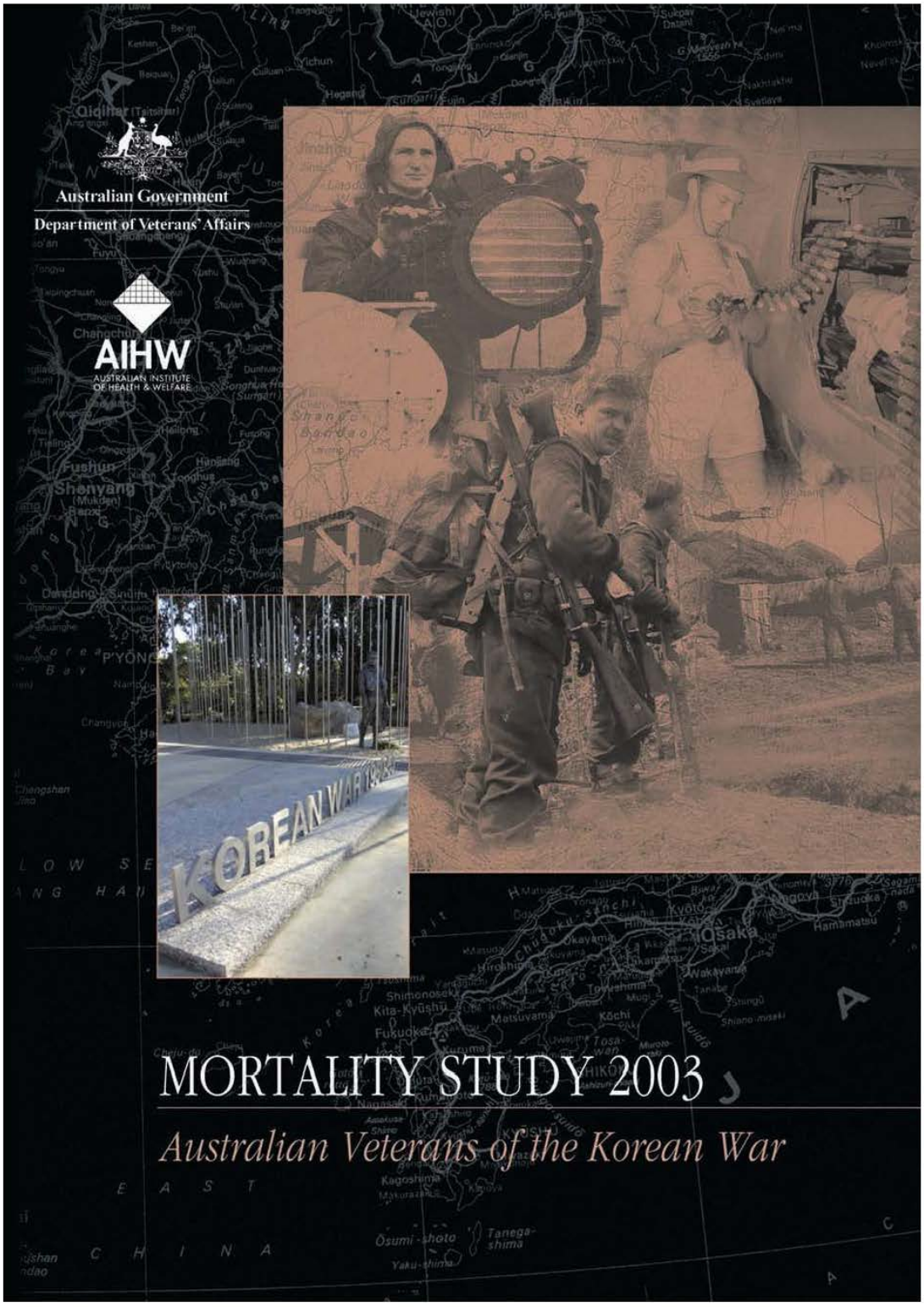
Australian Government
Department of Veterans' Affairs
AIHW
AUSTRALIAN INSTITUTE OF HEALTH & WELFARE
KOREAN WAR
MORTALITY STUDY 2003
Australian Veterans of the Korean War

In Memoriam

Dr John Bradley MBBS MRACP MD MRACR FRCR FRACR FRACP, Returned & Services League of Australia Limited, who contributed significantly to the commencement and development of the study, but did not live to see the results of his endeavours.

Acknowledgments

The Department of Veterans' Affairs and the study team in particular are grateful to:
the members of the Study Scientific Advisory Committee for their guidance;
the Australian Electoral Commission;
the staff at the Australian Institute of Health & Welfare who ascertained the causes of death and compared the death rates of Korean War veterans with the Australian population; and
the staff at the Health Insurance Commission who also did data matching.

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REPATRIATION COMMISSION

21 November 2003

The Hon Danna Vale MP
Minister for Veterans' Affairs
Parliament House
CANBERRA ACT 2600

Dear Minister

I have pleasure in submitting the final report of the *Mortality Study of Australian Veterans of the Korean War*. This study has investigated mortality rates, both generally and for specific causes of death, among Australian male veterans of the Korean War from their last day of service in Korea to 31 December 2000, and compared these with the corresponding rates for the general Australian male population of the same age.

The study has taken a significant time to complete. This was due to the need to develop a *Nominal Roll of Australian Veterans of the Korean War* required as the starting point for the study, and the complexity of subsequent research to establish whether individual veterans were alive or dead, and the reasons for death.

I would like to acknowledge the contribution to the success of the study made by my predecessor, Major General J P Stevens AO. From its commencement, the study was conducted under his direct supervision. His input and guidance continued until late August this year and this helped shape the final preparation of the report.

The study, although commenced first, is the second study concerning Korean War Veterans to be completed. The first to reach the report stage was the *Cancer Incidence Study of Australian Veterans of the Korean War*.

You have also approved the conduct of a *General Health Survey of Australian Veterans of the Korean War*. This is scheduled to commence early in the new year and the results of that study will be published separately.

I would like to take this opportunity to thank the members of the Korean War Veterans Mortality Study Consultative Committee for their assistance and cooperation during the conduct of the study. Due to the length of time over which the study was conducted, a number of changes in membership took place. A full list of members, and the ex-Service organisations they represented, is at Appendix E of the report.

RADM C S H Harrington AM RAN (Retd)
PO Box 21 Woden ACT 2606
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Email: simon.harrington@dva.gov.au

The report's preparation was supervised by the Study Scientific Advisory Committee, the membership of which is set out at Appendix F.

I would also like to thank the Australian Institute of Health & Welfare, which did the bulk of the data matching, Dr Keith Horsley, the Director of Research Studies and the other departmental staff who worked on the study.

Yours sincerely

Simon Harrington
COMMISSIONER

The Korean peninsula and the four stages of the war

i. Pusan Perimeter – limit of the North Korean advance to September 1950

ii. Furthest advance of UN forces to end October 1950

iii. Limit of Chinese advance to end January 1951

iv. Battle front June 1951 – July 1953 and ultimate demarcation line

Professor Priscilla Kincaid-Smith

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17 November 2003

Rear Admiral C S H Harrington AM RAN (Retd)
Repatriation Commissioner
PO Box 21
WODEN ACT 2606

Dear Rear Admiral Harrington

I have great pleasure in providing you with a copy of the Report of the *Mortality Study of Australian Veterans of the Korean War,* which has been completed by the Department of Veterans' Affairs and the Australian Institute of Health & Welfare. The Scientific Advisory Committee has endorsed this study.

Kind regards.

Yours sincerely

Priscilla Kincaid-Smith AC CBE
Chair
Scientific Advisory Committee
Korean War Veterans' Medical Studies

Australian operational locations 1950 – 1953

Naval Movements ★ POW Camps Airfields Major actions

Contents

Abbreviations

ABS	Australian Bureau of Statistics
ADF	Australian Defence Force
AEC	Australian Electoral Commission
AIHW	Australian Institute of Health and Welfare
AML	Acute myeloblastic leukaemia
ARA	Australian Regular Army
BCFK	British Commonwealth Forces Korea
BCOF	British Commonwealth Occupation Force (Japan)
BDM	Births, Deaths and Marriages
CARO	Central Army Records Office
CI	Confidence interval
COPD	Chronic obstructive pulmonary disease
DMZ	Demilitarized Zone
DVA	Australian Government Department of Veterans' Affairs.
HIC	Health Insurance Commission
ICD-9	International Classification of Diseases — Revision 9
ICD-10	International Classification of Diseases — Revision 10
KATCOM	Korean Augmentation Troops Commonwealth scheme
MASH	Mobile Army Surgical Hospital (US)
NAA	National Archives of Australia
NCSCH	National Cancer Statistics Clearing House
NDI	National Death Index
NKPA	North Korean People's Army
NYSIIS	New York State Intelligence Information System
PTSD	Post-traumatic stress disorder
RAAF	Royal Australian Air Force
RAF	Royal Air Force
RAN	Royal Australian Navy
RAR	Royal Australian Regiment
RBDM	Registrars of Births, Deaths and Marriages
RN	Royal Navy
ROK	Republic of Korea
RR	Relative risk
SMR	Standardised mortality ratio
UK	United Kingdom
UN	United Nations
UNCURK	United Nations Commission for the Unification and Rehabilitation of Korea
UNGA	United Nations General Assembly
US or USA	United States of America
USAF	United States Air Force
USN	United States Navy
USSR	Union of Soviet Socialist Republics
VEA	*Veterans' Entitlements Act 1986*
YMCA	Young Men's Christian Association
YWCA	Young Women's Christian Association

Definitions

1. Korean war veterans

For the purposes of the study, '*Korean War veterans*' were defined as:

> All members of the Royal Australian Navy, Australian Army, Royal Australian Air Force (including those airmen based in Japan who flew operational missions over Korea), who landed in Korea or entered Korean waters, including those who were seconded to the Army of the Republic of South Korea, the United States Air Force (USAF), the United States Navy (USN), the British Army, Navy or Air Force and any other allied Service; all members of philanthropic organisations; all members of the Australian Forces Overseas Fund and all official entertainers and war correspondents who saw service in Korea during the period between 27 June 1950 and 19 April 1956.

This definition excludes:

- members of the diplomatic corps;
- entertainers other than those who were regarded as 'official';
- members of the Army of the Republic of Korea or of any other army who have become Australian citizens subsequently;
- Australian citizens employed in Korea by overseas business organisations or governments;
- civilian non-medical aid and charity workers other than members of philanthropic organisations who were accredited to the Australian Defence Force; and merchant mariners

2. 'Allotted for Duty' and 'Operational Service'

Under the *Veterans' Entitlements Act 1986* (VEA), the terms 'Allotted for Duty' and 'Operational Service' have the following meanings:

- **Allotted for Duty** means a person or unit of the Defence Force that was allotted for duty in an operational area. Allotment may be retrospective or prospective, and occurs via a written instrument issued by the Defence Force; and
- **Operational Service** is rendered where a person is allotted for duty and serves in an operational area. Current use of this term is not the same as normal posting procedures used in the Defence Force to move members from one unit to another.

3. Tours and visits

- For the purposes of this study, a visit is defined as service of less than 28 consecutive days on land in Korea or on ships operating off the Korean coast. In contrast, a tour is defined as service equal to or more than 28 consecutive days on land in Korea or in ships operating off the Korean coast.

Flightdeck of the aircraft carrier, HMAS Sydney*, during a blizzard, Korea, 1951.*
AWM 301452

Executive summary

This is a study of the mortality patterns of Australian Korean War veterans following the Korean War. It was prompted by concerns from the Korean War veteran community that their death rates were higher than the Australian male population, and that this increase was due to their service in Korea.

It is the first mortality study of all Australian military personnel, Royal Australian Navy, Australian Army, Royal Australian Air Force and included a small number of members of approved philanthropic organisations — Australian Red Cross, Salvation Army and Young Men's Christian Association — who served in Korea. It covers deaths of veterans in the period 27 June 1950 to 31 December 2000 following completion of Korean service.

The aims of the Korean War Veterans Mortality Study were to:

- develop a nominal roll of all Australian veterans of the Korean War,
- develop a geographic profile of all living Australian veterans of the Korean War,
- determine mortality rates of Australian veterans of the Korean War, and
- compare the mortality rates of male Australian veterans of the Korean War with those of Australian males.

A protocol for this study was completed in September 1999. It defined the study aims, methods of data collection and analysis, limitations of the study, reporting, and privacy and confidentiality considerations. The absence of quantitative data on occupational and environmental exposures was acknowledged.

Ethical approval for the study was obtained from the Department of Veterans' Affairs (DVA) Ethics Committee and the Australian Institute of Health and Welfare (AIHW) Ethics Committee.

The study was conducted by DVA while the AIHW ascertained the causes of death and compared the death rates of Korean War veterans with the Australian population. An independent Scientific Advisory Committee was established to oversight the scientific aspects of the study and representatives of ex-Service organisations formed a Consultative Committee to represent the interests of Korean War veterans.

Table 1 shows the total numbers of male and female Korean War veterans on the Nominal Roll, categorised by the first organisation in which they served.

Table 1: Number of veterans on the nominal roll

	Males	Females	Total
Navy	5,769	0	5,769
Army	10,814	34	10,848
Air Force	1,204	21	1,225
Philanthropic organisations[a]	16	3	19
Civilians[b]	10	0	10
Total	**17,813**	**58**	**17,871**

a. Includes personnel from the Australian Red Cross, Salvation Army and Young Men's Christian Association.
b. Includes war correspondents and civilian canteen staff aboard HMAS *Sydney*

Because only 58 females served in the Korean War, it was not feasible to conduct a scientifically reliable cohort study of mortality rates amongst female veterans. Accordingly, mortality rates were derived for male veterans only.

Identifying deaths amongst veterans

After the nominal roll had been compiled, the names of male veterans were matched with a number of registers to determine whether the veterans had died since the end of their service in Korea or were still alive on 31 December 2000. The sources of data on vital status were: Department of Defence records; DVA records; the National Death Index; Electoral Commission rolls; the Health Insurance Commission Medicare database; and, for pre-1980 deaths, death registers maintained by New South Wales, Victoria, Queensland, Western Australia, South Australia, Tasmania and Australian Capital Territory Registries of Births, Deaths and Marriages. The New Zealand Registry of Births, Deaths and Marriages also provided details of Australian male veterans who had died in that country. Just over 81% of all veterans were identified on DVA databases, and this became the major source of information on the vital status of veterans.

A total of 17,813 males served in the Korean War, and 339 veterans were killed in action and 10 died of injury or disease in Korea during the cease-fire period between 28 July 1953 and 19 April 1956. These 349 deaths were excluded from the study. The study population thus consisted of the remaining 17,464 male veterans who returned to Australia following their Korean War service. Table 2 shows the number and percentage of male veterans determined to be alive or dead in the study as at 31 December 2000. After a search of death records covering nearly 50 years, the vital status of 5.1% remains unknown. This percentage is very low for a study of this type. The distribution of unknowns varied between the Services and vital status was most difficult to determine in the Army. There is evidence that many veterans of unknown vital status may have emigrated from Australia since the end of the Korean War, but the numbers were not able to be quantified. Other veterans may not have been found due to changed names.

Table 2: Summary results of nominal roll matching

Group	Alive	Dead	Unknown	Total
Navy	3,256	2,271	239	5,766
Army	4,976	4,929	626	10,531
Air Force	638	508	21	1,167
Total	**8,870**	**7,708**	**886**	**17,464**
		Per cent		
Navy	56.5	39.4	4.1	100
Army	47.3	46.8	5.9	100
Air Force	54.7	43.5	1.8	100
Total	**50.8**	**44.1**	**5.1**	**100**

The place of residence of Korean War veterans who were alive on 31 December 1999 (the initial study end-date) was determined from the postcode recorded on the relevant State or Territory electoral roll provided by the Australian Electoral Commission. Surviving male Korean War veterans live predominantly on the coast of the eastern states. Furthermore, approximately 60% of all surviving veterans are urban metropolitan dwellers — living in the State and Territory capitals.

The statistical analysis of the Korean War veteran cohort employed standard statistical methods for cohort studies. The following information was determined in order to conduct the analysis:

- the population at risk in the veteran cohort by age and calendar period, duration of service in Korea, and branch of Service;
- the number and cause of deaths in the veteran cohort by age, calendar period, duration of service in Korea, and branch of Service; and
- the age-specific mortality rates by calendar period and cause in the comparison population, in this case Australian males with a comparable age profile.

The results presented are obtained from analysis of deaths of veterans whose vital status has been determined. These results assume that veterans of unknown status had the same mortality rate as the veterans whose vital status is known which may or may not be true. The 886 veterans in the unknown category are referred to as the 'veterans whose vital status is unknown' for the purposes of this study. The effect on the results of excluding this group was assessed in an additional analysis. This additional analysis assumes that all veterans of unknown vital status are alive (an unlikely situation). The results from this analysis can then be compared with the previous results to assess their validity. Both sets of results are presented in the body of the report. The most likely results, that is, where it is assumed veterans of unknown status had the same mortality rate as the veterans whose vital status is known, are presented as Scenario 1. The additional analysis that assumes all veterans of unknown status are alive is presented as Scenario 2 and is an under-estimation of risk. The results from Scenario 2 reveal that the conclusions reached in Scenario 1 are robust. For readability, results from Scenario 1 only are presented in the Executive Summary.

Number of veteran deaths studied

Australian male mortality rates, against which the Korean War veterans' deaths are compared, only refer to deaths within Australia. Accordingly, veterans who died in the Vietnam War or elsewhere overseas during the period of the study have been excluded, as were 79 deceased veterans with an unknown date of death and two deceased veterans with unknown dates of birth.

Following these exclusions, a total of 7,514 veteran deaths were included in the study. Of these deaths, a cause of death could not be determined for 262 (3.5%). For these deaths, a cause of death was assigned in line with the mortality pattern of known causes existing amongst the other veterans who died in the same time period.

Findings

In this section, all references to elevation or lowering of mortality rates are statistically significant compared to the Australian male population.

During the development of the protocol for the study, causes of death of *a priori* interest were identified from the literature and consultation with veterans. Mortality from 13 causes of death of *a priori* interest were elevated (section 6.2 refers). They included mortality from all causes, chronic obstructive pulmonary disease, ischaemic heart disease, stroke, alcoholic liver disease and external causes, such as suicide and motor vehicle accidents.

Among the cancers of interest, mortality rates for cancer of the oesophagus, gastrointestinal and colo-rectal cancers, head and neck, lung, genito-urinary and prostate cancers were elevated. Mortality rates from two *a priori* diseases (tuberculosis and peptic ulcer disease)

and four cancers (liver and gallbladder, mesothelioma, melanoma and leukaemia) did not differ from that of Australian males.

None of the *a priori* diseases showed a lower mortality rate.

As for the Australian male population, the most common causes of death were from diseases of the circulatory system, cancer, external causes such as suicide and motor vehicle accidents, and diseases of the respiratory system.

Overall, Korean War veterans experienced a 21% higher mortality rate than an equivalent Australian male population.

Elevated mortality rates for specific causes of death were found for a number of conditions:

- the death rate from diseases of the circulatory system was elevated by 13%, with ischaemic heart disease elevated by 10% and stroke by 17%.
- the death rate from cancer was elevated by 31%;
- the death rate from all external causes (homicides, accidents and suicides) was elevated by 37%, with suicides elevated by 31%;
- the death rate from respiratory diseases was elevated by 32%. Chronic obstructive pulmonary disease information has been available since 1979 and was elevated by 49%. Respiratory diseases remained elevated by 45% after exclusion of chronic obstructive pulmonary disease;
- the death rate from all digestive diseases was elevated by 35%, with deaths from diseases of the liver, gallbladder and bile ducts elevated by 33% and deaths from alcoholic liver disease elevated by 36%.

Korean War veterans had lower mortality rates for diseases of the skin (reduced by 74%) and congenital malformations (reduced by 64%), with one and three deaths recorded respectively.

Mortality by Service branch

Of the three Services, Army veterans experienced the highest level of mortality followed by Navy, then Air Force. Air Force veterans showed a statistically significantly lower mortality rate than the Australian male population.

The most common causes of death in each Service were the same as for all Korean War veterans overall and the Australian male population, and were from diseases of the circulatory system, neoplasms, external causes such as suicide and motor vehicle accidents, and diseases of the respiratory system.

<u>Navy</u>

Navy veterans experienced an 11% overall increased mortality rate with an increased mortality from:

- circulatory diseases (elevated by 9%), including stroke (21% increase);
- neoplasms (elevated by 22%); and
- chronic obstructive pulmonary disease (elevated by 30%).

Navy veterans had a lower mortality for four of the 27 causes of death analysed:

- the death rate from infectious diseases was 44% lower;
- the death rate from tuberculosis was 73% lower;
- the death rate from genito-urinary diseases was 39% lower; and

- the death rate from motor vehicle accidents was 27% lower.

Army

Compared to the Australian male population, Army veterans had a 31% increased mortality rate for all cause mortality and for 13 other causes of death. Specifically:

- the death rate from all circulatory diseases was elevated by 20% with rates from ischaemic heart disease and stoke being elevated by 18% and 22% respectively;
- the death rate from neoplasms was elevated by 41%;
- the death rate from external causes was elevated by 58%, with suicides elevated by 53%;
- the death rate from all respiratory diseases was elevated by 48%. Chronic obstructive pulmonary disease information has been available since 1979 and was elevated by 69%, and respiratory diseases excluding chronic obstructive pulmonary disease elevated by 57%; and
- the death rate from all digestive diseases was elevated by 57%, including rates from diseases of the liver, gallbladder and bile ducts elevated by 51%, peptic ulcer disease elevated by 90%, and alcoholic liver disease elevated by 47%.

Army veterans showed a lower mortality rate for one cause of death, that being deaths from congenital malformations which was 79% lower than for Australian males.

Air Force

Air Force veterans demonstrated an 11% lower mortality rate for all causes of death. Lower mortality rates were demonstrated for three causes of death, specifically:

- the death rate from all circulatory diseases was 18% lower, including deaths from ischaemic heart disease which was 16% lower; and
- the death rate from alcoholic liver disease which was 65% lower.

Cancer mortality

All Services

Mortality from specific cancers was investigated by individual primary site. For all male Korean War veterans, the most frequently occurring cancer deaths are from lung, gastrointestinal and genito-urinary cancers. The overall death rate from cancers was elevated by 31% compared to the Australian male population. Specifically:

- the death rate from lung cancer was elevated by 47%;
- the death rates from gastrointestinal cancer and colo-rectal cancer were increased by 18%;
- the death rate from genito-urinary cancer was increased by 24%;
- the death rate from cancers of the head and neck was elevated by 96%;
- the death rate from cancer of the oesophagus was elevated by 59%;
- the death rate from cancer of the larynx was elevated by 95%; and
- the death rate from cancer of unknown primary site was elevated by 51%.

Cancer mortality by Service branch

The most common deaths from cancer in the Navy and Army were similar to those of all Korean War veterans, that is from lung, gastrointestinal and genito-urinary cancers. However, in the Air Force, genito-urinary cancers were more common than gastrointestinal cancers.

Navy

A significantly elevated mortality rate of 22% was found for all neoplasms. Lung cancer was elevated by 27%, genito-urinary cancers by 34% and cancer of the head and neck was elevated by 109%. Death from lymphoid leukaemia among Navy personnel was 60% lower than the Australian male population.

Army

An elevation in mortality rate from all neoplasms of 41% was found in the Army. Specifically:

- lung cancer was elevated by 69%;
- gastrointestinal cancer was elevated by 24% with colo-rectal cancer increased by 22%;
- cancer of the head and neck was elevated by 90%;
- cancer of the oesophagus was elevated by 82%;
- cancer of the liver and gallbladder was elevated by 67%;
- cancer of the larynx was elevated by 144%; and
- cancer of unknown primary site was elevated by 77%.

Air Force

Overall cancer mortality was not elevated, and only prostate cancer was statistically significantly elevated among Air Force veterans by 71%. Two cancer categories, liver and gallbladder cancer, and stomach cancer, showed a lower mortality rate among Air Force veterans of 75% and 59% respectively.

Smoking-related cancers

Many cancers for which there was elevated mortality among the Korean War veterans are cancers associated with smoking. Modelling indicates that very high rates of smoking would be required to account for the increases observed and might not account for all the cancer elevation. However in the absence of information about the percentage of veterans who smoked and the numbers of cigarettes smoked per day, it is not possible to determine precisely how much of the excess mortality could be attributed to smoking. Therefore this limits the ability to assess the extent to which other possible causes have contributed to the deaths apart from tobacco consumption.

Effect of Nature of Service

The nature of service in Korea varied considerably between the Navy, Army and Air Force. Navy personnel spent an average of 249 days in Korean waters with 85% completing one tour only. Army personnel averaged 305 days in Korea with 77% completing one tour only. In contrast, only 57% of Air Force personnel completed one tour only, with an average duration of service of 145 days. The large number of visits conducted by Air Force personnel reflects

both the arrangements for aircraft maintenance, which were split between Korea and Japan, and the operational transport role, including aeromedical evacuation.

Almost 9% of Korean War veterans participated in the Vietnam War and the DVA client database indicates that at least 30% of Korean War veterans participated in World War II. These factors need to be taken into consideration when interpreting the results.

Given the absence of quantitative data on exposure to occupational and environmental hazards, the effect of duration of service and the period of service in Korea were investigated for Navy and Army veterans. (The number of Air Force veterans was too small for this analysis.) Mortality by duration of service in Korea for Navy and Army veterans did not show any clear pattern between the different duration categories or within each Service branch.

However, investigating mortality by period of service among Army veterans reveals that those who completed their Korean service prior to 1952 (which marked the end of the offensive / counter-offensive phase of the conflict), had a significantly lower mortality rate from suicide compared to the Australian male community. Those who served in Korea after 1952 had a higher mortality rate from suicide compared to Australian males. Apart from this unexpected and possibly chance post hoc finding, there was no other apparent trend from the effect of period of Korean service on mortality.

Strengths and weaknesses of the study

The study has various strengths, and, given the constraints of the study design, unavoidable weaknesses that affect its interpretation.

The strengths of this study include:

- identification of the total veteran population was close to complete;
- follow-up or tracing was from the end of service until 31 December 2000 — the length of time that elapsed since service ranged from approximately 44 to 50 years;
- vital status was established for 94.9% of veterans in the study; and
- the study was conducted in a country with an advanced medical system ensuring the majority of causes of death are accurately classified.

The weaknesses of this study include:

- there was an under-ascertainment of deaths. About 5.1% of the Korean War veterans could not be located. It is expected that some of these have died prior to the establishment of the National Death Index. This may have lead to an under-estimation of the effects of Korean War service;
- there was a lack of measurement of exposure to risk factors that might contribute to the observed associations, such as cigarette smoking, alcohol intake, hepatitis B virus infection, endemic parasites and bacteria, pesticides, solvents, chemical exposures and environmental exposures in Korea; and
- the exposure measures available were duration and period of service in Korea. These could not reflect occupational variations or the variation in exposure to Korean War service within and between the Royal Australian Navy, Australian Army and Royal Australian Air Force.

Conclusion

This study has demonstrated that participation in the Korean War is associated with an overall increase in mortality of 21% and an increase in cancer mortality of 31%. Korean War veterans have an elevation in mortality from 12 of the *a priori* diseases of interest. Mortality was highest in Army veterans and lowest in Air Force veterans.

Because of the limitation in measurement of factors known to affect mortality, their contribution to the increase in mortality could not be determined. Some of the diseases with higher mortality rates have been linked with cigarette smoking. Although Korean War veterans have a higher mortality for several causes of death that have been identified, there is no way of determining whether this resulted from some exposure in Korea or whether it was the result of lifestyle changes arising as a consequence of Korean War service or a combination of both.

Recommendations

1. The Korean War has been referred to as ' The Forgotten War'. This study has demonstrated that participation in the Korean War is associated with an overall increase in mortality of 21% and an increase in cancer mortality of 31%. About 50% of all Korean War veterans are still alive. In light of the demonstrated increase in mortality consideration should be given to targeted health interventions for the surviving Korean War veterans.

2. This mortality study should not be considered in isolation, but with the companion studies that are being undertaken simultaneously. Thus, this study and the companion cancer incidence study should be referred to the Scientific Advisory Committee oversighting the health study of surviving Korean War veterans, as these studies may indicate additional areas to address in the health survey.

3. There is anecdotal evidence that Australian veterans of the Korean War smoked more than the comparable Australian population. A health survey of surviving veterans of the Korean War is about to commence. It is recommended that the level of cigarette consumption in the survivors be assessed and that the current survey of veterans of the Korean War include questions on current smoking. This may allow programs of smoking cessation to be more effective and to be better targeted within the Korean War veterans.

4. Similarly, the increase in mortality from alcoholic liver disease indicates that the level of alcohol consumption be assessed in the health survey of survivors. This may allow programs aimed at reducing alcohol intake to be better targeted within the surviving Korean War veterans.

5. The information from the current study, including the date when each veteran was last known to be alive or dead, should be stored safely together with the nominal roll. Updated vital status data should be stored separately and this information made available for the general health survey of surviving Korean War veterans.

6. In this study there was considerable difficulty in locating some veterans. Some of this difficulty was due to errors in recording client data in the DVA database and matching against Defence records. DVA should liaise with Defence to ascertain methods of improving matching against Defence personnel records. This should be of longer term benefit in conducting studies of cohorts of veteran populations and may lead to improvement in quality control systems on data entry.

Two Bofors gunners enjoy a quiet moment on HMAS Murchison *at Fork Anchorage, Han River estuary, 1951.*
AWM 0044747

Chapter 1 Introduction

This research study of Australian male veterans of the Korean War was announced by the Minister for Veterans' Affairs on 13 October 1997. It was prompted by concerns from the Korean War veteran community that their death rates, particularly those due to heart disease, diabetes, prostate and other cancers, respiratory illnesses and renal failure were higher than the Australian male population, and that this increase was due to their service in Korea.

This is the first mortality study of Royal Australian Navy, Australian Army, Royal Australian Air Force who served in Korea.

The study identified both male and female veterans who served in the Korean War and the enforcement period following the cease fire. However, the study was only able to analyse mortality data relating to the male veterans. The number of female veterans (58) was too small to allow the derivation of reliable results.

1.1 Korean War Veterans Mortality Study

1.1.1 Ethical approval

A protocol for this study was completed in September 1999. It defined the study aims, methods of data collection and analysis, limitations of the study, reporting, and privacy and confidentiality considerations.

The protocol was accepted by the study's Consultative Committee, the Study Scientific Advisory Committee, the DVA Ethics Committee and the AIHW Ethics Committee. During the course of the study approval for several variations and corrections to the protocol was sought and obtained. The protocol is reproduced at Appendix A.

1.1.2 Study Aims

The aims of the Study were to:

- develop a nominal roll of all Australian veterans of the Korean War;
- develop a geographic profile of living Australian veterans of the Korean War;
- determine mortality rates of Australian veterans of the Korean War; and
- compare the mortality rates of Australian veterans of the Korean War with those of the Australian community.

1.1.3 Study design

The study is a study of all male Australian personnel — Navy, Army, Air Force— who served in Korea. The analysis determines mortality rates for the period from the veterans' last date of service in Korea until 31 December 2000. All comparisons have been standardised by age and calendar year of death.

The study compares the mortality rates of male Australian veterans of the Korean War with those of Australian males. In addition, it analyses whether mortality rates vary between different groups of Korean War veterans or by different measures of exposure to Korea.

1.1.4 Study implementation

Representatives of ex-Service organisations formed a Consultative Committee to represent the interests of Korean War veterans (Appendix F) while a Scientific Advisory Committee (Appendix G) was established to oversight the scientific aspects of the study. The study was conducted by DVA in conjunction with the AIHW (Appendix H).

1.1.5 Definition

For the purposes of the study, '*Korean War veterans*' were defined as:

> All members of the Royal Australian Navy, Australian Army, Royal Australian Air Force (including those airmen based in Japan who flew operational missions over Korea), who landed in Korea or entered Korean waters, including those who were seconded to the Army of the Republic of South Korea, the United States Air Force (USAF), the United States Navy (USN), the British Army, Navy or Air Force and any other allied Service; all members of philanthropic organisations; all members of the Australian Forces Overseas Fund and all official entertainers and war correspondents who saw service in Korea during the period between 27 June 1950 and 19 April 1956.

This definition excludes:

- members of the diplomatic corps;
- entertainers other than those who were regarded as 'official';
- members of the Army of the Republic of Korea or of any other army who have become Australian citizens subsequently;
- Australian citizens employed in Korea by overseas business organisations or governments;
- civilian non-medical aid and charity workers other than members of philanthropic organisations who were accredited to the Australian Defence Force; and
- merchant mariners.

The concluding date of 19 April 1956 was selected as this is the end-date for the Korean Operational Area specified in the *Veterans' Entitlements Act 1986*. Although there was no longer an active threat of enemy action, the living conditions and environmental exposures of individuals maintaining defensive positions or on cease-fire enforcement duties were held to be still comparable to those existing prior to the cease-fire.

1.1.6 Data collection

The starting point for the veteran cohort study was the compilation of a nominal roll of all Australian veterans of the Korean War. This defined the veteran cohort. In itself, this was a major goal of this study and its accomplishment meant that the study was not restricted to those Korean War veterans with whom DVA had had contact by way of the provision of benefits. In addition, the nominal roll provided a baseline for a cancer incidence study as well as a general health survey of surviving male Korean War veterans. These studies will be reported separately.

For each person on the nominal roll, the following data were recorded:

- Service number;
- surname;
- up to three given names;

- date of birth;
- date of death;
- State/Territory in which death was registered;
- residential postcode for living veterans;
- the database source of vital status information;
- period/s of service in Korea;
- ship/unit/ squadron in which the veteran served in Korea; and
- the veteran's RAN branch or trade, Army Corps or RAAF category or mustering for service in Korea.

1.1.7 Specific causes of death

As well as assessing total mortality, specific causes of death, where it was considered that Korean War veterans may differ from Australian males, were also investigated.

The specific causes of death (shown in Table 1-1) were selected for one or more of the following reasons:

- they were suggested by a comprehensive review of current, relevant literature (see Appendix B); and/or
- they were suggested by veterans' organisations and the Consultative Committee to reflect the concerns of their members.

Table 1-1: Causes of death of *a priori* interest

Cause of death	ICD-9 Chapter/Code	ICD-10 Chapter/Code
Chronic bronchitis and emphysema	491, 492	J41, J42, J43.1-J43.9
Ischaemic vascular disease including myocardial infarction and peripheral vascular disease	410-414, 440.2	I21-I25, I70.2, I73.1. I73.9
Cerebrovascular accident (stroke)	430-438	I60-I66
Tuberculosis	010-018	A15-A19
Peptic ulcer disease	531-534	K25-K28
Cirrhosis of the liver	571.2, 571.5, 571.6	K70.3, K74.3-K74.6
External Causes (homicides, accidents and suicides)	E800-E999	V01-Y98
Malignant neoplasm of the oesophagus	150	C15, C26.8
Malignant gastrointestinal neoplasms (stomach, pancreas, colo-rectal)	151-154	C16- C21
Malignant colo-rectal neoplasms	153, 154	C18-C21
Malignant neoplasms of the oropharynx and larynx	141-149, 161	C01-C14, C32
Malignant neoplasm of the lung	162	C33, C34
Mesothelioma	163	C45
Malignant genito-urinary neoplasms including kidney, ureter, bladder, prostate and testicle	185-189	C60-C68
Malignant neoplasm of the prostate	185	C61
Hepatocellular carcinoma	155.0	C22
Malignant melanoma of the skin	172	C43
Leukaemia including Acute Myeloid Leukaemia	204-208	C91-C95
All Causes	-	

Numbers of veteran deaths and specific causes of death were obtained from the AIHW from the National Death Index and from manual searching of pre-1980 records by the Registrars of Births, Deaths and Marriages. These deaths were coded using the International Classification of Diseases, Revision 10 (ICD-10) (see Table 1-1). These were compared with data from the National Mortality Database for all Australian males (for results see Chapter 6). Not all of the diseases of concerns to veterans were able to be assessed directly (such as diabetes and renal failure) and these exceptions were advised to the Consultative Committee.

1.2 Influences on mortality

Two factors that may affect the mortality rates reported in this study deserve particular mention and are discussed below. The first is that service personnel had to be fit for military service at enlistment, so those with life-shortening illnesses or behavioural disorders were excluded by the medical assessment and psychological screening process. This suggests that at the time of service in Korea, Service personnel were fitter on average than other Australian men. The second is that while serving in Korea, service personnel may have been exposed to a range of pesticides and other chemicals, including DDT and various petrochemicals. They were also exposed to periods of extreme hardship, boredom and stress, and a number of infectious diseases were endemic in Korea. Their mortality and health in general may have been affected by these exposures.

1.2.1 Medical assessment for entry into the military

Australian Army

At the time of the Korean War, those wanting to join the Army as a career and those recruited for service in Korea (known among Korean War veterans as 'K Force') were assessed before they were enlisted into the Army. The assessment consisted of a medical examination, an interview and for those with education less than New South Wales intermediate level or equivalent, a set of Army aptitude tests. The purpose of the assessment was to classify each person as:

- medically fit for all service duties; or
- apart from temporary circumstances, fit for all service duties; or
- not fit for all service duties.

The medical examination consisted of a medical history, physical examination, urinalysis (for albumin and sugar) and a chest x-ray. The doctors conducting the examination could classify a recruit as not fit for all service duties for any of the following reasons:

- cardiovascular disease, including systolic blood pressure outside 100–140 mm Hg or diastolic blood pressure outside 60–90 mm Hg;
- chronic diseases of the respiratory, genito-urinary, alimentary, nervous, skeletal and/or haematopoietic systems;
- endocrine and metabolic disease;
- a history of malignancy;
- chronic diseases of skin, ear, nose, throat, eyes; and/or
- abnormalities of speech or dentition.

Those who did not meet the minimum educational standard were required to take psychological tests to screen out anyone with an IQ score of less than 80. The interview was designed to detect potential officer candidates, inconsistent scores on the tests or obvious personality problems. Those with long criminal records or who had committed major crimes were also rejected. Anyone classified as not fit for all service duties was ineligible to enlist.

Royal Australian Navy and Royal Australian Air Force

Those wishing to enter the RAN or the RAAF were also required to be assessed before they could enlist. There were no special enlistments as neither Service recruited specifically for the Korean War. The assessment was similar to that described above for the Army. Its purpose was to classify each applicant as either medically fit or not medically fit, for all service duties. The criteria for rejecting an applicant were similar to those used by the Army. However, there were some minor administrative differences, usually concerning whether, for particular conditions, the examining doctor or a specialist made the final decision to reject the applicant.

Summary

Those who were accepted into the RAN, Australian Army and RAAF differed from their peers. They were in good health, with no chronic diseases or serious congenital anomalies, and their IQ score was above 80. Furthermore, recruits did not include those with criminal records or overt personality problems.

1.2.2 Pesticide, solvent and chemical exposure

Australian troops were exposed, in varying amounts, to a wide range of pesticides, solvents and chemicals during their service in Korea. This range included DDT, solvents (including toluene), pharmaceutical drugs, and petrochemicals (including benzene). Levels of particular exposures have not been established for Australian veterans of the Korean War.

Without an index of exposure it is difficult to attribute adverse health outcomes or mortality directly to contact with pesticides or other chemicals. There are two indirect approaches which may be used to link outcome with exposure. The first approach assumes that the exposure occurred but is generally impossible to study directly, and hence the effects of exposure in other situations are used as surrogates for the effects of service in Korea. Using this approach, no attempt is made to take account of the variations in the level of exposure to pesticides of veterans in Korea compared with persons exposed in manufacturing or applying pesticides.

The second approach is to attribute any difference in mortality or health between the veteran and control groups to service in Korea in general rather than to pesticide or chemical exposure in particular.

In light of the lack of direct measures of exposure to pesticides, solvents and other chemical agents, any variations in mortality found in this study would need to be attributed to service in Korea, rather than exposure to particular agents.

1.3 Report structure

This introduction and Chapter 2 provide background to the study and the Korean War. The Nominal Roll is described in Chapter 3. The characteristics of the study cohort are presented in Chapter 4.

Chapter 5 is a key chapter in this report. It describes how vital status was determined and the statistical methods used in this study.

The mortality rates of male Korean War veterans compared with the Australian male population are presented in Chapter 6. Chapter 7 reviews the mortality findings and considers

them in the context of other mortality studies. Finally, Chapter 8 summarises the study and formulates conclusions and recommendations.

The study protocol is reproduced in Appendix A. The literature review for the study is at Appendix B. Appendix C lists the units allotted by Australian and allied forces to the Korean War. Appendix D provides detailed mortality rates. The geographic profile of living Korean War veterans as at 31 December 1999 is contained in Appendix E. Members of the study's Consultative Committee, the Scientific Advisory Committee and project staff are listed in Appendices F, G and H respectively.

Hill 317 (Maryang San),
September 1950.
AWM 044421

Chapter 2 Australia's involvement in Korea

2.1 Korean Geography and Climate

2.1.1 Geography and Geology

The Korean Peninsula is roughly 300 kilometers wide and extends about 1,000 kilometers southward from the north-east Asian continental landmass. Its northern borders are formed by the Yalu and Tumen rivers, which separate it from Manchuria. The west coast is bordered by the Korea Bay in the north and the Yellow Sea to the south, while the east coast is bordered by the Sea of Japan (East Sea).

Physiographically, the Korean Peninsula is mountainous, extending south-southeast from the north-eastern part of China. The north-northwest, south-southeast trend forms the T'aebaeksan range, which is close to the east coast. The east coast is of an uplifted topography, showing a relatively straight shoreline, while the west coast shows the features of a submerging shoreline. The mountains are not high, rarely exceeding 1,200 meters, but they are found almost everywhere. As a consequence, the terrain is rugged and steep. Only near the west and southwest coasts are there extensive flat alluvial or diluvial plains and more subdued rolling hilly lands (The Korean Overseas Culture and Information Service[1], page 29).

Most of the country's major rivers drain the western and southern slopes of the peninsula and flow into the Yellow Sea. A few flow into the South Sea. For its size, Korea has a relatively high number of large-sized rivers, with six exceeding 400 kilometers in length. Because much of the rainfall is received during the summer monsoon, the discharge of rivers varies significantly. During the summer, rivers swell, often flooding the valley plains. The other seasons are relatively dry and lead to very low water levels, often leaving much of the river beds exposed.

Korea's geological make-up is diverse. It is composed largely of Precambrian rocks, such as granite gneisses and other metamorphic rocks, while separate blocks of Paleozoic Strata are located in North and South Korea. The first block is located near P'yongyang in the north, while the second covers the T'aebaeksan range in the south. The south-eastern section of the peninsula contains Mesozoic Strata and Cenozoic Strata are limited to small areas scattered around the peninsula. Jurassic and Cretaceous granites intrude through the older rocks in a north-east/south-west direction in some areas, but show no specific trend in others.

Mountain ranges have traditionally served as natural boundaries between regions. Because these natural boundaries inhibited frequent interactions between peoples living on either side of the range, subtle, and sometimes substantial, regional differences developed in both the spoken language and customs of the people (The Korean Overseas Culture and Information Service[1], pp 11-12). These regional differences also correspond to traditional administrative units.

At the end of World War II, the peninsula was divided into a northern zone occupied by Soviet Union forces and a southern zone occupied by United States forces, with the boundary set along the 38th parallel. By the end of the Korean War in 1953, a semi-permanent boundary was fixed at the De-militarized Zone (DMZ), a four kilometre wide strip of land that runs along the cease-fire lines for 241 kilometers from the east coast to the west coast. This division left North Korea with a land area of 120,540 square kilometers and South Korea with 98,480 square kilometers.

2.1.2 Overview by Region

In this section, modern spelling conventions are used for place names, based on those quoted in 'A Handbook of Korea', published by The Korean Overseas Culture and Information Service[1], except when referring to locations of significance during the Korean War. In these instances, the earlier spelling has been retained in the interests of clarity to Korean War veterans. There may also be variations in spelling between this section of the Chapter and later sections that have been drawn from sources using different nomenclature systems.

Broadly, the Korean Peninsula is divided into three distinct regions: North, Central and South. These regions, in turn, are further divided into three separate geographical areas. Each area retains its own individual economic, cultural and physical identity, which is briefly described below.

Northern Area

The northern area is primarily divided into two regions: the P'yong-an province in the northwest and the Hamgyong province in the northeast. The third region, the Hwanghae province, lies to the south of P'yong-an province. It was a part of the Central region prior to the division of the peninsula and shares many cultural similarities with other west-central regions of the peninsula.

Hamgyong province is characterised by mountainous topography and has mining and forestry as its major economic activities. Most of the mountains are forested and hills are separated by deep, narrow valleys and small-cultivated plains. The most rugged areas are the north and east coasts.

P'yong-an province, by contrast, contains more flatlands and serves as the major agricultural area of North Korea. The North Korean capital, P'yongyang is located in this province as are also Sariwon, Yongju, Chongju and Pakchon, the sites of significant actions fought by 3RAR on its advance towards the Chinese border.

Central Area

This region consists of the Capital region, Ch'ungch'ong province to the south of the Capital region and Kangwon province to the east. The Capital region includes the Seoul metropolitan area, Inch'on and Kyonggi province. It also includes the lower reaches of the Han River, in the estuary of which the frigate HMAS *Murchison* distinguished herself. The region includes a number of smaller cities clustered around Seoul, forming a continuous and sprawling urban area. It is the transport hub for South Korea as well as its political, economic and cultural centre of activity.

Kwangwon province lies to the east of the Capital region. The T'aebaeksan range, which runs north-south through its middle, divides it into eastern coastal and western inland areas. The terrain is rugged and Kapyong, scene of the major 3RAR defensive action against Chinese forces, lies in the border region between this province and the Capital region.

Ch'ungch'ong province lies just below the Capital region and in recent times has been characterised as a southern extension of Seoul and new industries have recently mushroomed along the Asanman bay on the Yellow Sea coast. The leading urban centres in the province are Ch'ongju and Taejon. The province, together with Kyonggi province in the Capital region, specialises in horticultural and dairy farming to meet the huge demands of the nearby urban centres of the Capital region.

Southern Area

The South region includes the Kyongsang province located in the south-east, Cholla province, located to the south-west and Cheju Island, located about 140 kilometers south of Mokp'o, in the South Sea.

Kyongsang province contains both Pusan and Taegu, respectively the second and third largest metropolitan cities in South Korea. It also encompasses the area of the Pusan Perimeter, within which the allied forces were confined following the retreat from Seoul in the early months of the Korean War. The province currently contains one of the largest industrial agglomerations in the country, second only to the Capital region.

Geographically, the province is characterised by a vast basin of the Naktong River and is surrounded by the Sobaeksan mountains. Due to the rugged topography of the surrounding mountains, sub-areas within the region share common cultural traits such as dialect and custom which are quite distinct from other peoples of outlying regions (The Korean Overseas Culture and Information Service[1], page 13).

Cholla province, also known as Honam, is located on the south-west of the peninsula and contains the fertile lands of the Kumgang and Yongsan-gang river basins. These, together with the coastal lowlands, have made the region the major granary of the nation. The region is also endowed with vast tidal flats, a very irregular coastline and countless large and small islands.

Located south of the peninsula, Cheju Island is the largest in Korea and its isolation from the mainland has contributed to its people's distinct dialect and lifestyle. The island is of volcanic origin with rugged topography and enjoys a subtropical climate.

2.1.3 Climate

The climate on the Korean peninsula is characterised by four distinct seasons, spring, summer, autumn and winter, with a striking contrast in temperature between winter and summer. Winter is bitterly cold due to the influence of the Siberian air mass. Summer, by contrast, is influenced by the maritime pacific high, resulting in hot and humid weather. The transitional seasons of spring and autumn are sunny and generally dry.

Climate variations in the peninsula are more pronounced along the north-south axis and due to these variations, marked differences in vegetation can be seen along this axis. Generally speaking, the southern half of the Peninsula is warmer than the northern half.

Spring

Spring begins during the middle of April in the central part of the country and towards the end of April in the northern region, where the season is short. As the Siberian high pressure weakens, temperatures gradually rise. Yellow sand dust originating from the Mongolian desert occasionally invades Korea during the early spring causing low visibility and eye irritation.

Summer

Summer can be divided into two distinct periods: a rainy period during the early summer months and a hot and humid period during late summer. The weather during the early period is characterised by heavy rainfalls, with more than 60% of the country's annual rainfall concentrated between June and July in South Korea and a month later in the North. Much of

this rainfall is the result of summer monsoons originating in the Pacific Ocean and daily precipitation often exceeds 200mm. Occasional torrential storms are experienced as typhoons pass through the peninsula.

During the second period, the temperature rises abruptly and the weather becomes extremely hot and humid, particularly in the western plains and the Naktong river basin. The daily high temperature can often rise to over 38° during this period and nights remain hot and humid.

Autumn

Autumn is crisp and sunny, beginning in October when the continental air mass brings dry, clear weather. It is a transitional season between the hot, humid summer and the cold, dry winter.

Winter

Winter is characterised by bitter cold and dry weather, with occasional snow falls bringing (relative) warmth when they occur. The predominant influence is monsoonal arctic air from the interior of the Asian continent.

2.2 Korean War

2.2.1 Overview

The Korean War was the first occasion where members of the United Nations (UN) acted collectively to repel aggression. Australian Defence Force (ADF) units served in combat from 1950 to 1953 and continued in Korea from the armistice to 1956 as part of the United Nations Command to preserve the independence of the Republic of Korea[2].

The initial North Korean surprise assault on 25 June 1950 was completely successful and quickly led to the retreat of South Korean troops and the loss of the South Korean capital, Seoul. Despite attempts to block the North Korean army at several positions further south, its advance was not halted until the establishment of the Pusan Perimeter on the south-eastern corner of the Korean peninsula in the last week of July.

From September 1950, following the amphibious landing at Inchon and the breakout from the Pusan Perimeter, the multinational force cleared South Korea and advanced into North Korea towards the border with China. In November 1950 after the Chinese entry to the war, the UN ground forces faced Chinese offensives which forced them to retreat in appalling winter conditions to positions south of the 38th parallel.

The dramatic advances and withdrawals of the first six months came to an end after the early 1951 offensives and counter-offensives ground to a halt. Following this, the war entered a phase of contesting heavily defended emplacements along a front which stretched from coast to coast. This front eventually became the cease-fire line.

The first initiatives to end the war commenced in 1951. Despite this, it dragged on until 27 July 1953 when an armistice was signed. Offensives during this ‘stalemate’ period were launched to gain local tactical advantage or for political reasons during the negotiations.

From 27 June 1950 to 19 April 1956, nearly 18,000 Australian sailors, soldiers and airmen served in Korea. Australian casualties during the period of the war up to the armistice were 339 killed, 1,216 wounded and 29 taken prisoners of war. Twenty other countries contributed combat and medical units to the United Nations Command in Korea.

Australian sailors, soldiers and airmen won world respect for their courage, endurance and combat skills. The service of a small group of Australians in the years 1950-1953 and the sacrifice of those who did not return are not forgotten.

2.2.2 Chronology of Events[2]

On 25 June 1950, the North Korean People's Army (NKPA) crossed the 38th parallel to launch an all-out offensive on the Republic of Korea (ROK). The UN Security Council resolved that the attack by North Korean forces constituted a breach of peace and called for an immediate cessation of hostilities and the withdrawal of North Korean forces to the 38th parallel.

The Security Council passed a further resolution requesting members of the UN to furnish such assistance to the ROK as may be necessary to repel the attack and restore peace and security to the area. The US Representative, Warren Austin, informed the Council that his Government had decided, in accordance with the resolution of 26 June, to order air and sea forces to provide cover and support to the South Korean Government troops.

On 28 June 1950, the NKPA captured Seoul. The British Government placed the ships of the Royal Navy, then in Japanese waters, at the disposal of the US authorities for use in support of the ROK. The Australian Government placed naval vessels then present in Far Eastern waters, namely HMA Ships *Shoalhaven* and *Bataan*, at the disposal of the Security Council in support of the ROK.

On 30 June 1950, the Australian Government informed Lieutenant General Robertson, Commander-in-Chief, British Commonwealth Occupation Force (BCOF) that No 77 Squadron, RAAF, was to be committed to combat duties in Korea. President Truman authorised General MacArthur to use the four infantry divisions of the US Eighth Army, based in Japan, for action in Korea and on 7 July 1950, General MacArthur was appointed Commander-in-Chief, UN Command.

On 1 July 1950, HMAS *Shoalhaven* commenced two months of convoy escort duties and west coast blockade patrols and on 2 July 1950, No 77 Squadron, RAAF, flew its first combat mission over Korea. On 5 July 1950, Task Force Smith, the first American ground combat unit to arrive in Korea, encountered North Korean troops at Osan. On 26 July 1950, the Acting Prime Minister, the Rt Hon Sir Arthur Fadden, announced the commitment of Australian ground forces for service in Korea and advised that only volunteers would be sent to Korea. A recruiting campaign was accelerated.

On 20 July 1950, Taejon was abandoned by UN Command forces. By 4 August 1950, the Naktong River perimeter (Pusan Perimeter) had been established. The Prime Minister, the Rt Hon RG Menzies, visited Japan from 14 to 18 August 1950 and inspected Australian forces preparing for Korea.

The British 27th Brigade was transported by sea to Pusan, arriving on 28 August 1950. Escort vessels included HMA Ships *Warramunga* and *Bataan*. The Battle of the Pusan Perimeter reached its climax from 31 August to 6 September 1950. The US I and IX Corps became operational in Korea on 12 September 1950. On 15 September 1950, in a daring and dramatic move, the US X Corps made an amphibious landing at Inchon, outflanking the North Korean forces. HMA Ships *Warramunga* and *Bataan* were part of the cover force.

The Australian Army advance party arrived in Korea on 17 September 1950. Kimpo airfield, near Seoul, was captured by UN Command forces on the next day. Prime Minister Menzies

commenced a series of broadcasts called 'Defence Call to the Nation' over the following week.

The US Joint Chiefs of Staff authorised General MacArthur to conduct operations north of the 38th parallel on 27 September 1950. On 28 September 1950, the UN Command forces recaptured Seoul. On the same day, the 3rd Battalion, the Royal Australian Regiment (3RAR), brought to full strength by special enlistments from Australia, arrived at Pusan and joined the 27th Brigade.

Despite Chinese threats to enter the war if Americans crossed the 38th parallel, the United Nations General Assembly (UNGA) resolved on 7 October to authorise the UN Command forces to pursue the North Koreans across the 38th parallel. It also resolved to establish the United Nations Commission for the Unification and Rehabilitation of Korea (UNCURK). American forward patrols crossed the 38th parallel on the same day. A week later, the main advance began, with the Eighth Army driving northwards through Kaesong towards Sariwon and Pyongyang, the capital of North Korea. On 19 October 1950, Pyongyang was taken by the Eighth Army.

The Australian battalion reached Chongju, the most northerly point of its advance, on 29 October 1950. Just prior to this, on 27-31 October 1950, nine Chinese armies, totalling over 300,000 men, had crossed the Yalu River and launched their first phase offensive. Strong Chinese attacks on the Eighth Army at Unsan from 31 October to 2 November 1950 forced its withdrawal south of the Chongchon River. On 5 November 1950, General MacArthur ordered a heavy air offensive over North Korea, including the Yalu River bridges at Sinuiju.

On 24 November 1950, the Eighth Army launched its planned drive to the Yalu River. There was little opposition on the first day. However, on 25-26 November 1950, the Chinese launched their second phase offensive. The ROK II Corps was smashed in the central sector near Tokchon on 25 November, while on 26 November, over 200,000 Chinese attacked the Eighth Army north of the Chongchon River, inflicting heavy casualties. On 27 November 1950, the US 2nd, 24th and 25th Divisions withdrew south of the Chongchon River. By 5 December 1950, Pyongyang had been abandoned by the Eighth Army.

On 7 December 1950, UNCURK reported that between 231,000 and 400,000 Chinese troops were engaged against UN Command forces. The US 1st Marine Division and 7th Division withdrew into a defensive perimeter at Hungnam on 11 December 1950. On 15 December 1950, The UN Command forces withdrew south of the 38th parallel.

On 12 December 1950, thirteen Arab and Asian nations submitted a draft resolution proposing that a committee should investigate the basis for a cease-fire in Korea. On 18 December 1950, the US requested Australia to support a UN resolution condemning China as an aggressor. On 24 December 1950, the US X Corps completed its evacuation of the Hungnam beachhead and North Korea returned to Communist control. The Chinese third phase offensive was launched between 31 December 1950 and 5 January 1951, leading to the evacuation of Seoul and Inchon. UN Command forces withdrew to the general line Pyongtaek-Wonju-Samchok to regroup.

On 13 January 1951, the UNGA First Committee approved the Cease-fire Group's proposed five principles for an armistice in Korea. The Chinese Government rejected the Cease-fire Group's proposals on 17 January 1951 and called for a seven-nation conference on Far Eastern problems.

On 25 January 1951, General Ridgway launched Operation Thunderbolt, a counter-offensive by the US I and IX Corps northwards to the Han River. Operation Round-up, an advance by

the US X Corps, followed on 5 February 1951. The Chinese fourth phase offensive was launched between 11-17 February 1951.

On 21 February 1951, Operation Killer, a general advance by the IX and the X Corps, began and by 28 February 1951 the last Communist resistance south of the Han River collapsed. On 2 March 1951, Prime Minister Menzies announced a Three Year Defence Program by which Australia was to prepare for world war by the end of 1953.

On 7 March 1951, Operation Ripper began in the central and eastern sectors with an advance across the Han River by the IX and the X Corps. By 14-15 March 1951, the Eighth Army had retaken Seoul.

On 19 February 1951, President Truman asked Australia to provide reinforcements to Korea. This was followed on 16 March 1951 by renewed pressure from the US State Department for increased Australian force commitments to Korea. On 14 May 1951, Prime Minister Menzies informed President Truman of Australia's limited defence resources and inability to provide more forces for Korea.

Operation Rugged, a general advance to the Kansas Line north of the 38th parallel, began on 5 April 1951. On 11 April 1951, President Truman relieved General MacArthur of his command and appointed General Ridgway in his place. By 14 April 1951, UN Command forces had reached the Kansas Line. By 19 April 1951, the I and the IX Corps reached the Utah Line, south of the 'Iron Triangle'.

The first stage of the Chinese fifth phase offensive was launched during 22-28 April 1951. During this offensive, on 23-24 April 1951, 3RAR won a US Presidential Citation for its performance at the Battle of Kapyong, where it delayed the advance of far greater numbers of Chinese. After withdrawing to a new defence line, by 30 April 1951 the UN Command forces halted the Chinese offensive north of Seoul and the Han River.

On 16 May 1951, the second stage of the Chinese fifth phase offensive was launched. This was halted by a counter-offensive on 19 May, which led to UN Command forces resuming their advance. The Eighth Army regained the Kansas Line on 30 May 1951, when Operation Piledriver began. By 15 June 1951, elements of the I and IX Corps reached the Wyoming Line, some 30 kilometers north.

General Ridgway proposed negotiations to Communist commanders on 30 June 1951 and negotiations between UN Command and Communists began at Kaesong on 10 July 1951. On 3 July 1951, the US Delegation introduced a resolution into the Security Council denying North Korean allegations of germ warfare by the UN Command.

On 25 July 1951, HMAS *Murchison* commenced the first of her many patrols within the Han River estuary engaging enemy targets. On 28 July 1951, the 1st Commonwealth Division was formed.

On 17 August 1951, a demand by the Communists for an apology for alleged violation of the neutral zone at Kaesong was refused and on 23 August 1951, the Communists suspended armistice negotiations. The US 1st Marine Division opened an assault in the Punchbowl area of the eastern sector on 31 August 1951 and the 2nd Division opened its attack against Heartbreak and Bloody Ridges on 2 September 1951. By 18 September 1951, the Marines had advanced to Soyang River, north of Punchbowl.

On 5 October 1951, Lieutenant General W Bridgeford replaced Lieutenant General Sir Horace Robertson as Commander-in-Chief, BCOF, Japan. On the same day, the Australian Government announced the commitment of a second battalion to Korea.

During 2-8 October 1951, the 1st Commonwealth Division commenced Operation Commando. As part of this action, 3RAR took Hills 355 and 317 and destroyed at least two Chinese battalions during the battle of Maryang San. On 12 October, the US I Corps advanced to the Jamestown Line, north of the Imjin River. On 25 October 1951, following two weeks of discussion between liaison officers, truce talks resumed at a new site, Panmunjom.

On 12 November 1951, General Ridgway ordered the Eighth Army to cease offensive operations and begin active defence in Operation Ratkiller. On 18 December 1951, prisoner-of-war lists were exchanged by UN Command and Communist representatives at Panmunjom.

On 1 January 1952, a one-month artillery and air bombardment of Communist positions began. On 8 January 1952, the Communists rejected a UN Command proposal for non-forcible repatriation for prisoners of war. Between January and April 1952, there were riots in UN Command prison camps on Koje Island as screening of prisoners began.

On 3 April 1952, a second Australian battalion, 1RAR, arrived in Korea. On 28 April 1952, following extensive diplomatic negotiations, the BCOF became the British Commonwealth Forces, Korea (BCFK). The Japanese Peace Treaty became effective on the same day, while the ANZUS Treaty came into effect on 29 April.

In May 1952, negotiations at Panmunjom became deadlocked over the prisoner repatriation issue. Prisoners at Koje Island camp held Brigadier General Dodd hostage until 11 May 1952. General Ridgway, who departed to succeed General Eisenhower in Europe, was replaced by General Clark. On 22 May 1952, General Clark requested Lieutenant General Bridgeford to provide Commonwealth troops for prison camp duties on Koje Island. This task lasted until 14 July 1952.

From 23 to 27 June 1952, the UN Command bombed major hydro-electric plants at Suiho, Fusen, Chosin and Kyosen. On 29 August 1952, the UN Command bombed Pyongyang. On 6 October 1952, the Communists launched a ten-day heavy offensive which included a heavy Chinese bombardment of the Eighth Army on 7 October 1952. Armistice negotiations were suspended on 8 October 1952.

On 20 October 1952, the Rt Hon RG Casey addressed the UNGA and used evidence provided by Sir Macfarlane Burnet to refute Polish and Soviet germ warfare allegations.

On 3 December 1952, the UNGA adopted the Menon proposals for release and repatriation of prisoners of war in Korea.

Between January and February 1953, there was a winter lull in fighting in Korea. During this period, on 20 January 1953, General of the Army DD Eisenhower was inaugurated as President of the United States. On 2 February 1953, he announced that the US Seventh Fleet would no longer prevent Chiang Kai-shek's forces from attacking the Chinese mainland.

On 22 February 1953, the UN Command proposed the exchange of sick and wounded prisoners of war, as a preliminary to full exchange of prisoners. The Communists announced acceptance of the proposals on 28 March 1953 and such prisoners were exchanged during Operation Little Switch, at Panmunjom, from 20 April until 3 May 1953.

Armistice negotiations resumed at Panmunjom on 26 April 1953. On 7 May 1953, Communist negotiators presented an eight-point proposal regarding repatriation of prisoners of war, including establishment of a Neutral Nations Repatriation Commission. On 4 June 1953, the Communists accepted most of the UN Command's final armistice proposal.

From 10 to 16 June 1953, the Chinese launched an offensive against the ROK II Corps near Kumsong. On 18 June 1953, the President of the ROK, Syngman Rhee, released 25,000 anti-Communist Korean prisoners of war. On 13 July 1953, the final Communist offensive commenced, followed by a UN Command counter-offensive on 16 July. On 19 July 1953, final agreement was reached on all aspects of an armistice, which was signed and came into effect on 27 July 1953.

Prisoners of war were exchanged between 5 August and 6 September 1953. On 23 September 1953, the UN Command transferred control of more than 22,000 prisoners refusing repatriation to the Neutral Nations Repatriation Commission and the Indian Custodian Force in the demilitarised zone.

On 28 August 1953, the UNGA resolved that all belligerent powers should participate in the peace conference. On 13 September 1953, the Chinese replied to the UNGA resolution and suggested important amendments, including the addition of five neutral nations to the peace conference participants. On 16 September 1953, sixteen nations contributing forces to UN Command met to concert strategy for the peace conference. During this same period, a Mutual Defence Treaty between the US and the ROK was initialled in Seoul on 8 August 1953 and signed in Washington on 1 October 1953.

On 3 November 1953, the UNGA recommended impartial investigation of germ warfare charges against UN Command forces and condemned atrocities committed by North Koreans and Chinese against UN Command prisoners of war in their charge. By January 1954, the Neutral Nations Repatriation Commission's authority to hold prisoners refusing repatriation expired and remaining prisoners were released by the UN Command.

Between 25 January and 18 February 1954, the Foreign Ministers of Britain, France, the USSR and the US met in Berlin. On 18 February 1954, they agreed that a peace conference would be held at Geneva commencing on 26 April 1954, to settle the Korean and Indo-China conflicts. However, on 15 June 1954, the allies announced the failure of the Geneva conference to settle the Korean issue.

2.2.3 Forces involved in the Korea War

A list of Australian units allotted for duty in Korea is detailed at Appendix C. This appendix also lists Commonwealth and allied countries and their military commitment to the UN Command[3]. Those allied countries that committed medical units to the UN Command are listed at the end of Appendix C.

2.3 Australian Involvement

2.3.1 General Issues

All of the individuals who served in the Royal Australian Navy, Australian Army or the Royal Australian Air Force in Korea were volunteers. Although conscription operated in Australia from 1951 to 1959, no Australian personnel served in Korea during their conscript service. Conscripts during this period received full-time basic training in one of the three Services, followed by part-time service in the reserves. A number of individual conscripts, however, enlisted as regular members of the ADF and went on to serve in Korea.

Also of note is that not all those who served in the ADF were Australian citizens. At that time, the concept of Australian citizenship was still evolving within the traditional idea of being British subjects. Indeed, Australian passports of the period specified 'Australian Citizen by birth and British subject'. However, enlistment in the ADF simply required the individual to be a British subject. Thus, any British citizen, regardless of country of birth, presenting at a recruitment office would have been considered along with all other applicants. Consequently, a number of veterans who served in Korea with Australian units would today be considered citizens of New Zealand or the UK. Indeed, the Australian government had a recruitment office in London to facilitate recruitment directly from the UK population.

The level of recruitment from the UK and other Commonwealth countries varied between the three Services. The RAAF, for instance, did not seek overseas recruits other than to meet needs in specialist areas, for example medical staff. When faced with a shortage of trained fighter pilots for service in Korea, its solution was to seek the assistance of the Royal Air Force (RAF). The outcome was the secondment of RAF fighter pilots to the RAAF for duty in Korea. These pilots remained members of the RAF and returned to the UK at the end of their operational tour of duty.

In the case of the RAN, its close relationship with the Royal Navy (RN) meant that officers from both navies were posted to ships of either navy to gain experience as part of their development program. Apart from such exchange service, it appears to have been relatively easy for former RN personnel to seek enlistment in the RAN, particularly where shortages existed in specific Branches or trades. Short-term engagements were made available on occasion to assist such direct recruitment. Moreover, during the period of the Korean War, the newly formed RAN Fleet Air Arm included many who had transferred or were on loan from the RN.

Alone among the three Services, the Army actively recruited 'off the street' in the UK. Such recruits would have included individuals with prior service during World War II and others with no previous military experience.

At the conclusion of their period of enlistment, personnel recruited from the UK could elect to be discharged in Australia, or returned to the UK. The exact number of these people is not known. In some instances, where an individual had elected to return to the UK, DVA records indicate that the individual subsequently re-emigrated to Australia.

Many of those who fought in the Australian forces in Korea were veterans of World War II or of BCOF in Japan. Some of those who fought in Korea went on to serve in other conflicts in Asia, including the Malayan Emergency, Indonesian confrontation in Borneo and the Vietnam War.

Hence, many Korean War veterans were subject to exposures in a range of conflicts in addition to exposures they received during the Korean War.

2.3.2 The Royal Australian Navy

HMA Ships *Bataan* and *Shoalhaven* were committed to the Korean War on 29 June 1950, four days after the war began. These ships and their replacements were employed in patrolling, engaging shore batteries, gun-fire support, carrier screening, support for island operations and evacuation cover in a threat environment from mining, air attack and counter-bombardment.

When considering naval operations during the Korean War, the quite different marine environments encountered off the east and west coasts of the Korean peninsula need to be

noted. In particular, the mountains lie much closer to the sea on the east coast and the ocean bottom slopes sharply, allowing large ships to come close inshore to attack communications, fortifications, ports and towns.

By contrast, the coastal plain on the west is wider and the sea in some places is very shallow for considerable distances from the shore line. Most of the major rivers of Korea drain to the west, carrying large amounts of silt, which they have deposited to form extensive mudflats and islands. These features, combined with tides rising and falling over nine metres causing fast local currents and rapidly changing sea-beds, made navigation very difficult and rendered charts rapidly out of date and unreliable.

One result of these environmental constraints was that the large aircraft carriers of the US Navy (USN) were deployed in the deeper waters off the east coast and responsibility for west coast waters was delegated to a mix of USN units and light fleet carriers, cruisers, destroyers and frigates of the British Commonwealth and other naval forces. However, forces were frequently switched from the east coast to the west and vice versa to meet operational needs.

United Nations Command naval forces were not in great danger of attack from North Koreans or Chinese naval surface units. However, the threat of submarine attack was taken seriously and all aircraft carriers had to be screened by destroyers and frigates, which were required to maintain a constant surveillance against both submarines and fast surface craft.

Mines presented a more significant threat to allied shipping. The first were encountered on 7 September 1950, floating west of Chinnampo, the port for Pyongyang. Mines were launched from local fishing craft and British and Australian officers were impressed with the ease with which the mine campaign was initiated. Between 26 September and 1 October 1950, several US and South Korean naval ships were severely damaged or sunk by mines.

The mine laying campaign appears to have started gradually in August 1950, with the laying of defensive minefields in ports, followed by more extensive minefields to counter UN Command landings on the east and west coasts in September. Mine clearance started in earnest following the early ship losses. The final major mine clearance operation was at Chinnampo from October to November 1950.

A further threat to naval operations was presented by occasional attacks by Chinese MiG-15s on allied naval aircraft. In the event, allied aircraft had little difficulty in defeating attacks at low altitude and the Chinese did not persist with them. In addition, although enemy air attacks against allied naval forces were infrequent, the threat remained and ships had to be constantly vigilant to avoid any surprise attack.

In addition to threats from the enemy, as Robert O'Neill[4] (p415) pointed out, problems created by storms, typhoons, fast tidal currents, shifting mudflats, ice-bound waters and temperatures at and below freezing-point for long periods provided an exacting test of seamanship and imposed strong demands on men and equipment. Space constraints do not allow for a comprehensive description of RAN activities, but the following incidents provide an overview of the tasks and duties accepted during the course of the naval war in Korea.

The first major engagement in which RAN ships participated was the amphibious assault on Inchon, launched on 15 September 1950, where HMA Ships *Warramunga* and *Bataan* served in the blockade and covering force. The success of this strategic assault marked a turning point in the war and led to a complete rout of North Korean forces.

From 14 October to 7 November 1950, HMAS *Warramunga* was attached to the Gun-fire Support Group of Task Group 95.2 in preparation for an amphibious assault on Wonsan, on

the north-east coast. Five days had been set aside for clearance of a channel through mines laid in the approaches to Wonsan harbour prior to the landing. In the event, fifteen days were required, during which time three minesweepers were sunk with heavy loss of life, while the invasion force spent five days holding off the coast.

The strategic position facing UN forces changed again in November 1950 following the Chinese entry into the war. The rapid deterioration on land led to plans to evacuate large numbers of allied personnel from North Korean ports. Two major evacuation points were Hungnam in the east and Chinnampo in the west.

On 4 December 1950, HMA Ships *Warramunga* and *Bataan* in company with four other destroyers and with the cruiser HMS *Ceylon* in support off the estuary, participated in the evacuation of Chinnampo. During that night, both ships transited the Taedong estuary, a waterway characterised by shifting shoals and mudflats. Although the *Warramunga* ran aground during the approach, she was floated off with the tide without damage. The evacuation was completed successfully on 5 December and the last ships departed the estuary on the following morning. This operation was considered to be one of the most dangerous naval operations of the Korean War (O'Neill[4], p435).

During February 1951, a decision was taken to occupy two islands off the North Korean east coast port of Wonsan and to bombard military targets around the town. On 19 February, USN ships were joined by the cruiser HMS *Belfast* in company with HMAS *Warramunga*. Despite a shortage of spotter aircraft, *Warramunga*'s guns struck several road and rail junctions and buildings and partially destroyed a shore battery. After the departure of HMAS *Warramunga* from Wonsan, it became regular practice for one Commonwealth ship to serve on the east coast, replaced on the west coast by one American ship whenever possible.

One of the most celebrated operations involving the RAN took place during the period from July to November 1951, when HMAS *Murchison* established a strong reputation for aggression while conducting bombardment duties in the Han River estuary. This task presented major challenges. Charts of the estuary contained serious inaccuracies, while other hazards included nine metre tides creating streams which ran at 8 knots and continually shifted the mud banks. There were no navigation marks and approaches to possible fire positions lay parallel to enemy-held shores (O'Neill[4] p452). HMAS *Murchison* accumulated more time in the estuary than any other allied ship and engaged enemy forces at close range on many occasions.

In October 1951, the deployment of the aircraft carrier HMAS *Sydney* with its Carrier Air Group and three Naval Air squadrons brought to a peak the RAN's offensive capacity and commitment to the Korean War. During its tour, HMAS *Sydney* patrolled in the Yellow Sea, alternating with a US light aircraft carrier. Patrols normally lasted nine days with a further nine spent on replenishment at Sasebo and passage to and from the patrol area.

HMAS *Sydney*'s deployment lasted until January 1952 and missions flown included strikes, armed reconnaissance, close support for ground troops, spotting for naval gun fire, combat air patrols and aerial photography. Thirty-five piston-engine aircraft were embarked, comprising two squadrons of Sea Furies, a single seat fighter, and one squadron of Fireflies, a two seat fighter with anti-submarine capabilities. The number of aircraft on board pressed the ship's facilities to the limit and twenty of them had to be parked at any one time on the busy flight deck.

Hazards faced by HMAS *Sydney* included extreme weather during the night 14-15 October 1951 when it rode out Cyclone Ruth. During this storm, winds peaked at 100 knots and sea-water entering the ship's ventilation system resulted in a number of electrical fires during the

night. Fortunately prompt action brought each outbreak under control before much damage had occurred. A number of aircraft were lost over the side during this episode and others required significant repairs. Three days of intensive effort were required to get the ship back into operational readiness (O'Neill[4] pp472-3).

Other incidents included a daring rescue of the crew of a Firefly which crashed close to North Korean lines late on 26 October 1951. This involved a US rescue helicopter operating from HMAS *Sydney*, supported by Sea Furies from the ship and Meteor jets from 77 Squadron RAAF.

On operations, an average of 38% of aircraft returned to the ship unserviceable, presenting a heavy continuing workload for maintenance crews, particularly given the cold and cramped conditions on board during the tour of duty. Aircraft from HMAS *Sydney* were hit by flak on 99 occasions and nine were shot down. The tour of duty meant that Australia became the third nation to gain significant experience in operating an aircraft carrier in combat after World War II.

Despite the many actions and trying conditions, the RAN was fortunate to suffer only light casualties, with five dead and six wounded.

RAN ships serving in Korean waters as part of the US Seventh Fleet up to the date of the cease fire received the Korean Presidential Unit Citation.

2.3.3 The Australian Army

The Third Battalion, Royal Australian Regiment, (3RAR) commenced operations in early October 1950 and remained in Korea throughout the war. Two other Australian battalions (1RAR and 2RAR) served on rotation in 1952-1953. All battalions had to operate in very rugged country while contending with extremes of heat in summer and cold in winter.

At the outbreak of the Korean War, 3RAR was seriously under strength, under trained and poorly equipped. Reinforcements included many soldiers who had previous active service and had re-enlisted in the new Australian Regular Army together with others who had enlisted in 'K Force', a special enlistment program for the war. The battalion was brought up to full complement and operational readiness in Japan prior to its departure on 27 September 1950 for Pusan.

By 29 September 1950, 3RAR had joined the 27th Commonwealth Infantry Brigade near Taegu. By 9 October 1950, the brigade had moved northwards through Seoul to Kaesong, 60 kilometers to the north and just south of the 38th parallel and on 11 October, crossed into North Korea. By 17 October, 3RAR had launched its first attack, at Sariwon. Subsequent actions during the advance included Yongju, Pakchon and Chongju, which was reached by late October. These actions are collectively known by 3RAR veterans as the '*Stepping Stones*'[5].

On the day after the battle of Chongju, 3RAR suffered a serious loss when a single enemy shell exploded close to its Commanding Officer's tent, badly wounding him. Lieutenant Colonel Green died of his wounds on 1 November 1950.

By early November, following the entry of China into the war, the 27th Brigade had retreated from Chongju to Pakchon, where it held its ground during the middle of November, but by 27 November, heavy Chinese attacks on the US 2nd Division had led to the withdrawal of the Brigade to the south. By 1 December, the US Eighth Army was in full retreat. However, by mid-March 1951, the Eighth Army had retaken Seoul and was approaching the 38th parallel

again and by 31 March, the 27th Brigade had begun an advance up the valley of the Kapyong River.

On 22 April, the Chinese launched yet another major offensive. On 23 April, the 27th Brigade was ordered to defend the northern approaches to the town of Kapyong, disrupting 3RAR plans to celebrate ANZAC Day with the nearby Turkish Brigade. 3RAR occupied its positions later during the day and the Chinese assault commenced during the night. The main battle lasted all day on 24 April. The battalion lost 32 men killed, 59 wounded and three captured, but held off a continuous attack by far greater numbers of Chinese. 3RAR was one of several allied units jointly awarded a Presidential Citation for this action.

By the middle of July 1951, truce talks had begun and the war entered a new phase. Major military initiatives likely to threaten the negotiations were not allowed and both sides engaged in a strategy of attrition, coupled with tactical offensives to relocate sectors of the battle-line (O'Neill[4], pp164-5). During this period, 3RAR was transferred to the 28th Brigade and British Commonwealth units were consolidated into the 1st Commonwealth Division, which became operational on 28 July 1951.

On 2 October 1951, Operation Commando commenced with the objective of straightening the front line in the sector across the Imjin River and driving the Chinese from the first line of hills to the north-west of the salient. 3RAR was given the task of capturing Hill 317. This action became known as the Battle of Maryang San.

When considering the most suitable approach to this objective, the battalion Commanding Officer, Lieutenant Colonel FG Hassett drew on Australian experience in fighting the Japanese in New Guinea using a technique of 'running the ridges'. This utilised the tactical superiority of high ground, the cover afforded by the jungle and the relative ease of movement along a crest-line. The best way to attack Hill 317, he reasoned, was to approach along a wooded ridge which ran from the east to the summit. This required the battalion to cross a valley under cover of darkness, establish a firm base then cross the next valley, climb the ridge and turn westward to assault the Chinese positions defending Hill 317 (O'Neill[4] pp184-5).

The resulting battalion action took place over the period 2-8 October 1951 and achieved the destruction of at least two Chinese battalions. 3RAR lost 20 men killed and 89 wounded. During the five days of the battle, the battalion used some 900,000 rounds of small arms ammunition, 5,000 grenades and 7,000 mortar bombs. All this ammunition had to be carried by Korean Service Corps porters and Australian soldiers over long distances to reach the forward companies. The action has been described by Field Marshal Cassels, commander of the Commonwealth Division during the action, as one of the finest battalion attacks in British Army history.

After achieving a stronger defensive line in late 1951, the UN Command forces did not attempt any further significant advances during the remainder of the war. The chief function of the Eighth Army in 1952 and 1953 became that of maintaining constant pressure on the Chinese and North Koreans to try to force compromise during the armistice negotiations. This resulted in steady casualty losses through patrol actions and raids.

On 1 July 1952, 1RAR joined the 28th Brigade, making it more than half Australian in terms of its battalions. To reflect this, the British Government agreed it should be commanded by an Australian.

1RAR was relieved by 2RAR on 21 March 1953, while 3RAR continued for the remainder of the war with its existing individual replacement system.

During the last years of the war, Australian battalions were involved in raids against deeply entrenched Chinese positions and nightly fighting patrols to dominate in no man's land. Battles included 1RAR's attack against Hill 227 and Operation Fauna in 1952, 3RAR's Operation Buffalo in August 1952 and the defensive battle by 2RAR on the Hook in July 1953.

While attention has been concentrated on infantry actions, these could not have been sustained without the backup support from other fighting and service Corps. South Korean personnel employed under the Korean Augmentation Troops Commonwealth scheme (KATCOM) also frequently augmented and served with the Australians.

One further group that should receive mention is the medical support group, including nurses from the Royal Australian Army Nursing Corps. Initial medical support was provided at battalion level by medical orderlies and stretcher bearers under the command of the Regimental Medical Officer. Cases that could not be treated at that level were evacuated to the 60th Indian Field Ambulance. Where necessary, the individual could be further transferred to a US Mobile Army Surgical Hospital (MASH). The most serious cases were evacuated to the BCOF General Hospital at Kure, Japan.

The standard arrangement during the period of the war was that twenty-six Australian nurses were posted to Japan. From late 1952 to early 1953, several were detached to Korea. This was done initially to build morale, but was continued when the arrangement was found to be quite successful. Placements included two theatre nurses in Kure and six in Seoul (four British and two Australian). The principal medical task in Seoul was to assess and classify injuries and treat them according to medical priority, with the aim of providing advanced first-aid to enable the patient to arrive in Kure in a fit state to undergo orthodox surgical treatment.

Army casualties during the war were heavy, with 293 killed, 1,210 wounded (including 36 wounded twice) and 23 prisoners of war. Of the numerous battle honours won by the Royal Australian Regiment in Korea, three major honours are now emblazoned on regimental colours:

'Korea'	1950-1953	(1RAR, 2RAR, 3RAR)
'Kapyong'	April 1951	(3RAR)
'Maryang San'	October 1951	(3RAR)

2.3.4 The Royal Australian Air Force

No 77 Squadron, then located in Japan as part of the Australian commitment to BCOF, had been preparing to return to Australia on the day war broke out. Despite this, aircraft were rapidly brought back ready for action and the Squadron flew its first combat mission on 2 July 1950. The Squadron initially operated from its peacetime base at Iwakuni, Japan, but arrived in Korea on 12 October 1950. The Squadron operated as part of the US Fifth Air Force and, other than for a short period in Japan while converting to Meteor jet aircraft, remained in Korea for the remainder of the war.

Air power was critical in defeating the initial North Korean offensive and the Australian squadron earned the highest reputation in giving close air support to ground forces. This support was provided despite climatic extremes, in particular the winter conditions in North Korea, which challenged both air and ground crews.

At the outbreak of war, No 77 Squadron was equipped with piston engine P51D Mustang fighters. Although this aircraft was slower than jet aircraft available at that time, it had a far

superior range and payload and could operate from rough airstrips unsuitable to jet operations. In the absence of a significant enemy air threat, Mustangs were most suitable for the ground attack and air support role required during the early phase of the war.

The work-load on pilots during this phase was particularly intense as the Squadron was still located in Japan. Aircraft had to take off early in the morning, carry out a strike mission, then land at Taegu within the Pusan perimeter to re-fuel and re-arm. Pilots would carry out up to three further missions before returning to Japan in the evening. It was during this phase, on 9 September 1950, that the Squadron commander, Wing Commander L T Spence, was killed while conducting a close support mission.

The situation facing allied aircraft operating in Korea changed rapidly following the entry of China into the war. On 1 November 1950, a flight of six MiG-15s crossed the Yalu frontier and attacked a US Mustang Flight. The appearance of MiG-15s presented a serious challenge to UN Command air superiority. For the Australian Government, it meant that if 77 Squadron was to continue to play a leading role in the war, it needed higher performance aircraft.

In the meantime, however, the squadron continued to fly ground support missions, reconnaissance and interdiction strikes. By mid-November, the squadron had shifted north to Yonpo, near Hamhung in North Korea. Flying operations commenced on 19 November and were able to range over the whole of North Korea. This period was characterised by very cold conditions, with snow and ice on taxiways and parking areas and often severely restricted visibility during operations. Ground crews in particular suffered from extremely freezing working conditions while servicing aircraft. By early December, however, the squadron had been re-located to Pusan East in South Korea.

Also in December, the Australian Government took the decision to purchase Gloster Meteor aircraft despite their known inferiority to the MiG-15, on the basis that no other jet fighter aircraft appeared to be available within a reasonable time. The squadron departed from Korea in April 1951 for its base at Iwakuni, Japan to commence conversion to jet operations on Meteors. It returned to Korea in July and flew its first jet operational mission on 29 July 1951.

Combat experience against MiG-15s confirmed the inferiority of Meteors in the air combat role, particularly at high altitudes. Subsequently the Australian squadron reverted to the ground attack role where the Meteor's rugged construction and good low-altitude performance proved its worth. However, by May 1952, No 77 Squadron was also employed escorting fighter-bombers at intermediate altitudes. At these altitudes, the inferiority of Meteors to MiG-15s proved to be much less marked and five MiGs were destroyed in air-to-air combat.

RAF pilots also made a vital contribution to the Squadron during a period when the RAAF had an acute shortage of trained fighter pilots. In all, 37 RAF pilots served with the squadron in Korea. Four of these were during the Mustang/Meteor period and the remaining 33 during the later Meteor period.

On 1 November 1951, No 77 Squadron was awarded the Korean Presidential Unit Citation for 'exceptionally meritorious service and heroism'. By the end of the war, the Squadron had suffered 41 Australian fatal casualties from all causes and six prisoners of war. In addition, five RAF pilots were killed and one taken prisoner of war.

In regard to tours of duty by combat pilots, initially there was no set period and it was left to the Squadron Commanding Officer to decide on an individual basis. Later, it was decided for planning purposes that a tour of duty should consist of 100 missions over about six months,

although some individual pilots served well in excess of this limit and others returned early to Australia.

In addition to No 77 Squadron, the RAAF also provided transport support using C47 Dakota aircraft, based at Iwakuni, Japan. During the course of the war, as transport demands increased and additional aircraft were provided to meet them, the unit operating these aircraft was progressively re-named. Initially 30 Communications Flight, it became 30 Transport Unit on 5 November 1951, then No 36 Transport Squadron on 10 March 1953. During the full period of the war, the unit played a major role in supporting No 77 Squadron in Korea, providing transport for ground forces, evacuating wounded and carrying official visitors.

Technical support for RAAF aircraft in the Korean War was provided by No 391 (Base) Squadron and No 491 (Maintenance) Squadron, while all RAAF units in the theatre were grouped within 91 (Composite) Wing. No 391 and No 491 Squadrons were located at Iwakuni and gave essential support to the ground crews of the two aircraft squadrons by performing more complex maintenance operations to increase the operational availability of fighter and transport squadrons.

Finally, RAAF nurses were employed on medevac flights from Korea to Japan using RAAF C47 aircraft. During the course of the war, they flew some 12,000 sick and wounded from the war zone in medical evacuation flights.

2.3.5 Civilian groups

War correspondents, photographers and philanthropic organisations

War correspondents were accredited by the Army but represented their own media interests. Tours varied in length from months to years. The major philanthropic organisations represented in Korea were the Red Cross and the Salvation Army, who fulfilled their traditional roles with their accustomed efficiency and disregard for personal safety.

Where individuals have been identified as having served in Korea with such organisations, their names have been recorded on the Nominal Roll and they have been included in this Mortality Study.

2.4 Definitions: 'Allotted for Duty' and 'Operational Service'

Under the *Veterans' Entitlements Act 1986* (VEA), the terms 'Allotted for Duty' and 'Operational Service' have the following meanings:

- **Allotted for Duty** means a person or unit of the Defence Force that was allotted for duty in an operational area. Allotment may be retrospective or prospective, and occurs via a written instrument issued by the Defence Force; and
- **Operational Service** is rendered where a person is allotted for duty and serves in an operational area. Current use of this term is not the same as normal posting procedures used in the Defence Force to move members from one unit to another.

Royal Australian Navy, Australian Army and Royal Australian Air Force units allotted for duty in Korea during the active period of the Korean Operational Area are listed at Appendix C. Also listed in the Appendix are summaries of Commonwealth and allied military forces and allied medical units committed to the United Nations Command in Korea.

2.5 Operational Area

The Operational Area during the Korean War is defined in Schedule 2 of the VEA as the area of Korea, including the waters contiguous to the coast of Korea for a distance of 185 kilometres (100 nautical miles) seaward from the coast. The period during which it was active is specified to commence from and including 27 June 1950 to and including 19 April 1956.

Some of the units allotted for duty in Korea were based in Japan. Members of these units must have served in the Korean Operational Area before they are considered to have operational service under the terms of the VEA.

2.6 Health and Environmental Threats

2.6.1 Environmental Risks

In the absence of documentation on environmental health risks during the period of the Korean War, the following assessment has been based on that currently applicable to North Korea, as documented in *'Department of Defence (unpublished) Health Threats in Korea'*[6]. The decision to adopt this approach is based on the lack of significant economic or social development in North Korea over the years since the end of the war.

Also of relevance is that Australian military operations from September to December 1950 largely took place in North Korea. This included the first experience by ADF personnel of a Korean winter. The period covered the advance by ground forces towards the Chinese border followed by retreat in the face of the first Chinese offensive, which pushed the allies to a line south of Seoul by January 1951. Subsequent offensives pushed the war zone back to the north towards and around the 38th parallel. By early 1952, positions held by both sides of the conflict were consolidated along a line around the 38th parallel. Following the cease fire, this line stabilised into the post war DMZ that marks the current border between the two countries.

Areas covered by the current risk assessment that would be less relevant to the 1950s relate to air, soil and water contamination caused by heavy industry and mining. Environmental contamination is a major problem in North Korea due to the use of obsolete industrial plant, the lack of adequate sewage treatment of effluent and mine wastes, and the poor quality of

coal used as the primary source of energy. These segments have not been included in this assessment.

Temperatures

All temperatures quoted in this section are in degrees Celsius.

In the region encompassing the North Korean capital, Pyongyang, summers (June through to September) have mean daily maximum temperatures of approximately 26° and mean daily minimums of about 19°. Daily extreme highs occasionally reach 37°, while extreme lows occasionally drop to 0°.

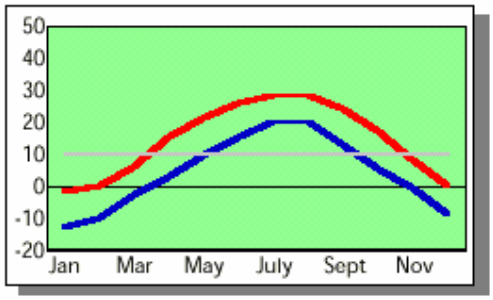
Winters in the same region of Korea last from November through to March. Mean daily minimum temperatures are approximately -4° and mean daily maximum temperatures are about 2°. Daily wind-chill temperatures commonly reach -31°.

Temperature Table for

Pyongyang

39-01-XXN
125-49-XXE

Elevation:
27 meters/89 ft



Temperature: Mean Daily Maximum/Minimum (°C) (°F = 1.8°C + 32)

Month	J	F	M	A	M	J	J	A	S	O	N	D
Max	-2	0	6	15	21	26	28	28	24	17	8	0
Min	-13	-10	-3	3	9	15	20	20	13	5	-1	-9

Source: 'Department of Defence'[6]

The temperature extremes between summer and winter presented a range of threats to ADF members. Some of these threats were unique to an individual Service.

Ships operated by the RAN during the period of the Korean War were steam powered and built for temperate conditions. They were not air conditioned. This meant that crews endured high temperatures during the summer months or in tropical regions. Within each crew, those serving in areas such as engine and boiler rooms and galleys would have been exposed to extreme temperatures.

Conversely, during the winter months in Korean waters, a thin steel hull in direct contact with freezing sea water combined with the lack of insulation and minimal heating meant that crews had to endure freezing conditions below as well as on deck. Conditions were particularly severe for those in exposed positions, such as open bridges and gun positions. This group included watchkeepers and those manning weapon systems at dawn action stations. These conditions were exacerbated in the first winter as, in common with the other two Services, crews had not been issued with adequate cold weather clothing.

In order to maintain what heat could be generated, ships were closed up which meant that the air below decks became stale. Further, the presence of relatively large numbers of crew confined within a small, poorly ventilated space presented a significant risk of the spread of diseases spread by contact or aerosols. This danger would have been exacerbated by a

practice recalled by several RAN veterans from the conflict. They have advised that, in addition to closing up ship, other methods tried in an attempt to maintain a habitable temperature included venting steam directly into the ship from its boilers. This method provided only short-term relief and temperatures fell rapidly. The resultant high humidity and moisture in crew accommodation areas would have provided an environment very suitable for moulds and other potential disease sources.

The Army experience can be divided into two parts. During the first, active phase, troops were continually on the move both in advance and retreat. Tactical positions were held for short periods and trench digging was limited to the minimum required. One concern during this phase arose as the first winter set in when it became quite apparent that clothing worn by Australian troops was entirely unsuited to winter conditions in northern Korea. Uniforms were essentially unchanged from those worn by troops in both World War I and II and provided no protection against severe cold. Following this experience, Australian soldiers began to acquire items of US military winter clothing that was better suited for the purpose. Apart from trying to maintain body temperature, significant problems arose due to frost-bite and injuries arising from flesh sticking to frozen weapons, vehicles and other metallic objects.

During the subsequent static phase, substantial defensive positions were dug along hill-tops and ridges. These comprised fighting bunkers, command posts and living quarters, all connected by communications trenches and incorporating substantial overhead cover for protection against artillery shell fire. Living quarters were underground sleeping bunkers, known as 'utchies' (not to be confused with the more recent 'hutchies', which are small tents). These bunkers slept either four or six men and were cramped and poorly ventilated.

Troops slept during the day and were active during the night. Activities included both heavy manual labour in maintaining and developing defensive positions and patrolling aimed at establishing the initiative over the enemy and denying it use of 'no man's land'. Patrols were despatched at night under all weather conditions. During winter, standing and ambush patrols in particular required participants to remain motionless for long periods in conditions of extreme cold.

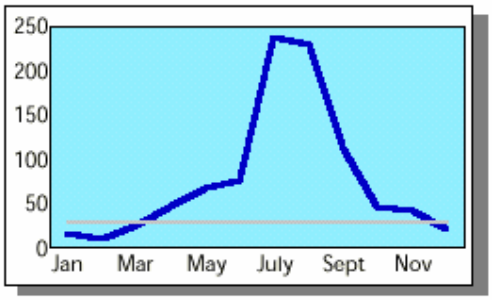
Freezing temperatures during winter also meant that fresh water for drinking, cooking or washing was in short supply. Drinking water was often obtained by heating snow.

Temperature extremes similarly presented difficulties to the RAAF, both for aircrew kitted out and waiting to fly and to the ground crew that had to maintain the aircraft. During summer, aircrew had to contend with the heat on the ground, while kitted out to cope with the cold experienced at high altitudes. During winter, the additional clothing required both on the ground and in the air significantly restricted freedom of movement of limbs.

For ground crew, maintenance was required to be done at night at the end of each day's flight program to ensure aircraft were airworthy and armed ready for the next day's missions. As with the Army, extreme cold during winter months caused significant problems with frostbite and flesh sticking to cold metal tools and aircraft components.

Precipitation

Summer is the monsoon season and in the Pyongyang area, approximately two-thirds of the total annual rainfall of 1,000 mm occurs during July and August. Severe flooding occurs frequently and typhoons make occasional appearances.



Precipitation: Mean Total (mm) (1 in = 25.4 mm)

Month	J	F	M	A	M	J	J	A	S	O	N	D
Mean	15	10	25	46	66	76	236	229	112	46	41	20

Source: 'Department of Defence'[6]

For the RAN, the chief concern arising from weather, including precipitation, was from an operational point of view. This aspect was brought home emphatically for the crew of the aircraft carrier HMAS *Sydney* on the night of 14-15 October 1951 when it rode out a typhoon at sea, experiencing high seas and wind gusts peaking at 100 knots.

In the case of Army troops living in trenches and underground dugouts without adequate drainage, periods of high precipitation during the summer monsoonal season meant living with water underfoot, the threat of collapsing trench walls and constantly damp clothing. During such periods, soldiers on 'stand-to' were up to their knees or waist in mud and water. The end result was that soldiers could not get dry for weeks at a time, increasing the threat of conditions such as 'trench feet'. Damp conditions, including stagnant pools of water, also provided a breeding ground for diseases and disease vectors. This is discussed further below.

The RAAF, like the RAN, was chiefly concerned with the impact of weather on operational activities. Concerns included flights with inadequate radio navigation aids in instrument meteorological conditions over mountainous terrain. As with the Army, however, health threats on the ground would also include the threat from disease vectors breeding in standing water.

Other Environmental Threats to Australian Service Personnel in Korea

Korean War veterans have expressed concern about the high levels of exposure to a range of chemicals, including DDT, during the Korean War. Anecdotal evidence suggests the level of exposure to pesticides was extreme, particularly among medical orderlies and others, often inadequately trained for the task, who were responsible for mixing and spraying them.

DDT and other pesticides were used extensively in unit areas where 'fogging' machines were used to treat tent-lines and other general areas. Individual application was in the form of pesticide powders applied directly to the body or clothing. Army personnel most exposed included those located in front-line or support echelon units and in units stood down to rest areas behind the lines, where tent-based accommodation was used. In all areas, vigilant control of vectors of insect-borne diseases was required. RAAF personnel living and working in No 77 Squadron unit areas would have faced similar exposures.

Exposure to DDT and other chemicals is included among the specific diseases or exposures that affect Korean War veterans listed in the Study Protocol. Further discussion on DDT is included at Appendix B to this Report.

Of the other environmental threats faced by all three Services, exposure to cigarette smoke was widespread. Cigarettes were freely available in large numbers and smoking was extensive among ADF members. Even non-smokers were exposed to high levels of cigarette smoke from others, particularly in Army front-line areas where soldiers lived in confined and poorly ventilated underground areas.

Further threats included alcohol and morphine abuse. Access to alcohol was strictly controlled in combat areas, but it was readily available to personnel on leave in Japan. Morphine, on the other hand, was required to be available to treat combat casualties as they occurred. Anecdotal evidence suggests that while abuse may not have been widespread, morphine was accessible to those seeking to abuse it.

On the individual Service level, threats faced by RAN crews included both those common to all ships of the period and others that were more specific to ships operating in Korean waters. Chief among the general threats was exposure to asbestos, which was present aboard all Navy ships.

RAN ships of the period were steam powered and asbestos was used extensively to lag boilers, engine rooms and steam pipes. Steam pipes ran throughout the ship, including through crew living and eating areas. Asbestos was also used as a fire retardant on all ships, but in particular aboard the aircraft carrier HMAS *Sydney*, where additional protection was required to reduce the risk of fire fuelled by aircraft fuel tanks, munitions and aviation fuel stores.

The risk of exposure to asbestos was elevated during maintenance periods when it would have been necessary to disturb or repair lagging or bulkheads treated with asbestos as a fire retardant. It would also have been elevated during times when ships were closed down during action stations or while trying to conserve heat in winter. During these periods, the flow of fresh air within the ship was reduced to a minimum, which would have led to a rise in the concentration of airborne asbestos dust particles.

A further potential threat to health was identified during the 1996 Vietnam Veterans Mortality Study (VVMS)[7]. This concerned the method used to produce fresh water for use in ships' boilers and by their crews. Under a process used extensively up until the introduction of reverse osmosis in the late 1980s, fresh water was obtained by low pressure vapour distillation of seawater. There was a suspicion that the process could have concentrated volatile contaminants, including herbicides or pesticides that may have been present in the seawater used as feed-stock.

The degree of risk has been assessed in a study established as a consequence of the VVMS. The results of that study demonstrated that where the feedwater was contaminated with dioxins or organochlorines, the distillation process concentrated such contaminants in the fresh water product.

Other environmental threats faced by ships operating within Korean coastal waters were likely to include exposure to organic wastes, pesticides and other contaminants washed out by rivers and other run-off. Most of Korea's major rivers drain into the relatively shallow waters off the western and southern coasts where RAN ships spent much of their time on patrol. Smaller ships and those on shore bombardment duties operated closer to shore where contamination levels could be expected to be higher.

Within the Army, members of front-line units during winter were exposed to high levels of hydrocarbon combustion products produced by home-made heating devices known as

'choofers' and solid fuel 'hexamine' heating blocks used for cooking. Both were utilised within the confined and poorly ventilated underground space of individual 'utchies'.

Choofers utilised a drip-feed system to add fuel to a fire contained within a metal drum. A common source of such fuel was petrol syphoned from jeeps. The degree of combustion would have been uncertain at best and resulted in the distribution of a mixture of soot and partially burnt combustion products throughout the living area. One by-product of this was a condition known as 'choofer neck', where the grime built up around necks and collars.

'Hexamine' tablets were hydrocarbon based solid fuel tablets used as a heating source for cooking individual meals. Food or water was heated directly and combustion products from the tablets would mix freely within the living area. Veterans report that, at times of peak activity, the combined effect of choofer and hexamine fumes together with cigarette smoke from several smokers made the atmosphere within an 'utchie' barely breathable.

Other exposures of interest included exposure to petroleum fuel and lubricants, particularly by transport personnel and aircraft ground crews (both Fleet Air Arm and RAAF), and exposure to asbestos dust from brake pads among maintenance personnel.

2.6.2 Infectious Disease Risks

Information drawn from unpublished Department of Defence documentation[8] was used in developing the following risk assessments.

Typhoid and Paratyphoid Fevers

Typhoid and paratyphoid fevers are highly endemic in North Korea, with a year-round risk period. Distribution is currently (November 2000) countrywide, with highest numbers of reports from North Hamyong Province.

Transmission is through ingestion of food or water contaminated by faeces or urine from infected humans.

Scrub Typhus

Scrub typhus is focally enzootic and a risk exists year-round whenever temperatures permit vector mite activity. In practice, this would mean most cases were likely between October and December. Distribution is countrywide. Focal areas are cultivated farmland or brush and scrub, which are the most favourable habitats for the vector and its small rodent hosts.

Transmission is through the bite of infected trombiculid mite larvae, usually Leptotrombidium pallidum or L. scutellare.

Hantaviral Diseases

Hantaviral diseases are focally enzootic and can occur year-round and countrywide. An elevated risk is associated with dry, dusty conditions and peak rodent populations. Most cases among the Korean human population occur from October to December during the harvest, which is the peak period for human activity in rodent infested areas.

At least three hantaviruses occur on the Korean Peninsula that collectively cause a spectrum of clinical diseases referred to as haemorrhagic fever with renal failure. Of these, Hantaan virus causes the more severe form, known as Korean haemorrhagic fever, while Seoul virus leads to a milder form. The third identified virus, Puumala virus, was first reported in 1991.

Transmission is primarily through aerosol transmission from infective rodent excreta or saliva, i.e. inhalation of the infective agent on airborne dust particles. The main reservoirs are the striped field mouse (*Apodemus agrarius*) for the Hantaan virus and house rats (*Rattus rattus* and *R. norvegicus*) for the Seoul virus.

Japanese Encephalitis

Japanese encephalitis is focally enzootic and associated with mosquito vector activity. Distribution is countrywide in areas where extensive mosquito-breeding sites and pig-rearing areas coexist. Cases usually occur from May to September.

Transmission is from the bite of an infective mosquito (*Culex tritaeniorhynchus* and other *Culex* spp.) and is frequently associated with rice-growing areas.

Sexually Transmitted Diseases (STDs)

STDs, including gonorrhoea and chlamydial cervicitis/urethritis, are endemic year-round and countrywide in North Korea.

Leptospirosis

Leptospirosis is enzootic and distributed countrywide, although an elevated risk is associated with stagnant water and muddy soil. The risk period is year-round, but most human cases in Korea occur during spring and summer (April to September).

Transmission is primarily through skin (especially if abraded) or mucous membrane contact with water, moist soil or vegetation contaminated with urine from infected animals. Incidence is usually associated occupationally with frequent exposure to the urine of the striped field mouse (*Apodemus agrarius*) in flooded rice and vegetable fields.

Meningococcal Meningitis

Meningococcal meningitis is currently considered likely to be endemic at low levels in Korea. The risk would be year-round and countrywide, but may be elevated during the cooler months of October to April.

Transmission is by direct contact, including respiratory droplets from noses and throats of infected persons.

Malaria

Vivax malaria is the only type known to be present on the Korean Peninsula and is endemic. There is currently a moderate risk from June to October in provinces bordering the DMZ. Transmission is through bite of an infective mosquito, with *Anopheles sinensis* (primarily an outdoor feeder) believed to be the primary vector.

Enterically Transmitted Viral Hepatitis A and E

Viral hepatitis A is highly endemic and risk is year-round and countrywide. Transmission is primarily person to person by the faecal-oral route. No specific data is available on viral hepatitis E in Korea.

Bloodborne Viral Hepatitis B, D and C

Viral hepatitis B is endemic and viral hepatitis C is likely to be endemic. There is no specific data available on hepatitis D. The risk period is year-round and countrywide. Transmission is by percutaneous and permucosal exposure to infective body fluids.

References:

1 The Korean Overseas Culture and Information Service, *'A Handbook of Korea'* Samsung Moonwha Printing Co, Seoul, Republic of Korea, 1998

2 Adapted from *Military History Chapter 3 Korean War*: Consolidated Library of Information and Knowledge. Department of Veterans' Affairs, Canberra, 2001

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5 Evans B, Stanley P, Reid R *'Out in the Cold: Australia's Involvement in the Korean War 1950-1953'* Department of Veterans' Affairs, Canberra, 2000

6 Department of Defence (unpublished). *'Health threats in Korea'*

7 Crane PJ, Barnard DL, Horsley KD, Adena MA. *Mortality of Vietnam veterans: the veteran cohort study. A report of the 1996 retrospective study of Australian Vietnam veterans*. Canberra: Department of Veterans' Affairs, 1997

8 Department of Defence (unpublished). *'Vector Risk Assessment - Korea'*

The destroyer HMAS Anzac*, photographed from the escort carrier USS* Sicily *in Korean waters, 1951.*
AWM 300152

Chapter 3 The Nominal Roll of Australian veterans of the Korean War

The Nominal Roll is a listing of all those who conform to this study's definition of 'Korean War veterans' (see Section 1.1.5). The roll compiled for this study lists for each veteran their surname, up to three given names, Service number, date of birth, date of death, one or more ship/unit/ squadron posting and period/s of service. As at 30 August 2002, it contained a total of 17,813 male Korean War veterans and 58 female Korean War veterans (see Tables 3-2 and 3-3, respectively). Data from a number of sources were used to compile the nominal roll.

3.1 Sources of data

At the time of the announcement that a mortality study of Australian veterans of the Korean War would be conducted, there were only two nominal rolls available. These were lists of Army and RAAF veterans published by Lt Col Neil C Smith AM[1] and Mr David Wilson[2] respectively.

Although both rolls were useful, neither list contained all the information needed in a nominal roll for research purposes. The RAAF list for example, gave surname and initials only and did not include Service Numbers. In the case of the RAN, there was no known nominal roll of participants in the Korean War.

3.1.1 Royal Australian Navy Korean War veterans

Preparation of Preliminary Nominal Roll

For many years up until the late 1950s, all ships of the RAN were required to maintain Pay Ledgers setting out rates of pay and allowances for all members of their crews. These Ledgers covered a financial quarter's 'pay and allowances' transactions.

The period during which the Ledgers were maintained covered the full period of the Korean War and post-cease fire monitoring period included in the Mortality Study. The Ledgers are now held by the National Archives of Australia (NAA) at its Mitchell repository.

The study team constructed the RAN component of the Nominal Roll by choosing one Ledger for a financial period falling within each ship's period(s) of service in Korean waters. Draft crew lists were then drawn up by extracting all information available on individuals listed in each Ledger. For most entries, this included Service number, rank, surname and first name. In a number of instances, second initial was included. In all cases, entries were hand-written.

Once crew lists had been prepared, these were combined and sorted alphabetically into one draft nominal roll. Duplicate entries due to misspelling of names in the original Ledgers had to be identified manually, as were multiple entries of individuals with more than one period of service in Korean waters.

The list produced at the end of this work was known to be incomplete as it was likely that crew members who joined ship after the chosen financial quarter would have been missed. It was also suspected that it included individuals who may have left the ship before service in Korean waters. Despite this, it resulted in the first known nominal roll of RAN participants in the Korean War.

Because the preliminary Nominal Roll was known to be deficient, all names required verification. Missing details also needed to be collected. This was done by reference to each individual's Service Certificate. At the time this task was undertaken, Navy Sailors Records held Service Certificates for all non-Commissioned ranks who had served between 1901 and the mid-1970s, when records were computerised. These certificates were stored in alphabetical order. Records for Commissioned officers had been transferred to the NAA some years before, but electronic scanned images were still held.

Verification work confirmed that with several of the ships, a significant number of personnel still included on Pay Ledgers had indeed left the ship before departure. In all remaining cases, data comparable to that collected for the other Services was extracted for the Nominal Roll.

One final group of RAN personnel requiring identification and verification consisted of those Commissioned officers, those with acting Commissioned rank and Midshipmen serving on exchange aboard Royal Navy (RN) ships in Korean waters. These were identified by reference to Navy Lists published quarterly by the RAN listing all Commissioned and acting Commissioned officers and Midshipmen serving in the RAN during that quarter. These lists included a record of those serving on exchange with other Commonwealth navies, including the ships on which they were serving.

The details of all individuals identified by this process as serving aboard RN ships during operational duty in Korean waters were verified using the methods outlined earlier.

A consolidated list of all Navy Korean War veterans was prepared by DVA.

3.1.2 Australian Army Korean War veterans

The list prepared by Lt Col Smith[1] was used as the starting point for the Army nominal roll. The Central Army Records Office (CARO) inspected all personal files of individuals identified in the list, recording full name, date of birth, Corps, rank on first arrival in Korea, unit(s) in Korea and dates of arrival in and departure from Korea.

The original list was further developed by incorporation of further names identified from medals lists held by CARO and from the Korean War Database previously compiled by CARO.

All work on identification of Army names, extraction of information and provision of data for entry onto the Nominal Roll was carried out by CARO staff.

3.1.3 Royal Australian Air Force Korean War veterans

A list prepared by the RAAF Historian, Mr David Wilson[2], was used as the starting point for the RAAF nominal roll. However, the lack of Service numbers for individuals recorded on the list added to the complexity of the task. RAAF personal files are stored in Service number order. Accordingly, positive identification of individual Korean War veterans and recording of relevant details required two separate exercises:

- identification of Service number(s) associated with each surname/initial(s) combination; and
- location of individual personal files to review service history and confirm Korean War service.

The first stage involved examination of a card index system containing a separate card for each member who had served in the RAAF from its establishment in 1921 until the introduction of a computerised system during the mid 1970s. While the total numbers involved could appear daunting, the task was made a little simpler since the introduction of a new service numbering system for RAAF personnel in 1949. This meant that all cards with the older style number could be ignored unless there was reason to believe the card had not been updated with the post-1949 Service number.

In many cases, this led to the identification of specific individuals. However, in other cases, particularly involving more common family names (eg Brown, Smith or Wilson) a number of alternatives were identified which needed resolution by inspection of each file until the correct one was located. Difficulty was also experienced in some cases due to cards having been stored out of alphabetic order.

Although a number of misplaced records were subsequently located, it is likely that this was the reason some names could not be identified. Other names are likely to have been missed due to either misspelt names in the original list or individuals leaving the RAAF during the period when records were changed from manual systems to computer based systems.

Identification of RAAF Nurses

A list of names of RAAF nurses who served either in Korea or on medevac flights to Korea was provided by Miss Betty Docker (since deceased) who had served as a senior nurse in Korea. Further names were provided by Mrs Cheryl Tizzard, a former RAAF nurse conducting her own research into RAAF nurses who served in war. Some further identification of individuals was obtained from a book on the RAAF nursing service published by Gay Halstead[3].

Names identified from these sources were verified by reference to personal files using the methods outlined above.

3.1.4 Civilians

Central Army Records Officer (CARO) holds records on all war correspondents and members of accredited philanthropic organisations who have served with the ADF. These records were reviewed by CARO to identify those who served in Korea during the period of the Study. In addition, requests for any information held on members of their organisations who may have served in Korea during the period of the Study were forwarded to:

- The Australian Red Cross;
- The Salvation Army;
- The YMCA; and
- The YWCA.

All names identified were verified by CARO before they were added to the roll.

3.2 Completeness of the nominal roll

This Nominal Roll is the first complete nominal roll produced of Australian veterans of the Korean War. According to this study's definition, nearly 18,000 armed forces personnel and 29 civilians are identified as having served in some capacity in Korea during the Korean War and the immediate post cease-fire period to April 1956.

Table 3-1, shows the actual numbers obtained on the Nominal Roll of those who served in the Korean Operational Area between 27 June 1950 and 19 April 1956.

Table 3-1: Coverage of the Nominal Roll

Group	Collected
Royal Australian Navy	
RAN total	5,769
Australian Army	
• ARA males	10,814
• ARA females	34
Army total	10,848
Royal Australian Air Force	
• RAAF males	1,204
• RAAF females	21
RAAF total	1,225
Philanthropic organisations	
• Australian Red Cross	
- male personnel	7
- female personnel	3
• Salvation Army	
- male personnel	7
• YMCA	
- male personnel	2
Philanthropic total	19
Civilians	
• RAN Ship's Canteen Staff (HMAS *Sydney*)	
- male personnel	6
• War correspondents and photographers	
- male personnel	4
Civilians total	10
Total	17,871

There are no earlier lists or estimates of the total number of ADF participants who served in Korea during the period covered by the study. However, a figure of approximately 17,000 has been quoted in the past as representing the total number of Australians who served in Korea during the period of the War, i.e. July 1950 to July 1953.

Robert O'Neill[4] (p582) provides a figure of 10,600 Australian Army personnel as having served in Korea between August 1950 and July 1953. He does not provide corresponding figures for either the RAN or the RAAF.

The Nominal Roll contains the names of 10,848 individuals who served in Korea with the Australian Army between July 1950 and April 1956. The figure of 10,600 quoted by Robert O'Neill appears close to the total number for the longer period. However, the source of O'Neill's figure is unclear and it is possible it includes some degree of double counting where individuals undertook more than one operational tour in Korea.

Because of concerns over known deficiencies in the Nominal Roll, the decision was taken to seek input from the Korean War veteran community to ensure individual veterans who had been missed could be identified and included in a final roll. This involved several steps.

The first step was to advertise in all major national and regional newspapers the intention of DVA to publish the Nominal Roll. This was required to meet the provisions of the *Privacy Act 1988* by ensuring that any veteran who did not wish to have his or her name included had the opportunity to request that it be withheld. Although four individuals contacted DVA seeking to have their names withheld, several thousand others rang to confirm that they were included.

The next step was the publication of a preliminary Nominal Roll in April 1999. This was formally launched by the Minister for Veterans' Affairs to ensure knowledge of its existence was spread as widely as possible. Articles were also published in the DVA publication '*Vetaffairs*', which is distributed to all its clients. This publicity led to further telephone calls from veterans seeking to rectify deficiencies. In all cases where individuals had been missed, their details were confirmed from Service records and entered onto the nominal roll.

Following verification of all Navy records and others who had been missed, a final version of the Nominal Roll was published in April 2000. Despite the publicity prior to and at the launch of the preliminary roll, the names of a further 30 RAAF veterans were provided shortly after the publication of the final roll. Although too late for the printed version, these names were confirmed and added to the roll for the purposes of the Mortality Study.

In the absence of definitive numbers for each Service, it is not possible to estimate how complete the current roll may be. However, given the extensive publicity and feedback from veterans concerning the roll, it is considered unlikely that any significant group of veterans has been overlooked. In this regard, it should be noted that 90.1% of known surviving Korean War veterans are DVA clients. These veterans were kept informed about developments with the Nominal Roll by means of the publication '*Vetaffairs*'.

3.3 Accuracy of data

All details on individual veterans were collected from original Service documents. For the Army and RAAF, available documents included the original enlistment papers signed by the veteran. In the case of the RAN, service certificates only were available. These provided personal details and a history of postings.

Not surprisingly, given the age of the documents, their condition varied significantly, with some having deteriorated quite badly. A number of RAN service record cards, in particular, presented problems due to the inappropriate use at some stage in their existence of Sellotape over areas recording name and date of birth information.

Where discrepancies were detected, and before matching against other databases, all veteran records that had missing or incomplete information for dates of birth, Service numbers, periods of service or showed initials instead of full given names were re-checked against their original service record.

During matching against the DVA client database, a number of discrepancies in the spelling of names or the recorded date of birth were detected. In each case, the veteran's DVA client file was examined to resolve discrepancies. Reasons for discrepancies varied. In some cases, the veteran had been under age at enlistment and had not given his true date of birth. Others, who would otherwise have been too old, reduced their ages. Veterans have advised that these groups referred to themselves colloquially as the 'Unders and Overs Club'.

False dates of birth occurred more frequently among Army veterans than among RAN or RAAF veterans. The latter two Services were stricter in requiring evidence of the enlister's date of birth. In part, this may have arisen because the Army was the only Service to seek

short-term special enlistment for service in Korea. The other two Services retained their normal recruitment procedures.

In a number of cases, the veterans had changed their name after completion of military service. Reasons varied, but included those who used the name of an older brother or used a false name to avoid the age restriction. Others changed the spelling of their name, either to anglicise it or comply with changing usage. Some changed their names for personal reasons; however, this was not a common occurrence with individuals in the age group of the Korean War veteran cohort. Name changes were a particular problem with female veterans who had subsequently married, but whose married name had not been recorded on service documents.

In all cases, an individual's Service number was found to be invaluable in ensuring that the correct individual had been identified on the DVA client database. Resolution of these discrepancies revealed that even where an individual had enlisted under a false date of birth, that individual used the correct date of birth when applying for DVA benefits.

3.4 Total number of veterans

3.4.1 Male Korean War veterans

Table 3-2, shows the numbers of male Korean War veterans, categorised by the first organisation in which they served. Some veterans may have had subsequent service in Korea, generally within the same Service. The civilian groups are, however, mutually exclusive.

The table shows that the Army constituted the largest group within the veteran cohort. The number of regular Army veterans was 10,814. The second largest group was the Navy group, with 5,769 veterans. In the case of the RAAF, there were a total of 1,204 Air Force personnel who served in Korea while posted or attached to No 77 Squadron, entered the Korean Operational Area as aircrew on transport aircraft or made short term visits from outside the area, usually while posted to Japan.

The number of male civilians who served in Korea was 26. These included 16 members of philanthropic organisations, who served alongside their military compatriots as chaplains and social workers, six civilian canteen workers on HMAS *Sydney* and four war correspondents.

Table 3-2: Number of male veterans by first Korean service

Service	Group	Number	%
Navy			
Sub-total		5,769	32.4
Army			
Sub-total		10,814	60.7
Air Force			
Sub-total		1,204	6.8
Philanthropic	Australian Red Cross	7	
	Salvation Army	7	
	YMCA	2	
Sub-total		16	0.1
Civilian	RAN Ship's Canteen Staff	6	
	War correspondents	4	
Sub-total		10	
Total		17,813	100.0

Note: Column total may not add up to 100% due to rounding.

3.4.2 Female Korean War veterans

As shown in Table 3-3, classified by first Korean service, 58 female veterans served in Korea: 34 were health professionals serving in the Army, 21 were Air Force nurses, and three were members of the Australian Red Cross.

Table 3-3: Number of female veterans by first Korean service

Service	Group	Number	%
Army	Female health professionals	34	58.6
Air Force	Nurses stationed outside Korea	21	36.2
Civilian	Australian Red Cross	3	5.2
Total		58	100.0

Note: Column total may not add up to 100% due to rounding.

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3 Halstead, Gay, 1994, '*Story of the RAAF Nursing Service – 1940-1990*', Nungurner Press Pty Ltd, PO Box 115, Metung, VIC, 3904

4 O'Neill, Robert, *'Australia in the Korean War 1950-53, Volume II, Combat Operations'*, The Australian War Memorial and the Australian Government Publishing Service, Canberra, 1985

Private Dick Gray, 3RAR, waits to go out on night patrol, Korea. He wears dark face paint, an armoured vest and a headscarf.
AWM HOBJ4383

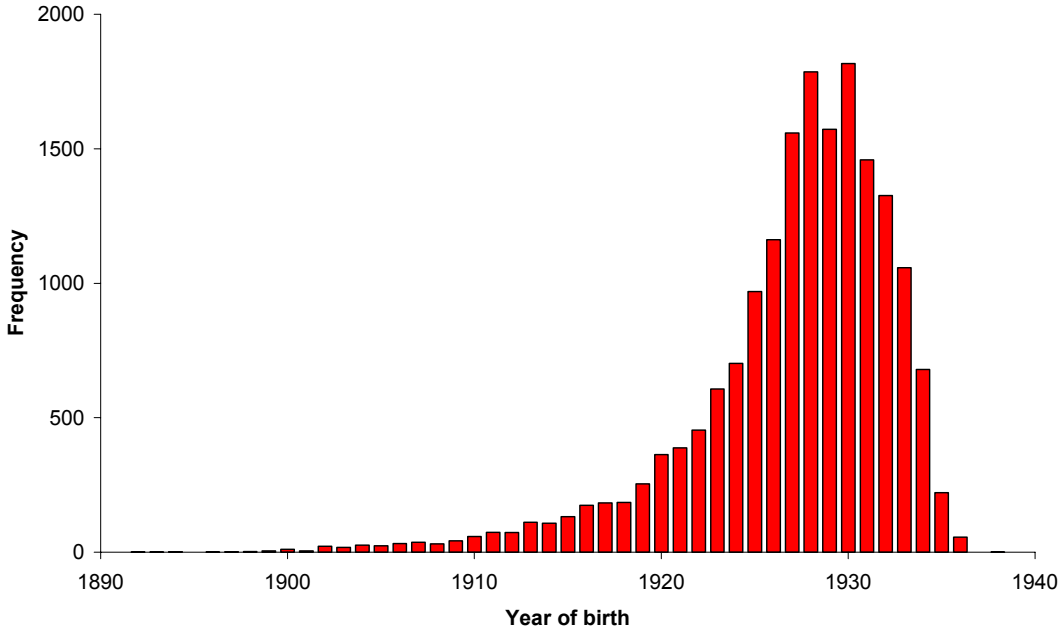
Chapter 4 Characteristics of the study cohort

This chapter describes in more detail the demographics and nature of service in Korea of the study cohort during the Korean War.

4.1 Birth year distribution of veterans

The birth year distribution of Korean War veterans on the Nominal Roll is illustrated in the histogram below (Figure 4-1). It is skewed to the left with most birth years clustered between 1920 and 1935. The median year of birth is 1928.

Figure 4-1: Number of Korean War veterans by year of birth
Note: Year of birth data were missing for 20 male Korean War veterans.



4.2 Age at first service in Korea

Using data for year of first service in Korea and year of birth for each veteran, the following descriptive statistics relating to age at first service in Korea, shown in Table 4-1, were obtained. Data were missing for six Navy veterans, 25 Army veterans and two Air Force veterans.

Table 4-1: Age in years at first service in Korea — descriptive statistics

Group	Range	Mean	Std dev	Median	Mode
Navy	15–51	23.7	4.5	23	23
Army	14–59	24.9	5.5	24	22
Air Force	18–54	26.6	6.5	25	24

These data show that, overall, Service personnel were generally young when they first served in Korea. The Navy was the youngest group and the Air Force was the oldest group when they first served in Korea.

4.3 Nature of service in Korea

To explore whether the death rates of veterans vary according to the duration or type of service, a number of measures of the nature of service in Korea were available. The duration of Korean service measures were: total days in Korea; total number of tours; and total number of visits. Each of these measures is described below.

4.3.1 Total days in Korea

Complete data were only available for 17,853 of the 17,871 personnel. Data were missing for three Navy veterans, 13 Army veterans and two Air Force veterans. Using data for the start and end date for each period of service in Korea for each veteran, the following descriptive statistics relating to the total number of days in Korea, shown in Table 4-2, were obtained.

Table 4-2: Number of days in Korea — descriptive statistics

Group	Range	Mean	Std dev	Median	Mode
Navy	7-880	249	108	219	176
Army	1–1467	305	158	346	386
Air Force	1–1161	145	123	123	33

Table 4-3 shows the number of personnel, grouped by branch of Service and the total number of days served in Korea. This data is displayed graphically in Figures 4-2 to 4-4 and shows the marked differences in the length of duty in the three Services. Whereas almost all Army personnel served approximately one year, the majority of Navy personnel served between five to 10 months and Air Force personnel for less than five months.

Table 4-3: Total number of days in Korea[a]

Days	Navy		Army		Air Force	
	Number	%	Number	%	Number	%
1–50	26	0.5	672	6.2	327	26.7
51–100	326	5.6	716	6.6	165	13.5
101–150	98	1.7	670	6.2	274	22.4
151–200	1,355	23.5	525	4.8	129	10.5
201–250	1,547	26.8	645	5.9	124	10.1
251–300	1,424	24.7	827	7.6	108	8.8
301–350	203	3.5	1,632	15.0	30	2.5
351–400	362	6.3	4,013	37.0	16	1.3
401–450	115	2.0	320	2.9	15	1.2
451–500	74	1.3	136	1.3	11	0.9
501–550	77	1.3	128	1.2	9	0.7
551–600	65	1.1	128	1.2	6	0.5
> 600	100	1.7	445	4.1	10	0.8
Total	**5,772**	**100**	**10,857**	**100**	**1224**	**100**

a. Includes 37 females and 16 members of philanthropic organisations

Note: Column totals may not add up to 100% due to rounding.

Figure 4-2: Navy service in Korea

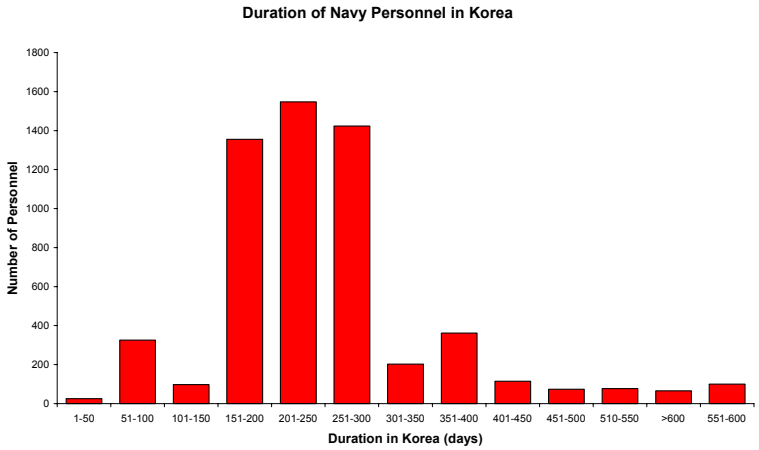


Figure 4-3: Army service in Korea

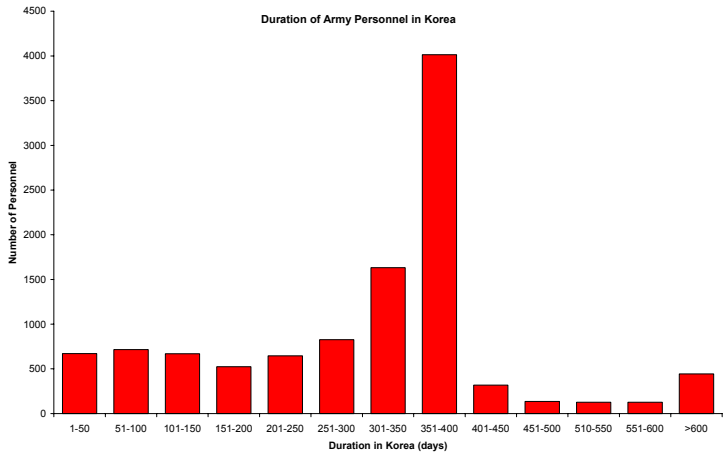


Figure 4-4: Air Force service in Korea

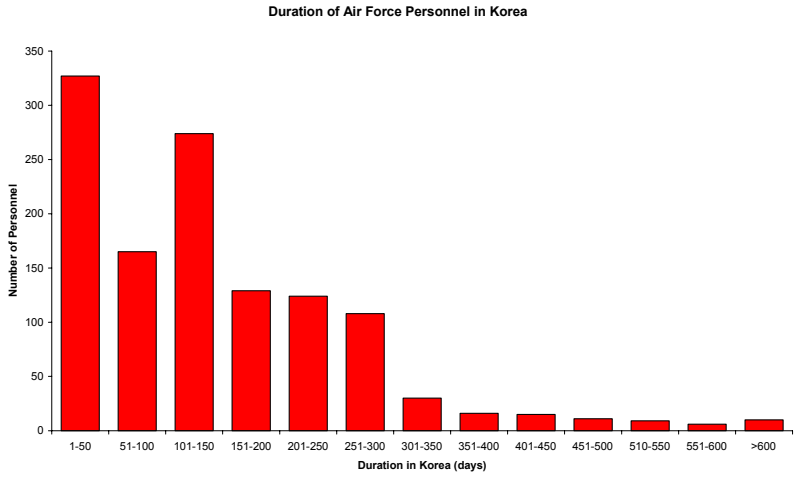


Table 4-4 shows the number of females, grouped by branch of Service and the total number of days served in Korea.

Table 4-4: Total number of days in Korea (females)

Days	Army[a]		Air Force	
	Number	%	Number	%
1–50	8	21.6	13	61.9
51–100	19	51.4	5	23.8
101–150	6	16.2	1	4.8
151–200	3	8.1		
201–250				
251–300			1	4.8
301–350				
351–400				
401–450	1	2.7	1	4.8
451–500				
501–550				
551–600				
> 600				
Total	**37**	**100**	**21**	**100**

a. Includes 3 members of philanthropic organisations
Note: Column totals may not add up to 100% due to rounding.

4.3.2 Tours and visits to Korea

Tables 4-5 to 4-8 show the total number of tours and the total number of visits undertaken by Navy, Army and Air Force veterans, and for the civilian groups — war correspondents and photographers. The Army personnel include 16 men from philanthropic organisations.

For the purposes of this study, a visit is defined as service of less than 28 consecutive days on land in Korea or on ships operating off the Korean coast. In contrast, a tour is defined as service equal to or more than 28 consecutive days on land in Korea or in ships operating off the Korean coast.

Navy Korean War veterans

Table 4-5 shows that this cohort is composed of a reasonably homogenous group. Most Navy personnel (84.7%) completed one tour and 99.8% performed one or more tours. The average number of days spent on land in Korea or in Korean waters by Navy personnel was 249 days.

Table 4-5: Service characteristics of Navy Korean War veterans

	Number of visits						
Number of tours	**0**	**1**	**2**	**3**	**over 3**	**Total**	**%**
0		8	1			9	0.2
1	4,836	50	3			4,889	84.7
2	784	7	1			792	13.7
3	72	4	1			77	1.3
Over 3	4	1				5	0.1
Total	5,696	70	6			5,772	100.0
%	98.7	1.2	0.1	0.0	0.0	100.0	

Note: Column and row totals may not add up to 100% due to rounding.

Army Korean War veterans

Table 4-6 shows that approximately 77% of Army personnel undertook one tour of duty and no visits during their service in Korea. Only 15.3% undertook two or more tours of duty, while 4.3% carried out visits but did not undertake a tour of duty. The average total number of days of service for veterans was 305 days.

Table 4-6: Service characteristics of Army Korean War veterans[a]

	Number of visits						
Number of tours	**0**	**1**	**2**	**3**	**over 3**	**Total**	**%**
0		278	68	119	1	466	4.3
1	8,325	336	62	1	1	8,725	80.4
2	1,324	108	0	1	0	1,433	13.2
3	228	2	1	0	0	231	2.1
over 3	2					2	0.0
Total	9,879	724	131	121	2	10,857	100.0
%	91.0	6.7	1.2	1.1	0.0	100.0	

a. Includes 37 females and 16 members of philanthropic organisations.
Note: Column and row totals may not add up to 100% due to rounding.

Air Force Korean War veterans

Table 4-7 presents the service characteristics of Air Force Korean War veterans.

Overall, 57.4% of Air Force personnel conducted one tour of duty in Korea. Only 25.1% conducted two or more tours of duty. The average duration of service for Air Force personnel was 145 days. A large number of visits were completed by Air Force personnel reflecting the operational transport role including aeromedical evacuation.

Table 4-7: Service characteristics of Air Force Korean War veterans[a]

	Number of visits[b]						
Number of tours	**0**	**1**	**2**	**3**	**over 3**	**Total**	**%**
0		103	40	25	46	214	17.5
1	533	101	34	17	17	702	57.4
2	156	38	16	9	13	232	19.0
3	25	13	8	3	6	55	4.5
Over 3	5	6	4	3	2	20	1.6
Total	719	261	102	57	84	1223	100.0
%	58.8	21.3	8.3	4.7	6.9	100.0	

a. Includes 21 females
b. Aeromedical evacuation flights are included
Note: Column and row totals may not add up to 100% due to rounding.

Females

Table 4-8 displays the service characteristics for females who served in Korea. There were 34 females in the Army, 21 in the Air Force and three with the Australian Red Cross. Only six Air Force females completed one tour or more, in contrast to Army females, of whom 31 completed one tour or more. The frequent visits reflect the aeromedical evacuation duties of Air Force nurses. One Air Force female completed 54 aeromedical evacuation flights.

Table 4-8: Service characteristics of females

Number of tours	Number of visits 0	1	2	3-20	over 20	Total	%
0		4	4	6	6	20	34.5
1	30	1	1	1		33	56.9
2	3					3	5.2
3	2					2	3.4
Total	35	5	5	7	6	58	100.0
%	60.3	8.6	8.6	12.1	10.3	100.0	

Note: Column and row totals may not add up to 100% due to rounding.

4.4 Involvement in other conflicts

One issue that arose during the study was whether any results might reflect involvement in conflicts other than the Korean War. In particular, the Vietnam Veterans Mortality Study[1] showed an increased mortality from involvement in that conflict. Accordingly, the Nominal Roll was matched against the Vietnam Veterans Nominal Roll and also against the DVA compensation claims database to estimate the participation rates of Korean War veterans in both World War II and the Vietnam War.

4.4.1 Involvement in the Vietnam War

Matching of the Korean Veterans Nominal Roll against the Vietnam Veterans Nominal Roll revealed that 1,562 (8.7%) Korean War veterans participated in the Vietnam War. Exploration of the DVA compensation claims database revealed that 1,462 Korean War veterans had submitted claims that they attributed to the Vietnam War. As DVA only has files on 81% of all Korean War veterans, this number was expected to be an under-estimate.

4.4.2 Involvement in World War II

Matching of the Nominal Roll against the developing World War II Nominal Roll was not feasible during the study. Exploration of the DVA compensation claims database revealed that 5,270 (29.5%) Korean War veterans had submitted claims that they attributed to their World War II service, and this is likely to be an under-estimate.

4.4.3 Compensation claims attributed to Korean War service

In contrast to involvement in the Vietnam War and World War II, 13,460 (75.3%) of Korean War veterans had submitted claims that they attributed to their service in Korea.

4.5 Summary

The nature of service in Korea varied considerably between the Navy, Army and Air Force. Navy personnel spent an average of 249 days in Korean waters with 85% completing one tour only. Army personnel averaged 305 days in Korea with 77% completing one tour only. In contrast, only 57% of Air Force personnel completed one tour only, with an average duration of service of 145 days. The large number of visits conducted by Air Force personnel reflects the operational transport role including aeromedical evacuation.

Almost 9% of Korean War veterans participated in the Vietnam War and compensation claims indicate that at least 30% of Korean War veterans participated in World War II.

Involvement in other conflicts may result in an increase or decrease in health outcomes depending on the circumstances. Whether involvement in the Vietnam War or World War II increases or decreases mortality among Korean War veterans requires further investigation.

The nature of service and involvement in other conflicts need to be taken into consideration when interpreting the results.

References:

1 Crane PJ, Barnard DL, Horsley KD, Adena MA. Mortality of Vietnam veterans: the veteran cohort study. A report of the 1996 retrospective study of Australian Vietnam veterans. Canberra: Department of Veterans' Affairs, 1997

Sergeant Chaperlin, Support Company, 3RAR, engages a Chinese patrol with a Vickers machine gun, Chipyon-Ni, February 1951. The bulbous shape on the muzzle of the gun is a flash suppressor.
AWM P1479/07

Chapter 5 Data sources, methods and limitations

In the conduct of a mortality study such as this one, the task of determining which Australian veterans of the Korean War have died since their service in Korea is of crucial importance. This information allows for an analysis of patterns of death in the cohort by various characteristics.

One of the key patterns to examine in a mortality study is the distribution of cause of death and how it compares with the Australian community. For the purposes of this study, deaths of veterans were analysed for the period after the servicemen left Korea until 31 December 2000. This study examines veterans of the Korean War, that is, those who returned to Australia from the war. Thus, while recognising the significance of the 349 deaths that occurred in Korea, these are excluded from this study.

Determining vital status (that is, whether alive or dead) was carried out in part using computerised matching of veterans' records with information in large national databases, such as the National Death Index (NDI), the electoral roll, DVA databases and other registers. Primarily, the Nominal Roll was matched against the DVA databases, as this contained information about both living and deceased veterans. Matching of deaths before 1980 was performed manually by the Registrars of Births, Deaths and Marriages.

5.1 Sources of data on vital status

Registration of deaths in Australia is compulsory and is the responsibility of the State and Territory Registrars of Births, Deaths and Marriages (RBDM). All veterans that died in Australia should be registered with the RBDM but the quality of information (eg. the lack of computerised records in the early years, changing names of veterans, incomplete date of birth) doesn't always make it easy to access or confirm the death. Therefore multiple sources of information are needed to maximise coverage and to get the best evidence regarding the vital status of each veteran.

Tables 5-1 and 5-2 summarise the different sources of vital status data used in this study. Table 5-1 shows the period covered for death information and Table 5-2 shows events indicating whether a subject is alive and on what date.

Table 5-1: Summary of sources of vital status — death

Died when?	Source
On active service in Korea	Department of Defence
In service, post-Korea	Department of Defence
Between 1950 and 1980	Australian State and Territory Registries of Births, Deaths and Marriages
After 1980	National Death Index
Since Korean service	Department of Veterans' Affairs Client Data Base
	New Zealand Registry of Births, Deaths and Marriages
After 1984	Health Insurance Commission Medicare database

Table 5-2: Summary of sources of vital status — alive

Action indicating the subject is alive	Assumed alive on the date of	Source
Receiving a Veterans' Affairs pension	their last payment	Department of Veterans' Affairs Client Data Base
Made a Medicare claim	their last claim	Health Insurance Commission Medicare database
Enrolled to vote	extraction of the roll	Australian Electoral Commission rolls

5.1.1 Client Data Base

DVA maintains a Client Data Base, which provides a central source of information about veterans who have registered for any benefit provided by DVA. The Client Data Base record contains information on surname, given name, other initials, date of birth, date of death and some information on military service and the service on which a claim was determined but records any subsequent service inconsistently.

Data quality

Because the personal data, names and pension details on the Client Data Base are regularly used and referred to in correspondence with veterans, these details are believed to be current and accurate. However, details of military service are less reliable and often incomplete as this database was originally intended for payment management, not military service tracking. For this reason, the Client Data Base was not used as a source of data on service details. Such details were obtained from the relevant Service records office. However, Service numbers, where recorded, provided confirmation of correct matches from other sources. It should be noted that pension related details were not accessed for the purposes of this study. Many veterans who died prior to the development of computerised databases are recorded as deceased but with no date of death.

DVA has no information on the vital status of Korean War veterans, or their dependants, who have not registered for any benefit provided by the Department.

5.1.2 The National Death Index and the National Mortality Database

The NDI is a database located at the AIHW. It contains identified records of all deaths in Australia registered after 1980. In excess of 2.5 million records are contained in the database. The Registrars of Births, Deaths and Marriages (RBDMs) in each Australian State and Territory supply the information for this database. As registration of death is a legal requirement, the database is virtually complete for deaths in Australia. The data available for matching in the NDI covered the period from 1980 to 2002 for all States and Territories, and some 2003 data.

Although the NDI identifies each person who dies, it does not record the cause of death in a standardised manner. This standardised cause of death information is available in the National Mortality Database, also located at the AIHW.

The National Mortality Database contains de-identified information on each person's *underlying* cause of death, coded using the International Statistical Classification of Diseases, Injuries, and Causes of Death (ICD)[1]. An NDI record can be linked to its corresponding record in the National Mortality Database, via a common registration number to obtain cause of death information, under Ethics Committee approval.

Data quality

The data quality of the NDI varies considerably between States and Territories and over time within each State and Territory. Data quality and completeness affected the matching strategy and the results of data matching for this study. The NDI does not have full dates of birth for:

- Queensland for the period 1980–1996 inclusive;
- New South Wales for the period 1980–1992 inclusive; and
- Victoria for the period 1980–1989, inclusive.

In these situations, a year of birth is derived from the date of death and the age at death.

Within the NDI there are inconsistencies in the way names are recorded. Data standardising procedures were therefore applied to the NDI in order to reduce inconsistencies. Examples are provided in section 5.3.3.

While personal information is usually provided about the deceased by the next of kin, acquaintance or official of the institution where the death occurred, information on the cause of death is variously supplied by family doctors, hospital resident physicians, pathologists, or the coroner's office. This large range of information sources contributes to the variable quality of cause of death data and a degree of inaccuracy overall. This situation also applies to the data held by the State and Territory and New Zealand Registries of Births, Deaths and Marriages. However, it should be recognised that Australia has one of the best death information systems in the world.

During the period of the study, six different versions of the ICD codes were in use in Australia. Disease classifications changed over time and meaningful observations could not be made for all diseases of interest for the entire study period. For example, chronic obstructive pulmonary disease (COPD) was first identified as a unique entity in the codex in 1979. Prior to this time, this disease was included in a range of other codes. Thus observations about COPD can be made for the period 1979 to 2000 only.

5.1.3 The electoral roll

The electoral roll is maintained by the Australian Electoral Commission (AEC). Matching against the electoral roll is undertaken by the AEC and is subject to its approval in accordance with legal and privacy legislation. Most living Australian citizens will appear on the roll.

Enrolment on the electoral roll is compulsory for all Australian citizens who have attained 18 years of age. However, the following people are not entitled to have their name included or retained on any electoral roll:

- the holder of a temporary visa;
- an unlawful non-citizen under the *Migration Act 1958*;
- a person of unsound mind;
- a person serving a sentence of five years or longer for an offence against the law of the Commonwealth or of a State or Territory; or
- someone who has been convicted of treason or treachery and has not been pardoned.

Few Korean War veterans would be expected to be ineligible to have their names included or retained on the electoral roll.

Data quality

There are known to be multiple registrations on the electoral roll of persons across States and Territories. This occurs if a person moved between a States and Territory of Australia and the previous entry had not been removed from the electoral roll.

Recorded names may not necessarily be legal names and there are persons who have died but their deaths are not known to the AEC.

5.1.4 Medicare

The Health Insurance Commission (HIC) has administered Medicare, Australia's national health insurance scheme, since its introduction on 1 February 1984. The scheme provides free access to hospital services for all Australian residents and subsidises the costs of a range of other medical services[2].

Two databases are maintained by the HIC: one of persons enrolled in the Medicare scheme; and one for claims processing. As at 30 June 2002 there were 10,146,235 males enrolled with Medicare, which is 103.8% of the estimated resident male population of Australia[3]. Medicare enrollers include some persons who are not Australian residents (eg. long term visitors whose stay is greater than 6 months and eligible short term visitors).

Data quality

When notified, the HIC records the date of death and the date of departure from Australia of persons on its database, but more commonly the record just becomes inactive. During 1992–93, approximately 800,000 records were culled from the enrolment database of those who had not claimed for five or more years[2].

The HIC only keeps records of claims made in the previous five years. Older claims are deleted from the database. As only recent and active records are kept, matching with HIC Medicare data can reliably ascertain that a person is alive provided they have made a claim in the last five years. Conversely, as information on deaths and departures from Australia is only gathered if the information is proffered, the finding of this type of information is less reliable than other sources.

Although many clients of DVA are entitled to free health care for accepted disabilities, most of those services are billed through the HIC.

5.1.5 National Cancer Statistics Clearing House

Cancer is a notifiable disease in all States and Territories. The data are collected by cancer registries and include clinical and demographic information about people with newly diagnosed cancer. This information is obtained from hospitals, pathologists, radiation oncologists, cancer treatment centres, nursing homes and Registrars of Births, Deaths and Marriages.

The AIHW is responsible for the national collection of cancer incidence statistics through the National Cancer Statistics Clearing House (NCSCH). The NCSCH receives data from individual State and Territory cancer registries on cancer diagnosed in residents of Australia. National statistics are available for all years from 1982 to 1999, for the purposes of this study. The database is updated annually.

The NCSCH was used as an additional check to determine the vital status of the Korean War veterans. The important data items for this purpose are names, date of birth and date of diagnosis. Surname was available for all records, first name for 99.9% of the records, second name for 52% (not all persons have a second name), date of birth for 99.9% and date of diagnosis for 99.9%.

5.2 Quality of Korean War nominal roll

Any individual, who was either a member of the ADF or a civilian from an organisation accredited by the ADF, who physically entered the Korean War Operational Area during the qualifying period between July 1950 and April 1956, was included in the nominal roll. The roll provides a list of names, dates of birth and service type of 17,813 male veterans, as well as all deaths of veterans notified to DVA.

Missing or incomplete data items reduced the chances of matching the nominal roll records with the NDI or other databases. Thus, failure to match with the NDI may falsely indicate that the veteran is alive (false negative) or, conversely, an incorrect match may give the false impression that the veteran is dead (false positive). Such errors may arise simply as a result of missing or incomplete data in the source record. Table 5-3, shows that missing and incomplete data were a minor concern for the nominal roll. Practically all first forenames were recorded — for only one Army servicemen there was just an initial. Most second forenames were recorded in full but for 14% of cases this data item was missing although the percentage of missing second names compared with those who had no second names to record is unknown. The number of records with missing dates of birth was negligible for the Navy and Army (three and one, respectively) and nil for the Air Force. In all, the quality of the nominal roll was considered good for matching purposes.

Table 5-3: Frequencies of incomplete and missing data

Roll	Initial only for first name	No second name[a]	Missing date of birth
Navy	1	745	3
Army	0	1,696	1
RAAF	0	131	0

[a] Not all persons have a second name

5.3 Record linkage between the nominal roll and selected data sources

5.3.1 Matching by DVA

DVA was responsible for identification of potential duplicate records and matching the nominal roll of Australian veterans of the Korean War with information indicative of vital status of veterans available within DVA. This included matching with the Client Data Base records of deaths and the Client Data Base records of payments to veterans. Approximately 81% of all Korean War veterans were identified on the DVA databases.

The nominal roll was matched with the Client Data Base records of veterans receiving payment of a pension or allowance from DVA. If there was a match the veteran was recorded as being alive. It was then matched against records of death. If there was a match, the veteran's date of death and cause of death, if recorded, were entered onto the nominal roll. Although date of death was frequently recorded, cause of death in ICD format had to be

obtained from the National Mortality Database. Known deaths, and those remaining of unknown status, were then matched with the NDI, Medicare and electoral roll.

For these matches only an exact match of surname, forenames, day, month and year of birth or an exact match of surname and service number were permitted. These criteria were more stringent than those for matching into the NDI where a probabilistic approach was taken, and were thus given precedence. Results of matching from external databases were then used to search for further Korean War veterans in the client database, to identify variations in recorded names and dates of birth. Discrepancies in matches were resolved by manual search of DVA and service records. Manual searches of DVA records were also undertaken for known deceased to determine dates and causes of death that were not recorded on the client databases. This was undertaken to increase the certainty of the probabilistic matching by AIHW. Correct matching of Korean War veterans on DVA databases was able to be confirmed for the majority of discrepancies between DVA and external databases by information located on DVA files including service number, dates or location of service and branch of Service.

All results of matching on external databases were subject to clerical review to try to resolve discrepancies. A number of discrepancies remained between DVA records and information provide on the initial nominal roll. Over 1,000 individual Service and DVA records were manually searched and a number of transcription errors were located. Many of these were attributed to the quality of handwritten records nearly 50 years old, but a significant number of discrepancies were unable to be resolved. For example, 470 Korean War veterans had different dates of birth recorded on Service and DVA records. A study nominal roll was finalised which recorded the results of all efforts to resolve discrepancies prior to matching by AIHW for cause of death information.

5.3.2 Matching by the AIHW

The AIHW was responsible for:

- matching with the NDI and the NCSCH; and
- supervising the matching with the State and Territory BDM Registries.

Identification of potential duplicate records and matching with the NDI and the NCSCH were undertaken using the Integrity software[4]. Integrity links records that are believed to relate to the same individual. The process is described as 'probabilistic' because for each linkage there is an associated degree of certainty that the records are correctly paired, the same as if the process were carried out manually[5].

The package calculates the likelihood of a correct linkage, i.e. that the records represent the same individual. The higher the likelihood of a correct linkage, the higher the weight accorded the match. Below a designated cut-off value, the weight of the match is too low to be considered a correct linkage and the records linked are considered to be different individuals.

5.3.3 Matching with the NDI and NCSCH

The nominal roll, the NDI and the NCSCH files were standardised to improve the likelihood of successfully matching veterans' details. This meant that apostrophes, hyphens and other miscellaneous characters were removed from surnames, and dates of birth and dates of death, where available, were presented within valid ranges. Soundex and New York State Intelligence Information System (NYSIIS) coded versions of the standardised surnames were created which allows for variations in spelling of names (e.g. Smith, Smithe, Smythe).

Standard versions of first names were added to all files (e.g. Robert for Bob and Rob)[5]. Allowance was made for slight variations and transpositions in dates of birth.

5.3.4 Matching with the State and Territory BDM

It was considered likely that a significant proportion of the "unknown" group may have been missed because they had died during the period from 1950, when the first veterans returned from Korea to 1980, immediately prior to the establishment of the NDI. In order to capture these deaths, the "unknown" group was matched against State and Territory death records for the period (except the Northern Territory, where the possible returns were deemed too low). NSW and Tasmanian records were matched in part by electronic means; all other records were matched manually. In some circumstances this meant searching nearly 30 yearbooks for approximately 1,500 names.

The data quality of the Registries' mortality information varies between States and Territories and over time within each State and Territory. Varying storage and indexing methods also influence the results of the data matching carried out for this study. Personnel carrying out the matching were provided with guidelines and encouraged to include doubtful matches which could then be further examined by the AIHW to maximise consistency across States and Territories. The relatively conservative matching criteria adopted for the NDI and NCSCH matching were then applied to the State and Territory BDM Registry results.

These deaths were then processed by the AIHW collaborating unit, the National Centre for Classification in Health, in order to determine the underlying cause of death. These deaths were coded in such away that was consistent with the coding rules used at the year of death in order to maintain consistency with other deaths at that time.

5.3.5 Matching with overseas databases

Veterans who are living or who have died overseas are also part of this "unknown" group. The group was matched against New Zealand death records for the period from 1950 by the New Zealand Registry of Births, Deaths and Marriages. Matching against UK and USA databases was considered but was deemed too costly and time consuming for limited results.

5.3.6 Matching with the electoral roll

A file was created of Korean War veterans who were not located on the DVA client databases, including those whose files were inactive and hence whose vital status was unknown to DVA. These unmatched records and those whose vital status remained unknown, were forwarded to the AEC for matching.

Exact matches were accepted as indicating that the veteran was alive. Close matches such as variations in spelling or date of birth resulted in a further search of the DVA client database, and a number of Korean War veterans were subsequently identified by this process. Where clerical review was unable to resolve discrepancies, a veteran's status was assessed as unknown.

5.3.7 Matching by the Health Insurance Commission

The HIC was responsible for matching 1,934 veterans whose vital status was unknown (i.e. no match with the Client Data Base or electoral roll) with its Medicare enrolment database records, then retrieving the most recent claim from the claim database.

For matching with the Medicare enrolment database, a generalised matching program developed by the HIC was used. This program distinguished three levels of match:

- an exact match of surname, given names and the day, month and year of birth;

- an exact match of surname, given names, and the month and year of birth; and
- an exact match of the day, month and year of birth and a phonetic match for the surname and given names.

Each matched record was linked to the claim database to determine the date on which the subject last received a medical service. That is, the date they were last known alive was recorded, unless there was a more recent date of death or departure from Australia. The results of matching underwent clerical review to resolve discrepancies.

5.4 Results of the matching process

5.4.1 Duplicate records in the nominal roll

In the initial nominal roll of 17,881 veterans, a number of duplicate records were noted. Three were duplicate entries, while seven were veterans who had served in Korea in more than one Service. The latter were classified by the branch of the Service in which they first served in Korea. The definitive nominal roll thus consisted of 17,871 Korean War veterans. This list, with an additional 470 duplicates, was submitted to the AIHW for matching. The duplicate entries consisted of 467 names with alternative dates of birth and three names with alternative dates of death. These alternative dates of birth and death had been unable to be resolved even after examination of Service and DVA records. After investigation, the appropriate duplicate records were removed from the final roll before conducting any analysis.

5.4.2 Final results of matching

The Korean nominal roll received by AIHW contained 18,341 records. Female veterans (58, comprising 37 Army and 21 Air Force), duplicate records (470) and those veterans who died in the Korean War (349, comprising nine Navy, 302 Army and 38 Air Force) were excluded from the study. The summary results of matching are presented in Table 5-4. It shows that vital status as at 31 December 2000 was determined for 94.9% of the cohort and 5.1% were 'lost to follow-up'. The final cohort for analysis was therefore 17,464.

Table 5-4: Summary results of nominal roll matching[a]

Group	Alive	Dead	Unknown	Total
Navy	3,256	2,271	239	5,766
Army	4,976	4,929	626	10,531
Air Force	638	508	21	1,167
Total	**8,870**	**7,708**	**886**	**17,464**
		Per cent		
Navy	56.5	39.4	4.1	100
Army	47.3	46.8	5.9	100
Air Force	54.7	43.5	1.8	100
Total	**50.8**	**44.1**	**5.1**	**100**

[a] Status as at 31 December 2000

In this study, the Air Force had the lowest proportion of subjects 'lost to follow-up' (1.8%). The figure was higher for the Navy and the Army at 4.1% and 5.9%, respectively. A possible explanation for these higher percentages in the Army and Navy is that the number of overseas recruits was higher in these groups, a proportion of whom returned to their country of origin after the war, making follow-up more difficult.

The Army had the highest proportion of subjects classified as deceased (46.8%), slightly higher than the Air Force (43.5%). The lowest proportion of deaths (39.4%) was found in those who served in the Navy.

5.5 Summary and discussion on determination of vital status

The prime objective of the matching was to determine the vital status of as many members of the cohort as possible. To achieve this, the study used a variety of data sources of vital status data. Some of these data are specific to Korean War veterans while others are general to the whole Australian population.

The cohort was first matched with data held by DVA. This included data on deaths obtained from the Department of Defence and data on deaths and those alive, obtained from the DVA Client Data Base. These sources were not mutually exclusive. Deaths that occurred before 1980 (including combat deaths) were identified from these sources.

Those veterans whose status remained unknown were then matched with the Medicare database, the Australian Electoral Roll and the NDI. Following clerical review, a final roll was prepared for forwarding to AIHW to determine cause of death.

All members of the cohort who were not assessed as being alive were then matched with the NDI to identify deaths in the period 1980–2000 not previously known to DVA and to obtain each underlying cause of death code from the associated National Mortality Database. Cause of death codes were obtained in this way in an effort to minimise potential bias that could have occurred if some of these had been obtained from DVA databases. The whole cohort was concurrently matched with the electoral roll to identify those who were alive. No further matches were obtained.

Overall, 50.8% of the cohort was determined to be alive and 44.1% were accepted as having died as of 31 December 2000, nearly 50 years after the conflict. The remaining 5.1% had a vital status that remains unknown. This latter group is on average 9.5 months older than the rest of the cohort. 19.6% of the unknown group would be aged 60 - 69 in 2000, 67.5% aged 70-79, 11.2% aged 80-89 and 1.7% aged 90 or older.

Some idiosyncrasies with the process described were noted. The DVA Client Data Base and other databases included deaths after 1980 that were not identified in the NDI. Similarly these databases identified deaths which were not identified in the BDM Registries prior to 1980. Thus even with inclusive matching criteria not all deaths were correctly found in the NDI or with the Registrars. The clerical review of the matching revealed a number of errors in the original nominal roll, DVA databases and also in the NDI. Clerical errors were noted in both transcription of names, dates of birth and dates of death. In addition, a systemic error was detected in the NSW death data between 1980 to 1991 that was foreshadowed in section 5.1.2. About 28 mismatches in dates of death were identified where the NSW death data had assigned a date of death of 30 June. These errors were reported to AIHW.

An inspection of the names for whom vital status could not be determined, revealed that a high proportion of these people have names that are common and result in multiple matches against the NDI that were unable to be resolved. Some names were likely to be anglicised and there were also some names that are commonly abridged or known by some other name. For example, Australians who are named William are often known as Bill or Will or Wills (such as Bill Hayden) and often the less formal name is entered on death certificates. People known as Benedict are often known as Ben (as in Benedict Chifley) but so are people whose more formal name is Benjamin. Other Australians choose to be known by their second name, such as Edward Gough Whitlam and John Malcolm Fraser. The matching software that was

used did try to accommodate this, but it is unlikely to be completely successful. The effect of this missing data would be to under-estimate the number of deaths; in other words, bias towards the norm.

5.5.1 Potential reasons for unknown status

The group of veterans with an unknown vital status will possibly contain subjects who died, most likely before 1 January 1980, the first date for data in the NDI, and who were not captured by any of the DVA databases or the manual searches by the various RBDMs.

Other reasons for 'lost to follow-up' include:

- emigration from Australia since the end of the Korean War;
- change of name since the end of the Korean War;
- living in certain types of institutional care;
- living in Australia but not recorded on the electoral roll;
- multiple matches with the NDI that were unable to be resolved;
- typographical or other errors in data records in nominal roll and/or databases used as sources of vital status information; and
- incorrect birth date recorded on the nominal roll as a result of membership in the 'Unders and Overs Club' in which veterans who were too old or too young for service enlisted for Korea using a false date of birth.

There is no additional information available about this group of veterans and therefore no further analysis was possible to investigate any bias these veterans may introduce.

In summary, from a total cohort of 17,464 male Korean War veterans followed up after approximately 50 years, the vital status of 5.1% remained unknown. This is comparable to the 3.1% unknown in the Vietnam Veterans Mortality Study[6] where 59,036 veterans were followed up after approximately 30 years.

5.6 Statistical methods

The statistical analysis of the Korean War veteran cohort employed standard statistical methods for cohort studies[7]. Essentially three components are necessary to undertake the study:

- the population at risk in the veteran cohort by age and calendar period, duration of service and service type;
- the number of deaths in the veteran cohort by age, calendar period, duration of service, service type and cause; and
- the age-specific mortality rates by calendar period and cause for the comparison population, in this case Australian males.

5.6.1 Population at risk

In broad terms the population at risk was derived by the person-years method which estimated the length of time each cohort member was out of Korean service and alive during the period of observation 1950 to 2000. This estimation of person years at risk was made for each calendar year and for each five-year age group.

Korean War veterans became part of the population at risk from the time they completed their Korean War service until they died or until the study end date, 31 December 2000. For example, a 23 year old soldier departing Korea in 1953 and dying in 1993 aged 63 would contribute 40 person years to the population at risk. Veterans who completed their service before 30 June were allocated to that years' population at risk; veterans who completed their service after 30 June were allocated to the next years' population at risk.

Several small variations to the population at risk compared to results of nominal roll matching needed to be considered—79 deceased veterans had no recorded date of death or cause of death, and four veterans (two deceased, two unknown) have no known date of birth. As no further evidence to clarify the records relating to these veterans was forthcoming, these records were excluded from the overall analysis.

Veterans whose last date of service in Korea is unknown (17 records) were added to the population at risk with a notional date of 31 December 1956. Table 5-7 shows the formation of the final population at risk for the analysis.

Table 5-5: Population at risk

Roll	Alive	Deceased	Unknown status	Total
Number	8,870	7,625	886	17,381
Percentage	51.0	43.9	5.1	100.0

The 886 veterans with an unknown vital status were not in contact with DVA, and were not found on the Australian Electoral Roll or any other databases interrogated for this study. For these veterans, it was therefore not possible to determine whether they were still alive and residing in Australia or if they had died or moved permanently overseas. This group is referred to as the 'veterans whose vital status is unknown' for the purpose of this study.

In this type of cohort study the size of this unknown vital status group may influence the results and therefore needed to be accounted for in the analysis. This was managed by considering the population at risk using two scenarios:

- Scenario 1 excludes all unknown veterans. This assumes the veterans lost to follow-up have the same rate of death as the other Korean War veterans. If the death rate of those lost to follow-up is substantially different, then the Standardised Mortality Ratio (SMR) using this scenario may be an over or under-estimate of the true situation.

- Scenario 2 includes the unknown veterans and assumes that all the veterans lost to follow-up are still alive and residing in Australia. This is unlikely and the analysis using Scenario 2 will result in an estimate of SMRs that are lower than the 'true' situation. This will provide an indication of the effect of excluding the unknowns from Scenario 1 to be assessed.

In presenting the findings from the analysis later in this report, both population Scenarios are provided.

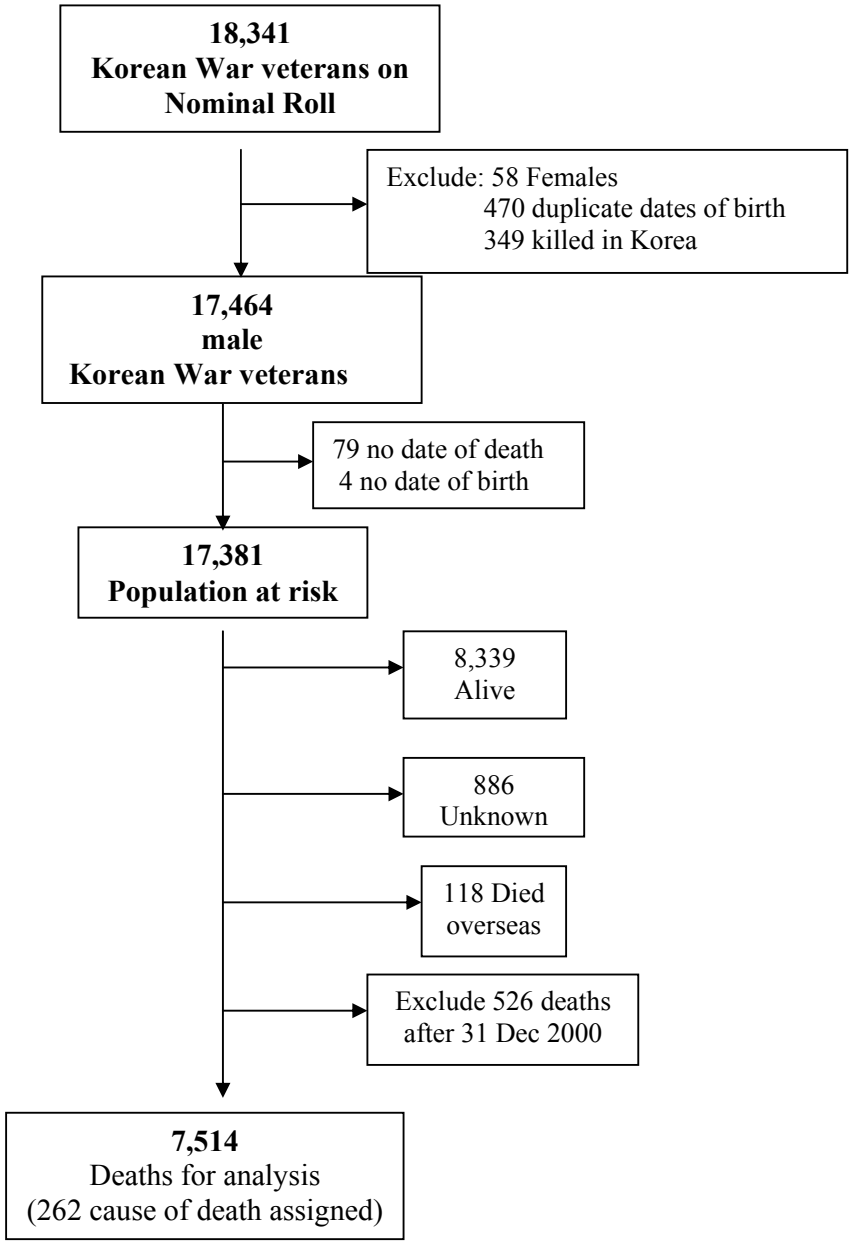
5.6.2 Deaths amongst veterans

The number of deaths in the veteran cohort by age, calendar period, duration of service, Service type and cause was derived from the final matched file described in earlier sections.

As part of the veteran follow-up exercise, an additional 531 veterans were found to have died after 31 December 2000, but for the purposes of this study are considered alive.

Australian mortality rates, against which the Korean War veterans' deaths are compared, only refer to deaths on Australian soil. Korean War veterans who died in the Vietnam War (13 veterans) or overseas (105 veterans) are therefore not included in this study. The 79 deceased veterans with an unknown date of death are excluded from the analysis as well as the two deceased veterans with an unknown date of birth. A total of 7,514 veteran deaths were analysed in this study. The categories are not mutually exclusive. For example five of the 531 veterans who died after 31 December 2000 died overseas and are included in the 118 overseas deaths. A flow chart for determining the number of veteran deaths for analysis is given in Figure 5-1.

Figure 5-1: Determination of Vital Status and Number of Deaths for Analysis



5.6.3 Expected number of deaths

In order to determine if mortality patterns in the veteran cohort are different from that experienced in the Australian population a *standardised mortality ratio* (SMR) approach is taken. This method compares the number of deaths amongst veterans with the number expected if the Australian mortality pattern was applied to the veteran population at risk. The expected number of deaths was computed by multiplying the person-years for each age and calendar year in the veteran cohort by the corresponding Australian mortality rate.

The Australian mortality rate is usually available for the complete study period, 1950-2000, but for some diseases these rates are only available for the later years. In those situations the observed number of deaths are restricted to the reduced time period. Deaths occurring in the earlier years are, however, analysed in the larger disease groupings. For example, head and neck cancer deaths are only counted for the period 1968-2000, but head and neck cancer deaths that occurred before 1968 are included in the 'Neoplasm comparison' as it investigates the 1950-2000 period. The situation is clarified in the tables under the heading 'Period examined'.

Comparing the observed and expected deaths in the veteran cohort

The *standardised mortality ratio* (SMR) is a measure of the relative mortality rate between the cohort and the reference population (in this study, the Australian male population). An SMR greater than one indicates higher death rates in the cohort compared with the Australian male population, adjusted for age and calendar year. An SMR less than one reflects lower death rates in the cohort than in the comparison population.

Analysis focused on causes of death identified in the study protocol as of *a priori* interest, however other conditions were also considered. All deaths were coded to ICD-10 and all SMRs for specific causes of death are based on these ICD codes.

SMR estimates based on small numbers of deaths are less certain than estimates based on large numbers of deaths. The variability of an estimate is reflected in its *95% confidence interval* (CI): an estimate based on few deaths has a wider 95% CI than one based on many deaths. The term *statistically significant* is used to describe mortality estimates (for veterans) which are different to the mortality estimate for the comparison group (Australian) allowing for this variability. For standardised mortality ratios where the 95% CI does not include one (1.0) the estimate is considered statistically significantly higher (or lower) than the comparison group. This corresponds to a two-sided 5% significance test. The method of calculation of confidence intervals assumes that the number of observed deaths can be modelled as a random variable with a Poisson distribution.

This chapter restricts itself to explaining the method of the various analyses. The results and analysis of the mortality patterns for the veterans as a whole and within the various groups can be found in Chapter 6.

5.6.4 Cause of death analysis

This study analysed the underlying cause of death of 7,514 veterans. Of these veterans, 262 have been recorded as having died, however no recorded cause of death was obtainable. Their date of death tends to occur towards the earlier years of the follow-up period (Table 5-6). In order to incorporate these deaths, the records were allocated a cause of death on a prorata basis using the patterns of causes of death of the other veterans in the same period.

Table 5-6: Analysis of missing cause of death data

		Navy	Army	Air Force	Total
Total deaths		2,226	4,795	493	7,514
1950-1967	Missing causes	23	51	14	88
	Percentage	*13.0*	*12.3*	*25.0*	*13.6*
1968-1979	Missing causes	12	65	4	81
	Percentage	*3.7*	*8.1*	*5.6*	*6.7*
1980-2000	Missing causes	18	71	4	93
	Percentage	*1.0*	*2.0*	*1.1*	*1.6*
1950-2000	Missing causes	53	187	22	262
	Percentage	*2.4*	*3.9*	*4.5*	*3.5*

5.6.5 Mortality analysis by duration of service

The deaths of servicemen were analysed by their length of service in Korea. Two approaches were taken in this study:

- Both the Navy and Army personnel were divided into three groups based on their duration of service. The boundaries of these groups were chosen by observing natural breaks in the distribution of the servicemen's length of stay in Korea. The boundaries are different for both Services reflecting their length of service, and are not indicative of any natural disease risk (Table 5-7). Two Navy records and 11 Army records had no recorded length of service and were excluded from the analysis. The number of deaths in Air Force personnel was too small for this type of analysis, resulting in unstable mortality estimates.

Table 5-7: Duration of service for Navy and Army personnel

	Duration in days	Average duration (days)	Number of veterans
Navy	1-174	96	504
	175-294	223	4,231
	295+	434	1,005
	Total	249	5,740
Army	1-345	197	4,997
	346-389	366	4,199
	390+	565	1,275
	Total	311	10,471

- The study also investigated the relationship between the duration of service as measured using a finer level continuous variable (months of service) and the risk of dying using the Cox Proportional Hazards Model. This investigation was carried out for all three services separately and combined. Fifteen records had no recorded length of service and were excluded from the analysis.

5.6.6 Mortality analysis by period of service

The Korean War had a number of distinct phases, the most notable being the periods before and after 31 December 1951. These varying war experiences were, of course, most noticeable for the Army, and analysis was restricted to these veterans.

The Army veterans were categorised into three groups: those veterans who returned from the war on or before 31 December 1951 (Period 1), those veterans who commenced their war

service before 31 December 1951 but returned after that date (Period 2) and those veterans who commenced their war service after 31 December 1951 (Period 3). Table 5-8 gives a breakdown of these three groups.

Table 5-8: Period of service for Army personnel

	Number of veterans	Deceased veterans	
		Number	Percentage
Period 1	1,395	784	56.2
Period 2	1,148	575	50.1
Period 3	7,939	3,436	43.3
Total	10,482	4,795	45.7

There is an obvious overlap between Periods 1 and 2 and between Periods 2 and 3. Period 1 and Period 3 are mutually exclusive. Consequently, the analysis focuses on the comparison between Period 1 and Period 3.

5.7 Statistical Power

The power of this study was assessed using standardised death rates for males from Australian Bureau of Statistics (ABS) publicised data for 1997. Table 5-9 shows the calculations for the estimated power of this study. This reveals that where a standardised death rate exceeds 30 per 100,000 per year then the study has an 85% chance of detecting a 20% increase in relative risk at the 0.05 level of significance.

5.8 Smoking prevalence

The study revealed high standardised mortality ratios in smoking-related cancers. An analysis was conducted to examine if smoking could explain all of the elevation in the smoking-related cancer deaths in Korean War veterans.

The prevalence of smoking amongst Korean War veterans is unknown either during the conflict or afterwards. While there is anecdotal evidence of high levels of smoking during the conflict and knowledge of the cigarette rations, there was no systematic measurement of smoking rates amongst veterans or the population. Therefore this analysis provides for a range of smoking prevalences from 30-100% and generates a hypothetical number of expected deaths based on these prevalence rates and estimates of attributable risk of cancer death due to smoking.

5.8.1 Calculation of estimated cancer mortality rates for varying levels of smoking prevalence

The method used to estimate mortality rates for hypothetical levels of smoking prevalence uses aetiological fractions, or estimates of attributable risk of dying from specified causes due to smoking, and smoking prevalence estimates for the Australian population for the study period (1950–2000). Smoking prevalence estimates were calculated by Ridolfo & Stevenson (2001)[8], using a method proposed by Peto et al. (1992)[9], and subsequently used in the Australian Burden of Disease Study (Mathers et al. 1999)[10]. These estimates of smoking prevalence take into account past exposure to tobacco rather than current exposure, and reflect the disease burden from the commencement of smoking.

Estimated mortality rates were calculated by separately deriving mortality rates attributable to smoking and rates not attributable to smoking. The total rate was then calculated by

weighting the rate attributable to smoking according to the hypothetical smoking prevalence in the population.

The formula is therefore:

$DR_h = SR*h + NR$

where DR_h = derived mortality rate, assuming the hypothetical prevalence h applies
SR = mortality rate due to smoking
NR = mortality rate not due to smoking
h = the hypothetical smoking prevalence

To calculate the smoking rate, SR, it was necessary to first estimate the aetiological fraction, or attributable proportion of the mortality due to smoking. The formula for calculating the aetiological fraction, F is:

$F = P*(RR-1) / (P*(RR-1)+1)$

where P is the actual smoking prevalence

RR is the ratio of the mortality rate of the cancer among those exposed to smoking to the mortality rate of those not exposed, or the relative risk of the cancer due to smoking.

The mortality rate due to smoking, SR, was then calculated using the formula:
$SR = R*F/P$
where R is the actual mortality rate.

The mortality rate for non-smokers is:
$NR = R*(1-F)$

5.9 Statistical software used

Several statistical packages were used for data management and analysis. Initial processing, such as the calculation of person-years, and the Cox Regression was performed in SAS Release 6.12[11]. Tables of observed and expected deaths and SMRs were compiled in EXCEL 97[12] and DeltaGraph Version 5.0.1[13] was used to produce the graphs.

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Table 5.9: Estimated Power of Korean Veteran Mortality Study

	Standardised Death Rate for males per 100,000 per year (ABS 1997)	Probability of detecting the relative risk of a given disease. Relative Risk (Ratio of change in disease incidence in study population)									
		1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2
Chronic bronchitis	34.7	38.2%	90.1%	99.7%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Emphysema	6.9	11.0%	30.0%	55.9%	78.5%	92.1%	97.8%	99.5%	99.9%	100.0%	100.0%
Ischaemic vascular disease	182.3	97.7%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Peripheral vascular disease	2.8	6.8%	14.8%	26.8%	41.7%	57.3%	71.3%	82.3%	90.0%	94.8%	97.5%
Cerebrovascular disease	58.6	58.3%	98.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
***Tuberculosis**	9.5	13.6%	39.2%	69.6%	89.8%	97.7%	99.6%	100.0%	100.0%	100.0%	100.0%
Peptic ulcer disease	2.4	6.3%	13.3%	23.6%	36.7%	51.0%	64.6%	76.2%	85.1%	91.3%	95.2%
***Cirrhosis of liver**	8.1	12.2%	34.3%	62.7%	84.6%	95.5%	99.0%	99.8%	100.0%	100.0%	100.0%
External causes	59.7	59.1%	99.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Malignant neoplasm of oesophagus	7.3	11.4%	31.5%	58.2%	80.8%	93.4%	98.3%	99.7%	99.9%	100.0%	100.0%
Gastrointestinal malignant neoplasms	37.4	40.7%	92.1%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Colo-rectal malignant neoplasms	28.5	32.3%	83.5%	99.1%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
***Malignant neoplasm of oropharynx and larynx**	13.0	17.1%	50.6%	82.6%	96.6%	99.6%	100.0%	100.0%	100.0%	100.0%	100.0%
Malignant neoplasm of lung	52.1	53.3%	97.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Mesothelioma	15.0	19.1%	56.4%	87.6%	98.2%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%
#Malignant neoplasm of bladder, Prostate, ureter, kidney and testicle	16.0	20.1%	59.2%	89.6%	98.7%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%
Malignant neoplasm of bladder	6.5	10.6%	28.6%	53.4%	76.1%	90.5%	97.0%	99.3%	99.9%	100.0%	100.0%
Malignant neoplasm of prostate	29.3	33.1%	84.5%	99.2%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
***Hepatocellular carcinoma**	4.9	9.0%	22.7%	42.7%	63.9%	81.0%	91.6%	96.9%	99.0%	99.7%	99.9%
Malignant melanoma of the skin	6.4	10.5%	28.2%	52.8%	75.5%	90.0%	96.8%	99.2%	99.8%	100.0%	100.0%
Leukaemia including AML	7.9	12.0%	33.6%	61.6%	83.7%	95.0%	98.9%	99.8%	100.0%	100.0%	100.0%
All causes	787.3	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Shaded area indicates where study power has less than 85% chance of detecting change in disease at the 0.05 level of significance

* overestimate
# slight underestimate

Assumptions:

Number of individuals in Australian population (male)	9,200,000
Number of Korean veterans in the study population	17,464
Length of time of follow-up of the study population (years)	47

Wing Commander R T Susans, 77 Squadron RAAF, makes an attack with napalm rockets against buildings at Chaeryong, North Korea, February 1952. The photo was taken from an aircraft of the USAF 67th Tactical Reconnaissance Wing.
AWM 083858

Chapter 6 Results

This chapter presents the results of the mortality analysis. The chapter discusses veteran mortality for broad disease groups of the International Classification of Diseases (ICD) chapters and specific diseases of interest within some of the groupings. It also reviews mortality by branch of Service. Mortality from cancers is discussed in detail with special reference to smoking-related cancers. Finally the chapter explores the mortality for those veterans who experienced different durations and periods of service in Korea.

6.1 Overview of analysis

The study has investigated the mortality of the Korean War veterans for the period 1950 through 2000, as per the protocol (Appendix A). Results are presented as standardised mortality ratios (SMRs). A SMR is the ratio of the observed number of deaths among the Korean War veterans to the expected number of deaths within the same aged Australian male population.

As detailed in section 5.6.1 of the preceding chapter, the population at risk includes 886 people whose vital status was 'unknown'. It was not possible to determine whether the unknown veterans were still alive and living in Australia. To reflect the uncertain status of the unknown veterans, results are presented using two scenarios:

- Scenario 1 excludes all unknown veterans. This assumes the veterans lost to follow-up have the same rate of death as the other Korean War veterans. This is the usual scenario used in mortality studies and is the preferred option. If the death rate of those lost to follow-up is substantially different, then the SMR using this scenario may be an over or under-estimate of the true situation.

- Scenario 2 includes the unknown veterans and assumes that all the veterans lost to follow-up are still alive and residing in Australia. The analysis using Scenario 2 will result in unlikely estimates of SMRs that are lower than the 'true' situation.

Calculation of the SMR by itself is insufficient for determining whether veterans experienced higher or lower rates of death than might be expected. A statistical test is required to test whether the actual number of deaths experienced by veterans was statistically different from those expected. The test involves calculating a 95% confidence interval around the SMR. This provides a range between upper and lower values within which the true SMR is likely to be. The range of values is likely to be narrower for those diseases with greater numbers of deaths, and conversely wider for deaths from conditions with fewer numbers.

Given that a SMR of 1.0 means that there is no difference in mortality between Korean War veterans and the Australian community, a confidence interval which does not include 1.0 indicates a significant difference. For example, a SMR of 1.21 with a confidence interval of 1.18 to 1.24 is significantly different because the interval does not include 1.0. If the confidence interval was 0.92 to 1.52, the difference would not be statistically significant because the confidence interval includes 1.0.

6.2 Deaths from diseases of *a priori* interest

In planning this study, several specific causes of death were considered to be of particular interest because they were suggested by the review of the current literature or of concern to

veterans' organisations. These specific *a priori* causes of death are listed in Table 1-1 of this report. Minor changes have been made to the list of diseases to compensate for changes in coding practices and availability of data over the past 50 years. Specifically, chronic airways obstruction (ICD9 code 496 and ICD10 code J44) was added to the item 'chronic bronchitis and emphysema' and is presented as chronic obstructive pulmonary disease (COPD). Cirrhosis of the liver was reclassified as alcoholic liver disease for consistency with the ICD10 coding. Malignant neoplasms of the oropharynx was expanded to include head and neck cancers. Hepatocellular carcinoma data was first available from 1968 and this category was changed to liver and gallbladder cancer for which data existed from 1950.

Table 6-1 details the mortality results for the revised coding of *a priori* diseases of interest. Mortality from a majority of the diseases of *a priori* interest was elevated. This included mortality from all causes, chronic obstructive pulmonary disease, ischaemic heart disease, stroke, alcoholic liver disease and external causes. Among the neoplasms of interest, cancer of the oesophagus, gastrointestinal and colo-rectal cancers, head and neck, lung, genito-urinary and prostate cancers were statistically significantly increased. Mortality from two *a priori* diseases (tuberculosis and peptic ulcer disease) and four cancers (liver and gallbladder, mesothelioma, melanoma and leukaemia) did not differ from that of Australian males. None of the *a priori* diseases showed a statistically significant decrease in mortality.

Table 6-1: Standardised Mortality Rates for *a priori* causes of death for all Korean War veterans

Cause of death	Number of deaths	Scenario 1 Unknowns excluded		Scenario 2 Unknowns included	
		SMR	95% CI	SMR	95% CI
All causes	7514	1.21	1.18-1.24	1.11	1.09-1.14
COPD*	362	1.49	1.33-1.64	1.34	1.21-1.48
Ischaemic heart disease	1951	1.10	1.05-1.15	1.02	0.97-1.06
Stroke	451	1.17	1.06-1.28	1.06	0.97-1.16
Tuberculosis	12	0.95	0.40-1.49	0.88	0.38-1.39
Peptic ulcer disease	43	1.42	0.99-1.84	1.30	0.91-1.69
Alcoholic liver disease	109	1.36	1.11-1.62	1.28	1.04-1.52
External causes chapter	814	1.37	1.27-1.46	1.29	1.20-1.38
Neoplasms					
Oesophagus	93	1.59	1.27-1.91	1.46	1.17-1.76
Gastrointestinal	390	1.18	1.07-1.30	1.09	0.98-1.20
Colo-rectal	295	1.18	1.05-1.32	1.09	0.97-1.21
Liver and gallbladder	63	1.30	0.98-1.62	1.20	0.90-1.50
Head and neck	114	1.96	1.60-2.32	1.82	1.48-2.15
Lung	802	1.47	1.37-1.58	1.36	1.27-1.45
Mesothelioma	4	0.51	0.01-1.00	0.46	0.01-0.91
Genito-urinary	286	1.24	1.10-1.39	1.13	0.99-1.26
Prostate	181	1.29	1.10-1.48	1.16	0.99-1.33
Melanoma	78	1.28	0.99-1.56	1.18	0.92-1.45
Leukaemia	60	0.99	0.74-1.24	0.91	0.68-1.14

*COPD = Chronic Obstructive Pulmonary Disease

6.3 Mortality of Korean War Veterans

There was a total of 7,514 deaths among all Korean War veterans. The most frequent causes of death were diseases of the circulatory system (2,894), cancer (1,895), external causes such as suicide and motor vehicle accidents (814), and diseases of the respiratory system (573).

Overall mortality for military Korean War veterans was elevated. The SMR for all causes of death using Scenario 1 was 1.21 (95% CI 1.18-1.24), that is, the overall death rate for male

Korean War veterans was 21% higher than the Australian male population. Table D1 (Appendix D) shows the SMRs and their confidence intervals for all causes and for specific causes for all Korean War veterans using both Scenario 1 and Scenario 2.

The SMR and 95% CI for all causes of death, and 27 specific causes of death, are shown in Figure 6-1.

6.3.1 Conditions with a statistically lower SMR

When analysed by cause of death, two groups of diseases, skin disease and congenital malformations, showed SMRs that were statistically significantly less than one. However, there were only one and three deaths respectively from each of these causes.

6.3.2 Conditions with a statistically elevated SMR

Those disease groups or chapters in which there were statistically significantly more deaths of Korean War veterans than were expected given death rates in the Australian male population include circulatory diseases, neoplasms, respiratory diseases, digestive diseases and external causes. The results for the chapters as well as specific diseases of interest are shown in Table 6-2.

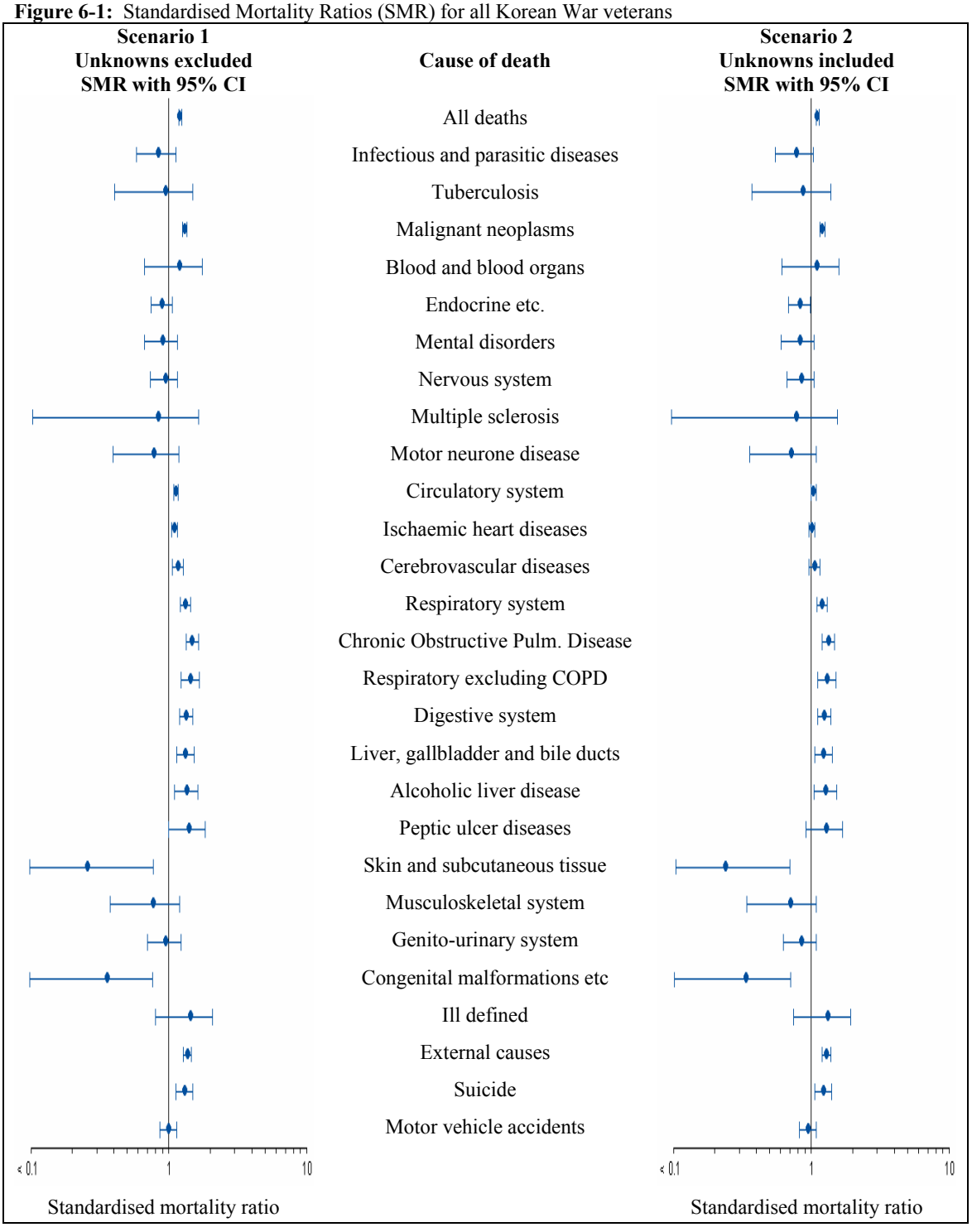
Specific cancers are detailed in Section 6.5, Neoplasms.

Table 6-2: Statistically significantly elevated causes of death for all Korean War veterans

Cause of death	Number of deaths	Scenario 1 Unknowns excluded		Scenario 2 Unknowns included	
		SMR	95% CI	SMR	95% CI
All causes	7514	1.21	1.18-1.24	1.11	1.09-1.14
Circulatory disease chapter	2894	1.13	1.09-1.17	1.04	1.00-1.07
Ischaemic heart disease	1951	1.10	1.05-1.15	1.02	0.97-1.06
Stroke	451	1.17	1.06-1.28	1.06	0.97-1.16
Neoplasms chapter	2476	1.31	1.26-1.36	1.20	1.16-1.25
Respiratory disease chapter	573	1.32	1.21-1.42	1.20	1.10-1.30
COPD*	362	1.49	1.33-1.64	1.34	1.21-1.48
Respiratory excluding COPD*	164	1.45	1.23-1.67	1.31	1.11-1.51
Digestive disease chapter	306	1.35	1.20-1.50	1.25	1.11-1.39
Liver, gallbladder, bile ducts	186	1.33	1.14-1.52	1.24	1.06-1.42
Alcoholic liver disease	109	1.36	1.11-1.62	1.28	1.04-1.52
External causes chapter	814	1.37	1.28-1.47	1.29	1.20-1.38
Suicide	211	1.31	1.14-1.49	1.23	1.07-1.40

*COPD = Chronic Obstructive Pulmonary Disease

Figure 6-1: Standardised Mortality Ratios (SMR) for all Korean War veterans



6.4 Mortality by branch of Service

Mortality was also investigated by Service branch. Table 6-3 summarises the number of deaths and person years which contributed to the analysis by Service branch.

Table 6-3: Number of deaths and person years contributed by branch of Service

Service Branch	Number of veterans contributing to the analysis	Number of unknowns	Number of deaths	Person Years contributed	
				Unknowns Excluded	Unknowns Included
Navy	5,742	237	2226	231,799	243,199
Army	10,482	628	4795	393,087	422,480
Air Force	1,157	21	493	47,150	48,173
Total	17,381	886	7514	672,036	713,852

6.4.1 Deaths of Navy Korean War veterans

Table D2 (Appendix D) shows SMRs for Navy Korean War veterans, by cause of death. There were 2,226 deaths observed in this group of 5,742 men. The most common causes of death were the same as for all Korean War veterans, that is, diseases of the circulatory system (875), neoplasms (767), external causes (211) and then respiratory diseases (156).

Navy veterans had an 11% increase in overall mortality with the SMR for all causes of death being 1.11 (95% CI 1.06-1.16). Figure 6-2 shows the SMRs for Navy veterans for the analysed causes of death.

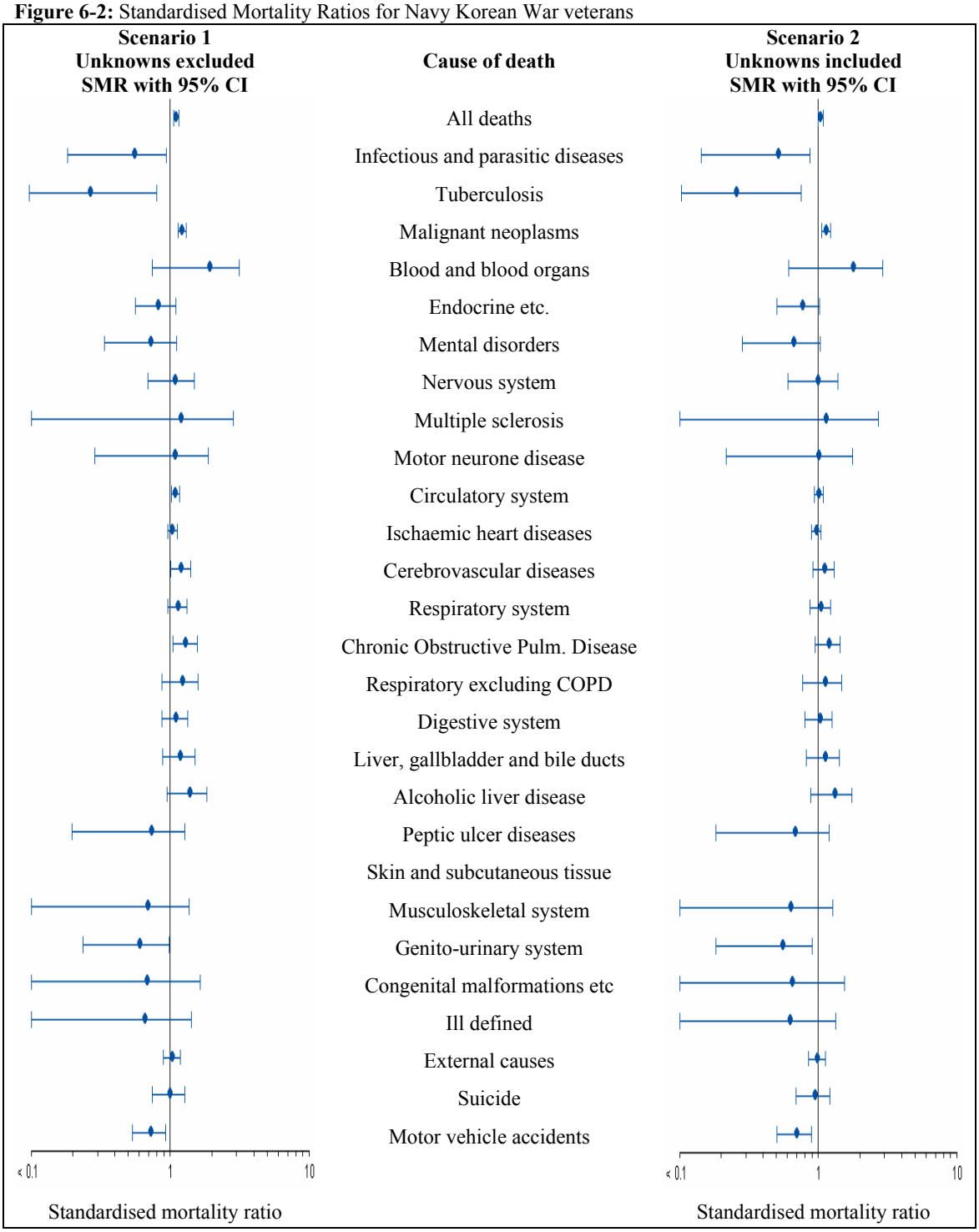
Conditions with a statistically lower SMR

There were two disease groups for which Navy veterans had a statistically significant reduced risk of mortality; infectious disease and genito-urinary disease. Two specific diseases, tuberculosis and motor vehicle accidents, also showed a reduced risk of mortality when compared to the age-matched male Australian population. Table 6-4 shows the SMRs and 95% confidence intervals for these diseases using both Scenarios.

Table 6-4: Causes of death for Navy Korean War veterans which were statistically significantly lower than the male Australian population

Cause of death	Number of deaths	Scenario 1 Unknowns excluded		Scenario 2 Unknowns included	
		SMR	95% CI	SMR	95% CI
Infectious disease chapter	8	0.56	0.18-0.94	0.52	0.17-0.87
Tuberculosis	1	0.27	0.00-0.80	0.26	0.00-0.75
Genito-urinary disease chapter	10	0.61	0.24-0.99	0.56	0.21-0.90
Motor vehicle accidents	53	0.73	0.54-0.93	0.70	0.51-0.89

Figure 6-2: Standardised Mortality Ratios for Navy Korean War veterans



Conditions with a statistically elevated SMR

Navy veterans had a statistically significantly elevated standardised mortality risk for circulatory diseases including stroke, neoplasms and chronic obstructive pulmonary disease. Table 6-5 shows the SMRs and 95% confidence intervals for these diseases.

Table 6-5: Causes of death for Navy Korean War veterans which were statistically significantly higher than the male Australian population

Cause of death	Number of deaths	Scenario 1 Unknowns excluded		Scenario 2 Unknowns included	
		SMR	95% CI	SMR	95% CI
Circulatory diseases chapter	875	1.09	1.02-1.16	1.02	0.95-1.08
Stroke	141	1.21	1.01-1.41	1.11	0.93-1.30
Neoplasms	767	1.22	1.14-1.31	1.14	1.06-1.23
COPD*	101	1.30	1.05-1.56	1.20	0.97-1.43

*COPD = Chronic Obstructive Pulmonary Disease

6.4.2 Deaths of Army Korean War veterans

Of the three Service branches, Army veterans had the highest mortality. Table D3 (Appendix D) shows the SMRs for Army Korean War veterans, by cause of death. There were 4,795 deaths observed in this group of 10,482 men.

As for all Korean War veterans, the most frequent causes of death for Army veterans were diseases of the circulatory system (1,819), neoplasms (1,555), external causes (552) such as suicide and motor vehicle accidents, and diseases of the respiratory system (380).

The SMR for all causes of death for Army veterans was 1.31 (95% CI 1.27 – 1.35). The SMR and 95% CI for all causes of death, for disease groups and some specific diseases of interest among Army Korean War veterans are shown in Figure 6-3.

Conditions with a statistically lower SMR

The only condition for which Army veterans had a statistically significant reduced risk of mortality was congenital malformations, with only one death being recorded.

Conditions with a statistically elevated SMR

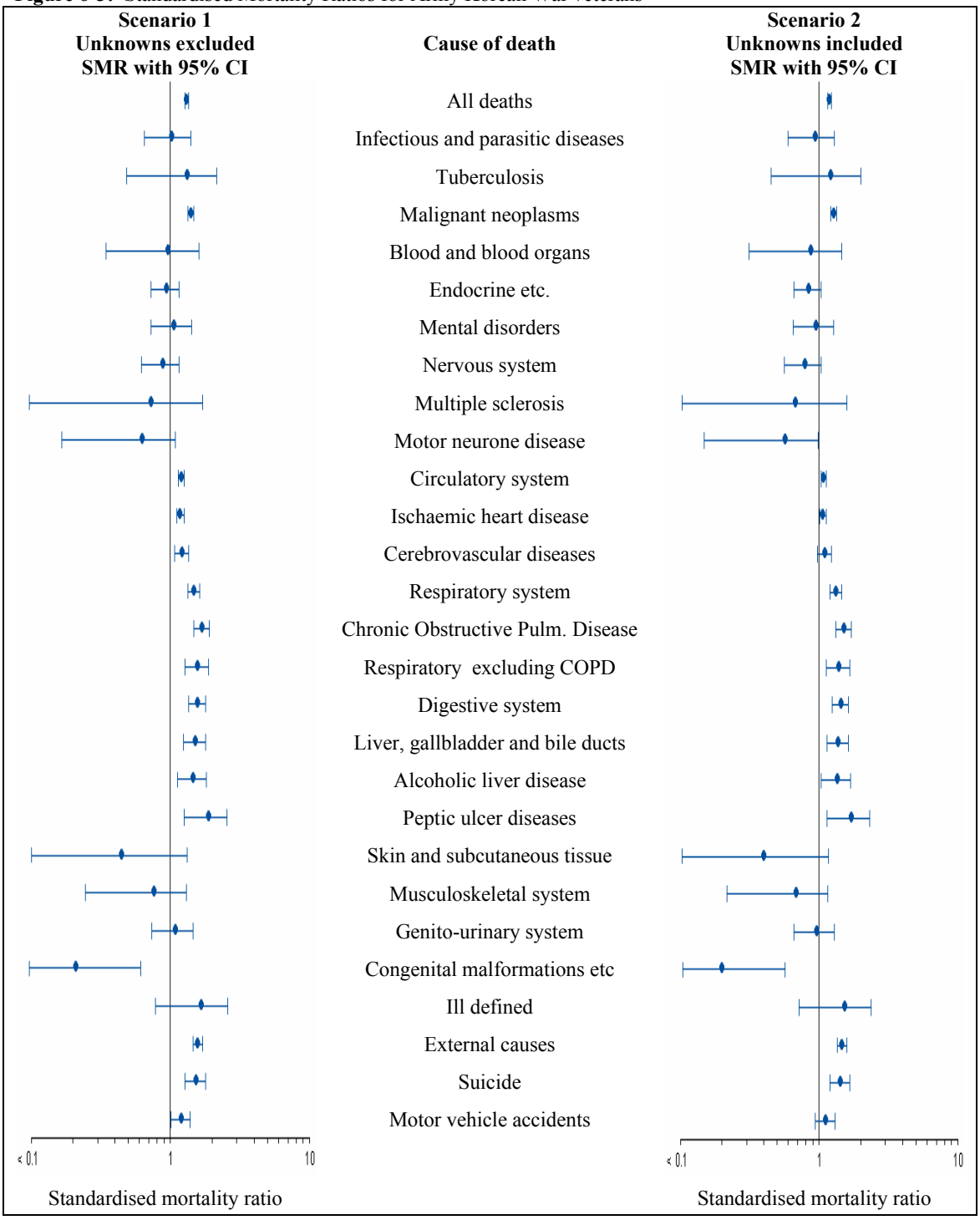
Those diseases for which there were statistically significant more deaths of Army Korean War veterans than were expected given death rates in the Australian male population in both Scenarios are shown in Table 6-6.

Table 6-6: Statistically significant elevated causes of death for Army Korean War veterans

Cause of death	Number of deaths	Scenario 1 Unknowns excluded		Scenario 2 Unknowns included	
		SMR	95% CI	SMR	95% CI
All causes	4797	1.31	1.27-1.35	1.19	1.16-1.22
Neoplasms chapter	1555	1.41	1.34-1.48	1.28	1.21-1.34
Circulatory disease chapter	1819	1.20	1.14-1.25	1.08	1.04-1.13
Ischaemic heart disease	1230	1.18	1.11-1.24	1.07	1.01-1.13
Stroke	280	1.22	1.08-1.36	1.10	0.97-1.22
Respiratory disease chapter	380	1.48	1.33-1.63	1.33	1.19-1.46
COPD*	241	1.69	1.48-1.79	1.51	1.32-1.70
Respiratory less COPD	104	1.57	1.27-1.87	1.40	1.13-1.66
Digestive disease chapter	209	1.57	1.36-1.79	1.44	1.24-1.63
Liver, gallbladder & bile ducts	123	1.51	1.24-1.77	1.38	1.14-1.63
Peptic ulcer disease	34	1.90	1.26-2.53	1.72	1.14-2.30
Alcoholic liver disease	69	1.47	1.12-1.82	1.36	1.04-1.68
External causes chapter	552	1.58	1.45-1.71	1.47	1.35-1.59
Suicide	145	1.53	1.28-1.78	1.43	1.19-1.66

*COPD = Chronic Obstructive Pulmonary Disease

Figure 6-3: Standardised Mortality Ratios for Army Korean War veterans



6.4.3 Deaths of Air Force Korean War veterans

Table D4 (Appendix D) shows SMRs for Air Force Korean War veterans, by cause of death. There were 493 deaths observed in this group of 1,157 men. The most common causes of death were from diseases of the circulatory system (199), neoplasms (153), external causes such as suicide and motor vehicle accidents (53), and diseases of the respiratory system (38).

Compared with the Australian male population, Air Force Korean War veterans had a statistically significant 11% lower death rate for all causes of death. The SMR for all causes of death was 0.89 (95% CI 0.81- 0.96). The SMRs and 95% CIs for the causes of death analysed for Air Force veterans are shown in Figure 6-4.

Conditions with a statistically lower SMR

Table 6-7 shows those causes of death that were statistically significantly lower when compared to the male Australian population.

Table 6-7: Causes of death for Air Force Korean War veterans which were statistically significantly lower than the male Australian population

Cause of death	Number of deaths	Scenario 1 Unknowns excluded		Scenario 2 Unknowns included	
		SMR	95% CI	SMR	95% CI
All causes	493	0.89	0.81-0.96	0.85	0.77-0.92
Circulatory disease chapter	199	0.82	0.71-0.93	0.78	0.67-0.89
Ischaemic heart disease	139	0.84	0.70-0.98	0.80	0.67-0.94
Alcoholic liver disease	2	0.35	0.00-0.83	0.34	0.00-0.82

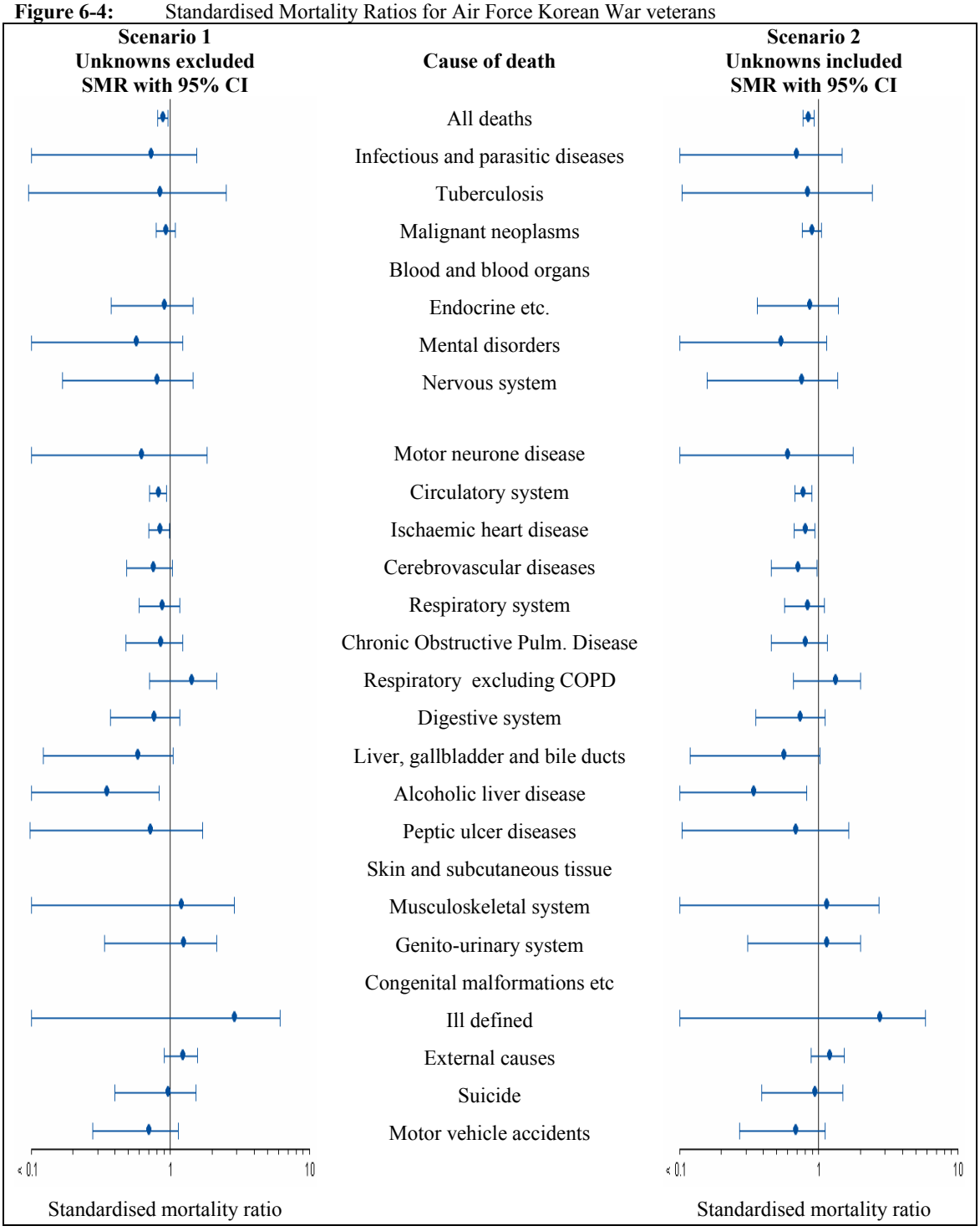
Conditions with a statistically elevated SMR

There were no causes of death which were elevated amongst Air Force veterans.

6.4.4 Summary

In summary, when comparing the mortality of Korean War veterans with the Australian male population, Army Korean War veterans had the highest mortality rate of the three Service branches. Mortality from all causes was 31% elevated and 13 causes of death were also increased. Army veterans showed a reduced mortality for only one cause of the 27 causes of death, congenital malformations. Navy veterans experienced an overall increased mortality rate of 11% with an increased mortality rate from circulatory system diseases including stroke, neoplasms and chronic obstructive pulmonary disease. Navy veterans had a reduced mortality for four of the 27 causes of death. Air Force veterans showed a 11% lower overall mortality rate, with a lower mortality rate in four of the causes of death analysed. However, because of the small number of Air Force veterans, it is difficult to reach definitive conclusions about the other diseases in this group.

Figure 6-4: Standardised Mortality Ratios for Air Force Korean War veterans



6.5 Neoplasms

Mortality due to all neoplasms was investigated by individual primary site. Table D5 (Appendix D) shows observed and expected deaths from 27 different cancers for all Korean War veterans for Scenario 1 and Scenario 2.

The most frequently occurring cancer deaths are from lung (802), gastrointestinal (390) (mainly colo-rectal), and genito-urinary cancers (286). The SMRs of selected cancers for all Korean War veterans and by branch of Service are shown in Figure 6-5.

Several cancers showed a significantly increased mortality compared with a similarly aged Australian male population and are detailed in Table 6-8.

Table 6-8: Elevated causes of death from cancer for all Korean War veterans

Causes of cancer deaths	Number of deaths	Scenario 1 Unknowns excluded		Scenario 2 Unknowns included	
		SMR	95% CI	SMR	95% CI
All neoplasms	2476	1.31	1.26-1.36	1.20	1.16-1.25
Gastrointestinal	390	1.18	1.07-1.30	1.09	0.98-1.20
Colo-rectal	295	1.18	1.05-1.32	1.09	0.97-1.21
Genito-urinary	286	1.24	1.10-1.39	1.13	0.99-1.26
Prostate	181	1.29	1.10-1.48	1.16	0.99-1.33
Head and Neck	114	1.96	1.60-2.32	1.82	1.48-2.15
Larynx	55	1.95	1.43-2.46	1.80	1.33-2.28
Lung	802	1.47	1.37-1.58	1.36	1.27-1.45
Oesophagus	93	1.59	1.27-1.91	1.46	1.17-1.76
Unknown	150	1.51	1.27-1.75	1.39	1.17-1.61

6.5.1 Navy veterans

Table D6 (Appendix D) shows the 767 deaths from cancer for Navy Korean War veterans. The most frequently occurring cancer deaths are from lung (228), gastrointestinal (130) and genito-urinary cancers (98).

One cancer, lymphoid leukaemia, demonstrated a statistically significantly lower mortality when compared with the male Australian population, with an SMR of 0.40 (95% CI 0.00-0.094). However, this SMR has been derived from only two cases.

Three cancers were statistically significantly elevated among Navy veterans. These are detailed in Table 6-9.

Table 6-9: Elevated causes of deaths from cancer for Navy Korean War veterans

Cause of cancer deaths	Number of deaths	Scenario 1 Unknowns excluded		Scenario 2 Unknowns included	
		SMR	95% CI	SMR	95% CI
All neoplasms	767	1.22	1.14-1.31	1.14	1.06-1.23
Genito-urinary	98	1.34	1.07-1.60	1.23	0.99-1.47
Head and Neck	41	2.09	1.45-2.72	1.97	1.37-2.56
Lung	228	1.27	1.10-1.43	1.19	1.03-1.34

6.5.2 Army veterans

Overall, Army veterans had a higher mortality from cancers than veterans from other Service branches. Table D7 (Appendix D) shows the mortality ratios for the 1,555 deaths using both scenarios for the 27 cancers of interest compared to the Australian population. As for all veterans, the most frequently occurring cancer deaths are from lung (536), gastrointestinal (238) and genito-urinary cancers (154).

Only one death from mesothelioma was observed among the Army veterans where five were expected. This was statistically significantly less than expected.

Eight cancers, listed in Table 6-10, are statistically significantly elevated among Army veterans compared with a similarly aged male Australian population.

Table 6-10: Elevated causes of deaths from cancer for Army Korean War veterans

Cause of cancer deaths	Number of deaths	Scenario 1 Unknowns excluded		Scenario 2 Unknowns included	
		SMR	95% CI	SMR	95% CI
All neoplasms	1555	1.41	1.34-1.48	1.14	1.06-1.23
Gastrointestinal	238	1.24	1.08-1.40	1.11	0.92-1.30
Colo-rectal	177	1.22	1.04-1.40	1.08	0.87-1.30
Head and Neck	64	1.90	1.43-2.37	1.97	1.37-2.56
Larynx	40	2.44	1.68-3.19	1.29	0.59-1.99
Liver and gallbladder	46	1.67	1.19-2.14	0.88	0.44-1.33
Lung	536	1.69	1.55-1.83	1.19	1.03-1.34
Oesophagus	62	1.82	1.36-2.27	1.21	0.74-1.68
Unknown	102	1.77	1.42-2.11	1.20	0.84-1.55

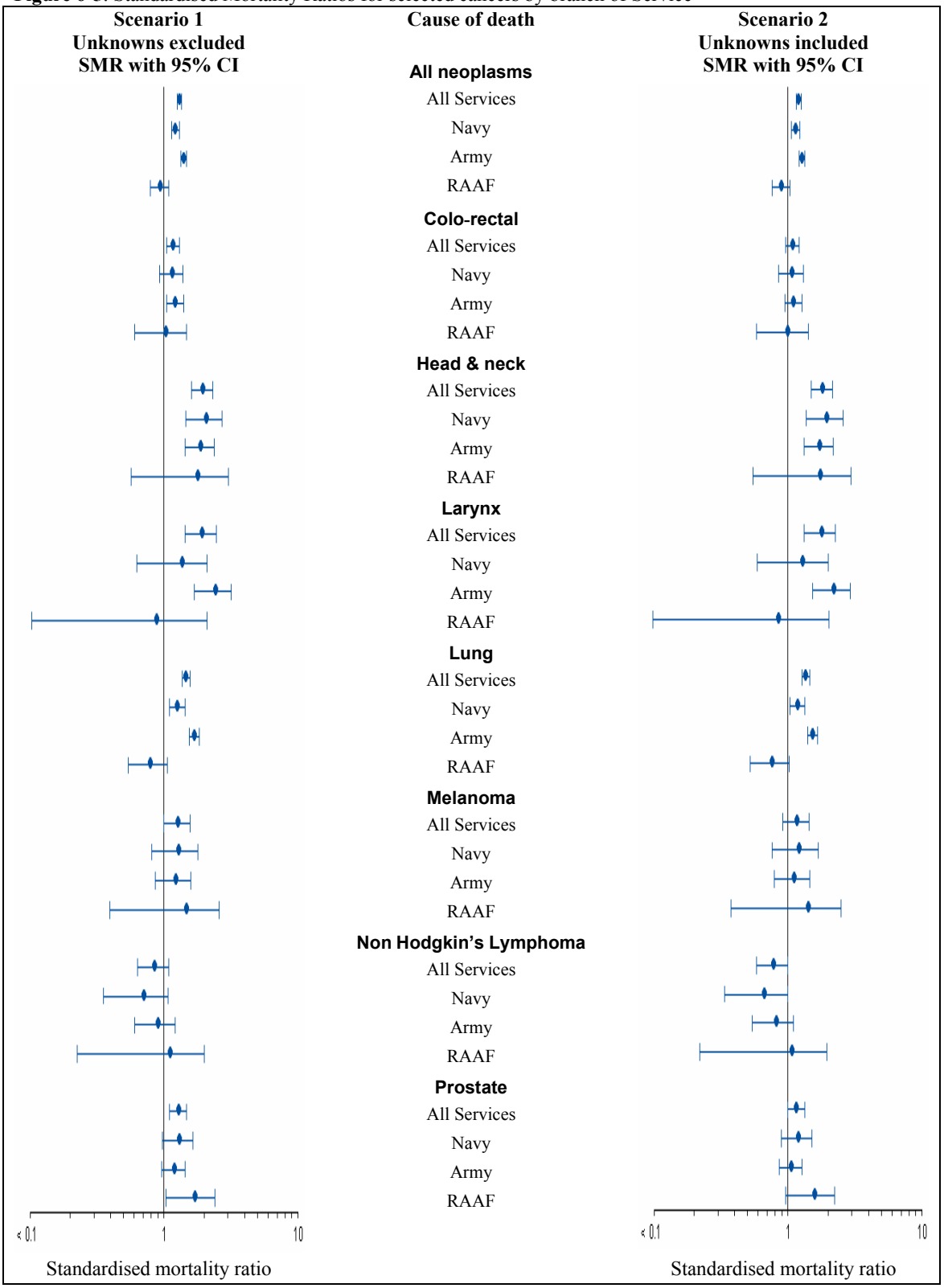
6.5.3 Air Force veterans

Table D8 (Appendix D) shows the 153 deaths from cancer for Air Force Korean War veterans. The most frequently occurring cancer deaths for Air Force veterans were lung (38), genito-urinary (33), mainly prostate, and gastrointestinal cancers (22).

Two cancers showed a significant reduction in mortality among Air Force veterans using both Scenarios: liver and gallbladder cancer and stomach cancer. However, the mortality ratio was based on one and three deaths respectively.

There was only one statistically significantly elevated cause of cancer death among Air Force veterans. This was prostate cancer with the SMR being 1.71 (95% CI 1.03-2.28). Death from prostate cancer was not statistically significantly elevated in any other branch of the Services.

Figure 6-5: Standardised Mortality Ratios for selected cancers by branch of Service



6.5.4 Smoking-related cancers

Many of the cancers for which Korean War veterans show an increased mortality are smoking-related cancers. An analysis was conducted to examine if smoking could account for all of the elevation in the smoking-related cancer deaths in Korean War veterans.

The level of smoking during the war and afterwards for Korean War veterans is not known. There was no systematic measurement of smoking rates during the war nor has there been an assessment of smoking rates of Korean War veterans in the years following the war. Anecdotal evidence suggests a high level of smoking during the war and cigarettes were freely available in large quantities to all ADF personnel during the Korean conflict. Furthermore, Army personnel in particular were living in confined and poorly ventilated conditions in the latter part of the war.

Given that no estimates of smoking prevalence rates exist, an analysis investigating a range of smoking prevalence rates from 30% to 100% was undertaken. This analysis generates a hypothetical number of expected cancer deaths based on these rates. The previous chapter, section 5.8.1, provides an explanation of the method used to derive the estimated cancer mortality. Table 6-11 provides the results of the analysis.

An analysis of six types of cancer revealed an elevation in mortality from two cancers, head and neck cancer and cancer of the larynx. These results cannot be explained by smoking alone as in both scenarios, even if 100% of the veterans smoked, the observed number of cancer deaths exceeds that expected.

In the case of a further two smoking-related cancers, cancer of the pancreas and cancer of the stomach, the cancers themselves did not show an elevated rate of mortality compared with the Australian community.

For the other two smoking-related cancers, cancer of the lung and cancer of the oesophagus, the elevated mortality among veterans is consistent with high levels of smoking. Levels of smoking prevalence that could explain the elevated mortality rates among veterans for each smoking-related cancer are as follows:

- Lung. For the expected number of cancer deaths to equal the observed number of deaths, smoking rates of veterans would have been about 69%.
- Oesophagus. For the expected number of cancer deaths to equal the observed number of deaths, smoking rates of veterans would have been about 94%.

These levels of smoking prevalence are higher than those of the Australian community.

Table 6-11: Expected deaths from cancer among Korean War veterans assuming various levels of smoking prevalence

Type of cancer	Observed	Expected	SMR	95% Confidence Interval	Period examined	Smoking prevalence (%)							
						30	40	50	60	70	80	90	100
			Scenario 1*			Expected Deaths							
Head and neck	114	58	1.96	1.60–2.32	1968-2000	47	53	60	67	74	80	87	94
Larynx	55	28	1.95	1.43–2.46	1950-2000	22	26	30	34	38	42	47	51
Lung	802	544	1.47	1.37–1.58	1950-2000	386	491	597	702	807	913	1018	1124
Oesophagus	93	59	1.59	1.27–1.91	1950-2000	49	56	63	69	76	83	90	96
Pancreas	94	84	1.13	0.90–1.35	1950-2000	77	82	86	90	94	99	103	107
Stomach	98	90	1.08	0.87–1.30	1950-2000	87	89	91	94	96	99	101	103
			Scenario 2*										
Head and neck	114	63	1.82	1.48–2.15	1968-2000	50	58	65	72	79	87	94	101
Larynx	55	31	1.80	1.33–2.28	1950-2000	23	28	32	37	41	46	50	55
Lung	802	590	1.36	1.27–1.45	1950-2000	419	534	648	763	878	992	1107	1222
Oesophagus	93	64	1.46	1.17–1.76	1950-2000	53	61	68	75	83	90	97	105
Pancreas	94	91	1.04	0.83–1.25	1950-2000	84	89	93	98	103	107	112	116
Stomach	98	98	1.00	0.80–1.20	1950-2000	94	97	99	102	104	107	109	112

* Scenario 1: Excludes veterans of unknown status.
Scenario 2: Assumes veterans of unknown status are alive in Australia

6.6 Effect of service in Korea

Exposure assessment has been a weak aspect of most cohort studies of veterans due to lack of information on a range of environmental and individual risk factors. This study is no exception. There was little data available to validate anecdotal accounts of exposure to occupational and environmental hazards during veterans' periods of service in Korea. Three surrogate measures were used in this study as an indication of the intensity of exposure to the hazards of the Korean War experience and to assess whether any dose-response relationship existed. They were:

- branch of Service;
- duration of service in Korea; and
- period served in Korea.

However, none of these surrogate measures can be directly linked to a particular disease.

The rationale for using branch of Service to classify exposure was that the activities and location of service of the Navy, Army and Air Force varied and therefore the potential for exposure may also have varied. Chapter 4 highlights some of these differences with respect to the nature of service in Korea. However, men performing a similar job in each of the Services may all have been similarly exposed to a hazard and not differently as this argument would suggest.

The preceding section has shown that there are differences in mortality between the Service branches. Army had a higher mortality than the other Service branches, followed by Navy. RAAF did not have significantly elevated mortality.

To explore differences between Services further, the study also assessed mortality by both duration and period of service in Korea for Navy and Army. The Air Force cohort was too small for this analysis.

Nevertheless, each of these measures has limited ability to characterise the degree and duration of exposure to specific aspects of Korean service that may have affected subsequent death rates. The measures are unlikely to discriminate between veterans who were exposed to hazardous agents or environments and those who were not.

6.6.1 Days served in Korea

As detailed in Chapter 4, the distribution of the days of service in Korea varied between the Service branches. The mean number of days of service for Navy was 249 days with a range of seven to 880 days, whereas Army personnel served an average of duration of service of 311 days with a range of one to 1,467 days. Air Force personnel served an average of 145 days with a range of one to 1,161 days.

Days served in Korea were grouped into natural divisions within each Service branch as described in Chapter 5, section 5.6.5. The numbers of RAAF veterans were insufficient to allow for a meaningful division into service duration for mortality analysis.

Navy veterans

Tables D9 to D11 (Appendix D) show the observed and expected number of deaths and the SMRs of Navy veterans who served for short, medium or long duration categories for selected causes of death.

Figure 6-6 illustrates the relationship between the SMRs for the duration categories among Navy personnel for all deaths and four main disease groups. Three categories demonstrated a significantly different mortality when compared with the Australian community. Navy Korean War veterans who served for a short duration (1-174 days) had a statistically lower mortality for digestive diseases. Navy Korean War veterans who served between 175 and 294 days had statistically elevated mortality for all causes of death and for all cancers in both Scenarios. However, there was no trend evident between any of the duration of service categories.

Figure 6-6: Standardised Mortality Ratios for major disease groups among Navy veterans by duration of service in Korea

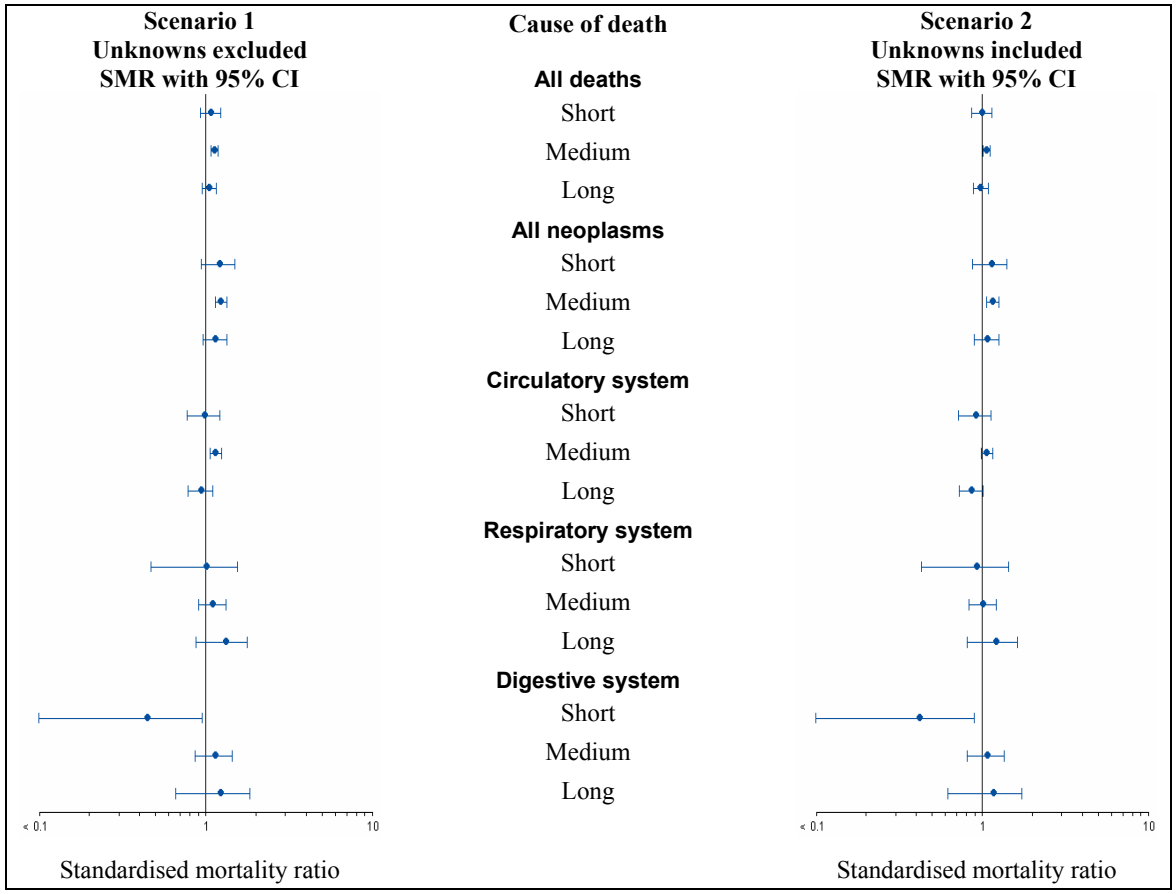
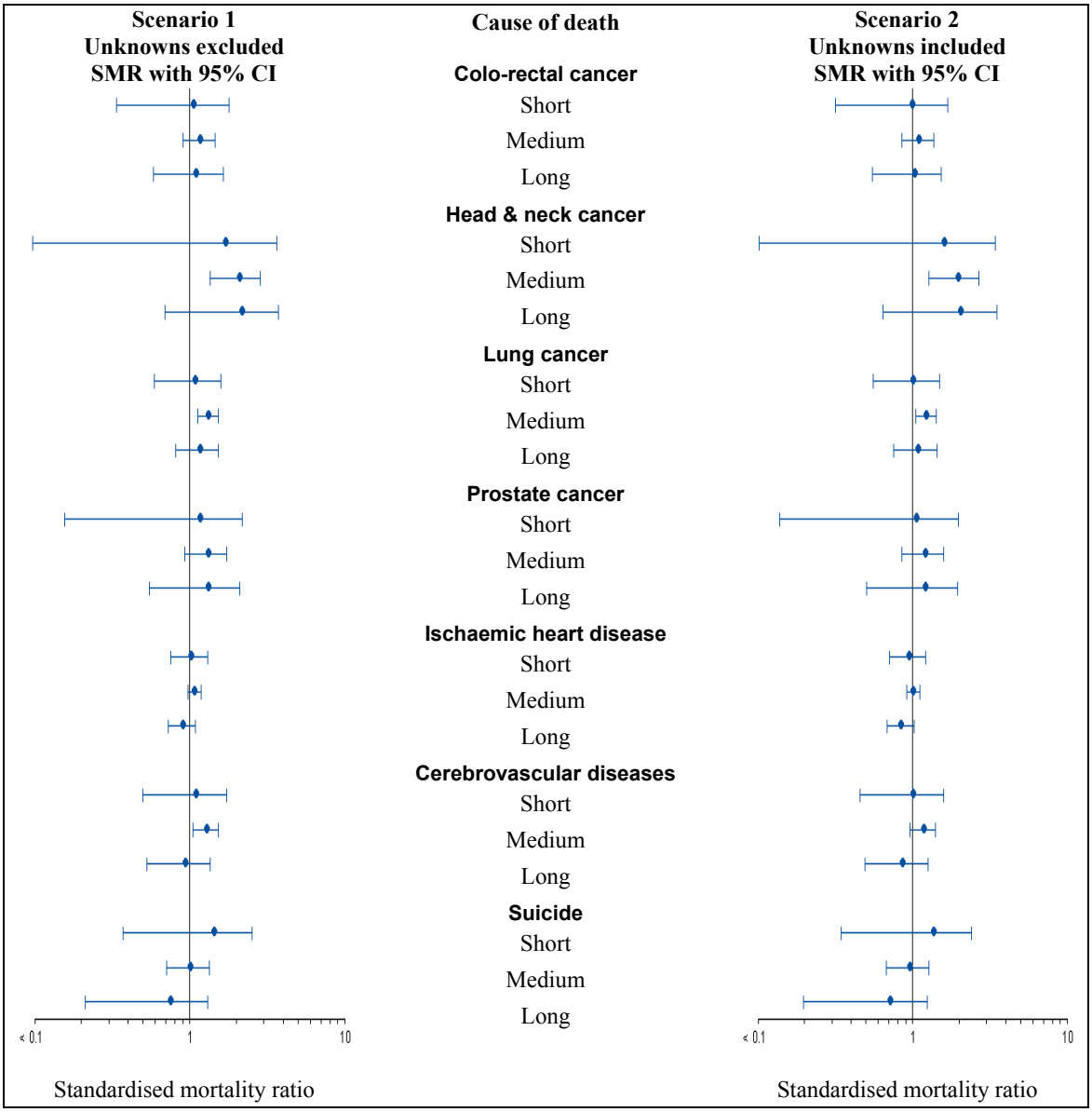


Figure 6-7 shows the relationship between duration of Navy service during the Korean conflict and mortality for specific diseases of interest. Those Navy personnel who served in the medium duration category had a significantly increased mortality rate from head and neck cancer (110% increase) and lung cancer (32% increase) compared with the Australian community mortality rates. No other diseases tested for Navy veterans demonstrated a statistically significant difference from the Australian community among the duration categories. Again, there was no trend evident between the duration of service categories.

Figure 6-7: Standardised Mortality Ratios for specific diseases among Navy veterans by duration of service in Korea



Army veterans

Army veterans demonstrated statistically significantly increased mortality for all causes of death in all three duration categories, peaking for the medium duration of 346 to 389 days. Tables D12 to D14 (Appendix D) show the observed and expected number of deaths and the SMRs for the three duration periods.

Figure 6-8 illustrates the SMRs for all deaths and four main disease groups by duration category for the Army veterans. For all deaths, all neoplasms and respiratory system diseases, all duration categories demonstrated elevated mortality compared to the Australian community. Mortality in the medium and long duration periods is not significantly higher than that for the short duration period. An increased mortality is noted for circulatory and digestive system diseases in the short and medium duration categories. However for all diseases analysed, the 95% confidence intervals for the three duration categories overlap, indicating a lack of significant difference between the discrete categories.

Figure 6-8: Standardised Mortality Ratios for major disease groups among Army veterans by duration of service in Korea

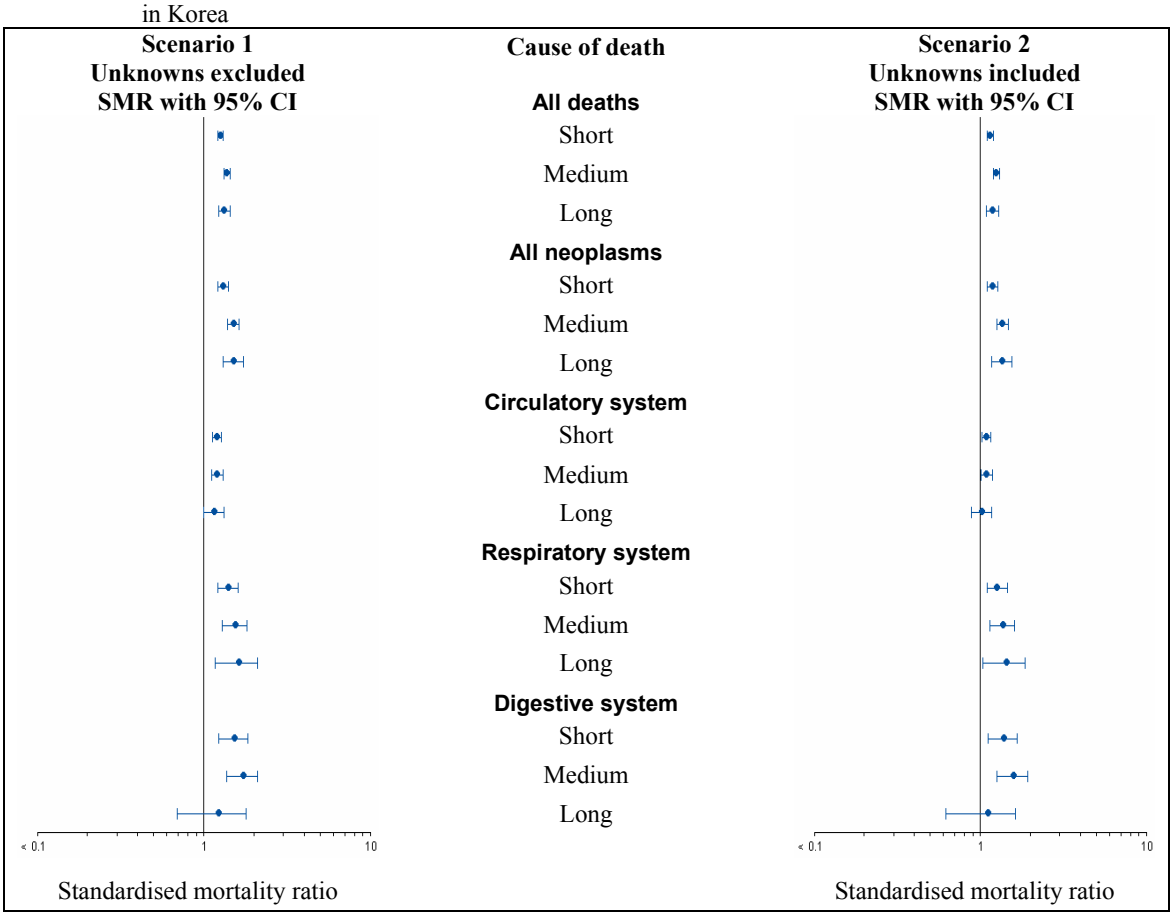
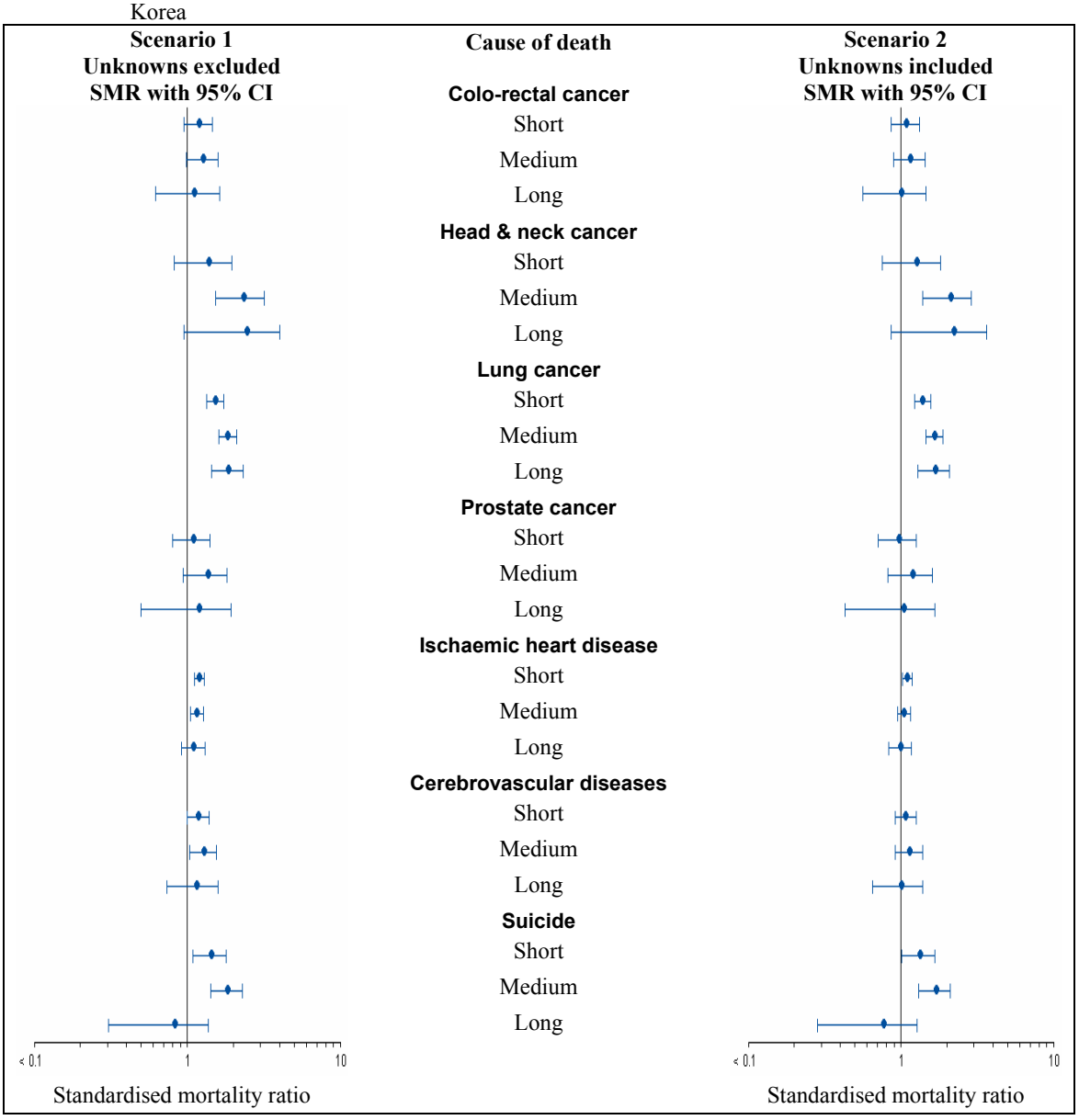


Figure 6-9 shows the standardised mortality ratios for specific diseases among Army veterans by duration of service category. Only lung cancer was statistically significantly elevated for the three duration categories with an elevation of 87% in the long duration category. Head and neck cancer was elevated 135% for the medium duration period. Ischaemic heart disease was elevated by 20% for those who served for a short duration. Finally suicide was elevated for the short and medium duration categories by 44% and 85%, respectively. However, as with the other analyses, the 95% CI for the three duration categories overlap, indicating a lack of significant difference between the discrete categories.

Figure 6-9: Standardised Mortality Ratios for specific diseases among Army veterans by duration of service in Korea



Survival time post Korea

The study further investigated the effect that duration of service had on the survival time of the servicemen after they left Korea. The Cox Proportional Hazards Model, in which duration of service was analysed as a continuum (months of service) rather than as discrete categories, showed that longer service was associated with a small but statistically significant shortening of survival when the servicemen were analysed as one group but the results of the analysis on each separate Service branch were not significant (Appendix D, Table D18).

The analysis took into account that the age of the servicemen in the war was an important factor in survival time after the war, but did not cater for other important influences such as combat experiences, war wounds or other health risk factor behaviours. War wounds could, for instance, directly shorten duration of service in Korea and have a detrimental effect on survival time.

6.6.2 Period of service in Korea

As detailed in Chapter 2, the Korean conflict had two distinct phases. The beginning of the war from 1950 to the end of 1951 was an offensive and counter-offensive phase where troops were on the move. By 1952 the war entered a defensive phase where the front remained relatively stable. Each of these phases exposed troops to different hazards which may have influenced their health. Mortality was investigated among Army veterans for the three period categories:

- Period 1: Service in Korea was completed on or before 31 December 1951 (Early)
- Period 2: Service in Korea commenced prior to 31 December 1951 and finished after 31 December 1951 (Both)
- Period 3: Service in Korea commenced after 31 December 1951 (Late)

For those who served in Period 1, 780 deaths were observed among the 1,395 Army veterans; for those who served in Period 2, 572 deaths were observed among 1,148 veterans; and for those who served in Period 3, there were 3,436 deaths among 7,939 veterans. Tables D15 to D17 (Appendix D) give the details of mortality for the three periods of service. Figure 6-10 shows the SMRs and 95% confidence intervals for the major disease groups by period of service and Figure 6-11 shows the SMRs and 95% confidence intervals for specific diseases by period of service.

For all periods of service, Korean War Army veterans had increased mortality from all causes of death, all neoplasms, lung cancer, circulatory diseases, digestive diseases and external causes. For those who commenced Korean service after 31 December 1951 (Period 3), mortality was also elevated from head and neck cancer, respiratory disease, ischaemic heart disease and stroke. With the exception of suicide, the 95% confidence intervals of the mortality results between the different periods overlap indicating the lack of statistically significant difference in mortality among the periods of service.

There was a significant difference in mortality from suicide between the periods of service. Those who completed service in Korea prior to 1952, (Period 1), experienced a 42% lower mortality due to suicide compared to the male Australian population. However those who served in Korea after 31 December 1951, (Period 3), experienced a 65% increase in mortality from suicide.

Analysis of the suicide deaths since the Korean War indicates that the increased mortality was consistently elevated throughout the post-war period with no particular years showing a dominant mortality period.

Figure 6-10: Standardised Mortality Ratios for major ICD disease chapters among Army veterans by period of service in Korea

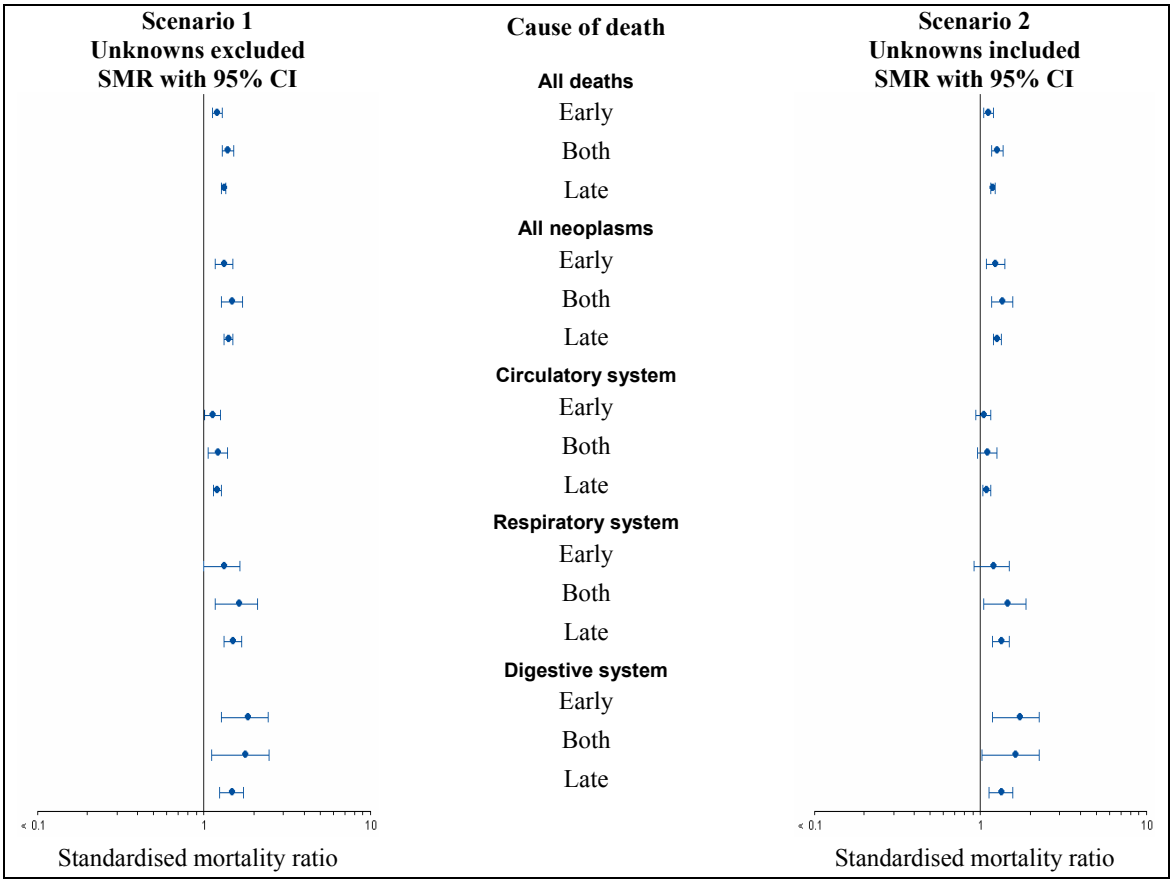
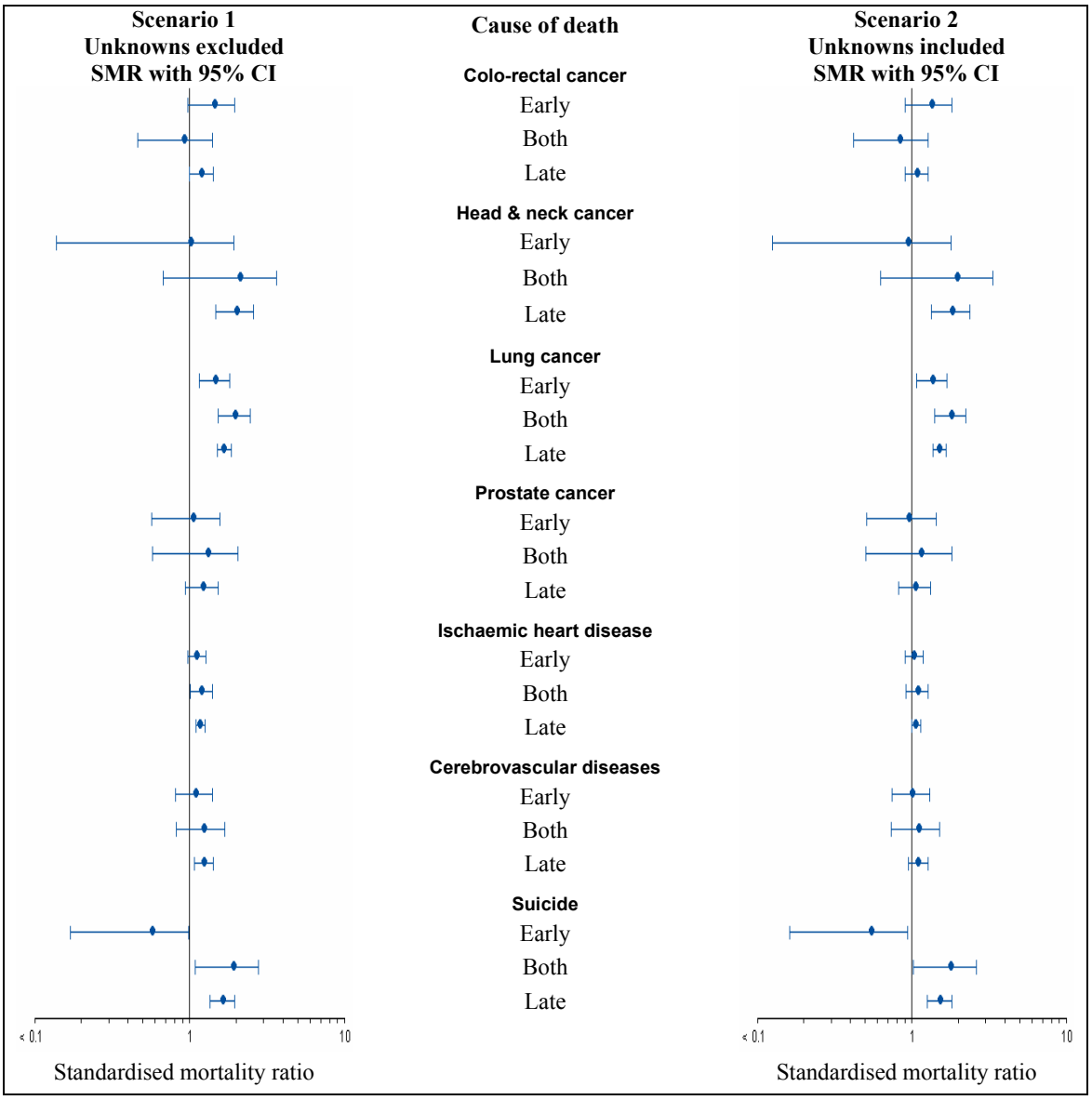


Figure 6-11: Standardised Mortality Ratios for specific diseases among Army veterans by period of service in Korea



6.7 Summary

Overall, Korean War veterans experienced a 21% higher mortality rate than an equivalent Australian male population. Of the three Services, Army veterans experienced the highest level of mortality followed by Navy, then Air Force. Air Force veterans showed a lower mortality rate than the Australian male population.

Mortality from a majority of the diseases of *a priori* interest were elevated. They included mortality from all causes, chronic obstructive pulmonary disease, ischaemic heart disease, stroke, alcoholic liver disease and external causes. Among the neoplasms of interest, cancer of the oesophagus, gastrointestinal and colo-rectal cancers, head and neck, lung, genito-urinary and prostate cancers were statistically significantly increased. Mortality from two *a priori* diseases (tuberculosis and peptic ulcer disease) and four cancers (liver and gallbladder, mesothelioma, melanoma and leukaemia) did not differ from that of Australian males. None of the *a priori* diseases showed a statistically significant decrease in mortality.

The most common causes of death overall and in each Service were from diseases of the circulatory system, neoplasms, external causes such as suicide and motor vehicle accidents, and diseases of the respiratory system. Compared to the Australian male population, Army Korean War veterans had a 31% increased mortality rate for all cause mortality and an additional 13 of the 27 causes of death which were analysed. Army veterans showed a reduced mortality for only one cause of the 27 causes of death, i.e. congenital malformations. Navy veterans experienced an 11% overall increased mortality rate and an increased mortality for neoplasms, circulatory diseases, stroke and chronic obstructive pulmonary disease. Navy veterans had a reduced mortality for four of the 27 causes of death. Air Force veterans had an 11% decreased mortality overall and demonstrated a lower mortality rate for three of the causes of death which were analysed.

Mortality from specific cancers was investigated where it was found that there was a 31% elevated mortality from cancer for all Korean War veterans. The most frequently occurring cancer deaths in descending frequency are from lung, gastrointestinal, genito-urinary, head and neck, oesophagus, and larynx, and their mortality rates were all significantly elevated compared to a similarly aged Australian male population.

The most common deaths from cancer in the Navy and Army are similar to those of all Korean War veterans. However, in the Air Force, genito-urinary cancers were more common than gastrointestinal cancers.

In the Navy, significantly elevated mortality rates were found for lung, genito-urinary, and head and neck cancers, while death from lymphoid leukaemia was lower than the Australian male population. Elevated mortality rates were found in the Army for deaths from gastrointestinal, colo-rectal, head and neck, larynx, liver and gallbladder, lung and oesophagus cancers, and cancers of unknown primary site. Only mesothelioma had a reduced mortality rate. Among Air Force veterans, only prostate cancer was elevated. Two cancers categories, liver and gallbladder cancer, and stomach cancer, showed a lower mortality rate among Air Force veterans.

Many cancers for which there was elevated mortality among the Korean War veterans are cancers associated with smoking. Modelling suggested that even a 100% smoking rate would not explain all the excess cancers. However, in the absence of information about the

percentage of veterans who smoked and the numbers of cigarettes smoked per day, it is not possible to determine precisely now much of the excess could be attributed to smoking.

Given the absence of quantitative data on exposure to occupational and environmental hazards, the effect of duration of service and the period of service in Korea were investigated for Navy and Army veterans. The number of Air Force veterans were too small for this analysis. Mortality by duration of service in Korea for Navy and Army veterans did not show any clear pattern between the different duration categories or within each Service branch. However investigating mortality by period of service among Army veterans reveals that those who completed their Korean service prior to 1952 (marking the end of the offensive / counter-offensive phase of the conflict), had a significantly lower mortality rate from suicide compared to the Australian male community. Those who served in Korea after 1952 had a higher mortality from suicide compared to the community norm. Apart from this unexpected and possibly chance post hoc finding, there was little evidence of any other trend from the effect of Korean service.

Chapter 7 discusses the results from the mortality study.

A Gloster Meteor F.8 of 77 Squadron RAAF is marshalled onto the flight line at Kimpo, South Korea, 1953.
AWM JK0891

Chapter 7 Discussion of mortality findings

This study aimed to compare the mortality rates of male Korean War veterans with those of the Australian male population. It is the first time a mortality study has been completed on an entire national cohort of Korean War veterans. This study obtained vital statistics on 94.9% of Australian Korean War veterans up to 50 years following their service in the Korean conflict. It followed sound scientific principles and represents a major advance in knowledge of Korean War veterans' health status.

The study has shown that, as a group, Korean War veterans have a 21% elevated overall mortality rate compared to similarly aged Australian males. Those who served in the Army have the highest rate of mortality followed by Navy personnel. Air Force personnel demonstrated a mortality rate that was slightly below the Australian community norm.

7.1 Consideration of Study design

7.1.1 Retrospective cohort study

This is a retrospective cohort study to describe the mortality of male Korean War veterans. Whereas the cohort of Korean War veterans all have served in the war, individual experiences varied greatly as did locations and experiences between the Services.

The study is descriptive and hypothesis generating. It does not allow for inferences of causality. Inferences for causality in epidemiological studies require that several criteria are considered. Firstly, the strength of an association or size of effect should be considered in interpreting results. Consideration should be given to the consistency of results and demonstration of a dose response relationship between exposure and effect. Issues of temporal relationship and biological plausibility must also be considered. Finally there should be a coherence of evidence in which the various pieces of evidence form a logical consistency.

7.1.2 Potential biases and confounding

In any given measurement in epidemiological studies, there is a possibility that an observation that satisfies a test of statistical significance may be a chance effect, may be due to bias or due to some confounding effect. Although every effort was made to reduce bias in this study, all epidemiological studies must consider and weigh the potential influence of bias and confounding when interpreting the study results.

While extensive effort was made to find all those who served in Korea, there exists the possibility, although small, that some veterans who served in Korea were missed from the nominal roll. Consequently some selection bias may have contributed to the accuracy of the study.

Bias due to loss to follow-up is an aspect of retrospective cohort studies. This study could not determine vital statistics for 886 or 5.1% of the Korean War veterans. The most likely results, that is, where it is assumed veterans of unknown status had the same mortality rate as the veterans whose vital status is known, are presented as Scenario 1. These results assume that veterans of unknown status had the same mortality rate as the veterans whose vital status is known which may or may not be true. If the death rate amongst the lost to follow-up is

greater or less than those whose vital status is known, then the derived SMRs may be an underestimate or an overestimate respectively of the actual rate.

The analysis using Scenario 2 assumes that all veterans of unknown vital status are alive (an unlikely situation). The results from this scenario will lead to an underestimation of the SMR. The Scenario 2 results may be used in comparison with the results from Scenario 1 to assess whether the loss to follow-up has any significant impact on the derived results. Both sets of results are presented in the body of the report. The other possibility is that those lost to follow-up have been lost because they have died, or for other reasons have a higher mortality rate than the rest of the veteran cohort. This is a more common scenario in epidemiological studies and would raise the SMRs.

The results from Scenario 2 reveal that the SMRs derived using Scenario 1 are not greatly affected by changes in the mortality rates in the lost to follow-up group. That is, most statistically significantly elevated SMRs using Scenario 1 also remain statistically significant when analysed using Scenario 2. For the statistically significant increased mortality rates of the *a priori* diseases using Scenario 1, the lower limit of the 95% confidence interval using Scenario 2 just falls below 1 for ischaemic heart disease and stroke, and gastrointestinal and genito-urinary neoplasms (Table 6-1). For the statistically significantly elevated causes of death for all Korean War veterans, the 95% confidence interval using Scenario 2 just falls below 1 for circulatory diseases (Table 6-2). Given the unlikely Scenario 2 assumption and also that those lost to follow-up usually have a higher mortality rate, the results derived from the Scenario 1 analysis are thus considered robust and the overall conclusions are likely to be valid.

Misclassification bias is also a possibility in a study where vital status needs to be determined. This study used the standard practice of probabilistic matching of the nominal roll against national databases such as the NDI to determine vital statistics. Although this method is the best currently available for matching databases, it does not achieve 100% certainty in matching.[1] This bias was minimised in this study as the vital status of approximately 70% of all Korean War veterans was able to be ascertained from the DVA Client database, and dates of death for many of the deceased were known prior to matching against the NDI, thus increasing the accuracy of the NDI matching.

Another source of bias is the results have not been adjusted for socio-economic status. There is a well known socioeconomic gradient in all western countries and this may have confounded the results slightly. Overall, the potential biases have been minimised in this study and the conclusions are considered valid.

7.2 Factors influencing mortality

There are a number of factors that may influence mortality rates in this study, including the healthy worker effect, occupational and environmental exposures in Korea, lifestyle, involvement in other conflicts, and occupation and socioeconomic status subsequent to the Korean War.

7.2.1 Healthy Worker Effect

One consideration when interpreting the results of any health study of veterans is the healthy worker effect. The healthy worker effect describes the effect of a selection bias which results in workers having lower death rates than the general population.[2,3] The selection bias arises because the general population includes persons who are not fit enough to work or to remain in work.[1] Death rates in employed populations are typically 70 - 90% of those in the general

population[1], but the effect usually diminishes with increasing age of the study cohort [4] or time from entry into the cohort.[2]

As for employed persons, Korean War veterans would be expected to have lower death rates than Australian males, at least at the time of enlistment. For example, presence of childhood diabetes, morbid obesity, congenital or acquired heart disease or psychiatric illness would be likely to be recorded or detected at an enlistment medical examination, and would result in rejection of young men from military service. Since these factors may lead to an early death, the Korean War veteran cohort excludes some men at high risk of an early death. The 'healthy worker effect' has been found in other studies of military cohorts: a SMR of 0.84 was noted for World War II US Army veterans followed for an average of 23 years[5] ; a SMR of 0.82 was determined for United Kingdom servicemen with tropical or desert service followed for over 20 years[6].

Traditionally, it has been said that the healthy worker effect is not large for some diseases, such as cancer. For example, in a major meta-analysis of more than one million workers covering 15 million person years, the SMR for all malignant diseases was 0.99, thus indicating an absence of any healthy worker effect for cancer[7]. Other cohorts have also shown a persistence of a healthy worker effect into malignant disease. For example Doody *et al* followed a population of 143,517 radiological technologists for 2.8 million person years, and observed a strong healthy worker effect for all cancers, with an SMR 0.79 (95% CI 0.76 - 0.83)[8].

The size of the 'healthy worker effect' is expected to be small for cancers and greatest for diseases that:

- appear early in life and would preclude enlistment, particularly non-malignant diseases of the respiratory, digestive, endocrine and urinary systems; or
- interfere with employment; or
- are likely to be detected at enlistment.

An examination of the cause of death for all Korean War veterans (see Figure 6-1) does show that for certain ICD chapters, such as congenital malformations, there is a significant decrease in mortality (under both Scenarios). This does suggest that there is some persistence of the healthy worker effect. The Air Force veterans showed a statistically significantly lower mortality rate than the Australian male population and this may well represent persistence of the healthy worker effect.

7.2.2 Occupational and environmental exposures

Korean War veterans have expressed concerns about their exposures to extremes of climate, infectious diseases, pesticides and solvents during their service in Korea. These hazards have been detailed in Chapter 2 and in the literature review at Appendix B. Although there is little quantitative information available on these hazards, it is possible they may have played a causal role in the increased mortality observed in this study.

Many of the Korean War veterans engaged in other occupations following the Korean War. Some of the increased mortality observed may be as a result of occupational exposures from engaging in hazardous occupations or activities following Korean service. Some of those occupations may have been in areas in which skill or trade knowledge was obtained during their military experience. In the absence of information both during the Korean War and subsequent employment history, it is impossible to evaluate the extent of these influences on mortality.

7.2.3 Lifestyle and at risk behaviours

Lifestyle choices and at risk behaviours following Korean service could influence mortality. A lifestyle involving smoking or increased consumption of alcohol is likely to influence the results of a mortality study conducted nearly 50 years later. There is no information available of the level of smoking or alcohol consumption of these veterans either during or following the Korean War. The ready availability of cheap cigarettes and a culture of smoking may have led to an higher smoking rate among Korean War veterans than the Australian population. Also, participation in the Korean War could influence whether or not an individual engaged in subsequent risk taking activities or suffered psychological disturbances, both of which can influence mortality.

7.2.4 Involvement in other conflicts

Chapter 4 details the matching of the Korean Veterans Nominal Roll against the Vietnam Veterans Nominal Roll. This revealed that 1,562 (8.7%) Korean War veterans participated in the Vietnam War and the DVA compensation claims database revealed that 1,462 Korean War veterans had submitted claims that they attributed to the Vietnam War. A previous study of Australian Vietnam War veterans[11] has already shown evidence of an increased mortality among these servicemen. That study attributed some of the excess mortality to lung cancer and cancers of the head and neck.

The DVA compensation claims database also revealed that 5,270 (29.5%) Korean War veterans had submitted claims that they attributed to their World War II service, and this is likely to be an under-estimate. Accordingly, involvement in other conflicts where other hazardous exposures occurred may have contributed to the observed increase in mortality.

7.3 Discussion of causes of death of *a priori* interest

As an initial step in the mortality study, a protocol (Appendix A) and literature review (Appendix B) identified specific diseases of *a priori* interest. This section discusses the mortality findings in reference to the *a priori* diseases.

Mortality from 13 of the 19 diseases of *a priori* interest were elevated. They included mortality from all causes, chronic obstructive pulmonary disease, ischaemic heart disease, stroke, alcoholic liver disease and external causes. Among the neoplasms of interest, cancer of the oesophagus, gastrointestinal and colo-rectal cancers, head and neck, lung, genito-urinary and prostate cancers were statistically significantly increased. Mortality from two *a priori* diseases (tuberculosis and peptic ulcer disease) and four cancers (liver and gallbladder, mesothelioma, melanoma and leukaemia) did not differ from that of Australian males. Six of the specific *a priori* causes of death for all Korean War veterans remained statistically significantly elevated using Scenario 2. These included three diseases (chronic obstructive pulmonary disease, alcoholic liver disease, and external causes) and three neoplasms (cancers of the oesophagus, head and neck, and lung). None of the *a priori* diseases showed a statistically significant decrease in mortality.

Among Army veterans, mortality from two other *a priori* causes of death, (peptic ulcer disease, and liver and gallbladder cancer), was also statistically significantly elevated in both Scenarios. However, mortality from genito-urinary and prostate cancers were not elevated in this Service.

Fewer *a priori* causes of death were elevated for Navy and Air Force veterans. For Navy personnel mortality was only increased for chronic obstructive pulmonary disease, stroke, lung, head and neck cancers, and genito-urinary cancer. Only lung and head and neck cancers

remained statistically significantly elevated in Scenario 2. Air Force veterans had an elevated mortality for only one *a priori* disease of interest, prostate cancer, which was only elevated in Scenario 1.

7.4 Discussion of specific causes of death

An enhanced understanding of health can be obtained by examining the rates for individual diseases and group of diseases and rates for different subgroups within the group of veterans. This section discusses the findings of the study for groups of diseases, specific diseases of interest and subgroup analyses.

7.4.1 Neoplasms

Death from neoplasms are elevated by 31% in Korean War veterans. The most frequently occurring cancer deaths are from lung, gastrointestinal, and genito-urinary cancers with statistically significant elevations of 47%, 18% and 24% respectively compared to Australian males. Other cancers with significant elevation in mortality were head and neck cancer, cancer of the oesophagus and cancer of the larynx. These cancers are associated with high levels of smoking. However the smoking model described in Chapter 6 indicates that smoking alone cannot account for the increased mortality observed among Korean War veterans. The rates for head and neck cancer were essentially twice that of Australian males, while lung cancer death rates were only elevated about 50%. This differential also suggests that there are other factors contributing to these cancers deaths apart from smoking.

Prostate cancer

Prostate cancer is the most frequently occurring cancer among Australian men. There were 181 deaths from prostate cancer among Korean War veterans. This represented a statistically significant increase in the rate of death from prostate cancer although the increase was not significant in Scenario 2. A statistically significant increase was only found in Air Force veterans. A satisfactory explanation for the increase awaits further knowledge into the causation of prostate cancer.

Colo-rectal Carcinoma

Colo-rectal cancer is the third most common cause of cancer mortality among Australian males after lung and prostate cancers. Colo-rectal cancer is also the third most common cancer death in Navy and Air Force veterans but the second commonest cause of death from cancer in Army veterans after lung cancer.

Mesothelioma

Mesothelioma is a rare malignancy highly associated with exposure to asbestos. This cancer was of interest for Korean War veterans, especially among Navy personnel, due to the extensive use of asbestos in RAN ships.

The rate of death from this cancer among Korean War veterans is lower than expected. Given the anecdotal evidence (particularly among RAN veterans) of exposure to asbestos, this finding appears paradoxical. However, the period of reporting for mesothelioma was limited and a separate classification of this disease only began in 1997. Mesothelioma is a very rare disease and power to detect modest elevations in mortality is limited. Furthermore, the comparison population of Australian males was a population with widespread, and in some cases much greater, exposure to asbestos due to an asbestos mining industry in Australia and its extensive use in construction.

Leukaemia and Non-Hodgkin's Lymphoma

The rate of mortality for all forms of leukaemia combined, and for each of the classic sub-divisions of leukaemia, was not significantly different than the community norm. In the protocol for this study, leukaemia was identified as a disease of *a priori* interest because of possible exposure to leukogenic agents such as benzene. Thus, the exposure differential to leukogenic agents was apparently insufficient to alter leukaemia mortality among Korean War veterans.

Non-Hodgkin's lymphoma is the most common form of lymphoma. In the early period under study, prognosis for this disease was poor. In the 1960s, the development of chemotherapy saw an improvement in treatment, and this improvement in treatment continued. Nevertheless, the mortality rates for Korean War veterans is not different to the expected rates.

The results for leukaemia and non-Hodgkin's lymphoma among Korean War veterans are different from that found among Vietnam veterans exposed to herbicides. In the 2002 update of *Veterans and Agent Orange*, chronic lymphocytic leukaemia and non-Hodgkin's lymphoma showed a positive association with herbicide exposure[9]. This suggests that concerns expressed in section 7.2.4 from participation of veterans in other conflicts may not be a major factor.

7.4.2 External causes

Death from external causes was significantly increased by 37% among Korean War veterans. The study investigated two specific diseases within the external causes ICD chapter, suicide and motor vehicle accidents. The former was significantly elevated whereas deaths from motor vehicle accidents are the same as for the Australian community.

Suicide

There are 211 Korean War veterans who are recorded as having committed suicide. This resulted in a statistically significant 31% increase in suicide. Further analysis reveals that the risk of increased suicide is confined to the Army Korean War veterans. Neither Navy nor Air Force veterans have an increased risk of suicide. A post hoc analysis showed there was no indication of a correlation between the number of days served in Korea and the risk of suicide among Army veterans. When the Army deaths were further analysed by period of service in Korea, an interesting pattern emerged. Those who served prior to 1952 had a significantly lower mortality from suicide whereas those who served after this time had a significantly elevated suicide rate.

Other studies of suicide in combat-exposed veterans give inconsistent results, and do not shed additional light on why Australian veterans of the Korean War suffer from an elevated rate of suicide. Hearst found an elevation in the rate of suicide for American Vietnam War era military conscripts compared to civilians, with an Odds Ratio of 1.65 (95% CI 1.26-2.15)[10]. A study of Australian veterans who served in Vietnam also showed a borderline increase in the rate of mortality from suicide, with an adjusted SMR of 1.21 (95% CI 1.02-1.42)[11]. The Centre for Disease Control (CDC) studied the suicide rate of American Vietnam Army veterans compared to Army personnel who did not serve in Vietnam. The study found an elevated but not significant increased risk of suicide in Vietnam veterans in the first five years following discharge. However when mortality was adjusted for selected characteristics of the veterans such as age, race and military occupation, a significant increase in suicide was noted in the early follow-up period[12]. In contrast, a study of UK Gulf War veterans, following them

for eight years after their deployment to the Gulf War of 1990-1, showed a rate of suicide that was consistent with that expected in a similar population[13].

7.4.3 Respiratory diseases

Mortality from diseases of the respiratory system is elevated by 32% for Korean War veterans. This elevation is most striking among Army veterans (48%), but not elevated for Navy veterans or for Air Force veterans. Respiratory diseases were further investigated by mortality from COPD and other non-COPD respiratory diseases as information has been available since 1979.

As COPD is closely associated with smoking, the difference between the Services may be a reflection of different levels of smoking among these groups. However there are no data available on smoking rates between the Services to substantiate or refute this speculation.

Other respiratory disease (excluding those who had died from COPD) was examined. In Australia, this represents deaths from influenza, pneumonia and, to a lesser degree, asthma. This study showed that the mortality rate from the residual disease within the respiratory group of diseases was only elevated among Army veterans but by 57%.

Further research would be needed to discern why COPD, which would indicate an elevated smoking rate, and other respiratory diseases, which may reflect other disease processes, are both elevated and to the same extent among Korean War veterans. It is possible that the elevation may reflect an increased susceptibility to these diseases from pre-existing smoking-related lung changes.

7.4.4 Digestive diseases

Digestive diseases were of interest to explore the possible effect of the potential exposures to hepatitis viruses, alcohol, endemic parasites and a variety of solvents and other chemicals which could affect mortality within this group of diseases.

Overall Korean War veterans have a significant elevation in mortality for digestive system diseases, specifically diseases of the liver, gallbladder and bile duct, and alcoholic liver disease. However, the pattern of disease between the Service branches varies substantially. The significant elevation for this group of diseases is only observed among Army personnel, who also have a significantly elevated mortality from peptic ulcer disease.

7.4.5 Circulatory diseases

Circulatory diseases were of *a priori* interest for the mortality study as this is the most common cause of death among Australian males and currently accounts for about 35% of all deaths[14]. The two main diseases within the circulatory disease group are ischaemic heart disease and cerebrovascular disease (stroke).

The study demonstrated an elevation in mortality for circulatory diseases for all Korean War veterans and modest increases in mortality for ischaemic heart disease and stroke. Army personnel showed significant elevation in mortality for all circulatory diseases, ischaemic heart disease and stroke, whereas Navy showed an increase for circulatory diseases and cerebrovascular disease only. Air Force showed a decrease in mortality among this group of diseases. As with the results for respiratory diseases, differences in smoking rates between the Service branches may be an explanation for these differences in mortality.

7.4.6 Other causes

Endocrine, Nutritional and Metabolic Diseases

As expected, mortality for this group of diseases did not differ significantly from that of the Australian male population.

Infectious and parasitic diseases

Based on relatively small numbers, there was little difference in the number of deaths observed for infectious and parasitic diseases when compared to those expected. This was an unexpected result as service in a war zone is often associated with poor sanitation which can lead to an increase in infectious and parasitic diseases. This may indicate that although there is a high morbidity from infectious diseases, there is a low morbidity. A low mortality from infectious and parasitic diseases may also reflect the effectiveness of preventative measures and treatment in the military.

Specific neurological disorders

The rate of death from specific neurological disorders, such as multiple sclerosis and motor neurone disease, was not significantly different to the expected rate and these diseases were not of *a priori* interest. There are few deaths from these conditions and consequently confidence levels are wide. However, this result differs from the Vietnam Veteran Morbidity Study which showed an increase in morbidity and mortality from motor neurone disease among Vietnam War veterans[15].

7.4.7 Variations in mortality experience by branch of Service

The nature, location and duration of service experienced in Korea differed between the Navy, Army and Air Force. These differences might be postulated to lead to differences in death rates.

Navy veterans

For Navy Korean War veterans, there is a small but significant elevation of 11% in mortality, and a smaller non-significant elevation when unknowns are included (Scenario 2). This suggests that RAN veterans of the Korean War may experience mortality at a rate greater than that predicted by Australian standardised mortality rates.

The increase in mortality among Navy veterans occurs mainly from head and neck cancer, lung and genito-urinary cancer, chronic obstructive pulmonary disease and cerebrovascular disease. This combination of diseases is suggestive of a level of smoking greater than that of the Australian population.

Army veterans

The SMR for Army Korean War veterans for all causes of mortality was elevated by 31% and is significantly greater that the mortality rate of either of the other Services. There is an increased mortality from numerous disease groups including circulatory systems diseases, respiratory system diseases and digestive system diseases, as well as an increase in suicides and a number of neoplasms. Given that there was a strong selection bias for healthy soldiers at recruitment of service, that there was some ongoing health surveillance and to some degree there has been preferential access to health care through veteran programs, this result is of concern and may partly be a reflection of lifestyle at risk behaviours including cigarette smoking and excessive alcohol consumption.

Air Force veterans

For Air Force Korean War veterans, the mortality was 11% below the community norm. Given the small numbers in this group, the wide confidence intervals indicate there is insufficient power to determine whether there is any real increase in mortality in the disease groups. This lower mortality rate might be a reflection of socio-economic factors during selection or possibly as an example of the persistence of the healthy worker effect. The only elevated mortality is from prostate cancer, but given the small numbers, this may just be a chance finding.

Conclusions

The differences in outcome between the branches of the Services suggests that the effects being observed are not due to some methodological flaw. That is, if there was a systematic bias that resulted in under-estimation or over-estimation in the rate of death, it would be expected that this bias would produce a uniform increase or decrease across the three Services. This is not observed. This adds confidence to the interpretation that the increase in mortality rates observed in the Army veterans (and to a lesser degree, in Navy veterans) reflect real exposures that have had adverse effects on long term health. The influences that have had an adverse effect on mortality do not appear to be uniform across the three Services.

7.5 Possible exposures that could contribute to the elevation in mortality among Korean War veterans

Although little is known or quantified of the specific and unique exposures experienced by Korean War veterans, anecdotal evidence does allow for some speculation of those exposures which could contribute to an increased mortality among Korean War veterans. There was a wide variety of exposures to pesticides, solvents, chemicals and infectious agents, and to psychological stressors experienced by veterans.

7.5.1 Occupational and environmental exposures

Korean War veterans were exposed to pesticides, solvents and chemicals in quantities that are likely to have been well in excess of currently acceptable occupational health and safety standards. For example, large quantities of DDT were used in the trenches held by the Australians; the DDT was used to kill insects and rodents, and as a personal pesticide.

There was also exposure to a wide range of fuels that were burnt in containers to provide warmth: the fuels included kerosene, gasoline and diesel. Records were not kept of which fuel was used at which time.

The health effects of the combination of such exposures have not been studied in great detail in human populations.

In addition, each of the Services used different combinations and quantities of solvents, chemicals and pesticides. In this study, differences in mortality outcomes between the Services have been detected. It is possible that some of these differences reflect differences in exposure to occupational and environmental hazards between the Services.

7.5.2 Tobacco Consumption

The Korean War veteran cohort is likely to have smoked more than the general population. Death rates from several of the diseases that are most closely linked with tobacco consumption are elevated, such as lung cancer and chronic obstructive airways disease. There is also a pattern of elevation in mortality rates for tobacco-related diseases among Navy and Army veterans, but not among the Air Force veterans.

This elevation in tobacco consumption could be interpreted as a longer term effect of service in the Korean War. At the time of the war, the health consequences of tobacco consumption were generally unknown. The War was at times extremely stressful; at other times, there were long periods of boredom and on occasion, hunger. Veterans report that tobacco consumption was seen as a mechanism to counter these conditions. Cigarettes were made available cheaply, and on some occasions were given to personnel free of charge. As a result of these circumstances, many Service personnel returned from Korea addicted to tobacco.

The analysis completed in this study shows an elevation in deaths that are related to smoking. However in the absence of information about the percentage of veterans who smoked and the numbers of cigarettes smoked per day, it is not possible to determine precisely how much of this excess could be attributed to smoking. Therefore this limits the ability to assess the extent to which other possible causes have contributed to the deaths apart from tobacco consumption.

7.5.3 Alcohol Consumption

There is anecdotal evidence that this is a group that had greater alcohol consumption than the general population. One disease that was found to be elevated in mortality is alcoholic liver disease. This strongly suggests that the cohort or a sub-population of the cohort consumes excessive alcohol. This would be in keeping with the hypothesis that exposure to stress gave rise to conditions such as Post-traumatic stress disorder (PTSD) and anxiety states that in turn led to alcohol abuse by sufferers of these diseases.

7.5.4 Combat Stress

Finally, the elevated suicide rate found in Korean War veterans is possibly a longer-term manifestation of the stress of combat. For reasons that are not clear, this seems to have manifested itself among the Army veterans who served in the later stage of the Korean War.

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News from home. Two soldiers from 3 RAR read a letter from home, which has arrived as part of a package seen at their feet. behind the men is a Korean farm building, with chilli peppers hanging to dry from the lintel.
AWM P)1813.459

Chapter 8 Summary, conclusions and recommendations

The Korean War Veterans Mortality Study is the first study to examine the mortality of all Australian male Korean War veterans.

The study has various strengths, and given the constraints of the study design, unavoidable weaknesses that affect its interpretation.

The strengths of this study include:

- follow-up or tracing was from the end of service until 2000 — the length of time that elapsed since the veterans' service in Korea ranged from approximately 45 to 48 years;
- vital status was established for 94.9% of veterans in the study;
- the study had sufficient power to be able to detect increases of 20% in the relative risk for most of the diseases of interest; and
- it was conducted in a country with an advanced medical system where the diagnosis and coding is likely to be correct in the majority of instances.

The weaknesses of this study include:

- there was an under-ascertainment of deaths. About 5.1% of the Korean War veterans could not be located. It is expected that some of these have died prior to the establishment of the National Death Index. This possibly leads to an under-estimation of the effects of Korean War service;
- there was a lack of measurement of exposure to risk factors that might contribute to the observed associations, such as cigarette smoking, alcohol intake, hepatitis B virus infection, endemic parasites and bacteria, pesticides, solvents, chemical exposures and environmental exposures in Korea; and
- the exposure measures available were length of service and period of service in Korea. These could not reflect occupational variations or the variation in exposure to Korean service within and between the Navy, Army and Air Force.

8.1 Summary of findings

The death rate from all causes for Korean War veterans relative to Australian males was estimated to be 1.21 (95% CI 1.18 - 1.24) These results demonstrate a 21% increase in mortality among Korean War veterans compared with the Australian male population. This increase in mortality among these veterans is continuing to occur.

Of the three Services, Army veterans experienced the highest level of mortality followed by Navy, then Air Force. Air Force veterans showed a lower mortality rate than the Australian male population.

Mortality from 13 of the 19 diseases of *a priori* interest was elevated. This included mortality from chronic obstructive pulmonary disease, ischaemic heart disease, stroke, alcoholic liver disease and external causes. Among the neoplasms of interest, cancer of the oesophagus, gastrointestinal and colo-rectal cancers, and head and neck, lung, genito-urinary and prostate cancers were statistically significantly increased. Mortality from two *a priori* diseases (tuberculosis and peptic ulcer disease) and four cancers (liver and gallbladder, mesothelioma,

melanoma and leukaemia) did not differ from that of Australian males. None of the *a priori* diseases showed a statistically significant decrease in mortality.

In descending order, the most common causes of death overall and in each Service were from diseases of the circulatory system, neoplasms, external causes such as suicide and motor vehicle accidents, and diseases of the respiratory system. Compared to the Australian male population, Army Korean War veterans had a 31% increased mortality rate for all cause mortality and an additional 13 causes of death which were analysed.

Army veterans only showed a reduced mortality for congenital malformations and this was expected because of the recruit selection process. Navy veterans experienced an 11% overall increased mortality rate with an increase in mortality from neoplasms, circulatory diseases, stroke and chronic obstructive pulmonary disease. Navy veterans had a reduced mortality for four of the 27 causes of death. Air Force veterans had an 11% decreased mortality overall and demonstrated a lower mortality rate for three of the causes of death which were analysed.

Mortality from specific cancers was investigated in detail. Overall, there was a 31% elevated mortality from neoplasm for all Korean War veterans. The most frequently occurring cancer deaths in descending frequency were from lung, gastrointestinal, genito-urinary, head and neck, oesophagus, and larynx and these cancer mortality rates were all significantly elevated compared to the Australian male population.

The most common deaths from cancer in the Navy and Army were similar to those of all Korean War veterans. However, in the Air Force, genito-urinary cancers were more common than gastrointestinal cancers.

In the Navy, elevated mortality rates were found for lung, genito-urinary, and head and neck cancers, while death from lymphoid leukaemia was lower than the Australian male population. Elevated mortality rates were found in the Army for deaths from gastrointestinal, colo-rectal, head and neck, larynx, liver and gallbladder, lung, and oesophageal cancers, and those cancers of unknown primary site. Only mesothelioma had a reduced mortality rate. Among Air Force veterans, only prostate cancer was elevated. Two cancers categories, liver and gallbladder cancer, and stomach cancer, showed a lower mortality rate among Air Force veterans.

Many cancers for which there was elevated mortality among the Korean War veterans are cancers associated with smoking. Modelling suggested that smoking rates well in excess of community levels were required to explain these increases, and may not account for all of the increase. However, in the absence of information about the percentage of veterans who smoked and the numbers of cigarettes smoked per day, it is not possible to determine precisely how much of the excess could be attributed to smoking.

Alcohol related deaths are also increased, and this may be an effect of both lifestyle and post traumatic stress disorder.

Given the absence of quantitative data on exposure to occupational and environmental hazards, the effects of duration of service and the period of service in Korea were investigated for Navy and Army veterans. The number of Air Force veterans were too small for this analysis. Mortality by duration of service in Korea for Navy and Army veterans did not show any clear pattern between the different duration categories or within each Service branch.

Investigating mortality by period of service among Army veterans reveals that those who completed their Korean service prior to 1952 (the offensive / counter-offensive phase of the conflict), had a significantly lower mortality rate from suicide compared to the Australian

male community. Those who served in Korea after 1952 had a higher mortality from suicide compared to the community norm. Apart from this unexpected and possibly chance post hoc finding, there was little evidence of any other trend from the effect of Korean service.

8.2 Conclusions

Overall, Korean War veterans have a 21% increase in all cause mortality compared to Australian males with an elevation in 12 of the 18 *a priori* diseases of interest. Deaths from cancer were elevated by 31%. Mortality was highest in Army veterans and lowest in Air Force veterans.

Because of the limitation in measurement of factors known to affect mortality, their contribution to the increase in mortality could not be determined. Some of the diseases with higher mortality rates have been linked with cigarette smoking. Although Korean War veterans have a higher mortality for several causes of death that have been identified, there is no way of determining whether this resulted from some exposure in Korea or whether it was the result of lifestyle changes arising as a consequence of Korean War service or a combination of both.

8.3 Recommendations

1. The Korean War has been referred to as ' The Forgotten War'[1]. This study has demonstrated that participation in the Korean War is associated with an overall increase in mortality of 21% and an increase in cancer mortality of 31%. This increase in mortality is continuing. About 50% of all Korean War veterans are still alive. In light of the demonstrated increase in mortality consideration should be given to targeted health interventions for the surviving Korean War veterans.

2. This mortality study should not be considered in isolation, but with the companion studies that are being undertaken simultaneously. Thus, this study and the companion cancer incidence study should be referred to the Scientific Advisory Committee oversighting the health study of surviving Korean War veterans, as these studies may indicate additional areas to address in the health survey.

3. There is anecdotal evidence that Australian veterans of the Korean War smoked more than the comparable Australian population. A health survey of surviving veterans of the Korean War is about to commence. It is recommended that the level of cigarette consumption in the survivors be assessed and that the current survey of veterans of the Korean War include questions on current smoking. This may allow programs of smoking cessation to be more effective and to be better targeted within the Korean War veterans.

4. Similarly, the increase in mortality from alcoholic liver disease indicates that the level of alcohol consumption be assessed in the health survey of survivors. This may allow programs aimed at reducing alcohol intake to be better targeted within the surviving Korean War veterans.

5. The information from the current study, including the date when each veteran was last known to be alive or dead, should be stored safely together with the nominal roll. Updated vital status data should be stored separately and this information made available for the general health survey of surviving Korean War veterans.

6. In this study there was considerable difficulty in locating some veterans. Some of this difficulty was due to errors in recording client data in the DVA database and matching against Defence records. DVA should liaise with Defence to ascertain methods of improving matching against Defence personnel records. This should be of longer term benefit in conducting studies of cohorts of veteran populations and may lead to improvement in quality control systems on data entry.

Reference:

1 Korean War .net, website: http://www.koreanwar.net/why.htm

The first group of 3 RAR soldiers to get leave in Japan wait to board a C-47 Dakota of 86 Transport Wing RAAF, Kimpo, January 1951.
AWM P01813.497

Appendix A: Protocol for a Retrospective Study of Mortality of Korean Veterans

MORTALITY OF

KOREAN

VETERANS

THE VETERAN COHORT STUDY

PROTOCOL

Commonwealth Department of

VETERANS' AFFAIRS

Protocol for a Retrospective Study of Mortality of Korean Veterans

1. Introduction

1.1. The effects of war service upon a veteran's long-term health have been the subject of epidemiological investigation. A mortality study of Australian national servicemen, known as the 1984 Australian Veterans Health Study (AVH Study) was commissioned in 1981. It was followed in 1995 by the initiation of another study of mortality of Vietnam veterans. This study was completed in 1997.

1.2 The Australian Korean War veteran community also has expressed concern that their death rates are disproportionately high, and it is now proposed to conduct a mortality study of Korean War veterans. Approximately 17,000 Australian personnel served in the Korean conflict between 1950 and 1954, many of them enduring particularly harsh conditions. Their exact number is not known and is required to be ascertained.

1.3 This investigation will add further value to the findings of the previous studies of veterans, providing a more complete understanding of the long-term effects of war upon a veteran.

1.4 This study will be a retrospective cohort study. It will examine the numbers, causes and ages at death of Korean veterans between the date of first service in Korea and 31 December 1998. It will compare their mortality rates, classified by age and calendar year of death, with those of same sex Australians of comparable age.

1.5 A Nominal Roll for all Korean War veterans to be developed to establish the cohort. This would take considerable time and cost but it is thought that at least 95% of Korean War veterans could be identified within twelve months from readily available information.

1.6 Two good quality nominal rolls of Korean War veterans are available. There is a published nominal roll of those who served with the Australian Army in Korea. There is also a published nominal roll of No 77 Squadron, which was the main RAAF unit in Korea.

1.7 While there is no similar RAN information there are good records of all ships' companies. A nominal roll will be prepared from these records.

1.8 Such a nominal roll will provide sufficient information upon which to base a sound study.

1.9 The special case of Prisoners of War was considered. As there were only 29 veterans in this category it is considered most unlikely that any statistically valid conclusions might be drawn from the study of such a small group.

2. Aims and literature review

2.1. Aims

The study aims are:

- to develop a nominal roll of Australian veterans of the Korean War;
- to determine the mortality rates of Australian veterans of the Korean War;
- to compare the mortality rates of Korean War veterans with those of other Australian males; and
- to develop a geographic profile of living Australian veterans of the Korean War.

3. Literature review

3.1 A review of the relevant literature is at Attachment 1. The purposes of the review are:

- to identify from the current literature the causes of death to be targeted by the study;
- to identify those causes of death for which the study may have sufficient power to detect a significant difference in mortality between Australian veterans of the Korean War and the rest of the population; and
- to identify those medical conditions for which Australian veterans of the Korean War may be at greater risk of death but which cannot be adequately assessed from previous studies.

4. Specific causes of death to be examined

4.1 A wide range of health effects is apparent among Korean War veterans many of which may relate to service in Korea.

4.2 As well as total mortality, the study will consider several specific causes of death for which Australian veterans of the Korean War may differ from other Australians. These causes of death are displayed in the following table. A limitation of a cohort study is that it has limited power to detect significant differences between Korean War veterans and the rest of the Australian population for causes of death which have a low incidence (See Attachment III).

4.3 As a result of experiences in developing the *Vietnam Veterans' Mortality Study* it is considered both valid and useful to group the following disorders together for joint consideration:

- All neoplasms
- All deaths from external causes
- Cancers of the oropharynx and larynx
- Cancers of the gastrointestinal tract

- Cancers of the genito-urinary tract
- Ischaemic vascular diseases including myocardial infarction and peripheral vascular disease

4.4 It is possible that Korean War veterans smoked more than the general community. However, it is necessary to obtain accurate figures with regard to the proportion of veterans who smoked, when they commenced the habit, how much they smoked and for how long. (Medical examinations of RAAF personnel for their fitness for flying are the only service records that have information with regard to smoking habits.)These figures have then to be compared with similar statistics from the general population in order to obtain meaningful conclusions. From Government excise figures on tobacco it is apparent that between 1938 and 1962 there was a dramatic rise in tobacco consumption in Australia. Attempts will be made to achieve maximal accuracy in assessments of the situation, but it does appear unlikely that complete accuracy can be assured.

4.5 Other studies, including the initial studies of Vietnam Veterans, have suggested that the stress and trauma experienced during war service appear to be associated with an increase in post-war deaths from homicide, suicide and motor vehicle accidents. Such relationships will be investigated in this study.

4.6 It is possible that Korean war veterans may consume more alcohol than the general community. It is recognised that stress and trauma experienced on service in Korea could possibly lead to the later development of alcohol abuse. It is for this reason that alcohol-related deaths are to be investigated.

4.7 Morphine abuse involving the medical grade product may have occurred on a short-term basis in some stress-of-war situations in Korea. All causes of death related to drug addiction will be examined.

4.8 Evidence has been provided that Korean War veterans were exposed to a higher level of DDT than would be experienced in normal civilian life. Evidence has also been provided indicating exposure to other chemical compounds either not normally encountered in civilian life or, at greater levels than would have been encountered in civilian life. All causes of death related to such chemical exposures will be examined.

4.9 Summary of specific causes of death to be examined

Cause of death	**ICD 9 Chapter/Code**	**ICD 10 Chapter/Code**
Chronic bronchitis and emphysema	491, 492	J41, J42, J43.1-J43.9
Ischaemic vascular disease including myocardial infarction and peripheral vascular disease	410-414, 440.2	I21-I25, I70.2, I73.1. I73.9
Cerebrovascular accident (stroke)	430-438	I60-I66
Tuberculosis	010-018	A15-A19
Peptic ulcer disease	531-534	K25-K28
Cirrhosis of the liver	571.2, 571.5, 571.6	K70.3, K74.3-K74.6
External Causes (homicides, accidents and suicides)	E800-E999	V01-Y98
Malignant neoplasm of the oesophagus	150	C15, C26.8
Gastrointestinal malignant neoplasms (stomach, pancreas, colo-rectal)	151-154	C16- C21
Colo-rectal malignant neoplasms	153, 154	C18-C21
Malignant neoplasms of the oropharynx and larynx	141-149, 161	C01-C14, C32
Malignant neoplasm of the lung	162	C33, C34
Mesothelioma	163	C45
Genito-urinary malignant neoplasms including kidney, ureter, bladder, prostate and testicle	185-189	C60-C68
Malignant neoplasm of the prostate	185	C61
Hepatocellular carcinoma	155.0	C22
Malignant melanoma of the skin	172	C43
Leukaemia including AML	204-208	C91-C95
All Causes	-	

4.10 **Scrub Typhus**

While recognised as being endemic in Korea, there were no recorded deaths among Australian veterans, and it is highly unlikely there would have been mortality from this cause following service in Korea.

4.11 **Hepatitis B and C**

Identification of these viruses was not made until the 1970s, and a specific diagnosis of Hepatitis B or Hepatitis C would not have been recorded during the Korean War. As these diseases are known to be an important factor in the later development of liver cancer, all cases of liver cancer will be documented. (Hepatitis A, the more common epidemic type of "infectious hepatitis", is not associated with the later development of liver cancer.)

4.12 **Liver and lung fluke disease**

While these diseases are prevalent in Korea, their spread is via shellfish and fish consumption. All rations for Australian service personnel were supplied by the United States, with only vegetables and fruit being provided locally. It therefore appears likely that consumption of Korean fish and shellfish, either raw or cooked, would have been limited.

4.13 **Haemorrhagic fever with renal syndrome**

This disease is endemic in Korea. Some service personnel were affected by it. It has not been possible to obtain a list of names of those personnel who were treated for this condition. With insufficient data it is unlikely that definitive conclusions can be drawn.

4.14 **Venereal diseases**

During the time of the Korean War the use of penicillin, combined with repeated diagnostic serology testing, provided effective control of both gonorrhoea and syphilis. It is not considered likely that these diseases represent a cause of death in Korean War veterans.

5. Methodology

5.1 Study Design

5.2 This is a mortality study of all Australian personnel - navy, army, and air force, who served in Korea. Much of this analysis will focus on the period 1 January 1980 to 31 December 2000, since National Death Index data is available only for that period. Analysis of deaths prior to this will also be carried out as determined by the availability and reliability of records. All comparisons will be standardised by age and calendar year of death.

5.3 This study will compare the mortality rates of Korean War veterans with those of other Australians. In addition, it will analyse whether mortality rates vary between different groups of Korean War veterans or by different measures of exposure to Korea.

6. Definition

6.1 For the purposes of this study, Australian veterans of the Korean war , *'Korean veterans',* are defined as:

All members of the Australian Army, Royal Australian Navy, Royal Australian Air Force (including those airmen based in Japan who flew operational missions over Korea), who landed in Korea or entered Korean waters, including those who were

seconded to the Army of the Republic of South Korea, the United States Air Force (USAF), the United States Navy (USN), the British Army, Navy or Air Force and any other allied service; all members of philanthropic organisations; all members of the Australian Forces Overseas Fund and all official entertainers and war correspondents who saw service in Korea during the period between 27 June 1950 and 19 April 1956.

6.2 This definition excludes:

- members of the diplomatic corps;
- entertainers other than those who were regarded as 'official';
- members of the Army of the Republic of Korea or of any other army who have become Australian citizens subsequently;
- Australian citizens employed in Korea by overseas business organisations or governments;
- civilian non-medical aid and charity workers other than members of philanthropic organisations who were regarded as official, and
- merchant mariners.

7. Legislation

7.1 Two Acts of Parliament are relevant to the conduct of this study:

The Privacy Act 1988

7.2 This is the major piece of legislation in the area of privacy. Eleven Information Privacy Principles (IPP) address the collection, management and use of personal information. Disclosure of personal information by Commonwealth agencies is permitted in a number of circumstances specified by IPP. These include requirements or authorisation under law, (IPP 11).

7.3 In accordance with Departmental procedures, this study must be approved by the Department of Veterans' Affairs Ethics Committee.

The Commonwealth Electoral Act 1918

7.4 In accordance with Regulation 8 of the Electoral and Referendum Regulations and Section 91 of the *Commonwealth Electoral Act 1918*, in Part 1 of Schedule 2, the Department of Veterans' Affairs is listed as a 'Prescribed Authority' under that Act. This permits the Department to be given information from electoral sources that is not available publicly.

8 Data collection and processing

8.1 Data will be collected and processed to:

- create the nominal roll of Korean War veterans;

- determine which Korean War veterans have died since their first service in Korea;

- collect information on causes of death for all Korean War veterans;

- record the date on which each Korean War veteran was last known alive; and

- identify and map the places where Korean War veterans live.

9. Creation of the nominal roll

9.1 The nominal roll of Korean War veterans will be structured in two tables, one containing personal data and the other containing data about service in Korea. The nominal roll of Korean War veterans will be a major outcome of the study. Its accomplishment will mean that the study will not be restricted to those Korean War veterans with whom the Department of Veterans' Affairs has contact and will, in addition, remain a useful baseline for any future study of Korean War veterans.

9.2 The personal data table will contain:

- veterans' surname;
- up to three given names;
- gender;
- day, month and year of birth;
- day, month and year of death;
- ICD cause of death code;
- date last known alive;
- source of data; and
- residential postcode.

9.3 The Korean service table will contain:

- start day, month, year of service;
- end day, month, year of service;
- service number;
- service arm; and
- service unit.

9.4 Separating the service data from the personal data will allow details of multiple periods of service or service with different arms of the service to be recorded. Data will be as complete as possible, although in some records only the month and year of a date may be known and in others only the initials of the given names.

9.5 Australian residential postcodes for those veterans found on the electoral roll will be used to create a geographic profile of living Korean War veterans.

9.6 Each veteran on the nominal roll will be given a unique identifying study number. This identifying number will allow for ease of reference to individual veterans and will be a factor in preserving the confidentiality of personal information.

10. Primary sources of information

10.1 Korean War veterans are defined in section 6.1 of this study protocol. Initial lists from official ie. primary sources, are available for the various groups of Korean War veterans coming within the scope of this definition.

10.2 Combining primary source lists will be the first stage in the development of a definitive nominal roll of Korean War veterans.

10.3 A number of these primary sources are known to be incomplete or inadequate. In the case of females, for example, further investigations may be required to follow up the surnames provided.

10.4 The consolidation of the primary lists will be undertaken in stages and the timing of completion of the nominal roll will depend on when comprehensive primary lists can be obtained and subsequently how quickly these lists can be put into the required record format for matching to eliminate any duplicate records.

10.5 Duplicate veteran names are expected both within and between the primary source lists and these will have to be identified and eliminated. For a discussion of the criteria to be used in the matching process, see Attachment XX. Computerised methods for 'un-duplicating' the nominal roll are discussed in Attachment XY.

10.6 Duplicates may occur for reasons including where veterans served in more than one branch of the military, left a particular service and subsequently re-joined the same service, undertook more than one posting and due to clerical error.

10.7 Because duplicates may be due to multiple postings and the sources may contain other data relevant to the same veteran, all information pertinent to a veteran whose name is duplicated will be consolidated and retained. Once identified, duplicate names will be removed from primary sources.

11. Secondary sources of information

11.1 The nominal roll of Korean War veterans compiled from primary sources will be compared with a number of partial lists of veterans from secondary sources such as, comprising DVA files, Defence Service Homes files, publications, unit histories and lists from veteran organisations. The extent to which the secondary sources might identify additional Korean War veterans is not known.

11.2 Ideally the matching criteria for these comparisons will be the same as those used in the 'un-duplicating' process for primary lists. In practice, however, these criteria are likely to be too stringent for matching between the nominal roll and a number of secondary sources of veteran names. For example, a list contained within the book 'Home by Christmas' by Lt Col Neil C. Smith published in 1990 containing surnames and initials and service numbers.

11.3 Where a secondary source identifies an apparent Korean War veteran not known from primary sources, verification of Korean service will be obtained from the relevant service records office, Defence archives or other appropriate custodial repository.

11.4 When Korean War veteran status is confirmed by such means, the veteran's comprehensive personal data will be added to the nominal roll and the custodian of the secondary source information will be advised of the outcome of the investigation.

12. Specific causes of death

12.1 Studies of Korean War veterans have shown a wide range of health effects. Therefore as well as assessing total mortality, several specific causes of death, for which it is considered that Korean War veterans may differ from other Australian persons, will also be investigated. All causes of death will be identified.

12.2 The specific causes of death will be selected for one or more of the following reasons:

- they were suggested by a comprehensive review of current, relevant literature;

- they were suggested by veterans' organisations to reflect the concerns of their members.

13. Influences on mortality

13.1 Two factors that may affect the mortality rates reported in this study deserve particular mention and are discussed below. The first is that servicemen have to be fit for military service at enlistment, so men with life-shortening illnesses or behavioural disorders were excluded by the medical assessment and psychological screening process. This suggests that at the time of service in Korea, Korean veterans were fitter on average than other Australian persons.

13.2 The second is that while serving in Korea, service personnel have been exposed to a range of insecticides and other chemicals, infective agents, and to extremes of heat and cold, and to the stress of combat. Their mortality and health in general may have been affected by these exposures.

14. Determining vital status

14.1 There are a number of sources available to assist in determining the vital status of Korean War veterans. A search sequence, devised to promote efficiency and to reduce the burden of manual searching as much as possible, will be carried out to produce:

- a register of Korean War veterans known to be alive (an 'alive' register);
- a register of Korean War veterans known to have died; and
- a list of those not able to be confirmed as alive or dead.

14.2 In each of the searches undertaken, records will be kept of where information is found and the date at which veterans were last known to be alive. Criteria for matching are discussed in Attachment XX. A description of testing the accuracy of matching using 'test subjects' is in Attachment XY.

15. Search of the most recent electoral records

15.1 The nominal roll will be matched against the most recent Australian electoral records, including date of birth information, to identify:

- those veterans who are known to have been alive at the date of the electoral roll compilation; and

- those not confirmed to be alive.

15.2 Where matching is successful, an 'alive' register will be generated and any incomplete basic personal details including the veteran's address post code will be recorded. This information will be basic to the development of a demographic and geographic profile of living Korean War veterans.

16. Sources of information about deaths of Korean veterans

Type of death	Source of information	Complete ?	Electronic ?
1 Deaths in Australia 1980-1998	National Death Index	Yes	Yes
2 Deaths known to DVA	DVA		
2.1 Client Data Base		No	Yes
2.2 Vietnam Veteran Mortality Studies		No	Yes
3 Combat related deaths in Korea	Department of Defence	Yes	Yes
4 Other deaths on service			
4.1 Within Australia	Department of Defence	Yes	No
4.2 Outside Australia	Department of Defence	Yes	No
5 Cancer Registers	States and Territories	?	Yes
6 Deaths in Australia 1950-1979	State Registrars of Births, Deaths	Yes	No
7 Deaths	Veterans organisations	No	?
8 Deaths	Unit organisations	No	?

16.1 The degree of overlap between the different registers of deaths will be evaluated to assess the reliability of determining deaths in the cohort. Given the expected reliability of the official Australian death registers (sources 1, 5 and 6), any deaths of Korean War veterans that are identified only in sources 2, 4, 7 or 8 will be of particular interest. In the case of deaths identified from veterans' or unit organisations, evidence of a death certificate will be obtained before death will be confirmed for the purposes of the study.

16.2 The underlying cause of death contained in the various death registers will be the only source of information about the cause of death of Korean War veterans used in this study.

16.3 Causes of death will be coded using the internationally accepted standard, International Classification of Diseases (ICD). These codes are used for all deaths in Australia (sources 1 and 6) using ICD revisions 7 or 8 for deaths registered in 1978 or earlier and ICD revision 9 for deaths registered in 1979 or later. For pre-1979 deaths, ICD7 or 8 codes will be converted to ICD 9 codes by means of a conversion table, so that causes of death can be standardised and mortality aggregated. ICD codes are used to produce the official, published death rates for Australia, and will facilitate comparisons of death rates between the Korean War veterans and the rest of the Australian population. ICD cause of death coding may also be available from sources 2, 4 and 5.

17. Search of the National Death Index

17.1 The nominal roll will be matched against the National Death Index (NDI) to identify Korean War veteran deaths that have occurred since 1980 and have been recorded in computerised death registers. See Attachment XX for details of computerised matching procedures. Pre 1980 deaths will be determined by manual search of State registers, and other means identified in sections 18-23.

17.2 The matching process will identify Korean War veterans who have died, the dates (from which ages at death can be calculated) and causes of death as coded by the Australian Bureau of Statistics (ABS), using the ICD. This information will be recorded and will be basic to the study of Korean War veteran mortality and how it compares with mortality in the Australian population.

18. Search of DVA Client Data Base

18.1 The nominal roll will be matched against the DVA Client Data Base to determine whether any deaths known to the Department have:

- also not been picked up by means of matching against the NDI: such deaths could have occurred outside Australia and be either service related or non-service related; or

- occurred before 1980 - identification from DVA Client Data Base of deaths occurring before 1980 will reduce the burden of manual searching of manual death registers.

19. Search of Department of Defence records of Korean combat deaths and service deaths among Korean veterans since the Korean War

19.1 The nominal roll will be matched against Department of Defence records identifying veterans who died whilst serving in the Defence Force.

20. Department of Immigration and Ethnic Affairs (DIEA) records of arrivals and departures

20.1 The list of names of those who have not been confirmed alive from the 'alive' register less those who have been confirmed dead by one or more of the previous searches may be compared with DIEA records to identify dates at which veterans were last known alive. This information about veterans who cannot be confirmed as presently dead or alive is important for statistical purposes in the interpretation of mortality figures.

21. Search of non-computerised (pre-1980) death registers

21.1 The remaining list of names of those who have not been confirmed alive from the 'alive' register or confirmed dead by one or more of the previous searches will be compared manually by study staff with non-computerised pre-1980 death registers.

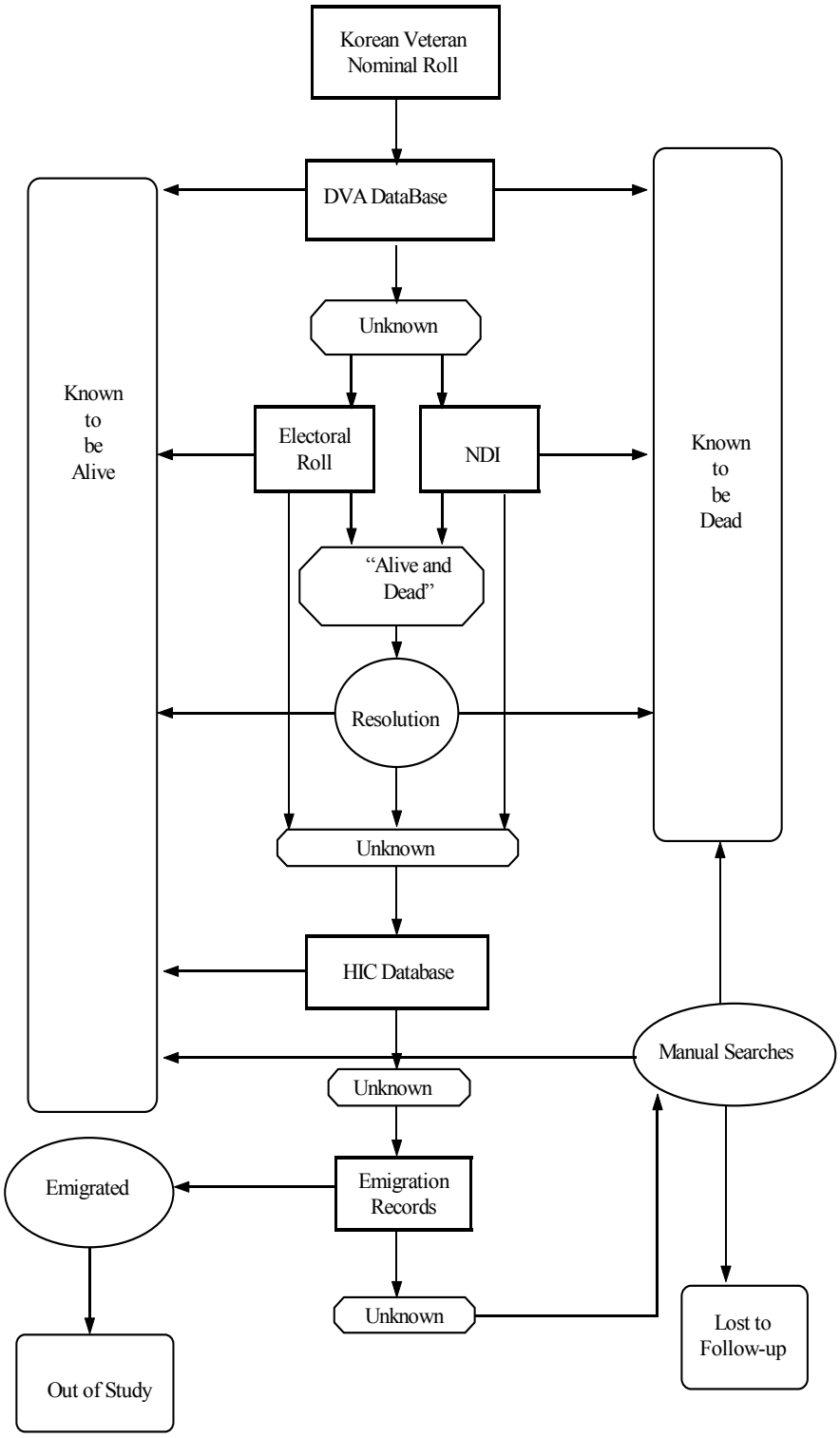
22. Korean War veteran and military unit organisations

22.1 The list of names of those not confirmed alive or dead through all the above searches may then be matched with both Korean War veteran organisation and military unit organisations lists of deaths to identify any deaths among veterans that have not been identified from other sources. A death identified from either of these sources will require evidence of a death certificate for the purposes of the study.

23. Other potential sources of information

23.1 Additional potential sources of information about Korean War veterans include police and corrective services records of drivers' licence registers, cancer registers, and the white pages. The extent to which searching for information about the vital status of Korean War veterans will proceed is a matter to be determined on the advice of the Study Advisory Committee.

Figure 1 - Matching Strategy



25. Unmatched records

25.1 By not confirming the vital status of all Korean War veterans on the nominal roll there is a risk that not all deaths will be detected. Those who cannot be confirmed as either alive or dead will constitute a group known as 'lost to follow-up'. Causes of 'lost to follow-up include:

- death overseas;
- living overseas;
- living in Australia but have never been or are no longer on the electoral roll;
- change of name or gender; and
- certain types of institutional care.

25.2 For some in this group, a date when last known alive be recorded. For others there will be no information.

26. Identifying and mapping where Korean War veterans live

26.1 From veterans post codes a geographic profile will be developed. Higher level aggregation of post code areas may be necessary to ensure that individuals cannot be identified.

27. Comparison with mortality rates of Australian males

27.1 The number of deaths among Korean War veterans, and their death rates, will be tabulated. Published data on death rates of all Australian males will be used in conjunction with the data on deaths of Korean War veterans to calculate the number of deaths that would have been expected in the cohort if the Australian male death rates for non-veterans had occurred. The expected number of deaths of Korean War veterans will also take account of the number of Korean War veterans who cannot be confirmed as either alive or dead.

27.2 Death rates in the Australian male population depend markedly on age, and also vary with calendar year. Accordingly, all comparisons of death rates will take account of the age distribution of study subjects and the calendar year of deaths.

27.3 The observed and expected number of deaths, classified by age group and calendar year, will be analysed using Poisson regression techniques. The deaths will be further classified and analysed by cause of death (see, in particular, the causes listed in Section X). Additional analyses will examine whether the death rates vary between different groups of Korean War veterans.

27.4 A number of potential confounding variables, including demographic variables, Army service characteristics, variables potentially influenced by Korean service and variables related to service in Korea will be examined.

27.5 The Korean Study will collect limited information on possible confounding variables. Section XX will outline the range of data to be recorded on the nominal roll which could potentially be used in the analysis of mortality to control for possible confounding.

28. Comparison with mortality rates of Australian females

28.1 A study identical to that for Australian males will be carried out for Australian females.

29. Methods of Statistical Analysis

29.1 The procedure outlined in section 27 above will produce a Standardised Mortality Ratio, also known as an SMR. However, it has been found that, when using the main methods of identifying dead veterans (namely, the National Death Index (NDI) and the DVA database) that a certain proportion of members of the cohort are identified in both databases, and a proportion are identified in one, but not the other. It can be deduced that a certain proportion of veterans who have actually died will not be matched into either the NDI or the DVA database. Thus, the SMR calculated will under-estimate the true rate of death.

29.2 This level of under-ascertainment may or may not be large. If large, the SMRs will need to be adjusted to correct for this under-ascertainment. By calculating the number of veterans found only in one database, and the numbers found in both databases, it is possible to estimate the number of veterans who have died, but who were not matched into either database. The SMR can then be adjusted to take account of this under-ascertainment. The mechanism for this adjustment is to deflate the number of deaths from a particular cause of death that would be expected.

29.3 Although these adjusted SMRs are probably a more accurate reflection of the true rate of death, it is possible that this method of correction will result in some bias. A method to overcome potential bias is to estimate the ratio of SMR to SMR (which can be called a SRMR or standardised relative mortality ratio) for particular causes of death. As the bias is present in both the numerator and the dominator, the bias will cancel out each other.

29.4 SRMRs are also measures with limitations. As with all proportionate studies, they are unable to make meaningful observations concerning overall levels of mortality. Further, as each chapter's elevation or decrease affects the measure of other chapters, if there are several effects, the SRMRs may become unstable and difficult to interpret.

29.5 The effectiveness of data matching will impact on statistical analysis. The proposed matching strategy is outlined in Figure 1. In brief, there is an initial matching against the Departmental database. This has the highest level of data integrity. It is estimated that around 10,000 DVA clients will be in this first match, and it is likely that those who match are, in every case, Korean War veterans. In the second stage, the surviving 6,500 unmatched will be matched with both the electoral roll and the NDI. This should capture the vital status of a further 5,200 veterans, leaving about 1,300 lost to follow up. After resolution of the double matches, the remaining 1,300 names will be matched with the HIC database. This will add a further 650 to the living, leaving about 650 veterans to find. These 650 will be matched against the electronic records of the Department of Immigration. This will provide about 50 names, leaving 600 to find.

29.6 Manual searches will then be instituted against:

- ex-service membership lists;
- manual records of the Department of Immigration;
- electronic white pages;

- location of next of kin; and
- location of surviving veterans from the same unit.

29.7 Although this process will be slow, it is estimated that about three hundred of the survivors will be found, leaving a residual of about 300 unable to be actually lost to follow-up.

29.8 Once this level of lost to follow-up is determined, it will be appropriate to consider avoiding using methods to adjust for under-ascertainment. The rate would be about 1.8 per cent, would be small when compared to an estimated mortality of about 20 per cent.

29.9 It may be necessary to reconsider the method of statistical analysis depending on the effectiveness of progress of data matching.

30. Study power

30.1 Study power refers to the precision of estimates from a study. In a study based on few data, the estimated death rates are imprecise, and it may not be possible to detect as statistically significant even apparently large differences in death rates.

30.2 Standardised death rates for Australian males have been obtained for several causes of death expected among Korean War veterans. These rates have been derived from deaths of Australian males between 1980-98, the period for which the National Death Index has been computerised.

30.3 The power of the proposed study is shown at attachment XX. This attachment shows where the study has greater than 85% chance of detecting quite modest changes in relative risk for all causes of death as well as a number of common diseases such as neoplasms (cancer), ischaemic heart disease, motor vehicle accidents and suicide. However, the current study has limited power to detect even modest increased risks for rare causes of death where few Korean War veterans are involved.

31. Limitations of the study

31.1 Cohort studies which compare death rates in a service cohort with general population rates often have difficulties of interpretation because healthier people are selected into the service cohort. The process by which persons enter the cohort, in particular because of their fitness for undertaking the activities of the cohort, means that the cohort consists of persons who are, on average, fitter than the general population. Thus, the death rates observed in the cohort are typically lower than those in the general population.

31.2 This ‘healthy serviceman’ effect can be expected to apply to Korean War veterans, who were required to be fit for service in Korea. This effect was evident at least for the National Service cohort in the AVH Study. That study found that national service Vietnam veterans had death rates that were on average only 83 per cent of those in the general Australian male population. The ‘healthy serviceman’ effect is expected to reduce with time since service in Korea and consequently should have less impact than on the analyses of mortality rates in both the AVH Study and the Vietnam veteran study. The effect was not evident at all for cancer mortality in the AVH Study.

32. Study Committees

32.1 The study will be monitored by the following committees.

32.2 Consultative Committee

32.3 The consultative committee, comprising representatives from relevant ex-service organisations, the Minister's office and the Department, will keep a non-scientific watching brief on the study, and will report to the Minister. It will meet:

- to act as liaison with the Korean War veteran community;
- before the study commences, to agree to the protocol;
- during the study, to monitor overall progress; and
- after the study finishes, to agree to the draft report.

32.4 *Study Advisory Committee*

32.5 The study advisory committee, comprising people expert in appropriate fields, will be the final arbiters of scientific matters in the conduct of the study and will report to the steering committee. It will meet:

- before the study commences, to advise the protocol meets scientific and medical standards;
- occasionally during the study, to monitor progress from a scientific and medical point of view; and
- after the study finishes, to agree that the results are presented in a manner appropriate for a scientific or medical paper.

32.6 *Ethics committees and involvement of other bodies*

32.7 The following Ethics Committees will review the study protocol and aspects of its conduct:

- Medical Research Ethics Committee, Department of Veterans' Affairs will be responsible for providing ethical clearance for the conduct of the research study;

- Ethics Committee, Australian Institute of Health and Welfare (AIHW) will be responsible for providing ethical clearance for use of the National Death Index; and

- Ethics Committee, Department of Defence will be responsible for the ethical clearance for use of data held by Department of Defence.

32.8 Other bodies likely to be involved with this study are the holders of registers in which study staff would like to search for the names of Korean War veterans. The bodies (with the registers in brackets) are:

The Australian Electoral Commission (Australian Electoral Roll);
Department of Immigration and Ethnic Affairs (records of arrivals and departures from Australia);
Registrars of Births, Deaths and Marriages - State and Territory (registers of deaths registered before 1980);

Registrars of Motor Vehicles - State and Territory (registers of drivers' licences); and
Registrars of Cancer Registers - State and Territory (registers of cancer incidence and deaths).

Appendix B: Review of the Literature on the Health of Korean Veterans

This is a review of selected literature which is relevant to the mortality of Australian veterans of the Korean conflict. Section B.1 provides a brief overview of that literature which relates to the mortality of Korean veterans and other veterans. The next section reviews available literature in relation to specific causes of death or categories of causes of death.

It is pertinent to examine veteran mortality studies which relate to all recent conflicts whilst, additionally, addressing those facts and situations peculiar to the Korean conflict. While no study has been located which relates solely to the mortality of Korean veterans, several overlap the Korean conflict and will include, for example, veterans who may also have served in World War II or Vietnam.

Other than this there are those effects upon mortality which may be associated with the stresses of warfare and service, as well as those resultant upon incarceration as a POW.

B.1. Mortality in Veterans

B.1.1. The Healthy Soldier Effect

One of the effects that is found to be most noticeable in studies of veterans is the marked (sometimes profoundly so) decrease in mortality that military and veteran populations display, often called "the healthy soldier effect", as a variation on the healthy worker effect.

The healthy worker effect, and, to a greater degree, the healthy soldier effect, arise because there is a process of screening of these populations at the beginning of the study. In the more common healthy worker effect, working populations often display decreased mortality when compared with the general population because you need to have a certain level of health to enter the work force. In military populations, this effect is more pronounced, as only the very fit are usually permitted to enter the military work force. This selection effect is often compounded by rigorous fitness programs in military populations, which is also accentuated by screening programs for particular diseases, such as hypertension. In addition, in some countries, military personnel have superior access to medical treatment.

For example, a study of veterans of the Persian Gulf, which followed veterans for a little over two years after the cessation of the conflict, found a Standardised Mortality Ratio (SMR) of 0.44 (95% Confidence Interval [CI] 0.42 - 0.47) for male veterans, and an SMR of 0.56 (95% CI 0.44 - 0.71) for female veterans of the Gulf war.[1] For military personnel who did not serve in the Gulf, the effect was even more pronounced, with an SMR for males for 0.38 (0.36 - 0.40) and for females of 0.37 (0.30 - 0.45). Similarly, a study of the mortality of soldiers in the US Army in calendar year 1986 found that the all-cause mortality for male members of the US Army was significantly reduced (with an SMR of 0.5) for male members of this military work force, and a decrease of borderline significance in women.[2]

Selyer and Jablon were able to demonstrate that this healthy soldier effect persisted in a large group of World War II veterans for at least 23 years after service, although the effect

[1] Kang H K and Bullman T A. Mortality Among US Veterans of the Persian Gulf War. *N Engl J Med.* 1996; 335: 1498 - 504

[2] Rothberg J M, Bartone P T, Holloway H C and Marlowe D H. Life and Death in the US Army. *JAMA*. 1990; 264: 2241 - 2244.

attenuated with time.[3] The result was very similar to a study of the mortality of British veterans of the nuclear atmospheric tests, which showed that both controls and those who participated in the tests, had a mortality about 20 per cent below the community expectation, after 17 to 32 years of follow-up.[4] Similarly early studies of Vietnam veterans did demonstrate a noticeable healthy worker effect,[5] although some more recent studies have suggested that this effect has disappeared, and has been replaced by an elevation in mortality.[6]

The presence of a healthy worker effect in this population will make the interpretation of results difficult. It is likely that there could be a substantial decrease in the observed mortality, particularly in the period immediately after the conflict. This should attenuate with time.

B.1.2. Mortality from External Causes

Studies of veterans of other conflicts have also shown an elevation in mortality due to external causes. For example, some of the initial studies of Vietnam veterans demonstrated an increase in death from external causes.[7] [8] [9] This is particularly so among Vietnam veterans who suffer from PTSD.[10]

In a carefully executed natural experiment, Hearst *et al* were able to present data that indicated that conscripted veterans of the Vietnam conflict had an elevated rate of death from both suicide and motor vehicle accidents.[11]

A study of the mortality of British veterans who served outside of the United Kingdom during the 1950s and 1960s, revealed a SMR of 137 for accidents and violence, which was significantly different from the expected, $p<0.001$.[12]

An elevation in mortality from motor vehicle accidents has also been noted in a population of Gulf War veterans.[13] An increase in fatalities from motor vehicle accidents has also been noted in Swedish conscripts.[14]

Taken together, these results strongly suggest that veteran populations do have increased rate of death from External Causes, particularly motor vehicle accidents and suicide. There is

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[3] Selfyer C C and Jablon S. Effects of Selection on Mortality. *Am J Epidemiol.* 1974; 100: 367 - 372.
[4] Doby S C, Kendall G M, Fell T P, *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. *BJM.* 1988; 296: 332 - 338.
[5] Adena M A, Cobbin D M, Fett M J, *et al.* Mortality among Vietnam veterans compared with non-veterans and the Australian population. *Med J Aust*. 1985; 143: 541 - 544.
[6] Crane P J, Barnard D L, Horsley K W *et al*. Mortality of Vietnam veterans: the veteran cohort study. A report of the 1996 retrospective cohort study of Australian Vietnam veterans. Canberra. Department of Veterans' Affairs, 1997.:
[7] Bullman T A, Kang H K and Watanabe K K. Proportionate Mortality Among U S Army Vietnam Veterans who served in Military Region I. *Am J Epidemiol* 1990;132:670-4.
[8] Watanabe K K and Kang H K. Mortality Patterns among Vietnam veterans. *JOEM* 1996; 38:272-8.
[9] Lawrence C E, Reilly A D *et al* Mortality Patterns of New York State Veterans. *Am J Public Health* 1985;75:277-9.
[10] Bullman T A and Kang K K. Postraumatic Stress Disorder and the risk of Traumatic Deaths among Vietnam Veterans. *J Norv Ment Dis* 1994;182:602-10.
[11] Hearst N, Newmant T B and Hulley S B. Delayed Effects of the Military Draft on Mortality. *N Engl J Med* 1986;314:620-4
[12] Darby S C, Muirhead C R, Doll R, Kendall G M, Thakrar B. Mortality among United Kingdom servicemen who served abroad in the 1950s and 1960s. *Br J Ind Med.* 1990 Dec; 47(12): 793-804.
[13] Kang H K, and Bullman T A. Mortality Among US veterans of the Persian Gulf War. *N Engl J Med* 1996; 335: 1498-504.
[14] Bylund P O, Thorson J, Enilesson A and Ostron M. Vehicle-related fatalities among Swedish conscripts *Mil Med* 1997; 162: 412-5.

some evidence to suggest that these effects are more pronounced in the years immediately after the conflict.

B.2. Specific diseases or exposures that affect Korean War veterans

B.2.1.Chemicals

Pesticides in General

It is known that in the course of service in Korea there was exposure to organochlorine insecticides (eg, dichlorodiphenyltrichloroethane (DDT), aldrin, dieldrin, heptachlor, chlordane and lindane), but the extent of the exposure is not known. Their widespread use was to control vectors of insect-borne diseases, especially ticks, mites and mosquitoes.

DDT

Worldwide interest has been stimulated with regard to the association between DDT and other pesticides, and their toxicity to man and the environment. Of particular concern is the fact that DDT and its metabolites tend to accumulate in the body (animal or human) as well as in the environment. They may be detected in human organs as well as in maternal milk. As the compounds are resistant to breakdown they are readily absorbed by sediments and soils and find their way into all forms of animal, bird and fish life.

DDT and its metabolites do not breakdown readily. When applied to the soil surface, 50% of DDT was lost within 16-20 days, with an estimated time for 90% loss of 1.5-2 years. When mixed into the soil, the half-time of DDT was 5-8 years, with 90% loss occurring in 25-40 years.[15]

There are now national and regional pesticide residue limits for DDT in foods, but there were none at the time of the Korean conflict.[16]

In 1991 the International Agency for Research on Cancer (IARC), following consideration by previous Working Groups in 1973 and 1987 and with the incorporation of latest available data, also published its monograph with regard to DDT and its associated compounds.

IARC considered there to be inadequate evidence in humans for the carcinogenicity of DDT, although it found sufficient evidence in experimental animals for the carcinogenicity of DDT. There was an overall evaluation that DDT is *possibly* carcinogenic in humans.[17]

Since that evaluation, some other studies have indicated that under circumstances of heavy and prolonged exposure, there may be an association between DDT and related compounds exposure and pancreatic cancer.[18] [19]

[15] DDT and Associated Compounds. IARC Monographs; 53: 186 para 1.3.1.
[16] *Ibid*: 188, Table 4.
[17] Health Effects in Man from Long-Term Exposure to Pesticides. A Review of the 1975-91 Literature: 234.
[18] DDT and Related Compounds and Risk of Pancreatic Cancer. *Journal of the National Cancer Institute.* 1992 20 May; 84 No 10: 764-771.
[19] A Case Control Study of Self-Reported Exposures to Pesticides and Pancreatic Cancer in Southeastern Michigan. *Int J. Cancer*: 1997; 72: 62 - 67.

A study of lung cancer in Uruguay was undertaken.[20] After controlling for the major confounders, including smoking, the findings suggested that there might be an increased risk of lung cancer among those workers who had been exposed to DDT.

A prospective mortality study, with a fifteen-year follow-up, of a group of pest-control officers handling a wide range of pesticides was carried out by epidemiology units in the United Kingdom.[21] This failed to show any significant risk of cancer. The healthy worker effect could have resulted in biased results, as could the limited power of the study to detect significant increases in the less common tumours. Further long-term follow-up will be maintained.

Interest has recently been shown in a number of reports of abnormalities in male sex development and the present knowledge that a metabolite of DDT is a potent "oestrogenic chemical". The relationship, if any, between DDT and testicular cancer is being probed,[22] [23] and some compelling contrary views are held.[24] [25]

Asbestos

Asbestos is classified as a Grade One human carcinogen by the International Agency for Research on Cancer (IARC) (1986).[26]

Asbestos has been used as an insulator and fire retardant on many naval ships. It has been used to insulate buildings, armoured tanks and aeroplanes, as well as for clutch and brake linings of vehicles.

Prior to the 1970s there were many trades in the Armed Services where there was either an indirect or direct occupational exposure to asbestos. Naval personnel involved with the application or removal of asbestos lagging in ships, army personnel involved with repairing tanks and RAAF aircraft mechanics involved with dealing with engine and fuselage insulation are some examples where servicemen may have been exposed to asbestosis. Personnel who were required to displace asbestos lagging or asbestos containing material may have been subjected to heavy exposure. All personnel on board ships prior to the early 1970s were probably exposed to asbestos to some extent.[27]

While there is now widespread current awareness of the inherent dangers associated with contact with asbestos, this knowledge was not so widely appreciated at the time of the Korean conflict. The carcinogenic effects of asbestos were first established conclusively between 1950 and 1960.[28]

The adverse effects of asbestos are not immediately apparent. There may be a variable latent period of many years between exposure to asbestos and the development of some of the associated diseases.

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[20] Eduardo De Stefani *et al* Occupation and the Risk of Lung Cancer in Uruguary. *Scand J Work Environ Health* 1996;22:346-52.
[21] Thomas HF *et al* "Cancer Mortality among Local Pest Control Officers in England and Wales" *Occupational and Environmental Medicine* 1996;53:787-790
[22] Another DDT Connection. Richard M Sharpe. *Nature.* 19951 5 Jun; 375: 538.
[23] William R *Kelce et al.* Persistent DDT Metabolite p,p1-DDE is a Potent Androgen Receptor Antagonist. *Ibid. :*581-585.
[24] Anders Ekbom *et al* DDT and Testicular Cancer. *The Lancet.* 1996 24 Feb; 347: 553.
[25] Effects of DDE Thomas H Jukes. *Nature.* 1995 Aug; 376 No 17: 545.
[26] IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Supp 7 1987, 106-116
[27] Enfield J E. (1991) Report of the Independent Review of Asbestos in Defence. Pub Directorate of Departmental Publications Canberra F-24
[28] Gaensler E A. (1992) "Asbestos Exposure in Buildings" *Clinics in Chest Medicine* Vol 13(2): p231

Asbestos was first used extensively in the 1940s but since 1975 has largely been replaced with man-made mineral fibres, such as fibreglass or slag wool.

Asbestosis is a specific form of pneumoconiosis caused by inhaling asbestos fibres. It is a diffuse interstitial fibrosing lung disease resulting from permanent deposition of such particulate matter in the lungs, and may be progressively debilitating.

A large number of studies has demonstrated that asbestos increases the risk of bronchogenic carcinoma.[29] The data do not indicate a level below which there is no increased risk.[30] This risk is far greater when there is an associated smoking habit.

Mesothelioma, a malignant neoplasm which may involve the pleura, pericardium or the peritoneum is also associated with asbestos exposure.[31] The time between initial exposure to asbestosis and diagnosis of mesothelioma is in the order 15-60 years, with the average in Australia being 34 years.[32]

The exposure of Australia's Korean War veterans to asbestos may increase the rate of death from bronchogenic carcinoma and mesothelioma. This would particularly affect naval veterans.

Benzene

Benzene is classified as a Grade One human carcinogen by the International Agency for Research on Cancer (IARC) (1988) and is a recognised cause of leukaemias in humans.[33]

Benzene was an important additive in AVGAS that was used in World War II. The AVGAS used by piston driven aircraft was up to 10% benzene by volume. AVGAS is not used in jet engines.

The Department of Defence has been able to advise the Department of Veterans' Affairs that benzene was not a component of fuels and solvents used within the Royal Australian Navy.

It seems likely that benzene exposure in the Australian Army is limited to mild exposure from some petrol products.

The leukaemogenic and toxicological characteristics of benzene have been comprehensively reviewed.[34]

Prolonged exposure to benzene-containing products in humans has been conclusively demonstrated to lead to the development of bone marrow depression characterised by progressive leukopenia, anaemia and thrombocytopenia, as well as the generation of acute myeloblastic leukaemia and related forms of acute non-lymphocytic leukaemia.

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[29] Horne N W, and Spiro G (1987) Writing in *Oxford Textbook of Medicine* Pub OUP p15.145
[30] NAS (1984) *Asbestiform Fibres - Non-Occupational Health Risks* National Academy Press Washington DC 1984 p11
[31] Frank E. Speizer *Harrisons Principles of Internal Medicine* 13th ed 1994 1177-78
[32] Enfield E. (1991) Report of the Independent Review of Asbestos in Defence. Pub Directorate of Departmental Publications Canberra F-24
[33] IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Supp 7 1987, 120-22
[34] Snyder R A. Perspective on Benzene Leukaemogenesis. *Critical Reviews in Toxicology* 1994;24:178-81

Such a risk is incurred only after an extended period of exposure to high ambient levels of benzene.[35] [36]

The risk appears to be biologically specific to acute myeloblastic leukaemia (AML). There is no consistent evidence for the production of acute lymphocytic leukaemia (ALL), chronic myeloid leukaemia (CML) or chronic lymphocytic leukaemia (CLL) by benzene exposure.

Latency for the development of AML has not been systematically addressed in the literature. AML has only been observed among subjects chronically exposed to benzene products, and the average latency period from the start of exposure until diagnosis of acute leukaemia is about ten years.[37]

Analysis has been undertaken to establish the risk estimates for specific types of leukaemia.[38] Within limits of quantitative estimation there is good evidence that there exists a threshold of total cumulative benzene exposure below which there is no demonstrable risk of developing acute myeloid leukaemia. The estimates of this threshold cumulative dose have ranged from 50 parts per million-years (ppm-years) to 200 ppm-years and higher estimates. Existing American Occupational Health and Safety guidelines have promulgated a maximum standard workplace exposure of one ppm, which translates to a working lifetime cumulative exposure of 40 ppm-years.

These doses have been encountered among individuals who have been regularly exposed to high concentrations of benzene for protracted periods of time (40 ppm-years corresponds to 4 years exposure at 10 ppm or 40 years exposure at exposure level of 1 ppm).

Ultraviolet Radiation

Ultraviolet Radiation is a known cause of cancer in humans, resulting in the development of basal and squamous cell carcinomas.[39] However, these malignancies only rarely result in fatality, so a mortality study would not be an appropriate mechanism to study the incidence of these conditions.

Malignant melanoma, on the other hand, results in considerable mortality. Armstrong and Kricher have estimated that 94% of melanoma in Oceania is caused by exposure to ultraviolet radiation.[40] There is evidence to suggest that the increased rate of risk occurs as a result of intermittent exposure, particularly among those who work indoors or who have sun sensitive skins.[41]

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[35] Lamm S *et al* Consistencies and Inconsistencies Underlying the Quantitative Assessment of Leukaemia Risk from Benzene Exposure. *Environ Health Persp*. 1989; 82:296 (289-297)
[36] Crump K. Risk of Benzene-Induced Leukaemia: A Sensitivity Analysis of the Pliofilm Cohort with Additional Follow-Up and New Exposure Estimation. *J Toxicol and Environ Health 1994*; 219-42
[37] Brandt L. Exposure to Organic Solvents and Risk of Haematological Malignancies *Leuk Res* 1992; 16: 67-70
[38] Wong O. Risk of Acute Myeloid Leukaemia and Multiple Myeloma in Workers Exposed to Benzene *Occupational and Environmental Medicine* 1995;52:380-84 ibid Table 2 p382
[39] International Agency for Research on Cancer. Solar and Ultraviolet Radiation. IARC Moragraphs on the Evaluation of Carcinogenic Risks to Humans Vol 55 Lyon, 1992.
[40] Armstong B K and Kricher A. How much melanoma is caused by sun exposure. *Melanoma Research* 1993;3:395-401.
[41] Nelemans P J *et al* Effect of Intermittent Exposure to Sunlight on Melanoma Risk Among Indoor Workers and Sun-Sensitive Individuals. *Enviorn Health Perspect* 1993;101:252-5.

Although some Korean War veterans would not have been exposed to intermittent ultraviolet radiation, it is probable that some would have received such exposure. This may have resulted in an increase in mortality from melanoma.

B.2.2 Infections

Tuberculosis

As Smith and Schillaci noted in 1987, tuberculosis represents a special problem for military populations.[42] This is not only because military populations travel to parts of the world in which tuberculosis is more prevalent, but also because enclosed environments aboard ships and in barracks can facilitate the spread of the infection.

Tuberculosis can be a particular problem on naval ships, particularly those with controlled ventilation systems, which can spread the bacillus throughout the ship's company.[43]

Although there is no known record of a major outbreak of tuberculosis in Australian personnel in Korea, these personnel would appear to be at greater risk for tuberculosis infection.

Scrub typhus

Scrub typhus is a rickettsial disease which can result in cardiac complications (interstitial myocarditis is more prominent in scrub typhus) and affect mortality although, with modern therapeutic methods, deaths are rare and convalescence is short.[44]

During the Korean War, the only reported cases were among foreign military personnel. Since then it has become clear that the infection exists in all parts of Korea, and it now appears to be more prevalent than haemorrhagic fever with renal syndrome. It is possible that scrub typhus was rare during the 1960s, but it is now becoming a problem in Korea, especially in rural areas, and is of growing concern in the military.[45] However, there do not appear to be long term sequelae for scrub typhus that would result in increased mortality years after service.

Hepatitis B *and Hepatitis* C *virus infection*

The principal reason for the high prevalence of hepatocellular carcinoma of the liver in parts of Asia and Africa appears to be the frequency of chronic infection with *hepatitis B virus* (HBV) *and hepatitis C virus* (HBC). Such chronic infection frequently leads to cirrhosis of the liver, which itself is an important risk factor for hepatocellular carcinoma.[46]

Liver cancer is one of the most common cancers in Korea with a death rate in 1990 reported to be as high as 35.4 per 100,000 for males and 12.2 per 100,000 for females. Studies in Pusan, Korea, a region endemic for HBV infection have confirmed the

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[42] Smith L S and Schillaci R F. Tuberculosis Control in the Military Population: Apathy Revisited. *Mil Med* 1987;152:421-3.
[43] Distasio A J. The Investigation of a Tuberculosis Outbreak in a Closed Environment of a US Navy Ship, 1987. *Mil Med* 1990;155:347-51.
[44] Rickettsial Diseases. *Harrisons Principles of Internal Medicine* 13th edition: 754.
[45] Kang Su Yi, Yunsop Chong *et al.* Scrub Typhus in Korea: Importance of Early Clinical Diagnosis in This Newly Recognized Endemic Area. Military Medicine 158, 4:269.1993.
[46] *Harrisons Principles of Internal Medicine* 13th edition 1496

relationship between Hepatitis B and C viral infection and the development of liver cancer.[47] [48]

A separate study concluded that although HBV infection plays a more important etiologic role in the development of hepatocellular carcinoma in Korea than does HCV, HCV is no less frequently involved than HBV in the etiology of hepatocellular carcinoma for patients older than 61 years.[49]

In areas where HBV infection is endemic heterosexual transmission is considered to be the most common route of acute infection among adults.[50]

HBsAg (an antigen detectable in the blood indicating carrier state and potential infectivity) has been detected in virtually all body secretions and excretions; however only blood (and serum derived fluids), saliva, semen and vaginal fluids have been shown to be infectious. The major routes of infection are percutaneous (scratching, tattooing), sexual transmission, perinatal, and, especially in young children, 'horizontal' spread. The relative importance of the different routes of spread depends on the overall prevalence of infection.[51]

Exposure of the Korean War veteran population could give to an increase in mortality from hepatoallan carcinoma and cirrhosis of the liver.

Clonorchis sinensis infestation

The liver fluke *Clonorchis sinensis* has a wide prevalence and wide geographical distribution in Korea, and is transmitted through eating poorly cooked, pickled, or smoked fish, and by eating crabs or crayfish. Liver flukes reside in the biliary system and their presence can lead to inflammation and fibrosis of the ductal system. This may result in an enlarged gallbladder, cholelithiasis, or cholecystitis and can also lead to cholangiocarcinoma.[52]

However, as cholangiocarcinoma is so rare, it may be difficult for this study to have the power to detect increased risk.

Paragonimus westermani infection

The lung fluke *Paragonimus westermani* also has a wide prevalence and wide geographical distribution in Korea, and is transmitted by eating crabs or crayfish. Adult

[47] Keun-Young Yoo *et al*. A Reconstructed Cohort Study on the Hepatitis B Virus Infection as a Risk Factor of Liver Cancer in Korea . *Journal of Korean Medical Science.* 1991 Dec; 6 No 4: 319 - 324.
[48] Hai-Rim Shin *et al* Hepatitis B and C Virus, *Clonorchis sinensis* for the risk of liver Cancer: A Case-Control Study in Pusan, Korea. *International Journal of Epidemiology. ;*2 No 5: 933 - 40.
[49] Hyuo Suk Lee *et al* Predominant Etiologic Association of Hepatitis C Virus with Hepatocellular Carcinoma Compared with Hepatitis B Virus in Elderly Patients in a Hepatitis B-Endemic Area. *Department of Internal Medicine and Liver Research Institute, Seoul National University College of medicine, Seoul, Korea* June 9 1993
[50] Ming-Chih Hou *et al* Heterosexual Transmission as the Most Common Route of Acute Hepatitis B Virus Infection among Adults in Taiwan - The Importance of Extending Vaccination to Susceptible Adults. *The Journal of Infectious Diseases 1993*;167:938-41
[51] Beneson A S. (1990) Viral Hepatitis B Writing in *Control of Communicable Diseases in Man 15th edition Amer Pub Hlth Assoc* Washington DC 200-207
[52] Hai-Rim Shin *et al* Hepatitis B and C Virus. *Clonorchis sinensis* for the risk of liver Cancer: A Case-Control Study in Pusan, Korea. *International Journal of Epidemiology. ;*25;5:933-40.

lung flukes reside mainly in the lungs and can result in acute and chronic lung disease.[53] [54] [55]

Haemorrhagic fever with renal syndrome

This condition may be severe, and is endemic in Korea, where it is known as Korean Haemorrhagic fever. It is caused by the Hantaan virus, which is present in rodent urine, faeces and saliva. While good recovery may be made, the condition may result in protracted renal dysfunction and thus affect mortality.[56] [57]

Venereal Diseases

The Australian troops suffered from venereal infections, often contracted while on leave in Japan, with relatively high infection rates. For example, a census of the 3rd Royal Australian Regiment, taken in April 1953, revealed that approximately 25 per cent of the personnel had been or were being treated for some form of venereal disease.[58] This was mainly gonorrhoea, but would have involved a small amount of syphilis, and possibly some infection with HTLV1.

Gonorrhoea

Infection with *Neisseria gonorrhoea* usually results in acute symptoms within 14 days of infection. Although there can be medium term complications, such as arthritis and hepatitis, there are no known long term complications that could cause increased mortality. Treatment with penicillin was provided in Korea. As this was before the development of antibiotic resistance, it is presumed that treatment was effective. It is therefore difficult to see how this would have affected long term mortality.

Syphilis

Infection with *Treponema pallidum* appears to have been relatively uncommon in Korea. Further, it is likely that the infections would have proved sensitive to penicillin, which was used widely in Korea. However, it is possible that some cases may not have been effectively treated in Korea. This may have resulted in an increase in mortality from the late effects of syphilis.

HTLV1

This is a virus which is endemic in South Western Japan. The virus was first isolated in 1980, and is usually a symptomless infection. A small number of those who are infected go on to develop Adult T-cell Leukaemia-lymphoma (ATL) or HTLV-1-associated myelopathy (HAM), both of which are fatal. Thus, this may give rise to an increase in the rate of death from leukaemia, lymphoma or from neurological disease.

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[53] Hai-Rim Shin *et al* Hepatitis B and C Virus, *Clonorchis sinensis* for the risk of liver Cancer: A Case-Control Study in Pusan, Korea. *International Journal of Epidemiology* ;2 No 5: 933 - 40.
[54] Jong-Yil Chai and Soon-Hyung Lee. Intestinal Trematodes Infecting Humans in Korea. *Southeast-Asian -J Trop Med Public Health*. 1991 Dec; 22 Suppl:163 - 70.
[55] Schistosomiasis and Other Trematode Infections. *Harrisons Principles of Internal Medicine* 13th edition: 929.
[56] Haemorrhagic Fever with Renal Syndrome. *Harrisons Principles of Internal Medicine* 13th edition: 849.
[57] Kenneth E Dixon *et al*. A Hospital-Based, Case-Control Study of Risk Factors for Hemorrhagic Fever with Renal syndrome in Soldiers of The Armed Forces of The Republic of Korea. *Am J. Trop*. Med. Hyg., 1966; 54 (3): 284 - 288.
[58] McIntyre D. Australia in the Korean War Vol. II Combat Operations. Pub. A.G.P.S 1985 p581.

B.2.3 Psychological Factors

Stress

Increased Mortality may be also associated with the psychological stresses of warfare and service, as well as those particular stresses resultant upon incarceration as a POW. Some material specific to the Korean War has been located, but studies relating to World War II and the Vietnam conflict are also relevant. Many veterans would have been involved in more than one of these conflicts.

A study relative to World War II linking combat experience and physical health has concluded that combat in WWII predicted that in the 15 years after the war, a subject would experience physical decline or death. There was no evidence that the effect of combat was more pronounced among men of different ranks, theatres of engagement, or levels of self-worth in 1940.[59]

A 50-year prospective study of the psychological sequelae of WWII combat noted the possibility that their results might have been distorted by the higher mortality rate of men with high levels of combat and post-traumatic stress disorder.[60]

Prisoners of War

Studies concerning WWII and Korean conflict prisoners of war have been published. As there were only 29 Australian prisoners of war, and one died in captivity, comparison for statistical purposes is difficult. It is highly unlikely that conclusions of significance could be drawn. The American follow-up studies involving WWII and Korean conflict prisoners are considered to be appropriate to the situation.[61] [62]

Examination of US Army Korean conflict prisoner veterans revealed an increased risk of dying which, though diminishing with time, persisted for some 13 years. Whereas mortality from tuberculosis and trauma contributed to the perceived increase in mortality with WWII Pacific prisoners, the increase in mortality for Korean prisoners was limited to trauma.

An excess of deaths due to cirrhosis of the liver appeared in all three prisoner groups (WWII - European and Pacific - and Korean) from about the tenth follow-up year. After 22 years no evidence of increased ageing among former prisoners of war was seen in mortality from the chronic and degenerative diseases.

A review commissioned by the Sir Edward Dunlop Medical Research Foundation stresses the important fact that mortality among former prisoners of war and other veterans requires continued surveillance because a "healthy worker effect" (or exclusion of unfit persons from the armed forces) may partly conceal increased morbidity or mortality that should be attributed to service.[63]

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[59] Glen H Elder,Jr *et al* Linking Combat and Physical Health: The Legacy of World War II in Men's Lives. *Am J Psychiatry 154:3, March 1997*

[60] Kimberley A Lee *et al* A 50-Year Prospective Study of the Psychological Sequelae of World War II Combat. *Am Journal Psychiatry 152:4, April 1995*

[61] M.Dean Nefzger. Follow-up Studies of World War II and Korean War Prisoners Study Plan and Mortality Findings *Am J of Epidemiology Vol 91 No 2*. 123-138.

[62] Robert J Keehn. Follow-up Studies of World War II and Korean War Prisoners Mortality to January 1, 1976 *Am J of Epidemiology Vol 111 No 2 194-211*

[63] Charles S Guest and Alison J Venn. Mortality of former prisoners of war and other Australian veterans. July 20 1992 *The Medical Journal of Australia Vol 157 132-135*

As it is now approaching fifty years since the onset of the Korean War, it is possible to make some statistical correction to reduce the healthy worker effect[64] and, additionally, it is possible that the significance of those deaths attributable to diseases with a long latent period, such as malignancies, may be more correctly ascertained.

B.2.4. Drugs

Tobacco

Tobacco smoke and tobacco products**,** are classified as a Grade One human carcinogen by the International Agency for Research on Cancer (IARC) (1986).[65]

Smoking was a very widespread habit at the time of the Korean War. It was socially acceptable and freely practiced throughout most communities.

It has been established that many types of cancer, involving the lung, oesophagus, stomach, kidney, bladder, pancreas and other body organs are associated with the smoking habit.

Serious and debilitating respiratory diseases such as chronic bronchitis and emphysema are strongly related to tobacco usage. Cardiovascular diseases such as ischaemic heart disease and peripheral vascular disease are strongly associated with the smoking habit. Cigarette smoking has been stated as the leading cause of preventable death in the USA.[66]

Many veterans claim to have commenced the smoking habit during the stresses of war or, sometimes, by the exertion of peer pressure, and to have developed an addictive habit.

Specific disease processes may result from continued tobacco usage.

Cigarettes were freely available and it was more usual to smoke than not to smoke. Religious and welfare organisations alike would frequently hand out free cigarettes to troops, and cigarettes were a regular component of some ration packs issued to servicemen and servicewomen. Free issue and duty-free issue cigarettes were available on Navy ships. In all the habit was, to say the least, not discouraged. The products were in some instances more readily available to service personnel than to civilians.

Alcohol

Alcohol drinking is classified as a Grade One human carcinogen by the International Agency for Research on Cancer (IARC) (1988).[67]

Alcohol was subsidised and freely available to Australian service personnel, particularly while on leave in Japan.

Alcohol can be addictive, and people can become dependent upon it. Chronic usage may result in serious damage to the central nervous system, including peripheral neuropathy and alcoholic dementia.

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[64] Bernard C K Choi. Definition, Sources, Magnitude, Effect Modifiers, and Strategies of Reduction of the Healthy Worker Effect. *Journal of Occupational Medicine* Vol 34 No 10 979-988 October 1992
[65] IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Supp 7 p 42
[66] Virginia L Ernster. *Harrisons Principles of Internal Medicine* 13th ed 1994 13
[67] IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Vol 44 1988

The consumption of alcohol has a variety of effects on the mortality of populations. Alcohol consumption has been associated with an increased risk of death from external causes, cirrhosis and certain cancers.[68] However, it is also associated with lower overall mortality (in moderate amounts) and lower rates of death from cardiovascular disease, such as coronary artery disease.[69]

While it is uncertain that the Korean War cohort will have overall increased or decreased levels of alcohol consumption, it would seem likely that at least a sub-cohort (that with war related psychological injury) would have higher levels of alcohol consumption.

In a study of Australian National Servicemen who served in the Vietnam War, a relative rate of 2.7 (95% CI = 1.2 – 6.4) was noted for mortality from cirrhosis of the liver, when compared to National Servicemen who served only in Australia.[70]

If similar changes occurred within this cohort, then we could expect to see an increase in mortality from cirrhosis, and possibly external causes, and colo-rectal neoplasms. We may also see a decrease in mortality from cardiovascular disease, but there are multiple causative factors affecting mortality from cardiovascular disease.

Morphine

Morphine and codeine, prototype opiates, are obtained directly from the milky juice of the poppy, *Papaver somniferum*. Semisynthetic drugs produced from them include heroin.

The principal effects are those of significantly reducing a person's perception of pain, along with some mild sedation and a sense of euphoria. Opiates are capable of producing physical addiction.

Purely synthetic drugs such as propoxyphene, methadone and pentazocine, sharing many of the basic properties of opium and morphine, are known as opioids. These drugs are also capable of producing euphoria as well as psychological and physical dependence when taken in high enough dosage over a period of time.

Ampoules of morphine for the relief of severe pain were available in patrol medical kits for use in an emergency. It is possible that access may have been available to individuals embarking on patrols.

B.3. Summary

There is a wide range of potential health effects from service in Korea. These have given rise to a number of conditions that are considered of *a priori* interest in a study of the mortality experience of Korean War veterans.

[68] Thun M J, Peto R, Lopez A D, Monaco J H, Henley J, Heath C W and Doll R. Alcohol Consumption and Mortality Among Middle-aged and Elderly U S Adults. *N Engl J Med* 1997; 337:1705-14.
[69] Thun M J, *ibid.*
[70] Crane P J, Barnard D L, Horsley K W and Adena M A. Mortality of national service Vietnam veterans. A report of the 1996 retrospective cohort of Australian Vietnam veterans. Canberra. Department of Veterans' Affairs, 1997.

Appendix C: Australian and other United Nations Forces in Korea

C.1. Australian units allotted for duty in Korea

C.1.1 Royal Australian Navy

The following table provides information on Naval units allotted for operational service during the Korean War:

Ship or Unit	
HMAS *Shoalhaven*	(Two tours)
HMAS *Bataan*	(Two tours)
HMAS *Warramunga*	(Two tours)
HMAS *Murchison*	(Two tours)
HMAS *Anzac*	(Two tours)
HMAS *Sydney*	(Two tours)
Sydney Carrier Air Group	(Two tours)
Naval Air Squadrons	
• No 805 Naval Air Squadron (attached to HMAS Sydney)	(Two tours)
• No 808 Naval Air Squadron (attached to HMAS Sydney)	(First tour)
• No 816 Naval Air Squadron (attached to HMAS Sydney)	(Second tour)
• No 817 Naval Air Squadron (attached to HMAS Sydney)	(First tour)
• No 850 Naval Air Squadron (attached to HMAS Sydney)	(Second tour)
HMAS *Tobruk*	(Two tours)
HMAS *Condamine*	(Two tours)
HMAS *Culgoa*	(One tour)
HMAS *Arunta*	(One tour)

HMAS *Vengeance* has not been included. Although it was allotted for service in Korea, it sailed to Iwakuni, Japan, to return the RAAF No 77 Fighter Squadron to Australia after that squadron had departed from Korea. HMAS *Vengeance* did not enter the Korean Operational Area.

C.1.2 The Australian Army

The following table provides information on Army units allotted for operational service during the Korean War:

Unit
3 RAR
1 RHU (HS)
Aust Ancilliary Unit Korea
Fd Amb Sec Korea
Maint Area Korea
Visitors Sec Korea
Adv HQ BCOF Korea
AC HQ 1 Comwel Div

AC 16 Inf Wksp (Redesignated
1 Comwel Div Inf Wksp (AC)
1 RAR
119 Tpt Pl RAASC
ACS Britcom Det
Britcom Dent Unit (AC)
1 Aust RHU
Aust Kit Store
CDS Tokyo
USAS
Britcom Leave Unit Tokyo (AC) (Redesignated Leave Centre Tokyo (AC))
Britcom Base Cypher Tp
Britcom Gvs Regn Unit (AC)
121 Tpt Pl RAASC
Britcom Base Wksp Stores Sec (AC)
Britcom Base Wksp (AC)
Britcom BOD (AC)
Base Ord Office and Stores Distr Centre
Britcom MCE (AC)
Britcom Base Ldy
Aust Cash Office (Redesignated 101 Aust Cash Office)
Britcom Base B'casting Sta (Redesignated Britcom B'casting Unit)
Britcom Base Sig Regt
Britcom Gen Hosp (AC) (Redesignated Britcom Medical Reception Sta RAAMC)
Britcom Amen Unit
HQ Britcom Sub Area Tokyo (AC)
252 Sub Pl RAASC
HQ Aust Army Component
6 Aust Adv 2 Ech
Britcom Engr Regt (AC)
Britcom Tn Sqn (AC)
Britcom Postal Unit (AC)
Britcom MC Gp (AC)
Britcom SIS (AC)
Britcom Base Pro Coy (AC)
Britcom Sal and Disposal Unit
Britcom Lab Unit (AC)
HQ BCFK (AC)
AC HQ 28 Inf Bde
Aust Fd Cash Office Korea (Redesignated 102 Aust Cash Office)
Aust Sec 1 Comwel Div Pro Coy
Wks Sec Britcom Engr Regt (later amalgamated with Britcom Engr Regt (AC))
101 Dent Sec
1 Comwel Div Battle School (AC)
Aust Cash Office Tokyo (Redesignated 103 Aust Cash Office)
4 Mil Hist Fd Team
2 RAR
28 Britcom Inf Bde Def and Emp Pl
1 Comwel Div Rest Centre
102 Dent Sec
Aust Gd Sec Tokchong
Britcom Base Sup Dep (AC) (Redesignated Britcom Bulk Dep (AC))
104 Aust Cash Office
HQ Britcom Disposals Org (AC)

Britcom Disposals Store Org (AC)
Britcom Rft Base Dep Japan (AC)
Med Centre Tokyo
104 Dent Sec
Britcom Disposals Org Japan
Britcom Disposals Org Korea

C.1.3 Royal Australian Air Force

The following table provides information on Air Force units allotted for operational service during the Korean War:

Unit

Headquarters No 91 (Composite) Wing
No 77 Fighter Squadron
No 30 (Communication) Unit
Became No 30 (Transport) Unit
Became No 36 (Transport) Squadron
No 391 (Base) Squadron
No 491 (Maintenance) Squadron
RAAF Transport Flight Japan
Post of Senior RAAF Officer Japan

C.2. Commonwealth and Allied Military Forces

The following table lists Commonwealth and allied countries and their military commitment to the UN Command:

Country	Army & Marine (A)	Navy (N)	Air Force (AF)
Belgium	1 infantry battalion		
Canada	1 reinforced infantry brigade, part of the HQ 1st Commonwealth Division	3 destroyers	1 air transport squadron
Colombia	1 infantry battalion	1 frigate	
Ethiopia	1 infantry battalion		
France	1 reinforced infantry battalion	1 sloop	
Greece	1 infantry battalion		1 air transport squadron
Luxembourg	1 infantry platoon		
Netherlands	1 infantry battalion	1 destroyer	
New Zealand	1 artillery regiment, part of the HQ 1st Commonwealth Division	2 frigates	
Philippines	1 infantry battalion, 1 tank company		
Thailand	1 infantry battalion	2 corvettes, 1 transport ship	1 troop carrier flight
Turkey	1 infantry brigade		
Union of South Africa			1 fighter squadron
United Kingdom	2 infantry brigades, 1 armoured regiment, 1½ artillery regiments, 1½ engineer regiments, supporting ground forces, part of the HQ 1st Commonwealth Division	British Far East Fleet	Sunderland anti-submarine aircraft
United States	7 infantry divisions, 1 marine division, logistical & support forces, formation and theatre headquarters	1 naval fleet, carrier task group & escort forces, various support units	1 tactical air force & 1 air combat cargo command, 2 medium bomber wings

C.3. Allied Medical Units

The following table lists the allied countries that committed medical units to the UN Command:

Country	Kinds of Aid
Denmark	1 hospital ship & medical team
Italy	1 Red Cross hospital unit
India	1 field hospital unit
Norway	1 mobile army surgical hospital
Sweden	1 field hospital unit

Appendix D: Tables of Results

Table D1: Observed and expected numbers of deaths for all Korean War veterans and the standardised mortality ratio (SMR)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of death	**Observed**	**Expected[1]**	**SMR[2]**	**95% CI**	**Expected[1]**	**SMR[2]**	**95% CI**	**Period examined[3]**
Chapter I Infectious diseases	40	47	0.85	0.59–1.12	51	0.79	0.54–1.03	1950-2000
Tuberculosis	12	12	0.95	0.40-1.49	13	0.88	0.38-1.39	1950-2000
Chapter II Neoplasms	2476	1895	1.31	1.26–1.36	2058	1.20	1.16–1.25	1950-2000
Chapter III Diseases of the Blood	19	16	1.20	0.67–1.74	18	1.10	0.61–1.59	1968-2000
Chapter IV Endocrine diseases	124	137	0.90	0.75–1.06	150	0.83	0.68–0.97	1950-2000
Chapter V Mental disorders	52	57	0.91	0.67–1.16	63	0.83	0.61–1.06	1968-2000
*Chapter VI N*ervous system diseases	77	81	0.95	0.74–1.16	89	0.86	0.67–1.05	1968-2000
Multiple sclerosis	4	5	0.85	0.04–1.65	5	0.79	0.04–1.55	1950-2000
Motor neurone	15	19	0.79	0.39–1.18	21	0.72	0.36–1.09	1959-2000
Chapter VII Diseases of the Eye	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Chapter VIII Diseases of the Ear	0	0	0.00	0.00–0.00	1	0.00	0.00–0.00	1950-2000
Chapter IX Circulatory system diseases	2894	2564	1.13	1.09–1.17	2794	1.04	1.00–1.07	1950-2000
Ischaemic	1951	1769	1.10	1.05–1.15	1923	1.02	0.97–1.06	1950-2000
Stroke	451	386	1.17	1.06–1.28	424	1.06	0.97–1.16	1950-2000
Chapter X Respiratory system diseases	573	436	1.32	1.21–1.42	479	1.20	1.10–1.30	1950-2000
COPD	362	244	1.49	1.33–1.64	269	1.34	1.21–1.48	1979-2000
Respiratory minus COPD	164	113	1.45	1.23–1.67	125	1.31	1.11–1.51	1979-2000
Chapter XI Digestive system diseases	306	227	1.35	1.20–1.50	245	1.25	1.11–1.39	1968-2000
Liver, gallbladder and bile ducts	186	140	1.33	1.14–1.52	150	1.24	1.06–1.42	1968-2000
Alcoholic liver disease	109	80	1.36	1.11–1.62	86	1.28	1.04–1.52	1968-2000
Peptic ulcer disease	43	30	1.42	0.99-1.84	33	1.30	0.91-1.69	1968-2000
Chapter XII Diseases of the Skin	1	4	0.26	0.00–0.77	4	0.24	0.00–0.69	1968-2000
Chapter XIII Musculoskeletal diseases	14	18	0.78	0.38–1.19	20	0.71	0.34–1.09	1968-2000
Chapter XIV Genito-urinary diseases	53	55	0.96	0.70–1.22	62	0.86	0.63–1.10	1968-2000
Chapter XVII Congenital diseases	3	9	0.36	0.00–0.76	9	0.34	0.00–0.71	1968-2000
Chapter XVIII Unknown causes	20	14	1.44	0.80–2.07	15	1.33	0.74–1.92	1968-2000
Chapter XX External	814	595	1.37	1.27–1.46	633	1.29	1.20–1.38	1950-2000
Suicide	211	161	1.31	1.14–1.49	171	1.23	1.07–1.40	1950-2000
MVA	210	210	1.00	0.87–1.14	222	0.95	0.82–1.08	1950-2000
All deaths	**7514**	**6219**	**1.21**	**1.18–1.24**	**6756**	**1.11**	**1.09–1.14**	**1950-2000**

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates

Table D2: Observed and expected numbers of deaths for Navy Korean War veterans and the standardised mortality ratio (SMR)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of death	**Observed**	**Expected[1]**	**SMR[2]**	**95% CI**	**Expected[1]**	**SMR[2]**	**95% CI**	**Period examined[3]**
Chapter I Infectious diseases	8	15	0.56	0.18–0.94	16	0.52	0.17–0.87	1950-2000
Tuberculosis	1	4	0.27	0.00-0.80	4	0.26	0.00-0.75	1950-2000
Chapter II Neoplasms	767	626	1.22	1.14–1.31	670	1.14	1.06–1.23	1950-2000
Chapter III Diseases of the Blood	10	5	1.94	0.74–3.13	6	1.81	0.69–2.92	1968-2000
Chapter IV Endocrine diseases	37	45	0.83	0.56–1.10	48	0.77	0.52–1.02	1950-2000
Chapter V Mental disorders	13	18	0.73	0.34–1.12	20	0.67	0.31–1.04	1968-2000
*Chapter VI N*ervous system diseases	28	26	1.09	0.69–1.49	28	1.01	0.64–1.38	1968-2000
Multiple sclerosis	2	2	1.21	0.00–2.86	2	1.15	0.00–2.71	1950-2000
Motor neurone	7	7	1.09	0.29–1.89	7	1.02	0.27–1.77	1959-2000
Chapter VII Diseases of the Eye	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Chapter VIII Diseases of the Ear	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Chapter IX Circulatory system diseases	875	802	1.09	1.02–1.16	862	1.02	0.95–1.08	1950-2000
Ischaemic	582	557	1.04	0.96–1.13	598	0.97	0.89–1.05	1950-2000
Stroke	141	117	1.21	1.01–1.41	127	1.11	0.93–1.30	1950-2000
Chapter X Respiratory system diseases	155	136	1.14	0.96–1.32	147	1.06	0.89–1.22	1950-2000
COPD	101	78	1.30	1.05–1.56	84	1.20	0.97–1.43	1979-2000
Respiratory minus COPD	45	36	1.23	0.87–1.59	39	1.13	0.80–1.47	1979-2000
Chapter XI Digestive system diseases	83	75	1.10	0.87–1.34	80	1.04	0.81–1.26	1968-2000
Liver, gallbladder and bile ducts	57	48	1.19	0.88–1.50	50	1.13	0.83–1.42	1968-2000
Alcoholic liver disease	39	28	1.39	0.95–1.83	29	1.32	0.90–1.74	1968-2000
Peptic ulcer disease	7	10	0.74	0.20-1.28	10	0.69	0.18-1.20	1968-2000
Chapter XII Diseases of the Skin	0	1	0.00	0.00–0.00	1	0.00	0.00–0.00	1968-2000
Chapter XIII Musculoskeletal diseases	4	6	0.69	0.02–1.36	6	0.64	0.02–1.27	1968-2000
Chapter XIV Genito-urinary diseases	10	17	0.61	0.24–0.99	18	0.56	0.21–0.90	1968-2000
Chapter XVII Congenital diseases	2	3	0.69	0.00–1.64	3	0.65	0.00–1.55	1968-2000
Chapter XVIII Unknown causes	3	5	0.67	0.00–1.42	5	0.63	0.00–1.34	1968-2000
Chapter XX External	211	203	1.04	0.90–1.18	213	0.99	0.85–1.12	1950-2000
Suicide	55	55	1.01	0.74–1.27	58	0.96	0.71–1.21	1950-2000
MVA	53	72	0.73	0.54–0.93	76	0.70	0.51–0.89	1950-2000
All deaths	**2226**	**2004**	**1.11**	**1.06–1.16**	**2146**	**1.04**	**0.99–1.08**	**1950-2000**

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates

Table D3: Observed and expected numbers of deaths for Army Korean War veterans and the standardised mortality ratio (SMR)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of death	**Observed**	**Expected[1]**	**SMR[2]**	**95% CI**	**Expected[1]**	**SMR[2]**	**95% CI**	**Period examined[3]**
Chapter I Infectious diseases	28	27	1.03	0.65–1.42	30	0.94	0.59–1.29	1950-2000
Tuberculosis	10	7	1.32	0.48-2.15	8	1.22	0.45-1.99	1950-2000
Chapter II Neoplasms	1555	1104	1.41	1.34–1.48	1218	1.28	1.21–1.34	1950-2000
Chapter III Diseases of the Blood	9	9	0.97	0.34–1.60	10	0.88	0.31–1.44	1968-2000
Chapter IV Endocrine diseases	76	80	0.94	0.73–1.16	89	0.85	0.66–1.04	1950-2000
Chapter V Mental disorders	36	34	1.07	0.72–1.42	38	0.96	0.64–1.27	1968-2000
*Chapter VI N*ervous system diseases	42	47	0.89	0.62–1.16	53	0.80	0.56–1.04	1968-2000
Multiple sclerosis	2	3	0.73	0.00–1.71	3	0.68	0.00–1.58	1950-2000
Motor neurone	7	11	0.63	0.17–1.10	12	0.57	0.15–1.00	1959-2000
Chapter VII Diseases of the Eye	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Chapter VIII Diseases of the Ear	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Chapter IX Circulatory system diseases	1819	1519	1.20	1.14–1.25	1677	1.08	1.04–1.13	1950-2000
Ischaemic	1230	1047	1.18	1.11–1.24	1152	1.07	1.01–1.13	1950-2000
Stroke	280	230	1.22	1.08–1.36	256	1.10	0.97–1.22	1950-2000
Chapter X Respiratory system diseases	380	257	1.48	1.33–1.63	287	1.33	1.19–1.46	1950-2000
COPD	241	142	1.69	1.48–1.90	160	1.51	1.32–1.70	1979-2000
Respiratory minus COPD	104	66	1.57	1.27–1.87	75	1.40	1.13–1.66	1979-2000
Chapter XI Digestive system diseases	209	133	1.57	1.36–1.79	146	1.44	1.24–1.63	1968-2000
Liver, gallbladder and bile ducts	123	81	1.51	1.24–1.77	89	1.38	1.14–1.63	1968-2000
Alcoholic liver disease	69	47	1.47	1.12–1.82	50	1.36	1.04–1.68	1968-2000
Peptic ulcer disease	34	18	1.90	1.26-2.53	20	1.72	1.14-2.30	1968-2000
Chapter XII Diseases of the Skin	1	2	0.45	0.00–1.32	3	0.40	0.00–1.17	1968-2000
Chapter XIII Musculoskeletal diseases	8	11	0.77	0.24–1.29	12	0.69	0.22–1.16	1968-2000
Chapter XIV Genito-urinary diseases	36	33	1.09	0.74–1.45	37	0.97	0.65–1.28	1968-2000
Chapter XVII Congenital diseases	1	5	0.21	0.00–0.61	6	0.20	0.00–0.57	1968-2000
Chapter XVIII Unknown causes	13	8	1.68	0.78–2.58	9	1.54	0.72–2.36	1968-2000
Chapter XX External	552	349	1.58	1.45–1.71	375	1.47	1.35–1.59	1950-2000
Suicide	145	94	1.53	1.28–1.78	101	1.43	1.19–1.66	1950-2000
MVA	147	123	1.20	1.01–1.39	131	1.12	0.94–1.30	1950-2000
All deaths	**4795**	**3658**	**1.31**	**1.27–1.35**	**4030**	**1.19**	**1.16–1.22**	**1950-2000**

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates

Table D4: Observed and expected numbers of deaths for Air Force Korean War veterans and the standardised mortality ratio (SMR)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of death	**Observed**	**Expected[1]**	**SMR[2]**	**95% CI**	**Expected[1]**	**SMR[2]**	**95% CI**	**Period examined[3]**
Chapter I Infectious diseases	3	4	0.73	0.00–1.54	4	0.69	0.00–1.47	1950-2000
Tuberculosis	1	1	0.85	0.00-2.52	1	0.83	0.00-2.43	1950-2000
Chapter II Neoplasms	153	164	0.94	0.79–1.08	170	0.90	0.76–1.04	1950-2000
Chapter III Diseases of the Blood	0	1	0.00	0.00–0.00	1	0.00	0.00–0.00	1968-2000
Chapter IV Endocrine diseases	11	12	0.91	0.38–1.45	13	0.87	0.36–1.38	1950-2000
Chapter V Mental disorders	3	5	0.57	0.00–1.22	6	0.54	0.00–1.14	1968-2000
*Chapter VI N*ervous system diseases	6	8	0.81	0.17–1.45	8	0.76	0.16–1.37	1968-2000
Multiple sclerosis	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Motor neurone	1	2	0.62	0.00–1.83	2	0.60	0.00–1.77	1959-2000
Chapter VII Diseases of the Eye	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Chapter VIII Diseases of the Ear	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Chapter IX Circulatory system diseases	199	243	0.82	0.71–0.93	255	0.78	0.67–0.89	1950-2000
Ischaemic	139	165	0.84	0.70–0.98	173	0.80	0.67–0.94	1950-2000
Stroke	29	39	0.76	0.48–1.03	41	0.71	0.45–0.97	1950-2000
Chapter X Respiratory system diseases	38	43	0.88	0.60–1.16	45	0.83	0.57–1.10	1950-2000
COPD	20	24	0.85	0.48–1.23	25	0.81	0.46–1.16	1979-2000
Respiratory minus COPD	15	11	1.42	0.71–2.14	11	1.33	0.66–2.00	1979-2000
Chapter XI Digestive system diseases	14	19	0.77	0.37–1.16	19	0.74	0.35–1.12	1968-2000
Liver, gallbladder and bile ducts	6	11	0.58	0.12–1.04	11	0.57	0.12–1.02	1968-2000
Alcoholic liver disease	2	6	0.35	0.00–0.83	6	0.34	0.00–0.82	1968-2000
Peptic ulcer disease	2	3	0.72	0.00-1.72	3	0.69	0.00-1.63	1968-2000
Chapter XII Diseases of the Skin	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1968-2000
Chapter XIII Musculoskeletal diseases	2	2	1.21	0.00–2.87	2	1.15	0.00–2.72	1968-2000
Chapter XIV Genito-urinary diseases	7	6	1.25	0.33–2.16	6	1.15	0.31–2.00	1968-2000
Chapter XVII Congenital diseases	0	1	0.00	0.00–0.00	1	0.00	0.00–0.00	1968-2000
Chapter XVIII Unknown causes	3	1	2.89	0.00–6.11	1	2.76	0.00–5.85	1968-2000
Chapter XX External	53	43	1.23	0.90–1.56	44	1.20	0.88–1.52	1950-2000
Suicide	11	12	0.96	0.40–1.53	12	0.94	0.39–1.50	1950-2000
MVA	10	15	0.70	0.28–1.13	15	0.69	0.27–1.11	1950-2000
All deaths	**493**	**557**	**0.89**	**0.81–0.96**	**582**	**0.85**	**0.77–0.92**	**1950-2000**

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates

Table D5: Observed and expected numbers of deaths from cancer for all Korean War veterans and the standardised mortality ratio (SMR)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of cancer death	**Observed**	**Expected[1]**	**SMR[2]**	**95% CI**	**Expected[1]**	**SMR[2]**	**95% CI**	**Period examined[3]**
All Neoplasms	2476	1895	1.31	1.26–1.36	2058	1.20	1.16–1.25	1950-2000
Brain and CNS	60	64	0.94	0.70–1.17	69	0.87	0.65–1.09	1950-2000
Breast	2	2	1.03	0.00–2.46	2	0.95	0.00–2.26	1950-2000
Connective soft tissue	5	8	0.62	0.08–1.15	9	0.57	0.07–1.06	1968-2000
Gastrointestinal	390	330	1.18	1.07–1.30	358	1.09	0.98–1.20	1968-2000
Colo-rectal	295	250	1.18	1.05-1.32	271	1.09	0.97-1.21	1950-2000
Colon	205	177	1.16	1.00–1.32	192	1.07	0.92–1.21	1950-2000
Rectum	90	72	1.25	0.99–1.50	78	1.15	0.91–1.39	1950-2000
Stomach	98	90	1.08	0.87–1.30	98	1.00	0.80–1.20	1950-2000
Liver and gallbladder	63	48	1.30	0.98–1.62	52	1.20	0.90–1.50	1950-2000
Pancreas	94	84	1.13	0.90–1.35	91	1.04	0.83–1.25	1950-2000
Genito-urinary	286	230	1.24	1.10–1.39	254	1.13	0.99–1.26	1968-2000
Prostate	181	141	1.29	1.10–1.48	156	1.16	0.99–1.33	1950-2000
Testis	8	6	1.18	0.34–2.03	7	1.12	0.32–1.92	1950-2000
Bladder	41	42	0.97	0.67–1.27	46	0.88	0.61–1.15	1950-2000
Kidney	60	47	1.28	0.96–1.61	50	1.19	0.88–1.49	1950-2000
Head and neck[4]	114	58	1.96	1.60–2.32	63	1.82	1.48–2.15	1968-2000
Larynx	55	28	1.95	1.43–2.46	31	1.80	1.33–2.28	1950-2000
Oesophagus	93	59	1.59	1.27–1.91	64	1.46	1.17–1.76	1950-2000
Lung	802	544	1.47	1.37–1.58	590	1.36	1.27–1.45	1950-2000
Mesothelioma	4	8	0.51	0.01–1.00	9	0.46	0.01–0.91	1997-2000
Melanoma	78	61	1.28	0.99–1.56	66	1.18	0.92–1.45	1950-2000
Non-Hodgkins Lymphoma	55	64	0.86	0.63–1.09	70	0.79	0.58–1.00	1950-2000
Thyroid	3	3	0.90	0.00–1.89	4	0.83	0.00–1.75	1950-2000
Unknown primary	150	99	1.51	1.27–1.75	108	1.39	1.16–1.61	1968-2000
Leukaemia	60	61	0.99	0.74–1.24	66	0.91	0.68–1.14	1950-2000
Lymphoid leukaemia	14	15	0.92	0.44–1.40	17	0.84	0.40–1.28	1968-2000
Myeloid leukaemia	36	35	1.02	0.68–1.35	38	0.94	0.63–1.24	1968-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D6: Observed and expected numbers of deaths from cancer for Navy Korean War veterans and the standardised mortality ratio (SMR)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of cancer death	Observed	Expected[1]	SMR[2]	95% CI	Expected[1]	SMR[2]	95% CI	Period examined[3]
All Neoplasms	767	626	1.22	1.14–1.31	670	1.14	1.06–1.23	1950-2000
Brain and CNS	24	22	1.12	0.68–1.57	23	1.06	0.64–1.48	1950-2000
Breast	0	1	0.00	0.00–0.00	1	0.00	0.00–0.00	1950-2000
Connective soft tissue	1	3	0.36	0.00–1.07	3	0.34	0.00–1.00	1968-2000
Gastrointestinal	130	110	1.18	0.98–1.39	117	1.11	0.92–1.30	1968-2000
Colo-rectal	96	83	1.16	0.93-1.39	89	1.08	0.87-1.30	1950-2000
Colon	73	59	1.24	0.95–1.52	63	1.16	0.89–1.42	1950-2000
Rectum	23	24	0.97	0.58–1.37	26	0.91	0.54–1.28	1950-2000
Stomach	32	29	1.09	0.71–1.48	31	1.02	0.67–1.38	1950-2000
Liver and gallbladder	15	16	0.94	0.47–1.42	17	0.88	0.44–1.33	1950-2000
Pancreas	35	28	1.28	0.86–1.71	30	1.20	0.81–1.60	1950-2000
Genito-urinary	98	74	1.34	1.07–1.60	80	1.23	0.99–1.47	1968-2000
Prostate	58	44	1.31	0.97–1.65	48	1.20	0.89–1.51	1950-2000
Testis	2	2	0.99	0.00–2.31	2	0.95	0.00–2.21	1950-2000
Bladder	19	13	1.43	0.79–2.08	15	1.33	0.73–1.92	1950-2000
Kidney	23	16	1.46	0.86–2.06	17	1.36	0.80–1.93	1950-2000
Head and neck[4]	41	20	2.09	1.45–2.72	21	1.97	1.37–2.56	1968-2000
Larynx	13	10	1.37	0.63–2.11	10	1.29	0.59–1.99	1950-2000
Oesophagus	25	20	1.29	0.79–1.79	21	1.21	0.74–1.68	1950-2000
Lung	228	180	1.27	1.10–1.43	192	1.19	1.03–1.34	1950-2000
Mesothelioma	3	3	1.05	0.00–2.23	3	0.98	0.00–2.08	1997-2000
Melanoma	27	21	1.30	0.81–1.79	22	1.22	0.76–1.68	1950-2000
Non-Hodgkins Lymphoma	15	22	0.71	0.35–1.07	23	0.67	0.33–1.00	1950-2000
Thyroid	1	1	0.89	0.00–2.61	1	0.84	0.00–2.45	1950-2000
Unknown primary	42	33	1.28	0.90–1.67	36	1.20	0.84–1.55	1968-2000
Leukaemia	14	20	0.72	0.34–1.09	21	0.67	0.32–1.02	1950-2000
Lymphoid leukaemia	2	5	0.40	0.00–0.94	5	0.37	0.00–0.88	1968-2000
Myeloid leukaemia	11	12	0.96	0.39–1.52	12	0.89	0.37–1.42	1968-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D7: Observed and expected numbers of deaths from cancer for Army Korean War veterans and the standardised mortality ratio (SMR)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of cancer death	Observed	Expected[1]	SMR[2]	95% CI	Expected[1]	SMR[2]	95% CI	Period examined[3]
All Neoplasms	1555	1104	1.41	1.34–1.48	1218	1.28	1.21–1.34	1950-2000
Brain and CNS	31	37	0.84	0.55–1.13	41	0.77	0.50–1.04	1950-2000
Breast	2	1	1.77	0.00–4.21	1	1.61	0.00–3.82	1950-2000
Connective soft tissue	4	5	0.85	0.03–1.67	5	0.77	0.02–1.52	1968-2000
Gastrointestinal	238	192	1.24	1.08–1.40	211	1.13	0.98–1.27	1968-2000
Colo-rectal	177	145	1.22	1.04-1.40	160	1.11	0.94-1.27	1950-2000
Colon	120	103	1.17	0.96–1.38	113	1.06	0.87–1.25	1950-2000
Rectum	57	42	1.34	0.99–1.69	46	1.22	0.90–1.54	1950-2000
Stomach	63	53	1.19	0.89–1.48	58	1.08	0.81–1.35	1950-2000
Liver and gallbladder	46	28	1.67	1.19–2.14	31	1.51	1.07–1.94	1950-2000
Pancreas	54	49	1.10	0.81–1.39	54	1.00	0.73–1.27	1950-2000
Genito-urinary	154	135	1.14	0.96–1.32	151	1.02	0.86–1.18	1968-2000
Prostate	99	82	1.20	0.97–1.44	93	1.07	0.86–1.28	1950-2000
Testis	5	4	1.42	0.21–2.63	4	1.33	0.20–2.46	1950-2000
Bladder	20	25	0.79	0.44–1.14	28	0.71	0.39–1.02	1950-2000
Kidney	30	27	1.10	0.71–1.50	30	1.00	0.64–1.36	1950-2000
Head and neck[4]	64	34	1.90	1.43–2.37	37	1.74	1.31–2.16	1968-2000
Larynx	40	17	2.44	1.68–3.19	18	2.22	1.54–2.91	1950-2000
Oesophagus	62	34	1.82	1.36–2.27	37	1.65	1.24–2.06	1950-2000
Lung	536	317	1.69	1.55–1.83	349	1.54	1.41–1.67	1950-2000
Mesothelioma	1	5	0.23	0.00–0.66	5	0.20	0.00–0.59	1997-2000
Melanoma	44	36	1.23	0.86–1.59	39	1.12	0.79–1.46	1950-2000
Non-Hodgkins Lymphoma	34	38	0.91	0.60–1.21	41	0.82	0.55–1.10	1950-2000
Thyroid	2	2	1.01	0.00–2.40	2	0.92	0.00–2.19	1950-2000
Unknown primary	102	58	1.77	1.42–2.11	64	1.60	1.29–1.91	1968-2000
Leukaemia	42	35	1.17	0.82–1.53	39	1.07	0.74–1.39	1950-2000
Lymphoid leukaemia	12	9	1.36	0.60–2.12	10	1.22	0.54–1.91	1968-2000
Myeloid leukaemia	20	20	1.00	0.57–1.44	23	0.91	0.51–1.30	1968-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D8: Observed and expected numbers of deaths from cancer for Air Force Korean War veterans and the standardised mortality ratio (SMR)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of cancer death	Observed	Expected[1]	SMR[2]	95% CI	Expected[1]	SMR[2]	95% CI	Period examined[3]
All Neoplasms	153	164	0.94	0.79–1.08	170	0.90	0.76–1.04	1950-2000
Brain and CNS	4	5	0.81	0.02–1.60	5	0.79	0.02–1.55	1950-2000
Breast	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Connective soft tissue	0	1	0.00	0.00–0.00	1	0.00	0.00–0.00	1968-2000
Gastrointestinal	22	28	0.80	0.47–1.13	29	0.77	0.45–1.08	1968-2000
Colo-rectal	22	21	1.04	0.61-1.48	22	1.00	0.58-1.42	1950-2000
Colon	11	15	0.75	0.31–1.19	16	0.72	0.30–1.15	1950-2000
Rectum	11	6	1.75	0.70–2.79	6	1.68	0.68–2.69	1950-2000
Stomach	3	8	0.41	0.00–0.85	9	0.39	0.00–0.82	1950-2000
Liver and gallbladder	1	4	0.25	0.00–0.73	4	0.24	0.00–0.71	1950-2000
Pancreas	5	7	0.70	0.09–1.32	8	0.68	0.09–1.27	1950-2000
Genito-urinary	33	22	1.51	1.00–2.03	23	1.43	0.95–1.92	1968-2000
Prostate	24	14	1.71	1.03–2.38	15	1.60	0.97–2.24	1950-2000
Testis	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Bladder	2	4	0.50	0.00–1.19	4	0.48	0.00–1.13	1950-2000
Kidney	7	4	1.82	0.49–3.14	4	1.75	0.47–3.04	1950-2000
Head and neck[4]	8	5	1.80	0.56–3.03	5	1.75	0.55–2.95	1968-2000
Larynx	2	2	0.89	0.00–2.10	2	0.86	0.00–2.03	1950-2000
Oesophagus	6	5	1.23	0.25–2.20	5	1.19	0.24–2.13	1950-2000
Lung	38	47	0.80	0.54–1.05	49	0.77	0.53–1.02	1950-2000
Mesothelioma	0	1	0.00	0.00–0.00	1	0.00	0.00–0.00	1997-2000
Melanoma	7	5	1.48	0.39–2.56	5	1.43	0.38–2.49	1950-2000
Non-Hodgkins Lymphoma	6	5	1.12	0.23–2.02	6	1.08	0.22–1.94	1950-2000
Thyroid	0	0	0.00	0.00–0.00	0	0.00	0.00–0.00	1950-2000
Unknown primary	6	9	0.71	0.15–1.28	9	0.68	0.14–1.23	1968-2000
Leukaemia	4	5	0.79	0.02–1.55	5	0.76	0.02–1.49	1950-2000
Lymphoid leukaemia	0	1	0.00	0.00–0.00	1	0.00	0.00–0.00	1968-2000
Myeloid leukaemia	4	3	1.37	0.04–2.70	3	1.32	0.04–2.60	1968-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D9: Mortality of Navy veterans who served in Korea in the short duration of service category (1-174 days)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of Death	Observed number	Expected number[1]	SMR[2]	95% confidence interval	Expected number	SMR[2]	95% confidence interval	Period examined[3]
All deaths	203	188	1.08	0.93-1.23	202	1.00	0.87-1.14	1950-2000
Neoplasm chapter	71	58	1.22	0.94-1.51	63	1.14	0.87-1.40	1950-2000
Lung cancer	18	17	1.09	0.59-1.59	18	1.02	0.55-1.48	1950-2000
Prostate cancer	5	4	1.17	0.16-2.18	5	1.06	0.14-1.99	1950-2000
Colo-rectal cancer	8	8	1.07	0.34-1.18	8	1.00	0.31-1.68	1950-2000
Head and neck cancer[4]	3	2	1.72	0.00-3.65	2	1.62	0.00-3.43	1968-2000
Circulatory chapter	76	77	0.99	0.77-1.21	83	0.92	0.71-1.12	1950-2000
Ischaemic	55	53	1.03	0.76-1.30	57	0.96	0.70-1.21	1950-2000
Stroke	13	11	1.11	0.49-1.72	12	1.02	0.45-1.58	1950-2000
Respiratory chapter	13	13	1.01	0.47-1.55	14	0.93	0.43-1.43	1950-2000
Digestive chapter	3	7	0.45	0.00-0.95	7	0.42	0.00-0.89	1968-2000
External chapter	23	18	1.30	0.77-1.82	19	1.23	0.73-1.73	1950-2000
Suicide	7	5	1.45	0.37-2.53	5	1.37	0.35-2.40	1950-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D10: Mortality of Navy veterans who served in Korea in the medium duration of service category (175-294 days)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of Death	Observed number	Expected number[1]	SMR[2]	95% confidence interval	Expected number	SMR[2]	95% confidence interval	Period examined[3]
All deaths	1630	1444	1.13	1.07-1.18	1545	1.06	1.00-1.11	1950-2000
Neoplasm chapter	561	451	1.24	1.14-1.35	482	1.16	1.07–1.26	1950-2000
Lung cancer	170	129	1.32	1.12-1.52	138	1.23	1.05–1.42	1950-2000
Prostate cancer	41	31	1.33	0.92-1.73	34	1.22	0.85–1.59	1950-2000
Colo-rectal cancer	71	60	1.18	0.91-1.46	64	1.11	0.85–1.36	1950-2000
Head and neck cancer[4]	30	14	2.10	1.35-2.85	15	1.98	1.28–2.69	1968-2000
Circulatory chapter	659	575	1.15	1.06-1.23	618	1.07	0.99–1.15	1950-2000
Ischaemic	432	400	1.08	0.98-1.18	428	1.01	0.91–1.10	1950-2000
Stroke	108	84	1.29	1.05-1.53	91	1.19	0.97–1.42	1950-2000
Respiratory chapter	107	97	1.11	0.90-1.31	105	1.02	0.83–1.22	1950-2000
Digestive chapter	63	55	1.15	0.87-1.43	58	1.08	0.81-1.35	1968-2000
External chapter	147	150	0.98	0.82-1.14	157	0.93	0.78-1.09	1950-2000
Suicide	41	40	1.02	0.71-1.33	42	0.97	0.67-1.27	1950-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D11: Mortality of Navy veterans who served in Korea in the long duration of service category (295+ days)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of Death	Observed number	Expected number[1]	SMR[2]	95% confidence interval	Expected number	SMR[2]	95% confidence interval	Period examined[3]
All deaths	391	371	1.05	0.95-1.16	398	0.98	0.89-1.08	1950-2000
Neoplasm chapter	135	117	1.15	0.96–1.35	125	1.08	0.90–1.26	1950-2000
Lung cancer	40	34	1.17	0.80–1.53	36	1.09	0.75–1.43	1950-2000
Prostate cancer	11	8	1.33	0.55–2.11	9	1.22	0.51–1.94	1950-2000
Colo-rectal cancer	17	15	1.11	0.59–1.64	17	1.04	0.55–1.53	1950-2000
Head and neck cancer[4]	8	4	2.20	0.68–3.71	4	2.07	0.65–3.50	1968-2000
Circulatory chapter	140	150	0.94	0.78–1.09	161	0.87	0.73–1.02	1950-2000
Ischaemic	95	104	0.91	0.73–1.09	112	0.85	0.68–1.02	1950-2000
Stroke	20	22	0.94	0.53–1.35	23	0.87	0.49–1.25	1950-2000
Respiratory chapter	34	26	1.32	0.87–1.76	28	1.22	0.81–1.63	1950-2000
Digestive chapter	17	14	1.24	0.66-1.83	15	1.17	0.62-1.72	1968-2000
External chapter	39	35	1.11	0.76-1.45	37	1.05	0.72-1.38	1950-2000
Suicide	7	10	0.76	0.21-1.31	10	0.72	0.20-1.24	1950-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D12: Mortality of Army veterans who served in Korea in the short duration of service category (1-345 days)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of Death	Observed number	Expected number[1]	SMR[2]	95% confidence interval	Expected number	SMR[2]	95% confidence interval	Period examined[3]
All deaths	2427	1925	1.26	1.21-1.31	2110	1.15	1.10-1.20	1950-2000
Neoplasm chapter	739	564	1.31	1.22–1.40	619	1.19	1.11–1.28	1950-2000
Lung cancer	248	162	1.53	1.34–1.72	177	1.40	1.23–1.57	1950-2000
Prostate cancer	50	46	1.10	0.80–1.40	51	0.98	0.71–1.25	1950-2000
Colo-rectal cancer	88	73	1.20	0.95–1.45	80	1.09	0.86–1.32	1950-2000
Head and neck cancer[4]	23	16	1.39	0.82–1.96	18	1.28	0.75–1.80	1968-2000
Circulatory chapter	992	827	1.20	1.12–1.27	907	1.09	1.03–1.16	1950-2000
Ischaemic	676	564	1.20	1.11–1.29	617	1.10	1.01–1.18	1950-2000
Stroke	155	130	1.19	1.01–1.38	144	1.08	0.91–1.25	1950-2000
Respiratory chapter	199	142	1.41	1.21–1.60	157	1.27	1.10–1.45	1950-2000
Digestive chapter	102	67	1.53	1.23-1.82	73	1.39	1.12-1.67	1968-2000
External chapter	252	168	1.50	1.32-1.69	180	1.40	1.23-1.57	1950-2000
Suicide	65	45	1.44	1.09-1.79	48	1.34	1.02-1.67	1950-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D13: Mortality of Army veterans who served in Korea in the medium duration of service category (346-389 days)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of Death	Observed number	Expected number[1]	SMR[2]	95% confidence interval	Expected number	SMR[2]	95% confidence interval	Period examined[3]
All deaths	1808	1310	1.38	1.32-4.44	1448	1.25	1.19-1.31	1950-2000
Neoplasm chapter	618	409	1.51	1.39–1.63	453	1.36	1.26–1.47	1950-2000
Lung cancer	216	117	1.84	1.60–2.09	130	1.67	1.44–1.89	1950-2000
Prostate cancer	38	28	1.38	0.94–1.82	31	1.21	0.83–1.60	1950-2000
Colo-rectal cancer	70	54	1.28	0.98–1.58	60	1.16	0.89–1.43	1950-2000
Head and neck cancer[4]	31	13	2.35	1.52–3.17	14	2.14	1.39–2.89	1968-2000
Circulatory chapter	630	521	1.21	1.12–1.30	577	1.09	1.01–1.18	1950-2000
Ischaemic	422	363	1.16	1.05–1.27	402	1.05	0.95–1.15	1950-2000
Stroke	96	75	1.29	1.03–1.54	84	1.15	0.92–1.38	1950-2000
Respiratory chapter	134	87	1.55	1.28–1.81	97	1.38	1.15–1.61	1950-2000
Digestive chapter	88	50	1.74	1.38-2.11	55	1.59	1.26-1.92	1968-2000
External chapter	233	139	1.67	1.46-1.89	150	1.55	1.35-1.75	1950-2000
Suicide	70	38	1.85	1.41-2.28	41	1.71	1.31-2.12	1950-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D14: Mortality of Army veterans who served in Korea in the long duration of service category (390+ days)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of Death	**Observed number**	**Expected number[1]**	**SMR[2]**	**95% confidence interval**	**Expected number**	**SMR[2]**	**95% confidence interval**	**Period examined[3]**
All deaths	556	419	1.33	1.22-1.44	467	1.19	1.09-1.29	1950-2000
Neoplasm chapter	196	130	1.51	1.30-1.72	145	1.36	1.17-1.55	1950-2000
Lung cancer	70	38	1.87	1.43-2.31	42	1.69	1.29-2.08	1950-2000
Prostate cancer	11	9	1.21	0.50-1.93	11	1.05	0.43-1.67	1950-2000
Colo-rectal cancer	19	14	1.12	0.62-1.62	19	1.01	0.56-1.46	1950-2000
Head and neck cancer[4]	10	4	2.47	0.95-3.99	5	2.25	0.87-3.64	1968-2000
Circulatory chapter	196	170	1.16	0.99-1.32	190	1.03	0.89-1.18	1950-2000
Ischaemic	132	118	1.11	0.92-1.30	132	1.00	0.83-1.17	1950-2000
Stroke	29	25	1.16	0.73-1.58	28	1.02	0.65-1.39	1950-2000
Respiratory chapter	47	29	1.64	1.17-2.11	32	1.45	1.03-1.86	1950-2000
Digestive chapter	19	16	1.24	0.69-1.79	17	1.12	0.62-1.62	1968-2000
External chapter	66	41	1.59	1.21-1.98	45	1.48	1.12-1.84	1950-2000
Suicide	10	11	0.84	0.31-1.38	12	0.78	0.29-1.28	1950-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D15: Mortality of Army veterans who served in Korea prior to 1952 (period 1)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of Death	Observed number	Expected number[1]	SMR[2]	95% confidence interval	Expected number	SMR[2]	95% confidence interval	Period examined[3]
All deaths	780	646	1.21	1.12-1.29	695	1.12	1.04-1.20	1950-2000
Neoplasm chapter	244	184	1.33	1.16-1.50	198	1.24	1.08-1.39	1950-2000
Lung cancer	78	53	1.48	1.15-1.81	57	1.38	1.08-1.69	1950-2000
Prostate cancer	17	16	1.07	0.57-1.57	18	0.97	0.52-1.43	1950-2000
Colo-rectal cancer	34	24	1.46	0.98-1.95	25	1.36	0.91-1.82	1950-2000
Head and neck cancer[4]	5	5	1.03	0.14-1.92	5	0.96	0.13-1.80	1968-2000
Circulatory chapter	325	287	1.13	1.01-1.26	309	1.05	0.94-1.17	1950-2000
Ischaemic	217	194	1.12	0.97-1.27	208	1.04	0.90-1.18	1950-2000
Stroke	52	46	1.11	0.81-1.41	50	1.02	0.74-1.30	1950-2000
Respiratory chapter	66	50	1.32	1.00-1.63	54	1.21	0.92-1.51	1950-2000
Digestive chapter	39	21	1.85	1.27-2.43	23	1.73	1.19-2.27	1968-2000
External chapter	69	50	1.37	1.05-1.70	53	1.30	0.99-1.61	1950-2000
Suicide	8	13	0.58	0.17-0.99	14	0.55	0.16-0.94	1950-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D16: Mortality of Army veterans who served in Korea prior to 1952 and after 1952 (period 2)

		Scenario 1 (excluding veterans whose status is unknown)			Scenario 2 (including veterans whose status is unknown)			
Cause of Death	Observed number	Expected number[1]	SMR[2]	95% confidence interval	Expected number	SMR[2]	95% confidence interval	Period examined[3]
All deaths	572	411	1.40	1.29-1.52	451	1.27	1.17-1.38	1950-2000
Neoplasm chapter	185	124	1.49	1.27-1.70	136	1.36	1.16-1.55	1950-2000
Lung cancer	72	36	1.99	1.53-2.45	39	1.82	1.40-2.25	1950-2000
Prostate cancer	12	9	1.32	0.58-2.06	10	1.16	0.51-1.82	1950-2000
Colo-rectal cancer	15	16	0.93	0.46-1.40	18	0.85	0.42-1.28	1950-2000
Head and neck cancer[4]	8	4	2.15	0.68-3.63	4	1.99	0.62-3.35	1968-2000
Circulatory chapter	208	170	1.22	1.06-1.39	188	1.11	0.96-1.26	1950-2000
Ischaemic	142	118	1.21	1.01-1.41	129	1.10	0.92-1.28	1950-2000
Stroke	32	25	1.25	0.82-1.69	28	1.12	0.73-1.51	1950-2000
Respiratory chapter	47	29	1.63	1.17-2.10	32	1.46	1.04-1.88	1950-2000
Digestive chapter	27	15	1.79	1.11-2.47	16	1.64	1.02-2.26	1968-2000
External chapter	72	39	1.84	1.42-2.27	42	1.73	1.33-2.13	1950-2000
Suicide	20	11	1.93	1.09-2.77	11	1.81	1.02-2.59	1950-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D17: Mortality of Army veterans who served in Korea after 1952 (period 3)

	Scenario 1 (excluding veterans whose status is unknown)				Scenario 2 (including veterans whose status is unknown)			
Cause of Death	**Observed number**	**Expected number[1]**	**SMR[2]**	**95% confidence interval**	**Expected number**	**SMR[2]**	**95% confidence interval**	**Period examined[3]**
All deaths	3436	2602	1.32	1.28-1.36	2884	1.19	1.15-1.23	1950-2000
Neoplasm chapter	1124	796	1.41	1.33-1.49	884	1.27	1.20-1.35	1950-2000
Lung cancer	384	228	1.68	1.51-1.85	253	1.52	1.37-1.67	1950-2000
Prostate cancer	70	57	1.23	0.94-1.51	65	1.07	0.82-1.33	1950-2000
Colo-rectal cancer	127	106	1.21	1.00-1.42	117	1.09	0.90-1.28	1950-2000
Head and neck cancer[4]	51	25	2.03	1.47-2.59	27	1.85	1.34-2.36	1968-2000
Circulatory chapter	1285	1062	1.21	1.14-1.28	1180	1.09	1.03-1.15	1950-2000
Ischaemic	870	735	1.18	1.10-1.26	815	1.07	1.00-1.14	1950-2000
Stroke	197	158	1.25	1.07-1.42	177	1.11	0.96-1.27	1950-2000
Respiratory chapter	268	179	1.50	1.32-1.68	200	1.34	1.18-1.50	1950-2000
Digestive chapter	143	97	1.48	1.24-1.72	107	1.34	1.12-1.56	1968-2000
External chapter	410	259	1.58	1.43-1.73	280	1.46	1.32-1.61	1950-2000
Suicide	117	71	1.65	1.35-1.95	76	1.53	1.25-1.80	1950-2000

[1] Expected deaths calculated using Australian male 5-year age groups and single calendar years
[2] Standardised mortality ratio (SMR) = Observed deaths / expected deaths
[3] Period examined is restricted by the availability of community rates
[4] Head and neck cancer includes cancers of the tongue, salivary gland, gum, mouth, oropharynx, nasopharynx and hypopharynx

Table D18: Results of Cox Proportional Hazard modelling: Hazard Ratio by months of service

Group	No. analysed Veterans (deaths)	Hazard Ratio	Standard error	Chi Square	p value
All	16366 (7507)	**1.006**	0.002	5.766	**0.022**
Navy	5480 (2224)	0.992	0.006	1.797	0.170
Army	9757 (4791)	1.001	0.003	0.056	0.840
Air Force	1129 (492)	0.991	0.011	0.664	0.406

Appendix E: Location of surviving Korean veterans

E.1 Introduction

This section describes the geographic location of Australian veterans of the Korean War for whom a residential address had been identified as at 31 December 1999. Places of residence for these veterans were determined by the postcode recorded on the electoral roll for each individual.

The information has been mapped by shading each postcode area according to the frequency groupings of inhabitants shown in the legend. Postcode areas differ considerably in size and shape, as can be seen on the maps and some postcode areas contain non-residential areas, such as businesses, recreational facilities and parks.

The postcodes for 130 veterans known to be alive in December 1999 could not be mapped because the postcode given for those veterans is that for a Post Office box or is otherwise not connected with an identifiable geographical location. In the case of a further 70 veterans, no postcode was available because the current address could not be found or because the veteran was known to be living overseas.

E.2 Australia

Table E-1 shows the numbers of surviving Korean War veterans for whom a current address has been identified by state of residence. New South Wales and Queensland have the highest number of veterans at 36.4 per cent and 23.1 per cent respectively. The table also shows that 80.2 per cent of Korean War veterans live in the eastern mainland states. The table also illustrates that proportionally more Korean War veterans live in Queensland and the ACT when compared to Australian males 65 years or older. Conversely, proportionally less Korean War veterans live in Victoria and South Australia than non-veteran counterparts.

The veteran population distribution has been compared with the distribution of Australian males because of the low number of female veterans who served in Korea during the Korean War. The Nominal Roll includes 58 female veterans, of whom only 37 are known to be alive.

Table E-1: Living Korean War veterans by State of residence – 31 December 1999

State	Number	Per cent	Percent of Australian males 65 years and older[1]
NSW	3,157	36.4	34.9
QLD	2,004	23.1	17.7
VIC	1,566	18.0	25.5
WA	902	10.4	8.6
SA	489	5.6	9.1
TAS	279	3.2	2.7
ACT	231	2.7	1.1
NT	55	0.6	0.4
	8,683	100.0	100.0

Further discussion in this Chapter on veteran demographics uses a classification of "Rural and Remote Areas" (RARA) first developed in 1991 by the then Commonwealth Departments of Primary Industries and Energy and Human Services and Health. This was revised in 1994 to include categories of "capital city" and "other metropolitan area" and is now known as the "Rural, Remote and Metropolitan Area" (RRMA) classification system. The RRMA categorises all "statistical local areas" (SLAs) in Australia according to their remoteness.

The boundaries of SLAs are determined by the Australian Bureau of Statistics (ABS). SLAs can be further aggregated into "statistical divisions" to provide a regional overview, although this level had not been used in the current analysis.

The RRMA classification system uses the following definitions:

Capital Cities:	State and Territory capital city statistical divisions as defined by the ABS;
Other Metropolitan Areas:	Statistical subdivisions which include urban centres of population of 100,000 or more;
Large Rural Centres:	SLAs where most of the population reside in urban areas of population of 25,000 or more;
Small Rural Centres:	SLAs in rural zones containing urban centres of population between 10,000 and 24,999;
Other Rural Areas:	Remaining SLAs within the rural zone with a population less than 10,000;
Remote Centres:	SLAs in the remote zone containing urban centres of population of 5,000 or more; and
Other Remote Areas:	Remaining SLAs within the remote zone with a population less than 5,000.

Table E-2 shows the numbers of surviving Korean veterans for whom a current address has been identified, by RRMA category. In addition to their concentration in the eastern states, veterans are predominantly urban metropolitan dwellers, with 66.8 per cent living in the State and Territory capitals or other metropolitan areas. This corresponds to the Australian population in which 64.4% of those 65 years or older live in capital cities or other metropolitan areas.[2]

Table E-2: Living Korean War veterans by RRMA classification

Category	Number	Per cent
Capital City	4,969	57.2
Other Metropolitan Areas	832	9.6
Large Rural Centres	585	6.7
Small Rural Centres	862	9.9
Other Rural Areas	1,273	14.7
Remote Centres	67	0.8
Other Remote Areas	78	0.9
Unknown	17	0.2
	8,683	100.0

E.3 NSW and ACT

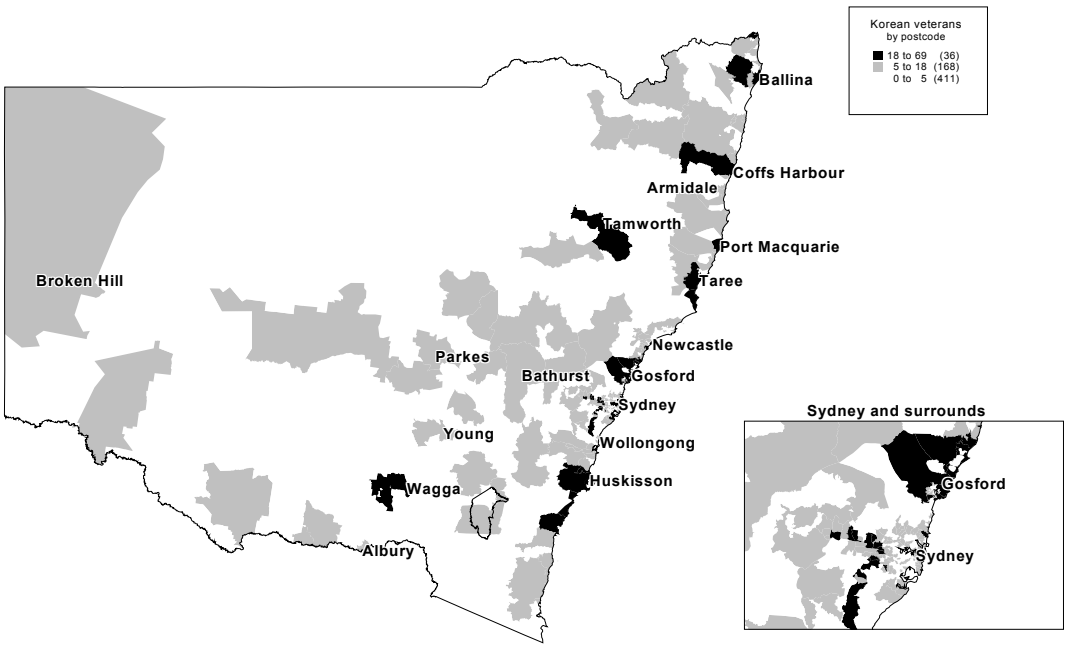
Of the 3,157 Korean War veterans residing in NSW 2,087 (66.1% per cent) live in the Sydney metropolitan or other metropolitan areas (Table E-3).

Table E-3: New South Wales Korean War veterans by RRMA classification

Category	Number	Per cent
Capital City	1,633	51.7
Other Metropolitan Areas	454	14.4
Large Rural Centres	191	6.0
Small Rural Centres	402	12.7
Other Rural Areas	447	14.2
Other Remote Areas	21	0.7
Unknown	9	0.3
	3,157	100.0

Map E-1 shows the numbers of veterans resident in New South Wales by residential postcode. In Sydney, veterans live throughout the metropolitan region, but with concentrations in the western and south-western suburbs.

Map E-1



New South Wales - location of surviving male Korean veterans by postcode, 31 December 2000

Significant concentrations are located in a band stretching from Blacktown and Penrith through Fairfield, Cabramatta and Liverpool to Casula and Moorbank. The Campbelltown, Appin area and south to the southern tablelands also include significant numbers of veterans, as do the south-western suburbs of East Hills, Revesby, Picnic Point and Lugarno, along the Georges River. Many of these suburbs would have been growth areas during the 1960s and

1970s, and would also have been convenient for access to the Holsworthy Army Base during that period.

Lower numbers of veterans are located in various Sydney beach suburbs from Port Hacking and Cronulla north towards Gosford.

Outside Sydney, the most striking concentration of Korean War veterans is located in the Gosford/Wyong region. The postcodes from 2250 to 2263, incorporating, among other locations, Gosford, Avoca Beach, Woy Woy, Umina, Wyong, Terrigal, The Entrance and Norah Head, contain 267 veterans, or 8.5 per cent of the NSW total.

Smaller concentrations are grouped north to and within Newcastle, while other significant groups are located further north at Taree, Port Macquarie, Kempsey, Coffs Harbour, Ballina and Lismore. Of note, the area around Tweed Heads and south of the Gold Coast, covered by postcodes 2485 to 2487, contains a further 77 veterans, the most concentrated group in the north coast.

Significant concentrations of veterans are also located on the NSW south coast. In particular, postcode 2540 (Huskisson, Jervis Bay, Sussex Inlet, etc) with 69 veterans, contains the equal highest number of veterans of any postcode in Australia. Coincidently, the other postcode with this number of Korean War veterans (6210), covering Mandurah, etc in Western Australia, is also in reasonable proximity to a Naval base, although both have also been popular tourist areas for some time.

Overall, 219 (6.9 per cent) veterans live within areas covered by postcodes along the south coast from Kiama to Moruya (2533 to 2541). This region includes Nowra and a number of popular tourist areas, including Batemans Bay, Mollymook and Ulladulla.

Map E-2

Australian Capital Terrirtory - location of surviving male Korean veterans by postcode, 31 December 2000

Table E-4: Australian Capital Territory veterans by RRMA classification

Category	Number	Per cent
Capital City	231	100.0
Other	0.0	0.0
	231	100.0

Map E-2 shows the numbers of veterans resident in the Australian Capital Territory by residential postcode. Table E-4 shows that there are no veterans living in the ACT classified as living outside the metropolitan area. As with the Sydney western suburbs, veterans tend to be grouped in suburbs that were popular growth areas during the 1960s and early 1970s. In particular, these include Ainslie, Dickson, Downer and Lyneham in the north and Curtin, Garran, Hughes, Mawson, etc in the Woden area. The Weston Creek suburbs are also well represented. Among the Belconnen suburbs, surprisingly, the outer suburbs of Charnwood, Flynn, Higgins, etc (postcode 2615), with 25 veterans, appear to be the most popular, with the closer Belconnen suburbs covered by postcodes 2614 and 2617 having a combined total only four higher.

E.4 Queensland

Map E-3 shows the numbers of veterans resident in Queensland by postcode. Of the 2,004 Korean War veterans residing in Queensland, 936 (46.7 per cent) live in the Brisbane metropolitan region (Table E-5). Numbers are spread widely throughout the metropolitan region, with larger numbers more common in the outer suburbs. Within the metropolitan area, 72 veterans are located in postcodes representing Amberley and Ipswich (4300 to 4306).

Map E-3

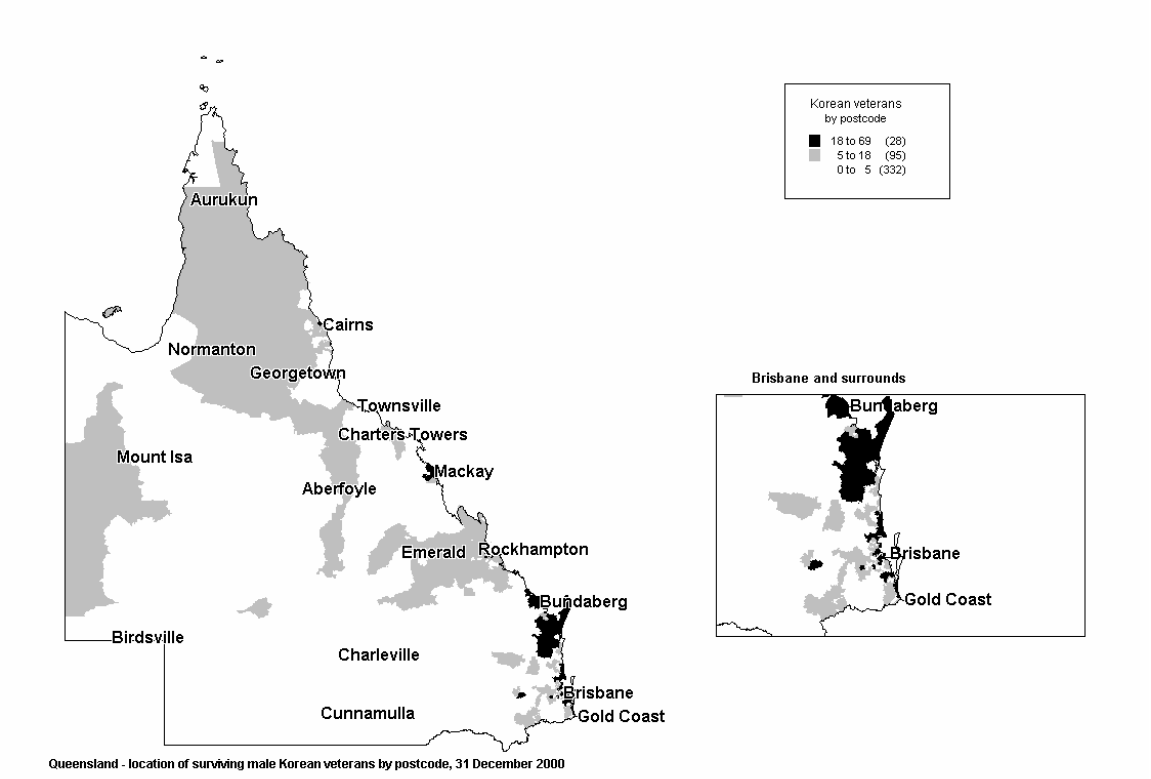


Table E-5: Queensland Korean War veterans by RRMA classification

Category	Number	Per cent
Capital City	936	46.7
Other Metropolitan Areas	319	15.9
Large Rural Centres	251	12.5
Small Rural Centres	179	8.9
Other Rural Areas	268	13.4
Remote Centres	28	1.4
Other Remote Areas	20	1.0
Unknown	3	0.1
	2,004	100.0

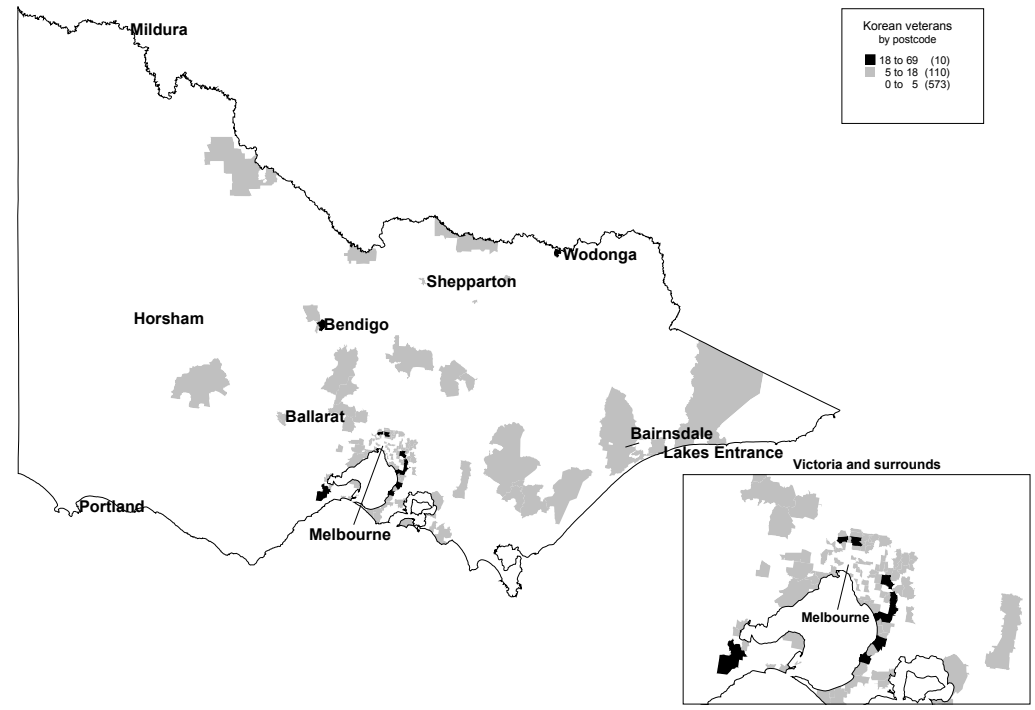
Outside the Brisbane metropolitan area, the next largest group live in the Southport to Coolangatta and Gold Coast hinterland area. There are 316 (15.8 per cent) veterans living in areas covered by postcodes 4205 to 4285. A further 201 (10.0 per cent) live in the Sunshine coast region in areas covered by postcodes 4550 to 4580. Some 117 (5.8 per cent) live in the region south of the Sunshine coast towards Brisbane, in the Bribie Island, Caboolture area covered by postcodes 4505 to 4510.

These numbers highlight the extent to which Queensland veterans are concentrated in the south-east corner of the State. The Brisbane metropolitan area and the regions identified above account for 1,570 veterans or 78.3 per cent of all Korean War veterans living in that State. Outside these areas, smaller numbers of veterans live in Toowoomba and the Darling Downs area, the Fraser Island/Hervey Bay area and the coastal cities from Bundaberg to Cairns.

E.5 Victoria

Map E-4 shows veterans by postcode and Table E-6 shows the numbers by RRMA classification. Melbourne has the highest concentration of Korean War veterans in Victoria, with 1,011 Korean veterans (64.6 per cent) living in the metropolitan area.

Map E-4



Victoria - location of surviving male Korean veterans by postcode, 31 December 2000

Table E-6: Victoria Korean War veterans by RRMA classification

Category	Number	Per cent
Capital City	1,011	64.6
Other Metropolitan Areas	59	3.8
Large Rural Centres	97	6.2
Small Rural Centres	113	7.2
Other Rural Areas	277	17.7
Other Remote Areas	8	0.5
Unknown	1	neg
	1,566	100.0

An examination of numbers by postcode reveals that, in common with Sydney, many veterans tend to be located out from the city centre in areas that are likely to have been growth areas during the 1960s and 1970s. However, a concentration of Korean War veterans is located along the eastern side of Port Phillip Bay and, in particular, within the Mornington Peninsula.

Outside the metropolitan area, Geelong with 56 veterans (postcodes 3214 to 3221) has the second largest concentration. Among other regional areas, Bendigo (35 veterans) and Ballarat (28 veterans) are also notable.

A further identifiable grouping of veterans is in the region from the Latrobe Valley to Lakes Entrance. This area was a significant source of employment during the post-Korean War period arising initially from the growth in demand for brown coal generated power and later with the development of the Bass Strait oil fields.

E.6 Western Australia

Of the 902 veterans residing in Western Australia, 651 (72.2 per cent) live in the Perth metropolitan area (Table E-7). This is the highest percentage of veterans living in a metropolitan area in Australia, outside the Australian Capital Territory. Map E-5 shows the numbers of veterans by their residential postcode. The insert map, 'Perth and surrounds', shows that the higher concentrations of veterans occur in a ring of postcodes which surrounds the city centre and the inner postcodes.

Map E-5

Western Australia - location of surviving male Korean veterans by postcode, 31 December 2000

Table E-7: West Australian Korean War veterans by RRMA classification

Category	Number	Per cent
Capital City	651	72.2
Small Rural Centres	115	12.7
Other Rural Areas	89	9.9
Remote Centres	25	2.8
Other Remote Areas	19	2.1
Unknown	3	0.3
	902	100.0

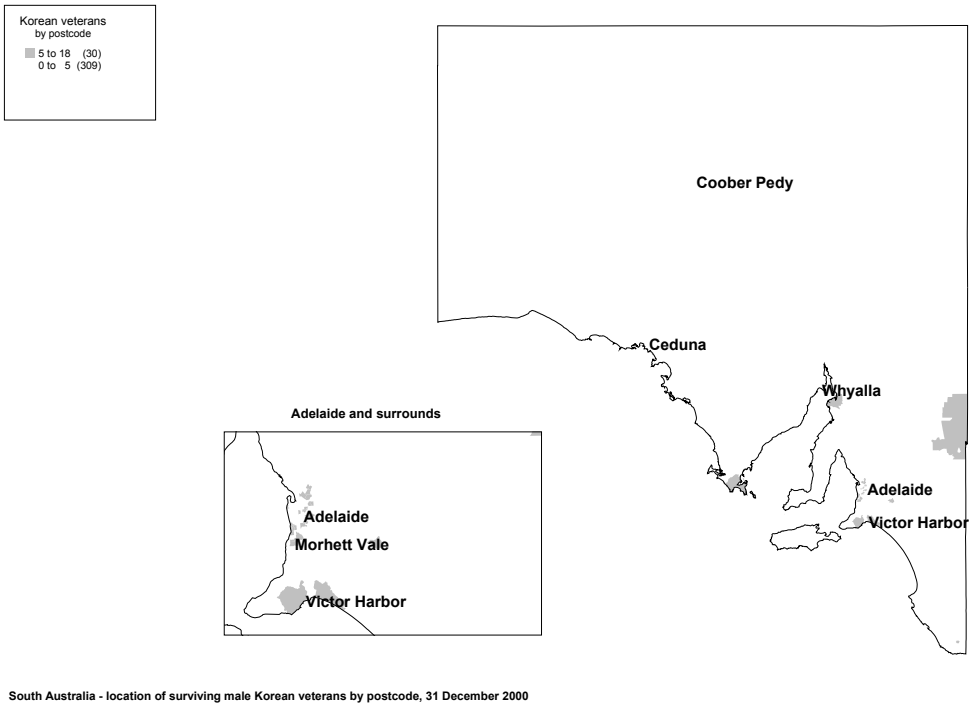
South of the city, 69 veterans (the equal highest for any postcode in Australia) live in the postcode of Mandurah (6210) and a further 53 live in the postcodes 6168 and 6169, covering Rockingham, Garden Island, Safety Bay, Waikiki, Warnbro, etc. Postcodes covering the general south-west region, from Collie and Bunbury through Busselton to Albany and including Narrogin and Beverley (6225 to 6330) account for a further 77 veterans.

Small numbers of Korean War veterans live in Geraldton, Carnarvon, Esperance and Kalgoorlie/Boulder. Few veterans live in the remaining areas of the State.

E.7 South Australia

Of the 489 veterans residing in South Australia, 340 (69.5 per cent) live in the Adelaide metropolitan area. A further 111 (22.7 percent) live in "other rural areas", ie SLAs with populations below 10,000 (Table E-8).

Map E-6



South Australia - location of surviving male Korean veterans by postcode, 31 December 2000

Table E-8: South Australia Korean War veterans by RRMA classification

Category	Number	Per cent
Capital City	340	69.5
Large Rural Centres	5	1.0
Small Rural Centres	28	5.7
Other Rural Areas	111	22.7
Other Remote Areas	5	1.0
	489	100.0

Map E-6 shows the numbers of veterans by residential postcode. The insert map, 'Adelaide and surrounds', shows veterans living predominantly in postcodes which extend in a band that runs northeast from the city, including Salisbury and in the postcodes which surround the southern suburb of Morphett Vale.

On an individual postcode basis, lesser, but still significant numbers are in suburbs ranging from Glenelg and Brighton on the coast, through Marion, Mitcham in the South to Burnside on the fringes of the Mount Lofty Ranges.

Around Salisbury and in the band to the northeast, there are concentrations in the postcodes which either adjoin or have ready access to the Edinburgh RAAF Base or the Defence

Research Centre near Salisbury. However, there are now no Korean War veterans recorded against the Edinburgh postcode (5111).

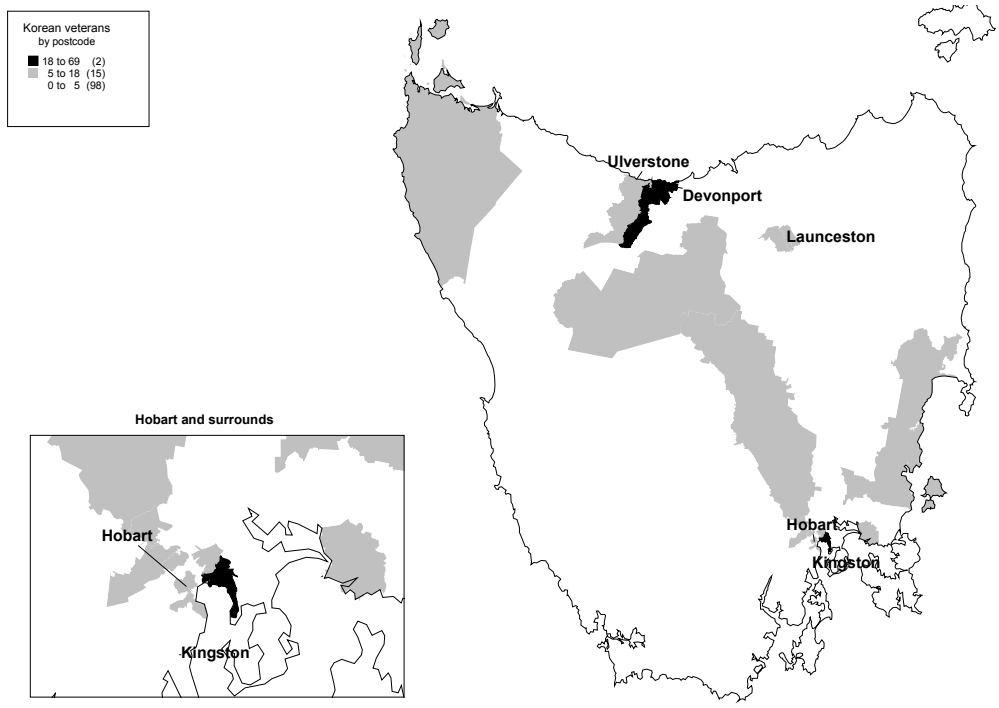
Outside Adelaide, veteran populations largely reflect the general State population. Regional groupings include:

- Murray Bridge and the Lake Alexandrina area including Victor Harbour, Goolwa and Murray Bridge;
- The Murray River region around Waikerie and Renmark;
- The lower south-eastern region around and including Mt Gambier and Millicent; and
- The Port Lincoln, Tumby Bay area at the southern end of the Eyre Peninsula.

E.8 Tasmania

Of the 279 veterans living in Tasmania, 133 (47.7 per cent) live in the Hobart metropolitan area (Table E-9 and Map E-7).

Map E-7



Tasmania - location of surviving male Korean veterans by postcode, 31 December 2000

Table E-9: Tasmania Korean War veterans by RRMA classification

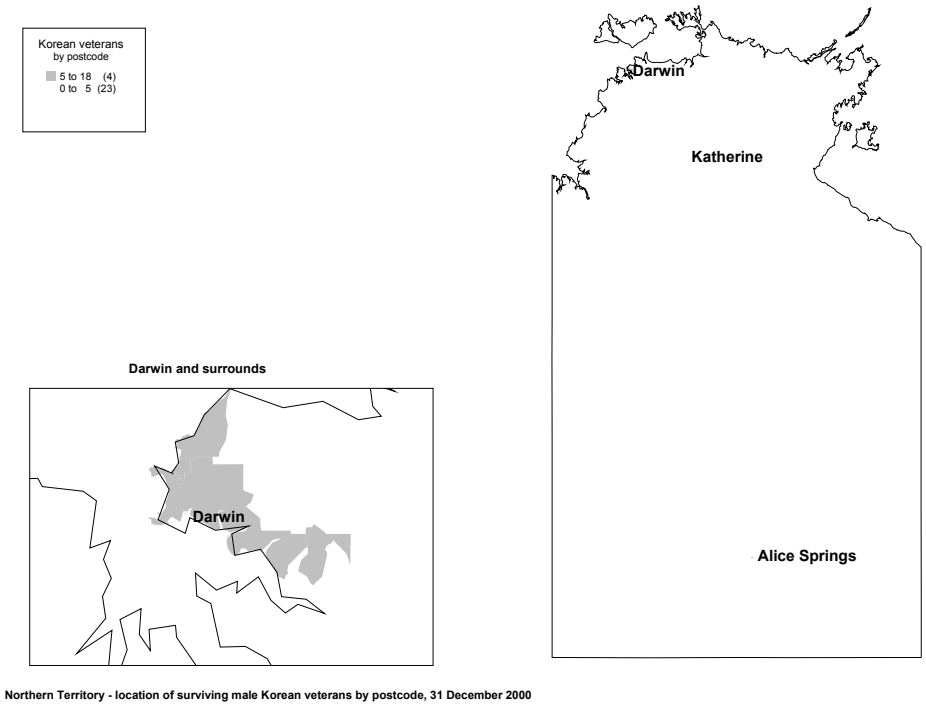
Category	Number	Per cent
Capital City	133	47.7
Large Rural Centres	41	14.7
Small Rural Centres	25	9.0
Other Rural Areas	78	28.0
Other Remote Areas	2	0.7
	279	100.0

Outside the Hobart area, significant concentrations of Korean War veterans are centred around Launceston and Devonport and their surrounding districts. Smaller numbers of veterans live in north coast towns from Ulverston to Smithton, along the east coast, and in rural centres along the Midland Highway between Hobart and Launceston.

E.9 Northern Territory

The Northern Territory has the lowest number of veterans, with 55 (0.6 per cent). Their distribution shows the same urban/rural split as found in the other States (Table E-10). The Darwin metropolitan area has 34 (61.8 per cent) of the Northern Territory veterans (Map E-8). A further 13 (23.6 percent) live in Alice Springs and surrounding regions (postcode 0870).

Map E-8



Northern Territory - location of surviving male Korean veterans by postcode, 31 December 2000

Table E-10: Northern Territory Korean War veterans by RRMA classification

Category	Number	Per cent
Capital City	34	61.8
Other Rural Areas	3	5.5
Remote Centre	14	25.5
Other Remote Areas	3	5.5
Unknown	1	1.8
	55	100.0

E.10 Discussion

Surviving Australian male veterans of the Korean War are similar to the Australian population in living predominantly on the coast of the eastern states. They are generally urban metropolitan dwellers with approximately 57 per cent living in the State and Territory capitals. Within each metropolitan area, veterans tend to live in postcodes covering areas that would have been outer/developing suburbs during the 1960s and 1970s, relatively few live in the city centre or the adjoining inner suburbs.

Where veterans are living outside the metropolitan areas, many have settled in popular retirement areas. These include:

- the NSW North and South coasts;
- the Mornington Peninsula in Victoria; and
- the Gold Coast and Sunshine Coast regions of Queensland.

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1. Australian Bureau of Statistics. Population by age and sex, cat.no. 3201.0. Canberra: Australian Bureau of Statistics, 2001.
2. Australian Bureau of Statistics. Older People, Australia: A social report, cat.no. 4109.0. Canberra: Australian Bureau of Statistics, 1999.

Appendix F: Membership of the Consultative Committee

Chair

Major General J P Stevens AO (RL)
(Repatriation Commissioner to 24 August 2003)

Members

Commander K M Barnett RAN (Retd)
(Australian Veterans and Defence Services Council)

Rear Admiral I M Crawford AO AM(Mil)
(Regular Defence Force Welfare Association)

Wing Commander R C Cresswell DFC (Retd)
(RAAF Association)

Mr S Gellatly (from July 2001)
(Korea and South East Asia Forces Association of Australia)

Mr M Rennie OAM (to July 2001)
(Korea and South East Asia Forces Association of Australia)

Mr D Gibson PSM
(Central Army Records Office, Department of Defence)

Mr N Goldspink MBE (from December 2000)
(Returned & Services League of Australia Limited)

Dr J Bradley (to November 2000)
(Returned & Services League of Australia Limited)

Dr J Henderson (from March 2002)
(Korea War Veterans Association, NSW Inc)

Mr J Callaghan (from February 2000 to July 2001)
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Mr V Lowe (to February 2000 and from July 2001 to March 2002)
(Korea War Veterans Association, NSW Inc)

Mr W Hindson MC MG (from July 2001)
(Australian Federation of Totally and Permanently Incapacitated Ex-Servicemen and Women)

Mr C Doust JP (from September 2000 to July 2001)
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Brigadier A Garland AM (RL) (from October 1999 to September 2000)
(Australian Federation of Totally and Permanently Incapacitated Ex-Servicemen and Women)

Mr W Weir OAM (to October 1999)
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Major General J C Hughes AO DSO MC (Retd)
(RAR Association)

Professor P Kincaid-Smith AC CBE
(Chair, Study Scientific Advisory Committee)

Mr G A H Lang
(Association of Queensland Korean Veterans Incorporated)

Mr J Manley OAM
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Colonel A M McDonald
(Korean Veterans Association of Australia Inc)

Mr I Street (from July 1999)
(Korean Veterans Tasmania)

Mr G Keep (to July 1999)
(Korean Veterans Tasmania)

Ms P Stevenson (from April 2003)
(Branch Head, Defence Links, Department of Veterans' Affairs)

Mrs H Parry (from July 2002 to April 2003)
(Branch Head, Defence Links, Department of Veterans' Affairs)

Mr A Edgar (from October 2001 to June 2002)
(Branch Head, Defence Links, Department of Veterans' Affairs)

Mr M Johnson (from August 2001 to October 2001)
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Mr N Bayles (from October 2000 to July 2001)
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Mr W Maxwell (to October 2000)
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Appendix G: Membership of the Study Scientific Advisory Committee

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(Steering Committee representative)
Korean Veterans Association of Australia Inc

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