The Deployment Health Surveillance Program: vision and challenges of health surveillance for Australian military cohorts

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Abstract

The Australian Government has supported the establishment of a Deployment Health Surveillance Program for the Australian Defence Force. Although some health screening mechanisms already exist for Australian Defence Force personnel, until now health data have been used largely for clinical management at an individual level and have not been aggregated to identify trends in health and risk factors in the shorter or longer term. We identify challenges for and potential benefits of health surveillance in the military context, describe features of the Program and progress to date. Retrospective and cross-sectional projects based on deployments to the Near North Area of Influence since 1997 are under way. A planned prospective model of health surveillance for those deploying to the Middle East promises more timely attention to any emerging health problems for military personnel and veterans.

Key words: military; veterans; health surveillance; epidemiology; public health

Aust N Z Public Health. 2008; 32:529-34

doi: 10.1111/j.1753-6405.2008.00304.x

Risks to life and health of deployed military personnel during warfare and war-like operations extend beyond the immediate effects during deployment. Combat veterans returning from deployment report both a wide range of exposures and a range of physical and psychological symptoms.[1,2] An enormous historical and contemporary literature exists on health problems that occur in military populations after they experience warfare.[3] Most recently, the 1990/91 Persian Gulf conflict resulted in a surge in research into post-deployment health, and the conflicts in the Middle East have seen another wave of research into the effects of warfare on the health of military personnel and veterans.

Although there are also positive impacts of deployment experiences on health and well-being, it is the negative impacts that are of prime concern to defence forces and the public. Negative impacts may arise from non-war-like as well as war-like deployments. Members of the Australian Defence Force (ADF) have deployed increasingly on peace-keeping and disaster assistance missions in recent years. These deployments may also involve environmental threats and immediate risks to life, physical and mental health and well-being.

Post combat disorders and syndromes

Post-deployment health is an interplay of physical and psychosocial environmental factors, leading to a complex mix of physical, mental and social health outcomes. Symptoms can be associated with clearly defined disease or injury, but can also manifest as non-specific clusters of symptoms in what are known as post-combat syndromes.[2] Post-combat syndromes are not new, and have been documented after all major wars of the past two centuries, but attributed different names in different eras, for example 'shell shock' or 'Gulf War syndrome'.

Limitations due to study designs

Several large, retrospective health studies of Australian veterans have been conducted in response to concerns about health problems

Submitted: February 2008 **Revision Requested:** July 2008 **Accepted:** October 2008

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expressed by veterans.[4-7] Typically these studies compared deployed personnel to a military comparison group who had not served on the specific deployment (but may have served on others) or to the general population. Information on exposure and outcome factors was obtained from self-report questionnaires and sometimes from physical examinations. Limitations include an inability to establish causal relationships between exposures and outcomes and the unreliability of retrospective information on health hazard exposures.

Further, these studies have yielded few insights that could translate into actions to protect the health of defence personnel. Defence organisations around the world have been looking to alternative research approaches, particularly prospective surveillance, to improve the situation. For example, large prospective cohort studies have been established internationally for this purpose in the UK by Wessely and colleagues at King's College London[8] and in the US with the US Millennium Cohort Study.[9,10]

Aims of paper

In this paper we describe the Deployment Health Surveillance Program established by the Centre for Military and Veterans' Health at the University of Queensland and the University of Adelaide for the Australian Department of Defence, and discuss potential benefits and challenges of population health research in the military and post-military environment.

Health surveillance and its recognised benefits and challenges

Classically, occupation health surveillance has been understood as a program comprising strategies and methods to detect and assess systematically the adverse effects of work on the health of workers. It has also been used to include systematic assessments of fitness for work, and/or of health status that is not directly related to occupation. Surveillance may be long-term, but it can be distinguished from longitudinal research by its shorter-term utility for intervention.[11,12]

Health surveillance in the military context

Substantial physical and mental health information is commonly collected by military organisations on their personnel, including the Australian Defence Force (ADF). Health requirements must be met to enter the military, routine periodic health assessments ascertain ongoing fitness to deploy, and additional screening is undertaken after deployment.

In the ADF, various clinical surveillance programs have existed for screening purposes, some having a post-deployment focus. However, the data have been used largely at an individual level. Aggregation for determining trends at the group level has not been used routinely nor consistently across available data sources.

Internationally, in recent years defence organisations have been seeking to take advantage of methodological and technological advances in occupational and environmental surveillance to make better use of routinely collected health data. A limitation of the numerous 1990/91 Gulf War studies is that as time elapses it becomes more difficult to link deployment-related exposures to illnesses.[13] It has been argued that one of the important lessons from that conflict is that epidemiological studies should be planned before military action is contemplated.[13]

A recent systematic review identified a number of military health surveillance methods in use by 14 countries around the world.[14] These programs ranged from periodic health assessments of personnel to complex databases of medical data linked to demographic and other supporting data. Short-term programs utilised sources such as periodic medical assessments, notifiable disease and condition reports, pre and post deployment health assessments, and disease and non-battle injury reports. Few countries had implemented long-term health surveillance. Health surveillance data sources included electronic medical records (US and Netherlands), health questionnaires (Canada, New Zealand, Israel, US), disease, birth and death registries (UK, Australia, Canada, US), and follow-up beyond military service (limited cohorts in Australia, Canada, UK, US). The US Army was developing advanced IT-based surveillance systems to link deployment, serological, medical and personnel databases,[15] while the British J97 military health surveillance system was based on primary care surveillance.[16]

Both the US and Australia have taken steps toward implementing deployment related screening consisting of pre-deployment and post-deployment questionnaires which provide a simple mechanism for detecting changes in the health status of operational personnel and veterans.[17]

Background to the Australian Deployment Health Surveillance Program

In recent times, ADF personnel have deployed to a wider range of situations and conditions than many other defence forces. They have experienced active service overseas in a variety of warlike and non-warlike roles. Operations (OP) involving small or large deployments have been undertaken for a wide variety of purposes. These include peacekeeping and truce monitoring (e.g. OP BEL ISI I and OP BEL ISI II in Bougainville, OP AZURE in Sudan), restoring law and order (e.g. OP ANODE in the Solomon Islands), border protection (e.g. OP RESOLUTE), humanitarian assistance (e.g. OP Sumatra Assist after the 2004 tsunami), rehabilitation and reconstruction (OP CATALYST, Iraq) and offensive military operations in support of coalition agreements (OP SLIPPER in Afghanistan).

Establishment of the Deployment Health Surveillance Program (DHSP)

Concerned about post deployment health, in 1999, the Minister for Defence Science and Personnel, Minister Bruce Scott, announced that health reviews would be conducted for all Australian defence personnel on future overseas deployments. The Australian Government subsequently established a deployment-focused health surveillance program for the ADF.[18] In July 2005, Air Vice Marshall Tony Austin, Head of Defence Health Services, stated "The vision for the deployment health surveillance program is to provide a systematic, prospective and ongoing means of assessing and understanding the health effects of operational deployment on ADF personnel." This description distinguishes

the direction of the program from retrospective studies like those conducted following the 1990/91 Gulf War.

Aims of the DHSP

This research program aims primarily to improve the health of ADF personnel through better understanding of factors related to ADF service, in particular overseas deployments. Thus, workplace conditions/arrangements that could be quickly changed are as important as modifying exposures to risks that might have longer term health effects.

The specific objectives of DHSP are to: 1) increase understanding of chemical and physical environmental factors, biological factors (including health countermeasures such as vaccinations), and psychological stressors that lead to physical and mental health problems associated with deployment; 2) increase understanding of longer-term physical and mental health effects of specific chemical and physical exposures (such as dust, smoke, depleted uranium), biological exposures (such as vaccines and infections), and psychological hazards (such as fear) associated with specific deployments; and: 3) improve the utility of ADF health records for health surveillance.

Components of the DHSP

The core of the DHSP is the formation of an integrated data system, that includes self reported data, civilian data such as deaths and cancer registration, and health and exposure information routinely collected by the ADF.

The components of the DHSP are shown in Figure 1. Data sources that have been selected are 1) health records routinely collected by defence such as annual health assessments, but these data have not been designed for epidemiological research purposes and therefore are subject to the limitations of other routinely collected data, so that the adequacy of their validity, completeness and coverage, and reliability needs to be determined; 2) exposure data collected from hazard assessments by defence in the field and also collected as part of post-deployment health screening; 3) purposely collected clinical data; 4) routine data from outside the defence health system, e.g. from the National Death Index and National Cancer Statistics Clearing House; 5) psychological screening data collected by Defence including validated scales administered in structured interviews by defence psychologists on return to Australia and three months post deployment; and 6) self-report questionnaire data allowing additional exposure, psychological, social and health data to be collected to address specific concerns of veterans from particular deployments. These self-report data also provides an opportunity to cross-check data collected from defence sources.

Other sources of data that potentially could be linked in future include Medicare, Department of Veterans' Affairs, hospitals, and other registries, e.g. mesothelioma, birth defects registries.

Data are managed by a single data warehouse located at the University of Adelaide. Information from all sources can be merged based on a unique identifier that is assigned to individuals. Consent to such data linkage will be obtained on a case by case basis as required by university and ADF ethics approval processes.

DHSP projects

The DHSP has been established through funding for specific projects based on particular deployments. The initial projects involve data collection about ADF personnel who deployed to operations in Australia's near north and comparison groups of people in the ADF during the same period but who were not in the specific deployment.

Thus far, the Solomon Islands cohort (n=500 veterans and n=500 era comparison), the East Timor (n=3,998 deployed and n=2,501 era comparison) and Bougainville (n=4,775 and n=2,363 era comparison) cohorts have been established and the Middle East cohort will be recruited in 2009 (estimated n=20,000+) and then on a prospective basis as further deployments take place. In all these studies deployed and comparison groups are frequency matched on age, gender, service and service type (i.e. active or reserve).

While there are some potential limitations associated with establishing the overall program cohort in this fashion, this approach has been necessitated by the funding model for the program. It is however consistent with the broader aim of recruiting all ADF personnel but doing so in a step wise fashion due to the sheer size of the final cohort.

The cohort-specific studies each provide data about single deployments at one point in time, but when integrated, will form the basis for a large cohort study in which comparison will be made across deployments and take into account multiple deployments.

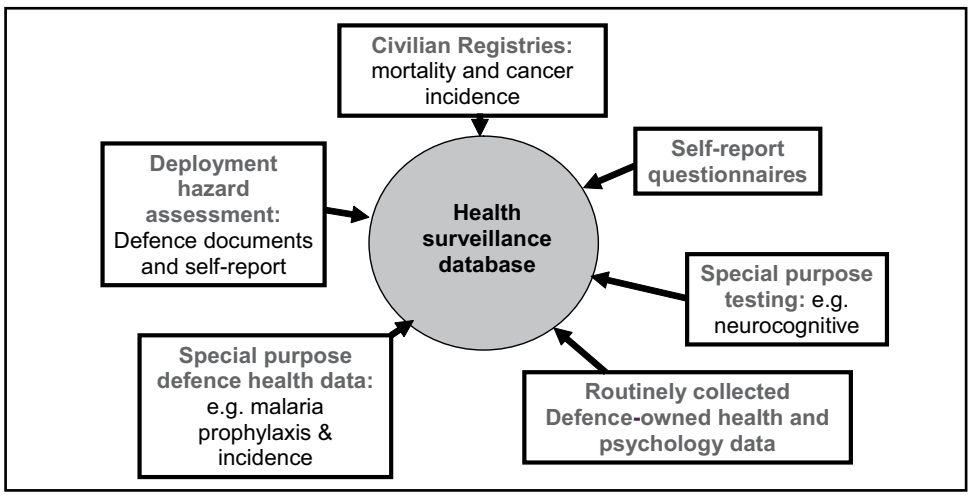

Figure 1: Data sources for the Deployment Health Surveillance Program.

A governance system has been established for the program. The research is overseen by an independent scientific advisory committee of experts in occupational epidemiology and environmental health. The overall program is directed by a scientific research team comprised of all the principal investigators for the individual projects. The program contract is managed by a program management board established within the Department of Defence.

All projects are approved by the Australian Defence Human Research Ethics Committee, the Department of Veterans' Affairs Human Research Ethics Committee and the University of Queensland and University of Adelaide Research Ethics Committees.

While these projects target different operations, it is recognised that there will be considerable overlap between eligible veterans and comparison personnel. This overlap is a strength of the program as it allows for different internal comparisons among groups of veterans and non-deployed personnel. Further, since the projects are at different stages of implementation, each will build and expand on the methodology of the previous project.

Discussion

While there are well-established methods of health surveillance in national or regional populations, there are special challenges for health surveillance in military populations. These include: 1) defining the study population, which may be relatively small and changes continually, as military careers last on average less than seven years; 2) defining exposures, some of which relate to whole groups such as regiments or battalions or an entire ship's complement who deploy together, while others are individual-specific exposures to particular threats and 3) defining and measuring health outcomes, including a) the healthy soldier effect, b) poorly defined health conditions, symptoms or syndromes and preclinical conditions, c) limitations of self-reported data, especially when self-report is essential, for example for some mental health conditions, d) difficulties in engaging participation from a young, largely male and mobile population due to postings and deployments, e) latency and possibly prolonged time lags between exposures and health outcomes.

Low prevalence, delayed onset conditions

Health problems of concern may be of low prevalence or associated with long latency periods between exposure and the presentation of symptoms. Long latency periods can be observed in both physical problems (such as some cancers) and mental health problems. The presentation of delayed onset post-traumatic stress disorder (PTSD) presents a particular challenge in this regard.[19]

Shifting from retrospective to prospective health studies

The first four studies of cohorts recruited into the program (InterFET, Solomon Islands, Bougainville and East Timor) are retrospective. Shifting from a tradition of undertaking retrospective health studies to establishing a prospective surveillance program is challenging. The prospective nature of the program will commence with the recruitment of personnel deploying to the Middle East Area of Operations. When recruitment into the cohort is conducted before ADF personnel deploy, contact should become easier post-deployment, but tracing following separation from the ADF but prior to entry into the Department of Veterans' Affairs (DVA) system, may still pose challenges. DVA is investigating methods to encourage contact following separation. Therefore, at the same time as building on previous cross-sectional studies of Australian veterans who served in either war or peace keeping operations, the DHSP is moving towards replacing that approach with a prospective, analytic system allowing for longitudinal surveillance of the health of ADF personnel deployed on specific operations.

Sample sizes

Obtaining sample sizes to provide adequate power to answer a particular scientific question needs to be balanced against important issues of bias, logistic feasibility and costs. While the advantage of sampling compared to studying the whole population of interest is cost containment; the disadvantages are the risk of sampling bias and that the sample may not have adequate power to detect small effects or rare events or to answer questions not yet conceptualised. The option of identifying and obtaining data on all personnel deployed on a particular operation minimises risk of sampling bias and maximises power to detect effects (both pre-specified and identified later) – this has been done for the Bougainville study which includes all ADF personnel deployed to that Operation. Health surveillance systems in non-military settings often use sentinel samples or events, but these involve large population samples in order to detect relatively rare outcomes or emerging conditions. For the ADF, which is relatively small (approximately 87,000 members depending on inclusion criteria),[20] the relative advantages of complete coverage (in terms of power to detect outcomes or associations, and avoidance of sampling bias) are persuasive, especially when viewed from the perspective of the need to consider multiple exposures.

Exposure information

Exposure assessment is a challenge in military health research,[21] and most studies still rely heavily on self-reported exposure data, which is of course subject to recall bias. Ability to accurately and objectively assess the exposure(s) of individuals or groups is a critical element of health surveillance, as it provides the opportunity to assess the level of exposure that results in ill-health.[22] Exposure data to environmental hazards and specific incidents are collected by the ADF and are available to the DHSP. A major limitation of these data is that they relate to particular measurements in a specific place at a specific time. The challenge is knowing which soldiers were exposed by knowing where they were, for how long, and when the potential exposures took place. However, exposures in a military context are often not known or are poorly understood and variations in distribution of hazards and the magnitude of exposure(s) complicate assessment.[23] An additional complication in the operational environment is the number of ADF personnel who have now participated in multiple

deployments, perhaps to different countries (e.g. East Timor and Afghanistan). Few surveillance programs could claim to have had the capacity to redress these limitations in the past, although future health surveillance projects that link data on hazardous exposures, jobs and the locations of personnel with their medical data, and that involve follow-up of personnel beyond their military service should address these limitations.[14] This is a goal of the DHSP, and we aim to establish procedures to assess specific location of service using Defence personnel management systems and then cross-referencing this with self-report data from the individuals themselves.

The ADF deployments that will be covered by the DHSP involve a diverse range of potential health hazard exposures. Current and recent past ADF operations cover a wide range of environmental conditions and have involved peacemaking (e.g. Bougainville, Solomon Islands), peacekeeping (e.g. East Timor) and war-like operations (e.g. Middle East). However, all share the potential health effects associated with deployment in and of itself, and it is important for the DHSP to take a longitudinal, life course approach to health, that considers the impact of multiple deployments.

The identification and prioritisation of potential hazards have involved several processes. For each deployment an extensive review of the literature was undertaken, and for the Middle East operations this included a review of defence hazard assessment team reports. The DHSP investigators communicate with defence commanders and health care providers to identify and prioritise environmental and other hazards, from their perspectives. There have been stakeholder meetings and consultation with ex-service and other relevant organisations. Additionally, the study for the Middle East operations will involve focus groups with defence personnel who have deployed to the Middle East to identify those hazards they perceive to be important.

Military work is intrinsically hazardous, sometimes uncontrolled and unpredictable and this creates some natural constraints with respect to controlling health problems. The most common short-term health outcomes associated with deployments that may be anticipated are medically unexplained symptoms and psychological disorders. A major priority is to ensure that the methodology is adequate to investigate patterns of outcomes (symptoms, use of services, etc.) or clusters of outcomes that occur with greater frequency than could be expected. These may serve as indicators of health problems (even if poorly defined) that are associated with particular deployments or exposures.

The DHSP is collecting and reviewing ADF information on environmental hazards on the relevant deployments as well as collecting self-reported exposure information. The InterFET pilot project identified limitations in the timeliness of hazard reports in relation to deployment exposures in that they were retrospective, which may be necessary when deployment has short lead time.[24] The DHSP is taking up opportunities to have input into the improvement of routine risk assessments, which may include multiple psychosocial as well as physical exposures. We need to collect data on the number, nature and timing of exposures within a deployment and to create variables that may operate for different individuals at different dose levels.

Defence health data quality

Defence health data that will be used by the DHSP include annual health reviews, pre and post deployment medical screens, post deployment psychological screens, injuries and fatalities and occupational health and safety reporting.

Data quality from defence health and psychological records is an issue, because these data are not collected for surveillance or research purposes. The InterFET Pilot Project found that most defence-owned health records were available, but vaccination records were only retrievable for 1% of the sample from the central medical record (which are in archives). It was noted that the methodology would need to be changed for subsequent studies as vaccination records would need to be retrieved from the unit medical record (i.e. current record) for serving members.[24] The DHSP provides an opportunity to check the completeness of records. Findings so far have already led to recommendations for how routine psychology screens are managed as it became apparent from the Solomon Islands study that the post-operational psychology screen data were often not available. As the program begins to generate information on the quality and completeness of other routine health examinations within defence, further recommendations can be made to improve the information.

Longitudinal data analysis

Previous retrospective defence health studies have involved comparisons of two or more pre-specified groups using statistical methods such as regression analysis to examine (usually single) health outcomes taking into account different exposures and adjusting for potential confounders.

For the DHSP initial comparisons will be made between participants within cohorts, including deployed and comparison (era) controls who were not deployed. As further follow-up data are collected from the same participants, the repeated measures data will be analysed using multi-level-modelling.

Multiple deployments

In recent history it has become usual for members of the ADF to deploy multiple times, so that the health outcomes cannot be related as readily as in past studies to individual deployments. Likewise, comparison groups are unlikely to comprise individuals who have never deployed, but rather people who have deployed to other operations at various times during their service careers but not the specific deployment of interest. This means that the data to be acquired for DHSP will bear greater resemblance to the data required for life course epidemiology[25] than to the retrospective data used in previous studies or to health surveillance programs in other populations.

Locating and encouraging participation of ADF members and ex-serving members

Experience with the DHSP studies to date has shown that locating and obtaining responses from ex-serving personnel is more difficult than for serving members and that there are differences in participation by service, age and gender. A clear

difference in response rates was observed for the Solomon Islands cohort between ex-serving (26%) and serving (46%) participants. Ex-serving personnel may have reasons for not wanting to be contacted by a study that relates to their military service, and it appears that the same motivating factors that led to a better than 80% response in the Gulf War study[26] are not present in the studies to date. This is consistent with other epidemiological studies of Gulf War veterans where it is reported that participation rates among Gulf War cohorts is 5-10% higher compared to non-deployed comparison groups.[13]

For serving members there are also challenges: military populations tend to be dominated by young males, who are traditionally much more mobile than other demographic groups. Furthermore, defence force personnel are protected by privacy regulations that limit who can access information about them from the electoral roll. Additional strategies for recruitment and follow-up of study participants need to be explored.

Conclusions

The Deployment Health Surveillance Program is a new research program being conducted for the ADF by the university based Centre for Military and Veterans' Health. While war service may be a unique experience, not all occupational exposures and experiences are unique to the military environment and the physical and mental health outcomes experienced by ADF personnel and veterans are largely shared with the civilian community (e.g. medically unexplained symptoms, anxiety, depression, substance abuse and post-traumatic stress disorder (PTSD)).[27] It is likely that post combat disorders will continue to be a feature of the health of military personnel, but their form cannot be entirely predicted, because they are moulded by individual health beliefs and the nature of warfare itself, as well as broader cultural and social (post deployment environment) factors including the attitudes of the community to the combat.[28]

A critical issue involves the engagement of ADF members and veterans. It is important that the study addresses their health concerns if they are to engage and participate in the program. The program's primary focus is signalling possible health effects associated with overseas operational deployment, and secondly providing longitudinal data to elucidate the epidemiology of deployment health outcomes. It is expected that this program will improve the understanding, prevention and management of post-deployment health problems. It will have implications also for the wider community, in particular the family members, health practitioners and social networks of those who have served Australia in recent years and will serve in the future.

Acknowledgements

This research was undertaken as part of the Deployment Health Surveillance Program (DHSP), conducted by the Centre for Military and Veterans' Health, The University of Queensland and The University of Adelaide. We are grateful to the Australian Government Department of Defence for funding and to the serving and ex-serving men and women who provided the survey data. We acknowledge the input of members of the DHSP teams.

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