

# *Australian Gulf War Veterans'* HEALTH STUDY 2003

*Executive  
Summary*



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# Executive summary

## Introduction

The Australian Gulf War Veterans' Health Study is the first comprehensive health study of a group of Australian War veterans involved in a single theatre of war. It has been conducted by a collaborative medical research team from the Department of Epidemiology & Preventive Medicine at Monash University, Health Services Australia Ltd, the University of Western Australia, and The Australian Centre for Posttraumatic Mental Health at the University of Melbourne.

A Scientific Advisory Committee, chaired by Professor Terry Dwyer, oversaw the study. A Consultative Forum, with representatives from several veteran and service bodies, was established to provide a link between the study team and the veteran and service communities. The membership of the Scientific Advisory Committee and Consultative Forum are detailed in chapter 5 of this report. The study was approved by the Ethics Committees of Monash University, the Department of Veterans' Affairs and the Department of Defence. The Ethics Committee of the Australian Institute of Health and Welfare oversaw approval of the cohort study of mortality and cancer.

This study was prompted by several factors. These include the results of several overseas studies, which had shown that the Gulf War veterans from coalition partner countries, such as the USA and UK, were reporting poorer than expected health. There was concern that some of the exposures and experiences unique to the Gulf War, such as the possible exposure to depleted uranium, chemical or biological weapons, anti-biological warfare medications, or smoke and oil from burning oil wells, may have resulted in health problems among Australian Gulf War veterans. In addition, there had been reports among Australian Gulf War veterans of a wide range of medical problems with no clear explanation.

## Study aims

The Australian study was designed to investigate whether Australian Defence Force personnel who served in the Gulf War have a higher than expected rate of several adverse physical and psychological health effects and, if so, whether these effects are associated with exposures and experiences that occurred in the Gulf War. The specific research questions were:

1. Do Australian Gulf War veterans have an increased risk of psychological disorders including depression, anxiety and substance disorders and, if so, are these associated with exposures and experiences that occurred in the Gulf War?
2. Do Australian Gulf War veterans have increased prevalences of symptoms, symptom clusters and medical conditions, related to several body systems; in particular psychological, respiratory, neurological, musculoskeletal and skin and, if so, are these associated with exposures and experiences that occurred in the Gulf War?
3. Do Australian Gulf War veterans have an increased prevalence of chronic fatigue syndrome and, if so, is this associated with exposures and experiences that occurred in the Gulf War?
4. Do Australian Gulf War veterans have significantly poorer lung function than expected and, if so, is this associated with exposures and experiences that occurred in the Gulf War?

5. Do Australian Gulf War veterans have an increased prevalence of laboratory test results that are indicative of adverse health effects, including evidence of increased rates of markers of infection; and if so, are these associated with exposures and experiences that occurred in the Gulf War?
6. Do Australian Gulf War veterans have increased risk of having a child with a major congenital malformation, a child who later develops cancer or an increased risk of fertility difficulties, following return from the Gulf? If so, are these associated with exposures and experiences that occurred in the Gulf War?
7. Do Australian Gulf War veterans have increased rates of mortality and cancer?

## **Methods**

The study compared the health of Gulf War veterans with that of a comparison group. The comparison group was randomly selected from members of the Australian Defence Force (ADF) who were eligible to be deployed to the Gulf War, but who were not deployed.

Attempts were made to contact all 1873 Gulf War veterans on the Gulf War Nominal Roll, and all selected comparison group members, to invite them to take part in the study. Subjects who could be contacted, and who gave informed consent to take part in the study, were asked to complete a lengthy postal questionnaire. This included several standardised questionnaires such as the Short-Form-12 Health Survey (SF-12) and the 12 item General Health Questionnaire (GHQ-12) and also contained questions about several aspects of physical, psychological and reproductive health, civilian occupational history, military and service history including all active deployments. Questions on Gulf War exposures and experiences included immunisations, medications against nerve gas agents, stressful military experiences, psychological stressors, smoke and oil clouds from the burning oil wells (SMOIL) and pesticides.

Participants were also asked to attend one of ten Health Services Australia medical clinics around Australia to undertake a comprehensive health assessment by teams comprising a doctor, nurse and psychologist, who were specifically trained for the study. The assessment included tests of lung function, skin testing for allergy, several blood tests, a fitness step test to assess fatigue, a full physical examination, more questionnaires relating to respiratory health and chronic fatigue, and an interviewer administered psychological assessment using the Composite International Diagnostic Interview (CIDI). All the blood samples were analysed at the Institute for Medical and Veterinary Science in Adelaide.

## **Recruitment, demographics and non-Gulf War exposures**

At the end of recruitment in April 2002, 1456 Gulf War veterans had taken part, which was 80.5% of those eligible. Of the eligible members of the comparison group, 1588 took part (56.8%). More than 85% of participating Gulf War veterans and more than 70% of participating comparison group subjects were from the Navy, and approximately two thirds of participants were no longer serving members of the Australian Defence Force. There were very few women in either participating group, representing less than 2.5% of all participants. Therefore, in this report, the results are presented separately for male and female participants.

When the male Gulf War veterans were compared to the comparison group on several demographic, socioeconomic and lifestyle factors, the two groups were found to be very similar. There were some slight differences in relation to age, education and rank patterns, and pack years of smoking. Where applicable, subsequent health outcomes analyses were

statistically adjusted for these factors to ensure they were not the explanation for differences in health status found between the two groups.

## **Gulf War and other exposures**

Gulf War veterans reported experiencing several chemical and environmental exposures, psychological stressors, immunisations and preventive medications in relation to the Gulf War. Amongst these, the most frequently reported exposures were typhoid and cholera immunisations; taking pyridostigmine bromide tablets (Nerve Agent Pre-treatment Set or NAPS); psychological stressors such as being in fear of death or injury, under threat of biological or chemical attack and being in a hostile environment; and chemical and environmental exposures such as solvents, fuel, dust storms, and the uncomfortable use of personal protective equipment.

Some exposures appear unique to the Gulf War military experience compared with other deployments or military activities, such as taking NAPS tablets and exposure to smoke and oil from burning oil wells (SMOIL). There were several exposures that veterans reported experiencing much more commonly during the Gulf War than during other deployments. These included possible exposure to depleted uranium, threat of chemical warfare and consequent use of protective clothing. These veterans also reported experiencing fearful situations more commonly during the Gulf War than during other military activities.

In relation to non-Gulf War exposures, male Gulf War veterans were a little more likely than the comparison group to have experienced one or more active deployments other than the Gulf War. Gulf War veterans and comparison group subjects who had been on other active deployments were similar in relation to the exposures and experiences reported for those non Gulf War deployments. The Gulf War veterans and the comparison group were also similar in relation to the exposures and experiences reported during other military activities and any civilian occupations.

## **Summary of health findings**

The most striking and consistent health finding in the study was that the Gulf War veteran group had developed more psychological disorders than the comparison group in the time since the Gulf War. The Gulf War veterans were also more likely to have persisting psychological symptomatology in the twelve months or four weeks prior to the study. The greatest increase in risk was for posttraumatic stress disorder, but other anxiety disorders, depression and substance use disorders including problem drinking were also more common in the Gulf War group. Within the Gulf War veteran group, the risk of psychological disorders increased as the number of reported adverse military experiences related to the Gulf War increased. The increased risk of psychological disorders was only slightly reduced when Gulf War veterans were compared with comparison group subjects who had also been on an active deployment. The effect of Gulf War service on psychological health, therefore, can not be fully explained as representing a 'deployment effect'.

Another major finding was that Gulf War veterans reported all of the general health symptoms more commonly than the comparison group. Further, Gulf War veterans were more likely to report a higher number of symptoms and to report symptoms that were more severe in nature. Neuropsychological and musculoskeletal symptoms were amongst the symptoms most commonly reported. When this increased symptom reporting was examined further using factor analysis to identify patterns of grouped symptoms, three groups of symptom "factors" were identified. They were groups of psychophysiological, cognitive and

arthro-neuro-muscular symptoms. However, these three groups of symptoms were very similar to the groups of symptoms found in the comparison group, suggesting that there was no unique pattern of symptom reporting in Gulf War veterans despite their higher rate of symptom reporting.

Gulf War veterans reported many medical conditions that had been diagnosed in 1991 or since (ie since the Gulf War) more commonly than the comparison group. The more commonly reported medical conditions in the Gulf War group related to back and other joint problems, skin and psychological disorders. When the reported medical conditions were restricted to those assessed by an HSA doctor as being 'probable' or 'possible' diagnoses, to improve the accuracy of diagnosis, the risks in the Gulf War veteran group remained elevated. Gulf War veterans were found to have a very low reporting rate of medical diagnoses, which were subsequently assessed as non-medical or unlikely, and similar rates as the comparison group, suggesting little over-reporting of these conditions by Gulf War veterans.

Self-perceived mental health status, as measured by the SF-12 and GHQ-12, was poorer in Gulf War veterans compared with the comparison group. Physical health status, again as measured by the SF-12, was also poorer however the difference between the two groups was not as marked. The reporting of health status by Gulf War veterans, according to other physical health indicators, was not consistently in the poorer direction. Gulf War veterans reported increased functional impairment but not increased current use of medication or increased hospitalisation. The groups were very similar on a range of physical health measurements, such as blood pressure, body mass index, waist-to-hip ratio and a fitness test.

The total number of symptoms reported, the physical and mental health measures using the SF-12 and functional impairment were associated in a similar pattern with several self-reported exposures that occurred in the Gulf War. These included 10 or more immunisations, stressful military service experiences, pyridostigmine bromide tablets, anti-biological warfare tablets, pesticides/insecticides and report of being in a chemical weapons area. General health symptoms, but not the SF-12 measures, were also associated with reported exposure to insect repellents. None of these health outcomes was associated with reported exposure to depleted uranium or to clusters of immunisations.

A wide range of laboratory investigations was undertaken. These included tests of the blood cells, function of the liver, function of the kidneys, biochemical indicators in the blood, measures of chronic inflammation and indicators of previous infections. While some of the Gulf War veterans' results were outside the expected range on many of these tests, a similar pattern was found in the comparison group. A greater proportion of Gulf War veterans had raised creatinine and sodium concentrations in the biochemical investigations, suggesting possible kidney disease, but the number of subjects affected was small and the clinical significance of this finding was uncertain. There was no unique pattern of blood test abnormalities in the Gulf War veteran group.

Gulf War veterans were more likely to report neuropathic symptoms than the comparison group but the medical examination of the neurological system, the findings of which were used to derive a 'neuropathy impairment score', showed little difference between the two study groups. However, analyses using combinations of neurological symptoms and medical examination findings were suggestive of an increased risk of a neuropathic disorder in Gulf War veterans. This is not able to be confirmed without further testing, such as nerve conduction studies. The reporting of neuropathic symptoms was associated with some

exposures that occurred in the Gulf War including immunisations, NAPS, antimalarials, solvents, repellents and pesticides.

Gulf War veterans were more likely than the comparison group to report respiratory symptoms, such as wheeze, cough, and shortness of breath, and wheeze was also a more common finding on physical examination in Gulf War veterans. Lung function testing using spirometry revealed no consistent differences between the two groups. In Gulf War veterans, no consistent association was found between abnormal respiratory health and reported exposure to the smoke and oil from the burning oil wells.

Gulf War veterans reported, or were assessed as having, all fatigue-related health outcomes more commonly than the comparison group. Chronic fatigue syndrome was defined using a recognised set of criteria for this condition. Eleven of the Gulf War veterans and only two of the comparison group met this definition. While this finding demonstrated an excess risk of developing chronic fatigue syndrome in Gulf War veterans, the numbers were too small to explore possible associated exposure factors. There was one minor difference in the immunological profile of Gulf War veterans compared with the comparison group subjects with chronic fatigue syndrome; the clinical implication of which is of uncertain significance.

Gulf War veterans were more likely than the comparison group to report difficulties with fertility following the period of the Gulf War. However, veterans with these difficulties were more likely than the comparison group to subsequently father a successful pregnancy. In the period since the Gulf War, Gulf War veterans were no more likely than the comparison group to father a pregnancy that resulted in a miscarriage, stillbirth or termination. In addition, for the live births since the Gulf War, rates of low birth weight, prematurity, reported birth defect, cancer or reported death in the children were similar for the two groups.

The mortality and cancer experience of the two groups since the time of the Gulf War was examined by matching the names against the national death and cancer registries. The numbers of deaths and cancers were small and the death and cancer rates for each group were lower than those expected in the general Australian population. When the Gulf War and comparison groups were compared with each other, there was a small excess of disease related deaths in the Gulf War group, but the numbers are too small at this stage to draw any meaningful conclusions from this. Deaths due to accident were similar in the two groups.

The health of female Gulf War veterans was considered separately from the male veterans. This was because the number of female Gulf War veterans was considerably smaller than the male veterans and health patterns in males and females differ. Of the 38 female Gulf War veterans, 32 (84.2%) took part in the study, as well as 40 of 73 (54.8%) female comparison group subjects.

Unlike male veterans, female Gulf War veterans only reported about half of the general health symptoms more commonly than the female comparison group. However, the more commonly reported symptoms, such as fatigue, headaches and irritability, were similar to those more commonly reported by their male counterparts. Of the reported medical conditions, psychological disorders were generally the conditions reported more commonly by female Gulf War veterans than by the comparison group, a similar pattern to that found in the male veterans. Female Gulf War veterans had poorer self-reported mental health, as measured using the SF-12 and the GHQ-12, than the comparison group, but were similar on the SF-12 physical health measure. Again, this was a similar pattern to that found in male participants. Female Gulf War veterans were more likely to have a CIDI diagnosed psychological disorder that was present within the previous 12 months, but were no more

likely to have a psychological disorder that was first present in the post-Gulf War period than the comparison group. Reported asthma was a little more common in the Gulf War group, but all other indicators of respiratory health were similar. No differences were found for blood pressure, body mass index, results of blood tests, neurological health, chronic fatigue syndrome or reproductive outcomes. Using the national registry searches, no female Gulf War veterans were found to have died while one was found to have developed cancer during the period of the cohort study.

Therefore, in response to the main hypothesis of the study we conclude that the psychological health and some aspects of physical health of Australian veterans of the Gulf War do differ significantly from similar Australian Defence Force personnel who were not deployed to the Gulf War. The differences in physical health primarily relate to self-reported symptoms and medical conditions rather than more objective measures of physical health.

Increased symptom reporting, increased medical condition reporting and poorer perception of health may be early indicators of more serious health outcomes occurring in the future. Increased psychological health abnormalities have also been shown to lead on to later physical health problems. The only way to assess longer term sequelae this would be to do a follow-up health study in the future, to enable comparisons to be made with the baseline data collected as part of the current study. Follow up matching studies will be needed to adequately assess rates of cancer and causes of death, as the numbers are too small at this stage to be able to investigate this in a meaningful way. Follow-up of other health disorders found in excess in Gulf War veterans, such as posttraumatic stress disorder, would be useful to document longer term outcomes of such conditions.

The analysis has also identified health outcomes, which were common in both groups and may relate to ADF service in general, and not just the Gulf War. These outcomes include musculoskeletal disorders, high body mass index and high rates of alcohol use. Therefore, the dataset and the subjects in the two groups who have taken part in the study should be seen as a unique resource, which could be used to further investigate such health patterns in ADF personnel, including veterans of other deployments. These were beyond the scope of the research questions for the present study, as they would not just relate to Gulf War service.

## **Strengths and limitations of the study**

There were several strengths of this study when compared with previous studies. Firstly, it included a comparison group, which was very similar on many characteristics that are predictive of health status, such as age and smoking status. This meant that these characteristics were unlikely to explain any differences in health between the two groups. Secondly, during the analysis we considered the effect that a lower participation rate in the comparison group may have had on our assessment of risk using two different but complementary methodological approaches. This determined that, while participation bias could not be excluded, it was unlikely to explain large differences found. A third strength was that we collected a large amount of information on exposures to allow us to explore the relationship between specific aspects of Gulf War service and health. Fourthly, we included several objective tests of health, rather than relying solely on self-reports of health from the participants themselves, which had been the main focus of many previous studies.

Another strength for this large, multidimensional study was having a large group of senior investigators with diverse expertise across a range of health research areas. In addition, the research was undertaken in a strong research environment by a study team which remained together over the almost three years of the study. This was complemented by the input of

HSA, which was able to ensure consistency in data collection through its network of health clinics throughout Australia. The study team met regularly with the Scientific Advisory Committee and Consultative Forum over the planning, data collection, analysis and reporting phases of the study.

There were however, some limitations to the study, which we were able to address to some extent. It needs to be noted that this was a cross-sectional survey undertaken at one point in time more than ten years after the Gulf War. Therefore, it is difficult to attribute the excesses in health problems with absolute certainty to this past period in the veterans' lives. Nevertheless, the inclusion of a comparison group drawn from the ranks of the ADF at the same time as the Gulf War does help to give more weight to the conclusions.

Secondly, much of the health and exposure information was reported by the veterans themselves, relying on their memory of events many years in the past, and these may not always be accurate or able to be validated. This can result in a form of recall bias, where the Gulf War veterans are more likely than the comparison group to date health outcomes to the time of the Gulf War. To address this, we undertook a validation of the reported medical diagnoses and found that the higher rates of these validated conditions in Gulf War veterans tended to persist. The level of inaccurate reporting was low, and at similar levels to that in the comparison group, suggesting that over-reporting was not a major factor. This type of validation could not be done for other health outcomes.

A third potential problem was that there were very many analyses undertaken for this study. This increases the likelihood that some apparent excesses in health risks may be found due to chance alone. To address this problem, we have tended to emphasise those findings where consistent patterns have been shown in different analyses, where these confirm similar findings in previous studies, or where there is a biologically plausible reason for the finding.

In summary, the study design for the Australian Gulf War Veterans' Health Study had several strengths over many previous studies of Gulf War veterans, which has allowed us to investigate more health outcomes, and to better assess the possible effects of Gulf War experiences and exposures. There are inevitable limitations in this type of study, but we were able to anticipate many of these and build into the study design and analysis several measures to reduce the impact of these factors. Nevertheless, factors such as participation bias and recall bias cannot be completely excluded as at least partly explaining some of the findings.

## Recommendations

While the main focus of this report has been to document the study findings in relation to the health of Gulf War veterans, we have also formulated a few key recommendations in relation to communication of the study findings, application of the findings, possible avenues for further research and measures to make such studies easier to undertake in the future. These recommendations, with some explanatory notes, are:

1. **There should be wide promotion of the study findings to the veteran and service communities, the Departments of Defence and Veterans' Affairs, the Repatriation Commission, ADF Medical Officers, the broader Australian community and the scientific community.**

The findings of this study are likely to be important factors in diagnosis and management of Gulf War veterans and in consideration of entitlements for these veterans.

2. **Consideration should be given to measures to reduce adverse psychological impacts of military service or deployment related activities on Defence Force personnel, especially in relation to better psychological preparation for the possibility of**



**chemical or biological weapons attack.**

Such weapons are likely to remain a threat in future conflicts. Having a deployed or deployable force which is psychologically better prepared, as well as more reliable systems for monitoring whether biological or chemical attack have in fact occurred, may assist in reducing the fear associated with the threat of such attack and subsequent psychological morbidity.

3. **Consideration should be given to developing a minimum health dataset collected routinely in a standardised manner on all individuals before active deployments.**  
Health status information for Gulf War veterans, which predated the Gulf War or was collected routinely at the time of deployment, would have provided extremely useful baseline data against which the health of veterans could later be compared.
4. **Consideration should be given to developing procedures for more accurately documenting exposures during active deployments.**  
One of the difficulties for our study was the paucity of accessible, well documented exposure data from the time of the Gulf War. This includes information on immunisations and preventive medications, such as pyridostigmine bromide.
5. **Consideration should be given to the further development, including validation, of the Military Service Experience questionnaire for use in practice to assess the effect of deployments and in future studies.**  
This questionnaire could become a standard measure of deployment-related stressors for ADF personnel, to be used as a predictor for psychological health outcomes and in any future psychological health intervention studies.
6. **Consideration should be given to undertaking further analyses of the dataset and/or collecting further data to address other questions raised about the impact of Gulf War service, or other aspects of military service, on health.**  
The data collected during this study is a unique resource, which could be further analysed to answer further questions in relation to the effects of Gulf War service, other deployments and other aspects of military service on health outcomes, especially where there were problems of small numbers or poor data quality. Examples are immunisations and chronic fatigue. This could be supplemented by further data collection for some health outcomes, such as peripheral neuropathy, which the study was not able to adequately address.
7. **Consideration should be given to undertaking follow-up studies, especially in relation to the cohort mortality and cancer study, but also in relation to some of the health outcomes found in excess in Gulf War veterans, such as posttraumatic stress disorder.**  
The mortality and cancer study will only start to provide useful data to investigate causes of death and different types of cancer as the cohort ages. Follow-up studies for other health outcomes, such as posttraumatic stress disorder, skin disorders and symptom reporting, found in excess in Gulf War veterans, will document the longer term outcome of these effects.
8. **A Board of Trustees should be appointed by the Repatriation Commission for the purpose of governing future access to the serum held in long-term storage.**  
The Board of Trustees should consist of members representing Monash University, the Department of Veterans' Affairs and the veteran community.