

## MORTALITY AND CANCER INCIDENCE AMONGST AUSTRALIAN NATIONAL SERVICE VIETNAM WAR VETERANS

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### Introduction

Australian Defence Force (ADF) personnel participated in the Vietnam Conflict from 1962 to 1973, involving nearly 60,000 personnel, of whom over 500 died during service and 3,131 were severely physically wounded. Between 1965 and 1972, the Australian government introduced a National Service (NS) scheme of conscription to provide personnel for the war effort. Men were selected by ballot based on their birthday at age 20. Following medical, psychological and educational assessment screening, those deemed fit for service were enlisted into the Army and after completing basic training were allocated to an operational unit within an Army corps. Selection for service in Vietnam was by corps. This selection process essentially resulted in a natural experiment of random selection of age-matched, fit, healthy men for Vietnam service. Of the 63,735 men who were ultimately conscripted into NS, 19,450 served in Vietnam as NS veterans (NSv), the remainder served in Australia as NS non-veterans (NSnv).

The Vietnam War is noted for extensive use of chemical warfare. The United States military sprayed more than 76,000,000L of herbicide over Vietnam in their Air Force Ranch Hand and Operation Trail Dust programs.<sup>1</sup> The most heavily used herbicide was Agent Orange, contaminated with 2,3,7,8-tetrachlorodibenzo-*p*-dioxin. Since the Vietnam conflict, veteran organisations have maintained that Vietnam service adversely affected the health of veterans. Initial studies showed no excess risk attributable to their service.<sup>2-4</sup> However, more recent studies have shown that Vietnam veterans have excess incidence and mortality rates from several conditions such as cancers and heart disease.<sup>5-9</sup>

This paper describes the results of the mortality and cancer incidence study for NS Vietnam veterans. It compares the rate of mortality and cancer incidence amongst NSv to NSnv and to the male Australian population.

### Materials and Methods

A study roll of NS personnel who satisfied the selection criteria of complete personal details and for NSnv, at least one year in service, was matched by name and date of birth with a number of national databases to determine vital status, cause of death and cancer incidence. The sources of data were: the National Death Index (NDI), Australian Electoral roll, the Health Insurance Commission Medicare database, the Department of Veterans' Affairs Client database, State and Territory Births, Deaths and Marriages for pre 1980 death records, and the National Cancer Statistics Clearing House (NCSCCH). Cancer incidence was assessed for the period of 1982 to 2000, and mortality was assessed from the time of completion of Vietnam service (or age 22 for NSnv) to 2001.

The relative rates for a direct comparison of mortality and cancer incidence of NSv to NSnv were calculated using the person-year method by applying the rates for the whole NS group to determine the expected numbers of deaths/cancer cases for NSv and NSnv and dividing the ratio of observed to expected deaths/cancer cases for the two groups. Standardised incidence and mortality ratios were also calculated using the person-year method. The expected number deaths by cause or cases of cancer by cancer type was calculated by applying age-specific incidence/mortality rates for the Australian male community to the number of living NSv or NSnv in that age group in each year.

### Results and Discussion

The NS cohort consisted of 43,969 personnel, 19,240 NSv and 24,729 NSnv. Vital status was determined for 96.7% of the cohort, 97.8% of NSv and 95.9% of NSnv. Within the respective study periods, there were 2,141

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deaths observed amongst the cohort, 1,052 for NSv and 1,089 for NSnv, and 1,724 cancers diagnosed, 810 for NSv and 914 for NSnv. The majority of National Servicemen were born between 1945 and 1950, so the cohort's age at the end of the mortality study period (2001) generally ranged from 51 to 56 years. Over 90% of the NSv were between 20-22 years old at the start of their Vietnam service.

A strong healthy worker effect was still evident for this cohort, SMR = 0.73 (95% CI 0.70, 0.76) but cancer incidence did not differ from community rates, SIR = 0.96 (95% CI 0.92, 1.01). However, the direct comparison of mortality and cancer incidence for NSv to NSnv showed a number of significant differences between those who served in Vietnam and those who served in Australia. Table 1 shows the relative rates for selected causes of death for the period of 1966 to 2001 and Table 2 shows the results of the cancer incidence analysis for the period 1982 to 2000.

**Table 1: Relative mortality rates for National Service veterans and non-veterans (1966 – 2001)**

Cause of death	Veterans		Non-veterans		RR	95% CI
	Observed	Expected	Observed	Expected		
All deaths	1,052	941	1,089	1,200	1.23	1.13–1.34
Neoplasms	290	268	320	342	1.16	0.98–1.36
Connective soft tissue	3	5	8	6	0.48	0.08–2.01
Colorectal	29	33	46	42	0.80	0.48–1.30
Genitourinary	0	13	22	18	0.53	0.22–1.20
Prostate	0	2	5	3	0.00	0.00–1.41
Head and neck	16	12	11	15	1.82	0.79–4.33
Larynx	2	4	6	4	0.42	0.04–2.37
Hodgkin's	4	3	3	4	1.72	0.29–11.77
Leukaemia	11	15	23	19	0.61	0.27–1.30
Lung	67	50	48	65	1.79	1.22–2.65
Melanoma	14	20	32	26	0.56	0.28–1.06
Multiple myeloma	5	5	7	7	0.90	0.22–3.29
Non-Hodgkin's lymphoma	21	17	19	23	1.42	0.73–2.80
Pancreas	19	12	8	15	3.13	1.31–8.26
Mental disorders	13	8	6	11	2.75	0.98–8.83
Nervous system	13	11	13	15	1.29	0.55–3.02
Motor neurone	7	4	2	5	4.73	0.90–46.65
Circulatory system	208	202	252	258	1.05	0.87–1.27
Ischaemic	159	145	172	186	1.18	0.94–1.47
Cerebrovascular	15	21	32	26	0.61	0.30–1.15
Respiratory system	18	17	20	21	1.12	0.56–2.23
COPD	8	8	10	10	1.00	0.34–2.80
Respiratory excluding COPD	10	9	10	11	1.24	0.46–3.32
Digestive system	58	40	33	51	2.25	1.44–3.56
Liver, gall bladder and bile ducts	51	34	26	43	2.50	1.53–4.17
Alcoholic liver	39	26	19	32	2.58	1.46–4.73
External causes	378	334	382	426	1.26	1.09–1.46
MVA	128	111	125	142	1.31	1.01–1.68
Suicide	129	107	115	137	1.43	1.10–1.85

NSv experienced a 23% higher overall mortality compared to NSnv. Mortality from digestive system diseases (primarily liver disease) was more than double that observed in NSnv. Deaths from motor vehicle accidents and suicide were significantly elevated, as was mortality from cancer of the lung and pancreas.

Mortality from mental disorders and neoplasms was also elevated, but of borderline statistical significance. There were no causes of death for which NSv had a statistically significant lower mortality rate than NSnv.

**Table 2: Relative rates of diagnosed cancers (1982-2000) for National Service veterans and non-veterans**

Cancer type	Veterans		Non-veterans		RR	95% CI
	Observed	Expected	Observed	Expected		
All cancers	810	753	914	971	1.14	1.04–1.26
Brain and CNS	23	20	22	25	1.36	0.73–2.56
Connective soft tissue	10	10	13	13	0.99	0.39–2.44
Eye	11	8	8	11	1.85	0.68–5.29
Gastrointestinal	121	117	145	149	1.06	0.82–1.36
Colorectal	103	96	116	123	1.13	0.86–1.49
Stomach	11	16	25	20	0.55	0.24–1.16
Genitourinary	124	136	189	176	0.84	0.67–1.06
Prostate	65	63	79	81	1.05	0.75–1.48
Hodgkin's disease	12	13	18	17	0.90	0.39–1.97
Leukaemia	16	22	34	28	0.60	0.31–1.13
Lymphoid leukaemia	9	10	14	13	0.82	0.31–2.04
LL_acute	0	0	1	1	0.00	0.00–58.45
LL_chronic	8	9	11	10	0.90	0.31–2.45
Myeloid leukaemia	7	11	18	14	0.50	0.18–1.25
ML_acute	3	7	13	9	0.30	0.06–1.11
ML_chronic	3	3	4	4	0.91	0.13–5.35
Lung	78	53	43	68	2.35	1.60–3.49
Melanoma	204	190	231	245	1.13	0.93–1.37
Mesothelioma	8	5	4	7	2.68	0.72–12.14
Multiple myeloma	8	4	11	12	2.19	0.76–5.98
NHL	35	32	39	42	1.17	0.72–1.89
Oesophagus	9	7	6	8	1.93	0.61–6.59
Oropharynx and larynx	52	42	44	54	1.52	1.00–2.33
Head and neck	44	32	28	40	2.02	1.23–3.37
Larynx	8	10	16	14	0.65	0.24–1.60
Pancreas	17	11	9	15	2.46	1.04–6.27

NSv had a significant 14% elevation in their rate of cancer incidence compared to NSnv. This was reflected by a more than doubling in the incidence of lung cancer, head and neck cancer and cancer of the pancreas.

The National Academies' *Veterans and Agent Orange* report<sup>10</sup> lists four cancers for which they consider there is sufficient evidence of an association with herbicide exposure: cancer of the connective soft tissue, chronic lymphoid leukaemia, non-Hodgkin's lymphoma and Hodgkin's disease. None of these four cancers were significantly more frequent amongst the NSv compared to NSnv, nor were the standardised incidence or mortality ratios significantly elevated among these groups compared to the general population. An additional four cancers are considered to have limited evidence of an association: cancer of the lung, prostate, larynx and multiple myeloma. Lung cancer and multiple myeloma, were more frequent amongst NSv, whereas cancer of the prostate and larynx did not differ between the groups nor were their incidence significantly different from community rates.

In conclusion, two groups of fit healthy men who were enlisted into military service more than 30 years previously were compared. Those who served in the Vietnam War experienced higher levels of mortality and cancer incidence than those who served in Australia. For the period under study this cohort of National

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Servicemen was generally younger than the peak age of incidence for many of the diseases of interest, and as this cohort ages clearer patterns of disease may emerge.

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