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Healthy workers or less healthy leavers? Mortality in military veterans

Authors:

Beverly P Bergman
Ewan B MacDonald
Daniel F Mackay
Jill P Pell

Dr BP Bergman PhD
Institute of Health and Wellbeing, University of Glasgow, Glasgow G12 8RZ, UK
Beverly.bergman@glasgow.ac.uk

Prof EB MacDonald FFOM OBE
Institute of Health and Wellbeing, University of Glasgow, Glasgow G12 8RZ, UK
ewan.macdonald@glasgow.ac.uk

Dr DF Mackay PhD
Institute of Health and Wellbeing, University of Glasgow, Glasgow G12 8RZ, UK
Daniel.mackay@glasgow.ac.uk

Prof JP Pell MD
Institute of Health and Wellbeing, University of Glasgow, Glasgow G12 8RZ, UK
Jill.pell@glasgow.ac.uk

Corresponding Author:
Dr BP Bergman PhD
Institute of Health and Wellbeing
Public Health & Health Policy
1 Lilybank Gardens
Glasgow
G12 8RZ
United Kingdom

Telephone: (++)44 141 330 6482
Fax: Nil
E-mail: Beverly.bergman@glasgow.ac.uk

ABSTRACT

Background: The 'healthy worker effect' predicts that longer employment is positively associated with reduced mortality, but few studies have examined mortality in military veterans irrespective of exposure to conflict.

Aims: To examine mortality in a large national cohort of Scottish veterans by length of service.

Methods: Retrospective cohort study comparing survival in up to 30 years follow-up among 57,000 veterans and 173,000 people with no record of service, matched for age, sex and area of residence, who were born between 1945 and 1985. We compared antecedent diagnoses in the two groups to provide information on probable risk factors.

Results: By the end of follow-up, 3,520 (6%) veterans had died, compared with 10,947 (6%) non-veterans. Cox proportional hazard analysis confirmed no significant difference overall unadjusted or after adjusting for deprivation. On subgroup analysis, those who left prematurely (early service leavers) were at significantly increased risk of death, hazard ratio 1.16, 95% confidence intervals 1.09-1.24, $P<0.001$, although the increase became non-significant after adjusting for socio-economic status, hazard ratio 1.05, 95% confidence intervals 0.99-1.12. Longer-serving veterans were at significantly lower risk of death than non-veterans; the risk decreased both with length of service and in more recent birth cohorts. Smoking-related disease was the greatest contributor to increased mortality in early leavers.

Conclusion: Among longer-serving veterans, there was evidence of a 'healthy worker effect' partly attributable to selective attrition of early service leavers, but birth cohort analysis suggests improvements over time which may also reflect a causal effect of improved in-service health promotion.

KEY WORDS: Military veterans; epidemiology; mortality; healthy worker effect; occupational health

INTRODUCTION

The Armed Forces require serving personnel to be physically fit and mentally robust, but concerns have been expressed about a negative impact of military service on health, and a widespread belief has developed that those who have served are damaged by their experience and, as a consequence, have poorer health outcomes and higher mortality than the general population. Early conflict specific studies such as those which followed up veterans of the Vietnam War tended to reinforce that belief, [1-3] although more recent work on UK veterans by the King's Centre for Military Health Research, and our analysis of the Scottish Veterans Health Study dataset, suggest that there may be important subgroup differences within the veteran population. The excess risk of post-traumatic stress disorder has been shown to affect predominantly combat troops [4], while the increased risk of smoking-related disease may be a legacy of historically high smoking prevalence among the armed forces [5] and disproportionately affects those with the shortest service [6-8].

In the civilian sector, an association between continued employment and reduced mortality has been acknowledged for many years [9]. It was termed the 'healthy worker effect' (HWE) by McMichael and co-workers in 1974 [10], and was later defined by them as "the consistent tendency of the actively employed to have a more favorable mortality experience than the population at large"[11]. The HWE is strongest in those civilian occupations which are the most physically demanding [9,12], therefore it is plausible that a HWE should be apparent in the military. However, it has been suggested that the HWE may reflect selection and retention bias rather than a causal protective effect of working [13]. Since the military screens applicants for physical fitness at the time of recruitment, a HWE

resulting from selection bias might therefore be expected to be more apparent among military personnel [14].

Most studies on UK veterans have looked at short- to medium-term health outcomes [15] and few have examined mortality, other than in specific high-risk groups [16-19]. Among civilians, the HWE attenuates with time since first employment [12, 20] but the impact of length of military service on the long-term outcomes of UK veterans is not known. Therefore, we used data from the Scottish Veterans Health Study to examine mortality in a large national cohort of Scottish veterans whose length of service was known, compared with a matched group of civilians, in order to explore whether there was evidence of a HWE.

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 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). We examined health outcomes and mortality from 1 January 1981 (or date of leaving the Service for veterans, if later) to the date of death or 31 December 2012. We have previously described the characteristics of the study cohort and the methodology [6,21]. Approval for the study was granted by the Privacy Advisory Committee of the Information Services Division of NHS Scotland (PAC 27/12). At the time of requesting access to the data, NHS Scotland did not require individual consent since the project met Schedule 2 Section 5(d) and Schedule 3 Section 8(2) of the Data Protection Act 1998, thereby fulfilling the requirements for non-consented processing of sensitive personal data laid down in UK legislation.

We used Cox proportional hazard analysis to calculate hazard ratios (HRs) for death in veterans compared with people with no record of service, using age as the time-dependent variable, age at death as the failure time, and age at the end of follow-up (if no death) as the censor time. The *a priori* rejection level was set at 0.05. We tested Cox proportionality assumptions using methodology based on Schoenfeld residuals [22]. We ran the models univariately and then repeated the analysis adjusting for the potential confounding effect of socioeconomic status (SES). We also stratified by length of service to examine the effect of failure to complete the minimum term of military engagement (veterans classified by the Ministry of Defence as early service leavers (ESL)), and the impact of longer military service, comparing length of engagement subgroups against all non-veterans. We defined ESL as 2.5 years service or less, and failure to complete recruit training as 0.4 years service or less [23]. Our definition of ESL is tighter than that used in some other studies [24], to accommodate changes in the minimum length of service over the long period of this study. We excluded veterans with between 2.5 and 3.5 years service from subgroup analyses comparing the categories of ESL and non-ESL, as their ESL status could not be determined with confidence owing to these changes. We did not exclude this group from any other analyses. We examined birth cohort effects in 5-year categories. We performed all analyses using Stata v12.1® or Excel® 2007.

RESULTS

After data cleansing to remove incomplete and invalid records, we included 56,205 (99%) veterans and 172,741 (100%) non-veterans in the analysis. Of the 56,205 veterans included in the study, 5,235 (9%) were women, reflecting the gender balance of the Service

population. A total of 14,702 (26%) veterans met the definition of ESL, of whom 5,854 (40%) left before completing training and 8,848 (60%) were trained but left before the end of the minimum engagement, whilst ESL status could not be determined for 3,182 (6%) veterans. 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.

Over the period of follow-up, there were 3,520 (6%) deaths among veterans, compared with 10,947 (6%) deaths among non-veterans. The difference overall was not statistically significant, HR 1.02, 95% CI 0.98-1.06, in the univariate Cox model and HR 0.97, 95% CI 0.93-1.00, after adjusting for socioeconomic status. The results were similar for both men and women, although there was a small but statistically significant overall reduction in risk in male veterans after adjusting for socio-economic status (Table 1). ESL veterans were at significantly increased risk compared with non-veterans in the univariate model, HR 1.16, 95% CI 1.09-1.24, $P<0.001$, but the increase in risk was attenuated and became non-significant after adjusting for socioeconomic status, HR 1.05, 95% CI 0.99-1.12. Non-ESL were at significantly lower risk of death than non-veterans in both the univariate and adjusted models, HR 0.94, 95% CI 0.90-0.99, $P<0.05$ and HR 0.92, 95% CI 0.88-0.97, $P<0.01$ respectively.

The median age at death for veterans was 53.0 years (IQR 46.7-58.2) overall; 52.5 years (IQR 45.6-57.9) for ESL and 53.3 years (IQR 47.3-58.5) for non-ESL, compared with 51.2 years (IQR 44.0-57.2) for non-veterans. The kernel density plot demonstrates fewer deaths in the younger veterans, with a higher peak in the older age-groups (Figure 1).

Analysis by length of service, in comparison with all non-veterans, showed an increased risk of death in the two ESL categories (untrained and trained) in the univariate model, although both became non-significant after adjusting for socioeconomic status. For veterans who completed at least a minimum engagement, there was no significant difference in risk of mortality in either the univariate or multivariate models, compared with non-veterans, whilst for those with the longest service (over 12 years), there was a statistically significant reduction in risk, which persisted after adjustment for socioeconomic status (Table 1). Veterans who served for four years or more were at significantly reduced risk of death compared with all ESL, HR 0.80, 95% CI 0.75-0.86, $P<0.001$ in the unadjusted model and HR 0.86, 95% CI 0.79-0.92, $P<0.001$ after adjusting for socioeconomic status.

Analysis by birth cohort demonstrated that mortality risk compared with non-veterans was only increased in the two oldest birth cohorts, 1945-1949 and 1950-1955, whilst the more recent birth cohorts demonstrated similar or lower risk than the reference population (Figure 2). Analysing ESL and non-ESL separately by birth cohort showed a similar overall pattern, although excess risk in veterans born 1945-1954 was confined to ESL. For those with longer service, the two oldest cohorts were at similar risk to the reference population. There was also a clear decline in risk of death over time in these longer-serving veterans, who had been able to benefit from ongoing improvements to military health promotion, which is not apparent in those who leave early (Figure 3).

The commonest causes of death, in veterans and non-veterans, were ischaemic heart disease/acute myocardial infarction and lung cancer. There were 356 (0.63%) alcohol-related deaths in veterans compared with 1,147 (0.66%) in non-veterans, a non-

significant difference. There were only 27 (0.04%) deaths in veterans from drug dependency, compared with 238 (0.10%) in non-veterans (P<0.001). Antecedent morbidities among those who died are summarised in Table 2. Forty-six per cent of veterans who died had a history of smoking-related disease, compared with 39% of non-veterans (P<0.001).

DISCUSSION

We found no overall difference in mortality between veterans and non-veterans, but analysis by length of service demonstrated a 15% increase in risk of death in veterans with the shortest service, who failed to complete military training, whilst those with longest service had an 18% reduction in risk compared with non-veterans. The excess risk in shorter-serving veterans became non-significant after adjusting for SES, suggesting that SES was explanatory in this subgroup. The significant reduction in risk in the longest-serving veterans persisted after adjustment for SES, indicating a true HWE. Veterans who died were more likely to have a history of smoking-related disease or peptic ulceration than non-veterans, whilst ESL who died were especially likely to have a record of mental health disorder. We found no evidence to support drug or alcohol misuse as a disproportionate contributor to mortality in veterans.

Strengths of this study include access to length of service data in a very large cohort, covering a wide spectrum of military experience, and up to 30 years follow-up. We used mortality data from national death records, which are likely to be reliable and reasonably complete for events occurring in Scotland. It is therefore likely that our results represent a true picture of the HWE in Scottish veterans, and may be generalisable to all UK veterans.

Limitations include possible loss of subjects due to migration or loss of data due to overseas deaths. We excluded military personnel who died in service, including as a result of hostile action, as they did not meet the inclusion criterion of registration with NHS Scotland post-service. As the in-service death rate has historically been around 1 per 1,000 per year, reducing recently to around 0.4 per 1,000 [25], the number excluded is likely to be small. We had no follow-up data before the start of linked health data collection in Scotland from 1 January 1981, but as the oldest members of the cohort were only aged 36 then, few are likely to have died after discharge from service by then. Because the dataset was derived from demographic, vital record and hospital admissions data, we had no information on individual combat exposure, military trade, civilian occupation, or personal lifestyle risk factors such as smoking or alcohol. We inferred smoking prevalence from earlier studies of serving military personnel [5]. Veterans with reserve service only could not be identified from NHS records and were therefore included as non-veterans. This may have reduced observed differences between veterans and non-veterans, although the number of reservists potentially included is small, and unlikely to have changed our findings.

Although mortality data for serving personnel are routinely reported as National Statistics [25], and studies have been conducted on personnel who have served in the Falklands[18], the Persian Gulf [19], and those who participated in nuclear tests in the 1950s and 1960s [26], this is the first study, to our knowledge, reporting mortality in a large unselected cohort of UK veterans with heterogeneous experience of exposure to conflicts and hazards, compared with people with no record of service. The poorest outcomes were in veterans with the shortest service (ESL), of whom 40% did not complete training and

therefore could not have deployed operationally. Education is probably a confounder [27], as longer service is generally associated with higher rank, which requires a higher educational level. Smoking is also likely to be a factor as higher rank is associated with increased prevalence of both never-smoking and smoking cessation [28].

We reported antecedent diagnoses rather than causes of death as we only had a single ICD code for each individual cause of death, which may not have captured underlying conditions. We have reported on mortality and case-fatality in specific conditions elsewhere [6,21,29]. Smoking-related diseases were the commonest antecedent diagnoses in veterans who died (Table 2), affecting 46% of veterans compared with 39% of non-veterans, demonstrating the importance of lifestyle factors. Even among non-ESL, the negative gradient of risk with length of service which we have demonstrated elsewhere, [8] combined with the greater proportion of non-ESL (two-thirds) who served for less than 12 years, results in these conditions having a major impact. Nonetheless, there were few differences in the proportion of pre-existing physical conditions between ESL and non-ESL veterans who died, apart from hepatitis C, which was less common in non-ESL. It was only among mental health conditions that differences emerged. ESLs who died were more likely to have previously experienced mental ill-health than the longer-serving veterans (Table 2).

As the oldest of the Scottish Veterans cohort were aged 67 at the end of follow-up, most deaths represent premature mortality. It is likely that the decision to choose a military career and the recruit selection process excluded many people with an early-onset life-limiting condition. It might therefore be expected that selection bias would reduce mortality in veterans, as the non-veterans include people unfit for military service. The absence of

any overall difference in the risk of mortality in veterans compared with the non-serving population is the net effect of higher risk in those with the shortest service and the earliest birth cohorts, and reduced risk in longer-serving veterans who experienced the benefits of continued employment.

Later non-ESL birth cohorts show reduced mortality risk, reflecting better health outcomes in this group as reported elsewhere [6-8], which may be attributable to military workplace health promotion initiatives introduced from the late 1970s. For ESLs who failed to complete training, it is highly unlikely that military service played a causal role in their increased mortality, as they could not have deployed operationally, and it is more likely that pre-service risk factors determined their longer-term trajectory. This is supported by the attenuation of their excess risk after adjusting for SES. The absence of reduced mortality risk in any ESL birth cohort is consistent with their service being too short to benefit from military health promotion. ESLs therefore form a cohort of 'less healthy leavers' compared with longer-serving 'healthy workers', paralleling findings of the Scottish Veterans Health Study in respect of mental health [23] and providing further evidence that health outcomes of ESLs are largely determined by pre-service factors.

KEY LEARNING POINTS

What is already known about this subject:

• The ‘healthy worker effect’ predicts that those who have been employed for longer exhibit reduced mortality, but it is not known whether this is also valid for military service.

What this study adds:

• The results of this large retrospective cohort study examining mortality among veterans have shown that the risk of mortality in comparison with a matched non-veteran group is increased in those with the shortest service.

• There is a reduction in risk with length of service, and veterans who have served for longest are at reduced risk of death in comparison with non-veterans.

• The increased mortality in those with shorter service is likely to be attributable to socio-economic factors and to risk factors such as higher rates of smoking.

What impact this may have on practice or policy:

• The study provides reassurance that longer service in the armed forces does not have a detrimental effect on post-service mortality.

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Competing Interests: The authors declare no competing interests. BPB is a military veteran and former military medical officer.

Data sharing: The Scottish Veterans Health Study remains in progress and the data are not currently available for sharing.

REFERENCES

1. O'Toole BI, Marshall RP, Grayson DA et al. The Australian Vietnam Veterans Health Study: II. self-reported health of veterans compared with the Australian population. *Int J Epidemiol* 1996;**25(2):**319-330.

2. Watanabe KK, Kang HK. Mortality patterns among Vietnam veterans: a 24-year retrospective analysis. *J Occup Environ Med* 1996;**38(3):**272-278.

3. Boehmer T, Flanders W, McGeehin MA et al. Postservice mortality in vietnam veterans: 30-year follow-up. *Arch Intern Med* 2004;**164(17):**1908-1916.

4. Goodwin L, Rona R. PTSD in the armed forces: What have we learned from the recent cohort studies of Iraq/Afghanistan? *J Ment Health* 2013;**22(5):**397-401.

5. Lewthwaite CJ, Graham JT. The smoking habits of young soldiers. *J R Army Med Corps* 1992;**138(2):**67-71.

6. Bergman BP, Mackay DF, Pell JP. Acute Myocardial Infarction in Scottish Military Veterans: A Retrospective Cohort Study of 57,000 Veterans and 173,000 Matched Nonveterans. *Am J Epidemiol* 2014;**179(12):**1434-1441.

7. Bergman B, Mackay DF, Morrison D, Pell JP. Smoking-related cancer in military veterans: retrospective cohort study of 57,000 veterans and 173,000 matched non-veterans. *BMC Cancer* 2016;**16(1):**9.

8. Bergman BP, Mackay DF, Pell JP. Chronic obstructive pulmonary disease in Scottish military veterans. *J R Army Med Corps* 2018;**164:**25-29.

9. Ogle W. Letter to the Registrar-General on the mortality in the registration districts of England and Wales during the ten years 1871–80. Supplement to the 45th Annual

Report of the Registrar General of Births, Deaths, and Marriages. England, p xxiii. 1885.

10. McMichael AJ, Spirtas R, Kupper LL. An epidemiologic study of mortality within a cohort of rubber workers, 1964-72. *J Occup Med* 1974;**16(7):**458-464.

11. McMichael AJ. Standardized mortality ratios and the "healthy worker effect": Scratching beneath the surface. *J Occup Med* 1976;**18(3):**165-168.

12. Li C-Y, Sung F-C. A review of the healthy worker effect in epidemiology. *Occup Med* 1999;**49(4):**225-229.

13. Arrighi HM, Hertz-Picciotto I. The evolving concept of the healthy worker survivor effect. *Epidemiology* 1994;**5(2):**189-196.

14. Kang H, Bullman TA. Mortality among U.S. Veterans of the Persian Gulf War. *N Engl J Med* 1996;**335(20):**1498-1504.

15. Iversen AC, Nikolaou V, Greenberg N et al. What happens to British veterans when they leave the armed forces? *Eur J Public Health* 2005;**15(2):**175-184.

16. Darby SC, Kendall GM, Fell TP et al. A summary of mortality and incidence of cancer in men from the United Kingdom who participated in the United Kingdom's atmospheric nuclear weapon tests and experimental programmes. *Br Med J* 1988;**296(6618):**332-338.

17. Holmes J, Fear N, Harrison K et al. Suicide among Falkland war veterans. *Br Med J* 2013;**346:**f3204.

18. Defence Statistics (Health). A study of deaths among UK Armed Forces personnel deployed to the 1982 Falklands Campaign: 1982 to 2012. Ministry of Defence, Abbey Wood, 2013.

19. Defence Statistics (Health). 1990/1991 Gulf Conflict - UK Veterans Mortality Data: Causes of Death. Ministry of Defence, Abbeywood, 2013.

20. Fox AJ, Collier P. Low mortality rates in industrial cohort studies due to selection for work and survival in the industry. *Br J Prev Soc Med* 1976;**30(4):**225-230.

21. Bergman BP, Mackay DF, Smith DJ et al. Suicide in Scottish military veterans: a 30-year retrospective cohort study. *Occupational Medicine*. 2017;**67(5):**350-5.

22. Grambsch PM, Therneau TM. Proportional hazards tests and diagnostics based on weighted residuals. *Biometrika* 1994;**81:**515-526.

23. Bergman BP, Mackay DF, Smith DJ et al. Long-term mental health outcomes of military service: National linkage study of 57,000 veterans and 173,000 matched nonveterans. *J Clin Psychiatry* 2016;**77(6):**793-798.

24. Buckman JEJ, Forbes HJ, Clayton T et al. Early Service leavers: a study of the factors associated with premature separation from the UK Armed Forces and the mental health of those that leave early. *Eur J Public Health* 2013;**23(3):**410-415.

25. Defence Statistics (Health). Deaths in the UK Regular Armed Forces 2005-2014. Ministry of Defence, Abbey Wood, 2015.

26. Muirhead CR, Bingham D, Haylock RGE et al. Follow up of mortality and incidence of cancer 1952-98 in men from the UK who participated in the UK's atmospheric nuclear weapon tests and experimental programmes. *Occup Environ Med* 2003;**60(3):**165-172.

27. Feldman JJ, Makuc DM, Kleinman JC et al. National trends in educational differentials in mortality. *Am J Epidemiol* 1989;**129(5):**919-933.

28. Lodge LH. Tri-service Health Questionnaire - 1989. *J R Army Med Corps* 1991;**137(2):**80-83.

29. Bergman BP, Mackay DF, Pell JP. Road traffic accidents in Scottish military veterans. *Accident Anal Prev* 2018;**113:**287-91.

Table 1. Cox proportional hazard ratios for mortality in veterans, overall and by subgroup, referent to all non-veterans

	Veterans *n=56,205* Deaths	Non-veterans n=172,741 Deaths	Univariate HR	Univariate 95% CI	Univariate *P*	Multivariate* HR	Multivariate* 95% CI	Multivariate* *P*
Overall	3529	10,947	1.02	0.98-1.06	NS	0.97	0.93-1.00	NS
Men	3342	10,192	1.01	0.97-1.05	NS	0.96	0.92-1.00	<0.05
Women	187	755	1.03	0.88-1.21	NS	1.01	0.86-1.18	NS
Length of service								
ESL untrained	453	NA	1.15	1.04-1.26	<0.01	1.06	0.96-1.16	NS
ESL trained	645	NA	1.17	1.09-1.27	<0.001	1.05	0.97-1.14	NS
4-12 years	1498	NA	1.02	0.97-1.07	NS	0.95	0.90-1.01	NS
>12 yrs	696	NA	0.82	0.76-0.88	<0.001	0.86	0.80-0.93	<0.001

*adjusted for socioeconomic status (SIMD quintile)
HR hazard ratio; CI confidence interval; ESL Early Service Leavers

Table 2. Antecedent diagnoses by leaver status, and odds ratios for veteran status

Recorded Medical history	All veteran Deaths *n*=3,529 n (%)	ESL Deaths *n*=1,098 n (%)	Non-ESL Deaths *n*=2,194 n (%)	Non-veteran Deaths *n*=10,947 n (%)	OR	95% CI	*P*
Smoking-related disease	1,609 (46)	503 (46)	1,002 (46)	4,230 (39)	1.18	1.13-1.23	<0.001
Any cancer	1,233 (35)	372 (34)	782 (36)	3,506 (32)	1.09	1.03-1.15	<0.01
Smoking-related cancer	709 (20)	217 (20)	442 (20)	1,729 (16)	1.27	1.18-1.38	<0.001
Lung cancer	370 (11)	119 (11)	224 (10)	900 (8)	1.28	1.14-1.43	<0.001
Colorectal cancer	126 (4)	37 (3)	78 (4)	380 (4)	1.03	0.84-1.25	NS
Prostate cancer	46 (1)	13 (1)	31 (2)	130 (1)	1.08	0.77-1.51	NS
Cardiovascular disease	808 (23)	253 (23)	498 (23)	2,139 (20)	1.17	1.09-1.26	<0.001
AMI	576 (16)	183 (17)	358 (16)	1,483 (14)	1.20	1.10-1.32	<0.001
COPD	482 (14)	173 (16)	280 (13)	1,300 (12)	1.15	1.04-1.27	<0.01
Alcoholic liver disease	445 (13)	138 (13)	271 (12)	1,361 (12)	1.01	0.92-1.12	NS
Peptic ulcer	323 (9)	102 (9)	201 (9)	819 (8)	1.22	1.08-1.38	<0.01
Hepatitis C	34 (0.9)	16 (2)	15 (0.7)	214 (2)	0.49	0.34-0.71	<0.001
Any mental health disorder	476 (14)	190 (17)	253 (12)	1,369 (13)	1.08	0.98-1.19	NS
Mood disorder	274 (8)	109 (10)	149 (7)	770 (7)	1.10	0.97-1.26	NS
Anxiety	225 (6)	93 (9)	120 (6)	577 (5)	1.21	1.04-1.40	<0.05
Stress/PTSD	89 (3)	36 (3)	49 (2)	199 (2)	1.39	1.08-1.78	<0.01
Other anxiety	136 (4)	57 (5)	71 (3)	378 (4)	1.12	0.93-1.36	NS
Psychosis	116 (3)	47 (4)	55 (3)	412 (4)	0.87	0.71-1.07	NS

Odds ratios for all veterans referent to non-veterans (prostate cancer: men only)
Cardiovascular disease: Acute myocardial infarction (AMI), stroke, peripheral arterial disease
Smoking-related cancer: Lung, oropharynx and larynx, oesophagus, stomach, kidney, bladder
Smoking-related disease: Smoking-related cancer, cardiovascular disease, chronic obstructive pulmonary disease (COPD), peptic ulcer
Any mental health disorder: Mood disorder, anxiety including post-traumatic stress disorder (PTSD), psychosis
OR odds ratio; CI confidence interval; ESL Early Service Leavers

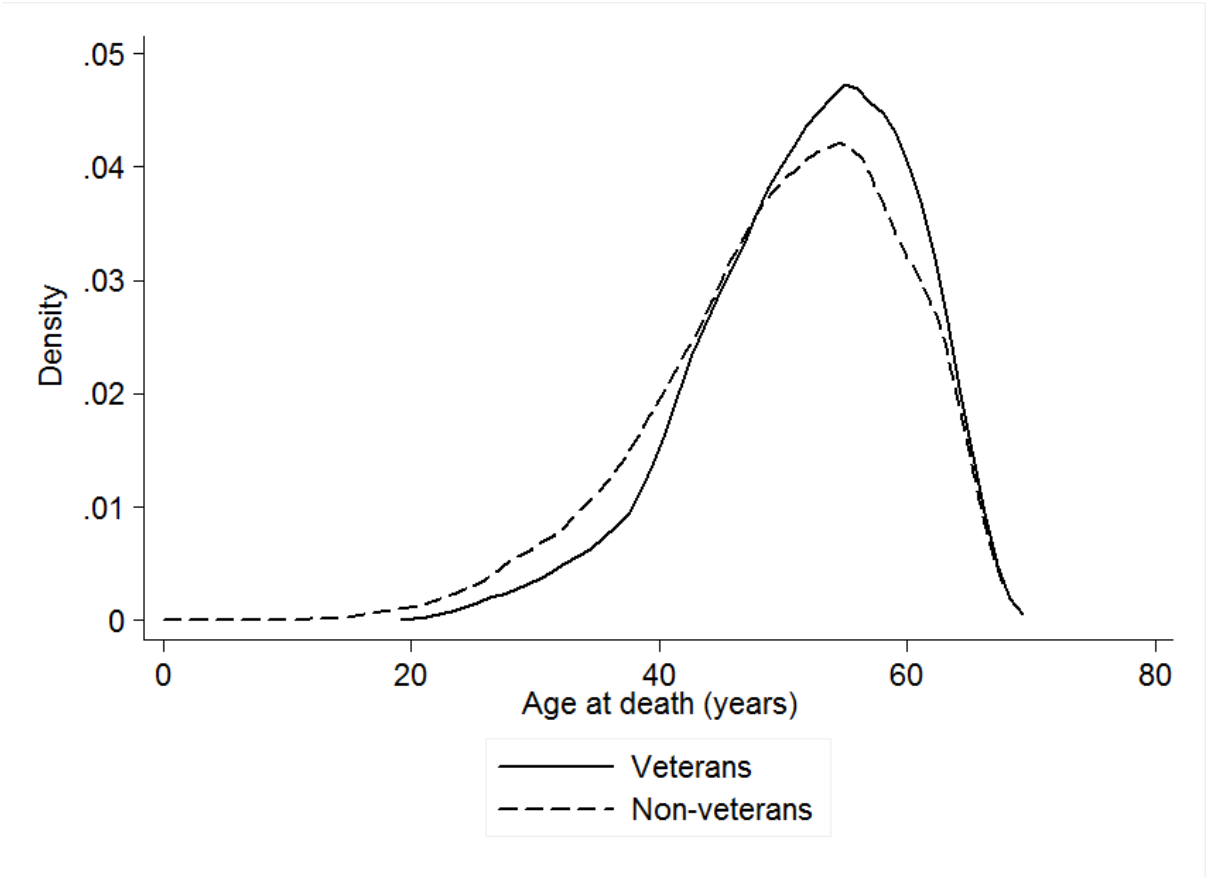

Figure 1. Kernel density plot of age at death in veterans and non-veterans

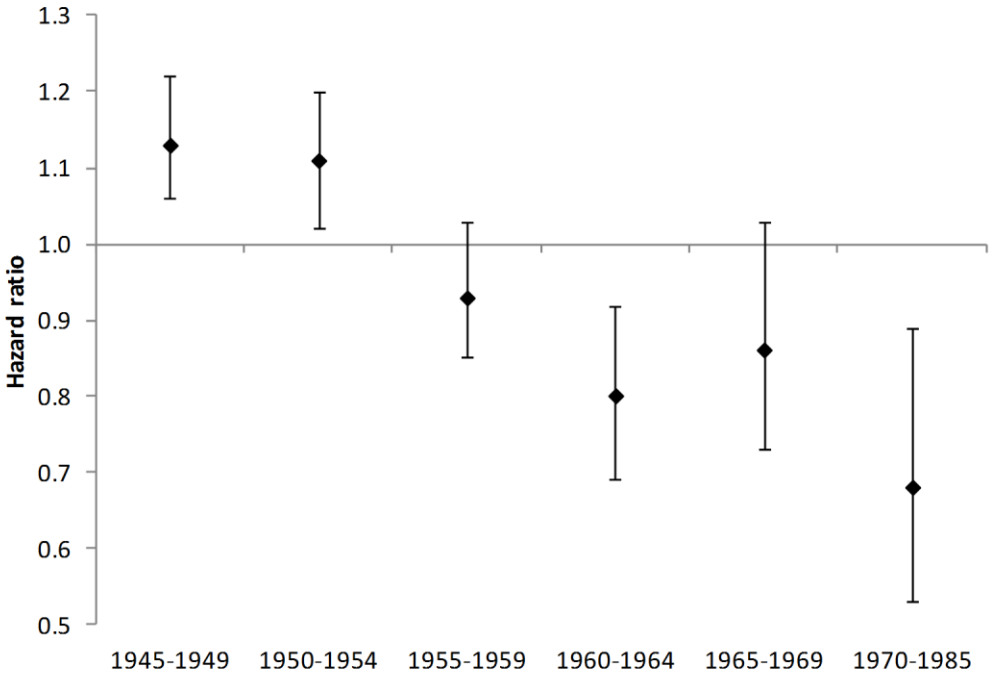

Figure 2. Hazard ratios and 95% confidence intervals for mortality in veterans referent to non-veterans, by birth cohort

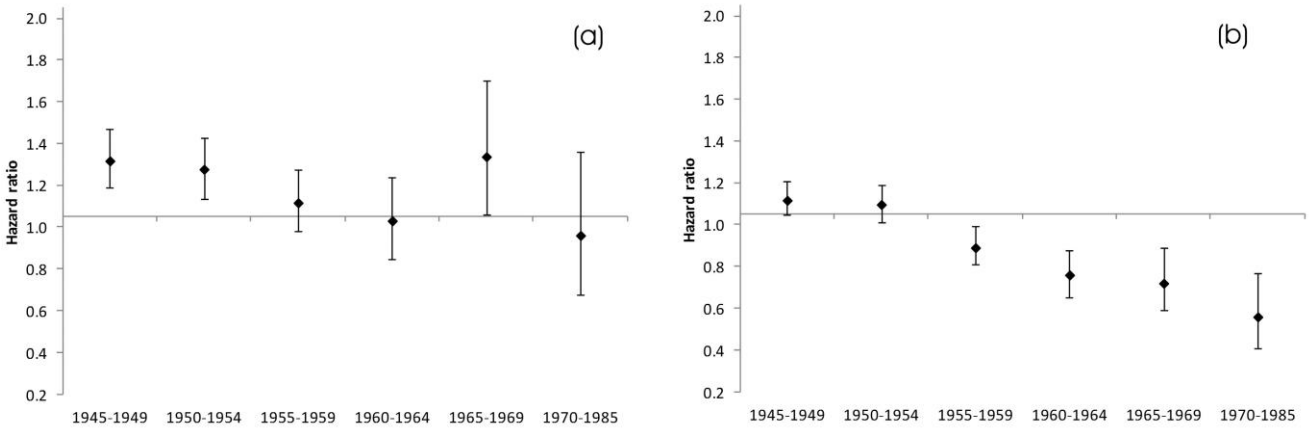

Figure 3. Hazard ratios for mortality in veterans by leaver status, compared to non-veterans, by birth cohort

(a) ESL referent to all non-veterans

(b) Non-ESL referent to all non-veterans