9 years | 1.18 | 1.05-1.31 | 0.004 | 1.13 | 1.01-1.26 | 0.027 |
| 10-12 years | 0.86 | 0.74-1.00 | 0.049 | 0.84 | 0.73-0.98 | 0.028 |
| 13-16 years | 0.99 | 0.84-1.17 | 0.908 | 0.97 | 0.82-1.14 | 0.724 |
| 17-22 years | 0.85 | 0.70-1.05 | 0.128 | 0.90 | 0.73-1.10 | 0.289 |
| 23 years and over | 0.59 | 0.47-0.75 | 0.000 | 0.67 | 0.53-0.84 | 0.001 |

^a Categories are common lengths of military engagement

^b Adjusted for Scottish Index of Multiple Deprivation quintile HR: hazard ratio; CI: confidence intervals

Table 4. Cox proportional hazard model of the association between veteran status and stage of discharge from Armed Forces, and any mental health disorder referent to all non-veterans, overall and by sex

| | | Univariate | | | Multivariate ^a | | |
|---------|----------------|------------|-----------|---------|---------------------------|-----------|---------|
| | | HR | 95% CI | P value | HR | 95% CI | P value |
| Overall | All veterans | 1.27 | 1.21-1.33 | <0.001 | 1.21 | 1.16-1.27 | <0.001 |
| | Non-ESL | 1.06 | 1.00-1.12 | 0.066 | 1.03 | 0.97-1.09 | 0.277 |
| | ESL | 1.65 | 1.54-1.76 | <0.001 | 1.51 | 1.42-1.61 | <0.001 |
| | Basic training | 1.63 | 1.47-1.80 | <0.001 | 1.51 | 1.37-1.67 | <0.001 |
| Men | All veterans | 1.30 | 1.24-1.37 | <0.001 | 1.24 | 1.18-1.30 | <0.001 |
| | Non-ESL | 1.10 | 1.03-1.16 | 0.003 | 1.07 | 1.01-1.14 | 0.029 |
| | ESL | 1.68 | 1.57-1.81 | <0.001 | 1.54 | 1.43-1.65 | <0.001 |
| | Basic training | 1.63 | 1.46-1.81 | <0.001 | 1.51 | 1.35-1.68 | <0.001 |
| Women | All veterans | 1.08 | 0.94-1.24 | 0.278 | 1.06 | 0.92-1.21 | 0.429 |
| | Non-ESL | 0.83 | 0.67-1.03 | 0.089 | 0.85 | 0.68-1.05 | 0.126 |
| | ESL | 1.41 | 1.18-1.67 | <0.001 | 1.32 | 1.11-1.58 | 0.002 |
| | Basic training | 1.62 | 1.24-2.10 | <0.001 | 1.53 | 1.18-2.00 | 0.02 |

^a Adjusted for Scottish Index of Multiple Deprivation quintile

HR: hazard ratio; CI: confidence intervals; ESL: Early Service Leaver;

Figures

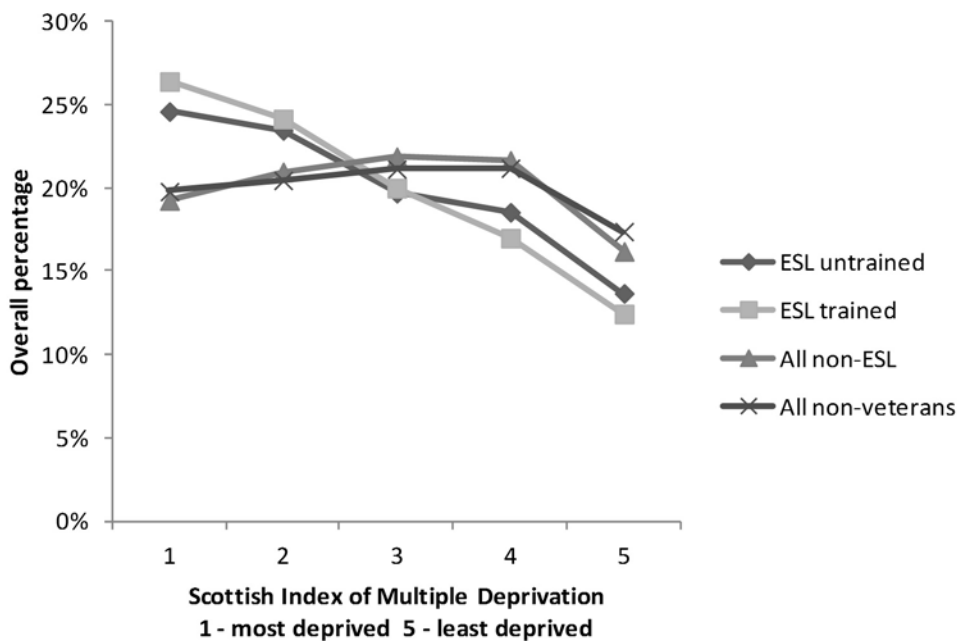


Figure 1. Scottish Veterans Health Study cohort, by socio-economic status and veteran/leaver category

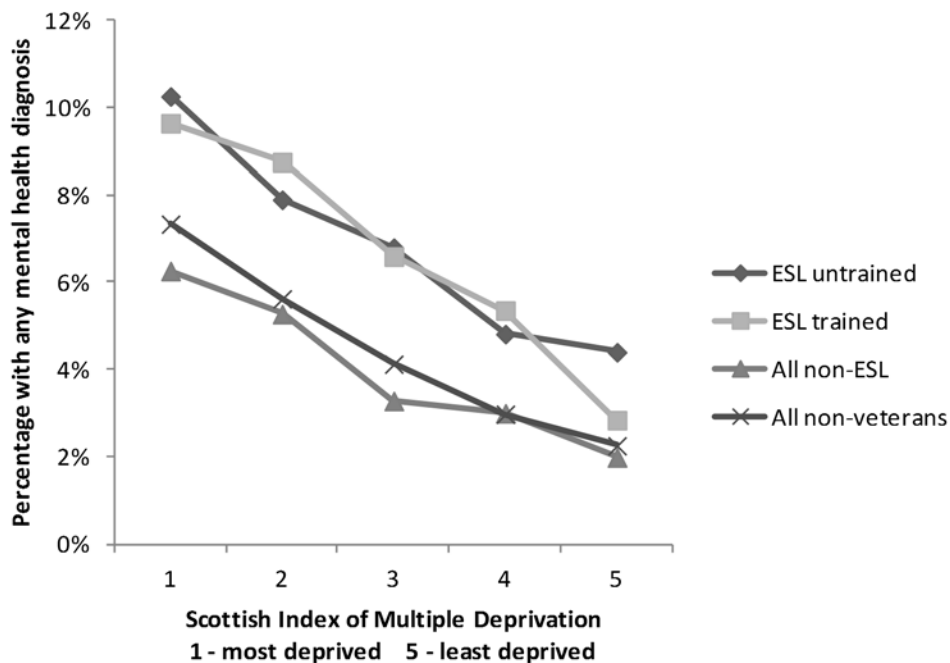


Figure 2. Scottish Veterans Health Study. Mental health diagnoses overall, by socio-economic status and veteran/leaver category

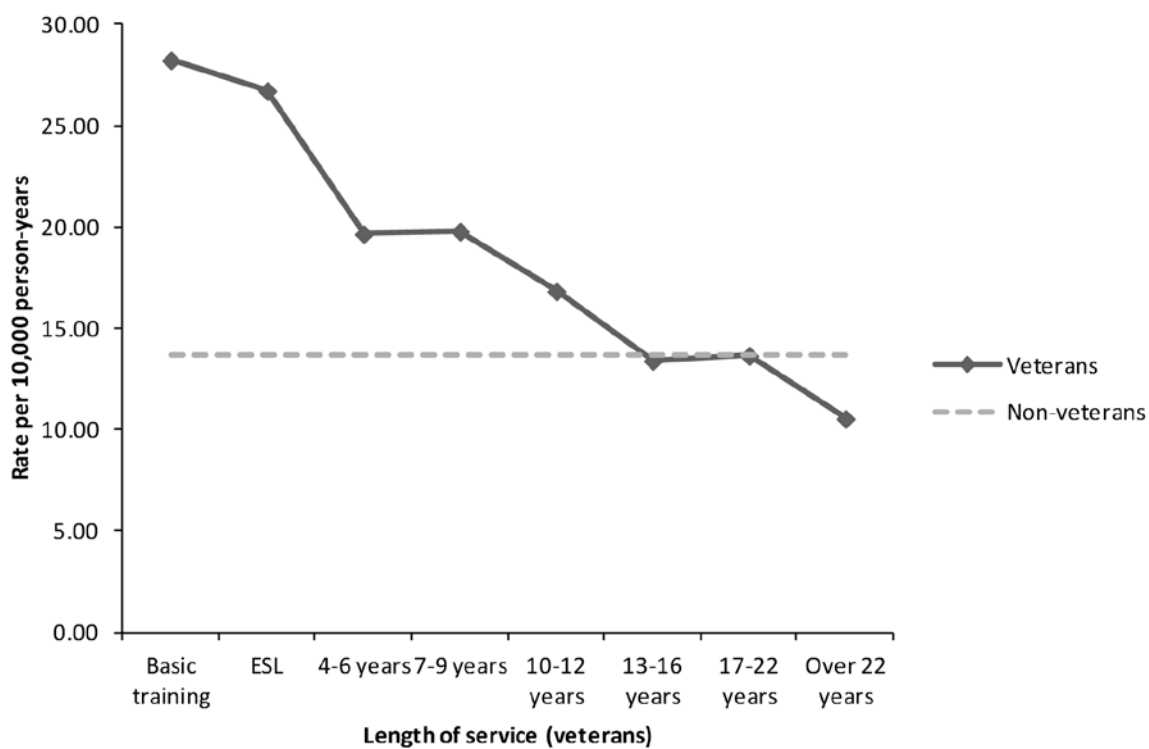


Figure 3. Scottish veterans Health Study. Incidence of mental health disorder by length of service. All non-veterans for comparison