

Cause-Specific Mortality Risks Through 2016, Among U.S. Veterans of the Southwest Asia Theater

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Introduction

Much of the research on the post-deployment mortality of veterans who deployed as part of Operations Enduring Freedom, Iraqi Freedom and New Dawn (OEF/OIF/OND) has focused on the risk of suicide among returning veterans.^{1,2} To date, mortality studies of OEF/OIF/OND veterans have not included analysis of specific disease-related mortality.

While mortality studies of OEF/OIF/OND veterans have focused on suicide, morbidity studies have assessed the risk of diseases that may be related to both environmental and anthropogenic exposures that were present in the theatre of operations. These exposures included infectious diseases, sand, dust and airborne particulates, industrial pollution, diesel exhaust and emissions from open burn pits.³ One of the most recognised exposures is that of smoke from burn pits. While there is no inventory of materials disposed of in burn pits, it is believed that solid waste such as chemicals, shipping and packing materials, medical waste and military matériel were disposed of in the burn pits.³ Contaminants and pollutants that might be expected to become airborne due to burning waste include dioxins, furans, polycyclic aromatic hydrocarbons (PAHs), metals, volatile organic compounds (VOCs) and particulates.³

While no studies have examined disease-related mortality among OEF/OIF/OND veterans, some studies have assessed disease mortality among veterans of the 1990–1991 Gulf War.^{4,5} These veterans may have been subject to some of the same environmental exposures as OEF/OIF/OND veterans. Therefore, their disease mortality risks may reflect that of OEF/OIF/OND veterans. Apart from a study that reported an increased risk of brain cancer deaths associated with modelled exposure to nerve agent released as a result of the Khamisiyah weapons depot demolition,⁶ no increased risks of

disease-related mortality have been reported among 1990–1991 Gulf War veterans. In their 2020 report reviewing research regarding potential respiratory health effects due to airborne hazards exposures in the Southwest Asia Theater of Military Operations, the National Academies of Sciences, Engineering and Medicine (NAS) concluded that there was inadequate or insufficient evidence of an association between deployment during the 1990–1991 Gulf War or post-9/11 conflicts and subsequent mortality due to respiratory disease.⁷ The report did find limited or suggestive evidence of an association between exposure to airborne hazards and subsequent development of respiratory symptoms, but not respiratory cancers. Regarding mortality studies of OEF/OIF/OND veterans, the report noted that no studies looked at respiratory disease mortality separately from overall mortality.

This current study examined cause-specific mortality risks, including both disease and traumatic deaths among a cohort of OEF/OIF/OND veterans. Because of the concern over airborne hazards, this study included an analysis of mortality risks due to respiratory diseases.

Materials and methods

Data collection

This study's cohort included 1 935 168 veterans who served in either active-duty component units or reserve/National Guard units as part of either OEF/OIF/OND and ended their deployment or separated from the military through 31 May 2015. The roster utilised in this study is an updated file of those examined in an earlier follow-up.¹ Those who died while in the military, whether in theatre or elsewhere, were excluded. This study's cohort of OEF/OIF/OND veterans only included those deployed through 31 May 2015, as it was the latest deployment data available to researchers at the time this study began.

Table 1:. Selected demographic and military service characteristics for US veterans¹ of conflicts in Afghanistan, Iraq and Southwest Asia Theater of Operations (n=1 935 168)

Characteristic	Frequency	Per cent
Age at entry to follow-up		
17-21	82 998	4.3
22-25	594 232	30.7
26-35	674 347	34.8
36-45	405 455	21.0
46-+	178 136	9.2
Mean age at entry to follow-up	31.4	
Years of follow-up		
0-5	660 875	34.1
6-10	785 334	40.6
11-15	488 959	25.3
Mean years of follow-up	7.5	
Standard deviation	3.5	
Sex		
Male	1 703 367	88.0
Female	231 801	12.0
Race		
White	1 338 166	69.2
Black	267 999	13.8
Hispanic	187 773	9.7
Other	141 230	7.3
Marital status		
Married	855 259	44.2
Not married	1 079 909	55.8
Unit component ²		
Active	1 178 815	60.9
Reserve/National Guard	756 353	39.1
Branch of service		
Army	1 005 285	52.0
Marines	256,414	13.2
Air Force	345 856	17.9
Navy	322,929	16.7
Coast Guard	4684	0.2
Rank		
Officer	198 186	10.2
Warrant Officer	18 455	1.0
Enlisted	1 718 527	88.8

1. Deployed as part of Operations Enduring Freedom (OEF), Iraqi Freedom (OIF), or New Dawn (OND) and separated/deactivated through May 2015.
2. Active duty are those who served in active-duty units while in theatre. Reserve/National Guard are those who served in Reserve/National Guard Units while in theatre.

Table 2: Selected cause-specific mortality for US veterans of conflicts in Afghanistan, Iraq and Southwest Asia Theater of Operations through 2016¹ compared to that of US population

Cause of death (ICD-10) ²	N	SMR ³	95% C.I. ⁴
All causes	20 868	0.59	0.59-0.60
Cancers	3 278	0.56	0.54-0.58
Malignancies of digestive system and peritoneum	1 018	0.56	0.52-0.59
Malignancies of respiratory organs	523	0.37	0.34-0.41
Malignancies of trachea, bronchus, lung	487	0.37	0.34-0.40
Malignancies of breast	113	0.80	0.66-0.96
Malignancies of female genital organs	41	0.50	0.36-0.68
Malignancies of male genital organs	111	0.63	0.52-0.76
Malignancies of urinary organs, major	129	0.47	0.40-0.56
Malignancies of other and unspecified site major	862	0.73	0.68-0.78
Malignancies of lymphatic and haematopoietic system	415	0.65	0.59-0.72
Diseases of the blood and blood-forming organs	30	0.22	0.15-0.31
Circulatory diseases (major)	2 071	0.37	0.35-0.38
Circulatory diseases (other)	571	0.37	0.34-0.40
Respiratory diseases	278	0.22	0.20-0.25
Digestive diseases	578	0.31	0.29-0.34
Motor vehicle accidents, driver	1 275	1.44	1.37-1.53
Suicides	4 618	1.44	1.40-1.48

1. Deployed as part of Operations Enduring Freedom (OEF), Iraqi Freedom (OIF) or New Dawn (OND) and separated or deactivated through May 2015. Mortality is through 12/31/2016.
2. The grouping of individual International Classification of Disease (ICD-10) codes included in each of the diagnostic groups, including their ICD-10 codes, are defined in the software used to calculate SMRs and can be downloaded from the National Institute for Occupational Safety and Health website that houses the LTAS (<https://www.cdc.gov/niosh/ltras/pdf/Rate-Info-Table-1.pdf>).
3. Standardised Mortality Ratio (SMR) is the ratio observed to the expected based on the US population, adjusted for age, sex, race and calendar year.
4. 95% Confidence Interval.

The beginning of follow-up ranged from October 2001 through May 2015. For active-duty veterans, the beginning of follow-up was their latest date of separation from the military. For reserve/National Guard veterans, the beginning of follow-up was their latest end of deployment date. End of follow-up was the earlier of date of death or December 31, 2016. All military service and demographic characteristics were obtained from the US Department of Defense (DoD), Defense Manpower Data Center. Mortality data was obtained by matching all cohort veterans against the VA/DoD Mortality Data Repository (MDR) data. The MDR contains cause-specific mortality for all military service members who separated from military service since 1979. At the time this study was initiated, MDR had cause of death data through 2016. Cause of death and fact of death in the MDR were obtained from the National Death Index (NDI). Cause of death was coded using International Classification Disease Codes, 10th revision (ICD-10).⁸

Cause-specific mortality risks were assessed by comparing the observed number of cause-specific mortality among veterans to the expected based on that of the US population, adjusted for age at entry to follow-up, race, sex and calendar year. These comparisons are expressed as standardised mortality ratios (SMR)s and were generated by the National Institute for Occupational Safety and Health (NIOSH) statistical software known as Life Table Analysis System (LTAS).⁹ Causes of mortality examined as part of SMR analyses were limited to those available in LTAS.

Results

Table 1 has selected demographic and military service characteristics for all 1 935 168 veterans. Most veterans were male (88%), white (69.2%) and served in an active-duty unit while in theatre (60.9%). The mean number of years of follow-up was 7.5 years, with 65.9% having 6 to 15 years of follow-up.

There were 20 868 deaths identified among all OEF/OIF/OND veterans. Compared to the expected based on the US population, there was a statistically significant decreased risk for overall mortality (SMR=0.59; 95% CI, 0.59–0.60). The risks of specific disease-related mortality presented in Table 2 among OEF/OIF/OND are also less than that of the US population. There were 523 respiratory cancer deaths and 278 non-cancer respiratory disease-related deaths. The risk of all respiratory cancers among OEF/OIF/OND veterans was less than that of the US population (SMR=0.37; 95% CI, 0.34–0.41). The risk for all respiratory-related

diseases, excluding respiratory cancers, was 22% of the expected (SMR=0.22; 95% CI, 0.20–0.25). Only for motor vehicle accident deaths (MVA) and suicides did OEF/OIF/OND veterans have statistically significant increased risks compared to the US population, (SMR=1.44; 95% CI, 1.37–1.53) and (SMR=1.44; 95% CI, 1.40–1.48), respectively. For over 80 other cause-specific disease mortality outcomes not presented here, but included in the LTAS SMR analysis,⁹ there were no increased risks of disease mortality among OEF/OIF/OND veterans.

Discussion

This study assessed cause-specific mortality risks among OEF/OIF/OND veterans. Comparing OEF/OIF/OND veterans to the US population, there was no increased risk of any disease-related mortality, including non-cancer respiratory disease deaths or respiratory cancer deaths. OEF/OIF/OND did have a 44% excess of deaths due to MVA while a driver and a 44% excess of suicides when compared to the US population.

The excess of suicides among deployed veterans compared to the US population replicates earlier follow-ups of OEF/OIF/OND veterans.^{1,2} However, as this excess of suicide is seen only when compared to the US population and not to non-deployed veterans, the association may be limited to military service in general, rather than OEF/OIF/OND deployment specifically. The excess of MVA deaths has also been observed in studies of veterans who served in the 1990–1991 Gulf War.^{4,5}

Of particular interest to this study was the decreased risk of respiratory disease-related mortality among OEF/OIF/OND veterans. This veteran cohort's mortality risks due to respiratory diseases and respiratory cancers were all statistically less than that of the US general population. In fact, this veteran cohort had statistically significant decreased risks for most of more than 80 diseases assessed by the LTAS software⁹ used in this study. This phenomenon may be due to the 'healthy soldier effect', which is often observed when veterans are compared to non-veterans.^{4,10} Health screening required to enter the military, access to medical care while serving in the military, and performance standards related to physical fitness to remain in the military likely result in active-duty military and veteran populations healthier than the US population.

This study lacked any exposure-related data to assess cause-specific mortality risks. If a specific in-theatre exposure, such as smoke from burn pits or elevated airborne particulate matter, is related to

an increased risk of cause-specific mortality, then not differentiating veterans with high exposure from those with low or no exposure at all could diminish the ability to detect an increased mortality risk related to exposure. Should an exposure experienced during their service as part of OEF/OIF/OND be related to an increased risk of cause-specific mortality, the maximum length of follow-up possible in this study, i.e. 15 years, might not be sufficient to discern mortality outcomes related to the exposure. This study also did not have a non-deployed veteran comparison group. Because of the 'healthy soldier effect' the US population may be an inherently unhealthier population than veterans.

As recommended by the NAS 2020 report,⁷ this study focused on respiratory mortality associated with OEF/OIF/OND deployment. There was no increased risk of mortality associated with any respiratory disease or respiratory cancer among this study's

cohort. The absence of increased mortality due to disease among OEF/OIF/OND veterans may not be unexpected given the 'healthy soldier effect'. Despite this study's findings, the mortality and morbidity of this cohort should be followed into the future. Future studies would be enhanced by the addition of a non-deployed veteran comparison group, and airborne hazard exposure data should such measures become available.

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