Annals of Epidemiology xxx (2016) 1–5

Contents lists available at ScienceDirect

Annals of Epidemiology

journal homepage: www.annalsofepidemiology.org

Original article

Disease-related mortality among 21,609 Norwegian male military peacekeepers deployed to Lebanon between 1978 and 1998

Leif Aage Strand MSc, PhD [a,b,*], Jan Ivar Martinsen [b], Einar Kristian Borud MD, PhD, MPH [a,c]

[a] Norwegian Armed Forces Medical Services, Sessvollmoen, Norway
[b] Cancer Registry of Norway, Oslo, Norway
[c] Institute of Community Medicine, UiT The Arctic University of Norway, Tromsø, Norway

ARTICLE INFO

Article history:
Received 4 May 2016
Accepted 15 August 2016
Available online xxx

Keywords:
Cohort study
Conflict exposure
Military
Lebanon
UNIFIL
Disease mortality
Healthy soldier effect

ABSTRACT

Purpose: Our study assessed disease-related mortality among Norwegian male military peacekeepers deployed to Lebanon during 1978–1998.
Methods: A total of 21,609 peacekeepers were followed from start of deployment through 2013. Standardized mortality ratios (SMRs) were calculated based on national rates for the overall cohort, by length of time since first deployment to Lebanon, and for service during high- and low-conflict periods. Poisson regression was used to determine the effect of conflict exposure.
Results: In the overall cohort, a decreased risk was seen for all-cause mortality (1213 deaths, SMR = 0.85), mortality from neoplasms (SMR = 0.89), and from non-neoplastic diseases (SMR = 0.68). Disease-related mortality was lower during the first 5 years of follow-up, while mortality from external causes was elevated. After 5 years, mortality from neoplasms and external causes were similar to national rates, but mortality from non-neoplastic diseases remained lower. The high-conflict exposure group had a two-fold increased risk of mortality from non-neoplastic diseases (rate ratio = 2.33), including ischemic heart disease (rate ratio = 2.25) compared to the low-conflict exposure group.
Conclusions: We found a "healthy soldier effect" for all-cause mortality and disease-related mortality, but for neoplasms, this effect disappeared after 5 years. Conflict exposure was positively correlated with increased risk of mortality from non-neoplastic diseases.

Introduction

Lowered overall mortality among military populations is often seen when compared to general populations. This difference is often ascribed to the "healthy soldier effect" (HSE), the military equivalent to the healthy worker effect. This effect is probably due to selection that takes place before and during military service, a demand to stay physically fit during service, and better access to medical services during and after service [1]. When present, the HSE seems to be strongest for deaths due to preventable diseases such as cardiovascular and respiratory diseases, and less strong, or absent, for cancer incidence and death and for mortality from external causes [1–8]. A meta-analysis of studies of deployed military personnel reported a lower overall standardized mortality ratio (SMR) of 0.78, while mortality from external causes did not differ significantly from that of the general populations (SMR = 0.89) [9,10]. One of the studies in the meta-analysis included World War II Army veterans and observed that a lower disease-related mortality (SMR = 0.79) was the biggest contributor to HSE for all-cause mortality (SMR = 0.84), as mortality from external causes was close to unity (SMR = 0.94). The study also reported an SMR from neoplasms of 0.88 [3]. By subtracting the observed and expected numbers of neoplasms from that of overall diseases, we calculated an SMR of 0.77 for non-neoplastic diseases.

Exposure to stress at wartime as well as mental health symptoms in the long-term aftermath of war and violence are significant predictors of late-life mortality [11–13]. Peacekeepers who served during high-conflict periods in Lebanon were probably exposed to higher levels of stress and psychological trauma due to the higher risk of being injured or killed, and/or from the perception of civilian suffering, than those who served in less-tense periods.

The aim of our study was to investigate cause-specific mortality with an emphasis on disease-related mortality in a cohort of Norwegian male military peacekeepers deployed to Lebanon during

* Corresponding author. Norwegian Armed Forces Medical Services, N-2058 Sessvollmoen, Norway. Tel.: +47 99586226; fax: +47 63926929.
E-mail address: laastrand@forsvaretshelseregister.no (L.A. Strand).

http://dx.doi.org/10.1016/j.annepidem.2016.08.005
1047-2797/

1978–1998, including mortality by length of time since first deployment. We also investigated mortality by service during high- and low-conflict periods.

Materials and methods

Study population

Our cohort consisted of 21,609 Norwegian military male peacekeepers who served in the United Nations Interim Force in Lebanon (UNIFIL) from its establishment in March 1978 until the withdrawal of the Norwegian forces in November 1998. This cohort was established by The Norwegian Armed Forces HR and Conscription Centre. It is regarded as virtually complete, and is, with the exception of minor updates (i.e., inclusion of a few more persons and updated data on residence and emigration), identical to the cohort used in a previous study on cancer incidence and all-cause mortality [6]. Median age at deployment to Lebanon was 22.8 years, and average duration of service in Lebanon was 10 months. Age at end of follow-up ranged from 21 to 91 years (median 50.3; Table 1).

Conflict exposure groups

The level of conflict during the study period varied, until 1987 it was relatively high, with incidents such as combat with the Palestinian Liberation Organization, attacks on UNIFIL headquarters, crash of a Norwegian helicopter, Israeli invasion in South Lebanon, massacres of Palestinian refugees, and abduction and killing of UNIFIL soldiers. After 1987, the level of conflict was lower, except from two Israeli operations in 1993 and 1996 causing killing and displacement of Lebanese civilians [14–16]. The cohort members were divided in two groups according to the level of conflict exposure: The high-conflict exposure group included 12,368 men who served at any time between March 1978 and February 1987 and/or during the Israeli operations in 1993 (25–31 July) and 1996 (11–27 April). The low-conflict exposure group included the remaining 9241 men.

Identification of cases and follow-up

Underlying cause of death and date of death was obtained through linkage to the Cause of Death Registry, which is virtually complete back to 1951. The linkage was based on the 11-digit unique personal identification number given to all citizens of Norway alive in 1960 or born later. Cause of death in the register is recorded according to the International Classification of Diseases (ICD), 8th (1978–1985), 9th (1986–1995), and 10th (1996–2013) revisions, grouped according to the European Shortlist for causes of death (65 key causes) [17], and expressed as ICD-10 codes in this report. Data on residence, emigration, and vital status were provided by the National Population Register, which is continuously updated for the whole Norwegian population. Each cohort member was followed from their first day of deployment to Lebanon until date of emigration, date of death, or the end of follow-up (31 December 2013) whichever came first. Information on vital and emigration status was available for all cohort members.

Table 1
Main characteristics of 21,609 Norwegian male military peacekeepers deployed to Lebanon during 1978–1998

Characteristics	*N*	%
Total cohort (Norwegian citizenship at start of service)	21,609	
Died during follow-up	1213	5.6
Emigrated during follow-up	537	2.5
No. of deployments to Lebanon		
1 deployment	12,739	59.0
2 deployments	6346	29.4
3+ deployments	2524	11.7
	Range	Median (IQR)
Year of birth	1921–1978	1963 (10)
Age at first deployment (y)		
Total cohort	18–59	22.8 (5.3)
High-conflict exposure group ($N = 12,368$)	18–59	22.8 (6.1)
Low-conflict exposure group ($N = 9241$)	19–59	22.9 (4.5)
Age et end of follow-up (y)	21–91	50.3 (10.4)
Length of follow-up (y)	0–35	26.2 (9.5)

IQR = interquartile range.

Statistical analysis

The analysis was based on a comparison of the observed number of deaths with the expected number of deaths, computed based on national, 5-year age-specific and 1-year period-specific rates among all Norwegian men. SMRs were calculated for the overall cohort from the first day of deployment until the end of the follow-up period. We then calculated SMRs for the overall cohort by length of time since first deployment to Lebanon (0–4, 5–9, and 10+ years). Finally, SMRs were calculated for the high- and low-conflict exposure groups separately, from the first day of deployment until the end of the follow-up period. Poisson regression analysis was used to compare mortality rates by conflict exposure group, with observation period and age included in the models. Relative risks, expressed as rate ratios (RRs), were calculated for the high-conflict exposure group, using the low-conflict exposure group as the reference category. Ninety-five percent confidence intervals (CIs) were computed on the assumption of a Poisson distribution of the observed deaths.

SPSS version 22 and Stata 13 (StataCorp LP, College Station, TX) software packages were used for statistical analysis. We chose a P smaller than .05 to indicate statistical significance.

Results

During follow-up, 561,689 person-years and 1213 deaths were accumulated. Average follow-up time was 26 years. An all-cause mortality reduction of 15% (SMR = 0.85, 95% CI 0.80–0.89) was observed in the overall cohort. The disease-related SMR in the overall cohort was 0.76 (95% CI 0.70–0.81) based on 767 deaths, of which neoplasms accounted for 43%. The 434 deaths from non-neoplastic diseases showed a highly significant mortality reduction of 32%. There was also a reduction in mortality from neoplasms, but it was closer to unity (SMR = 0.89, 95% CI 0.79–0.99). The number of observed deaths from external causes ($n = 348$) was similar to the expected numbers (SMR = 1.04, 95% CI 0.94–1.16). The remaining 98 deaths were classified as ill defined or unspecified, or of unknown kind (Table 2).

The largest group of disease-related deaths was due to neoplasms. Of the 333 deaths from neoplasms, the vast majority (330) were due to malignant neoplasms (ICD-10 C00–C97), two were due to neoplasms of uncertain or unknown behavior (ICD-10 codes D37 to D48), and the last was classified as a benign neoplasm (ICD-10 codes D10–D36). The second largest group of disease-related deaths was linked to cardiovascular diseases. Indeed, mortality was significantly lower for all cardiovascular diseases combined (SMR = 0.82, 95% CI 0.73–0.92), but the low SMRs for the subgroups ischemic heart disease (0.87, 95% CI 0.75–1.02), other heart diseases (0.79, 95% CI 0.54–1.10), and cerebrovascular diseases (0.75, 95% CI 0.54–1.02) did not reach statistical significance. Mortality from most of the diseases was lower than expected and was notably low