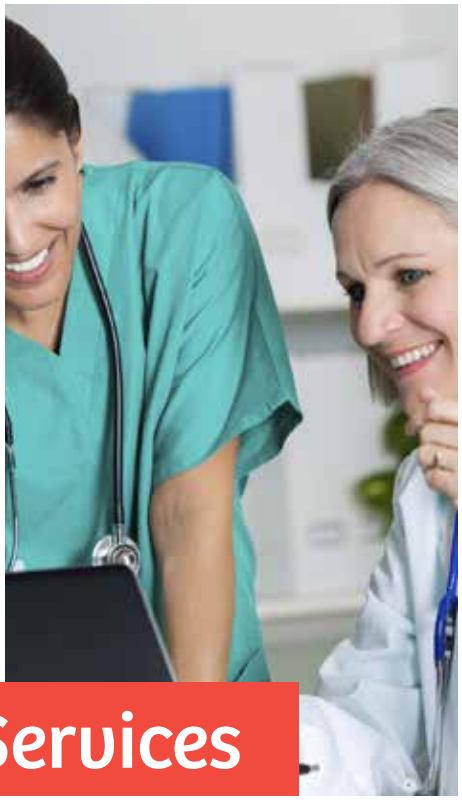
JMVH

Volume 26 Number 1 January 2018
Journal of Military and Veterans' Health

- Examining Moral Injury Awareness in a Clinical Setting
- Comorbidity Risks of a Cohort of Vietnam Veterans Diagnosed with PTSD
- MilTeenChat™ App to Promote Coping Resilience in Military Youth

The Journal of the Australasian Military Medicine Association



Medibank's Garrison Health Services

Delivering a national, integrated healthcare service to the Australian Defence Force

Through Medibank's extensive network, Garrison Health Services provides seamless access to quality healthcare for the 60 000+ permanent and 20 000+ reservist uniformed ADF personnel—from point of injury or illness to recovery.

The health of the ADF is central to everything we do.

medibankhealth.com.au/garrisonhealthservices

medibank health solutions

Garrison Health Services by Medibank

Image courtesy of Dept of Defence

Table of Contents

Letter to the Editor

Obituary

Short Communication

Original Articles

Book Review

Title: Damage Control

Description: Members of a shock trauma team debrief on a training resus, as the light surgical team continue the patient treatment.

Photo Courtesy of CAPT James Savage

Journal of Military and Veterans' Health

Australasian Military Medicine Association

STATEMENT OF OBJECTIVES

The Australasian Military Medicine Association is an independent, professional scientific organisation of health professionals with the objectives of:

- Promoting the study of military medicine
- Bringing together those with an interest in military medicine
- Disseminating knowledge of military medicine
- Publishing and distributing a journal in military medicine
- Promoting research in military medicine

Membership of the Association is open to doctors, dentists, nurses, pharmacists, paramedics and anyone with a professional interest in any of the disciplines of military medicine. The Association is totally independent of the Australian Defence Force.

JMVH is published by the
Australasian Military Medicine Association

227 Collins Street
Hobart Tas 7000
Australia
Ph: +61 3 62347844
Email: editorial@jmvh.org

ISSN No. 1835-1271

Editorial

Nearly 75 years ago, on 14 May 1943, the Australian Hospital Ship (AHS) Centaur was attacked and sunk by a Japanese submarine off Cape Morton on the Queensland coast. The ship was illuminated and marked appropriately, with prominent Red Crosses on the ship's side and funnel. On a return trip from Sydney to New Guinea, the ship was carrying 332 health personnel and crew. Of the 332 aboard, 268 died in the sinking, with only 64 surviving, who were picked up by the USS Mugford 36 hours later. This war crime, a direct contravention of the Hague Convention of 1907, was roundly denounced around the world and became a rallying cry in Australia in their fight against the Axis powers.[1] A tragic event that was unfortunately a harbinger of future conflicts.

In 2016, the World Health Organisation (WHO) believes that 418 people died because health facilities were attacked on over 302 occasions. Sixty-two per cent of the attacks were reported to have intentionally targeted health care, a direct contravention of international humanitarian law.[2] Unfortunately, this is probably an under-estimate and highlights the reality of many of the conflicts around the world. As military health practitioners, we need to be very aware of our obligations under international humanitarian law and the Geneva convention. WHO is working hard to highlight these abuses, with limited success, as seen recently in the conflict in Syria.[2]

Our first issue of 2018 tackles a broad range of topics. There are a number of articles looking at mental health and well-being, including on moral injury awareness, psychological development, comorbidity risks of Vietnam Veterans diagnosed with Post-Traumatic Stress Disorder, and promoting military resilience in military youth. There are also

two operational papers looking at lower extremity injuries and the Role 2E capability on HMAS Canberra. We also have Letters to the Editor, a book review on tropical medicine and an obituary for Surgeon Captain Rick Jolly OBE RN (Retired).

We continue to get a good range of articles, but other military and veterans' health articles are always very welcome, and we would encourage all our readers to consider writing on their areas of military or veterans' health interest. We do occasionally get complaints about the articles published, and, in these instances, would encourage people to write a Letter to the Editor or a rebuttal article, if it is felt to be warranted. As a medical journal, any articles should be evidence-based and appropriately referenced, and will be peer-reviewed. As we head into our new year, I would encourage all presenters to publish their presentations, to ensure they get to a wider audience.

Dr Andy Robertson, CSC, PSM

Editor-in-Chief

References:

1. Perry R. Pacific 360°. Hachette Australia; Sydney: 2012.
2. WHO. Attacks on Health Care. http://www.who.int/emergencies/attacks-on-health-care/en/

Dear Editor,

A REARGUARD DEFENCE: MEFLOQUINE, TAFENOQUINE, AND THE AUSTRALIAN ARMY MALARIA INSTITUTE

I read with interest the recent article by Dr. Howie-Willis[1], which extols the recent accomplishments of various staff of the Australian Army Malaria Institute (AAMI). I have concerns regarding the historical and factual accuracy of certain of the authors' statements, particularly those offered in defence of the actions of AAMI staff involved in trials of mefloquine and tafenoquine conducted among Australian military personnel in East Timor beginning in the late 1990s. I am also concerned that Dr. Howie-Willis's work reads not as an impartial historical review of the topic, but as an attempted rearguard defence of these actions and more generally of the safety of mefloquine and tafenoquine.

Dr. Howie-Wiilis describes this controversy as "unexpectedly" coinciding with the approach of the AAMI's 50th anniversary in 2016. In fact, the actions of the AAMI in East Timor became the subject of considerable controversy beginning well over a decade earlier in 2004, when concerned Australian soldiers enrolled in these trials first filed legal action[2]. Mefloquine was subsequently found to be neurotoxic by the developers of tafenoquine[2], and tafenoquine itself later was found to be more neurotoxic than mefloquine[3], further substantiating the concerns of these study subjects.

Dr. Howie-Willis risks trivialising a key point of debate in this controversy when he dismisses the concerns of antimalarial drug safety advocates in this community by stating that "all antimalarial drugs have unwelcome side effects". Unlike the daily medications doxycycline and atovaquone-proguanil, which lack published evidence of neurotoxicity, both mefloquine and tafenoquine can cause several neuropsychiatric adverse effects that can mimic symptoms of posttraumatic stress disorder (PTSD), including sleep disturbance and anxiety[4]. I challenge the claim by Dr. Howie-Willis that such neuropsychiatric effects affect only "a relatively small proportion" of those taking mefloquine and that fewer than 1 percent experience anxiety. In fact, a recent meta-analysis finds that of those exposed to mefloquine prophylaxis, in comparison to the alternative atovaquone-proguanil, symptoms of anxiety are reported in 6%, insomnia in 13%, and abnormal dreams in 14%[5] — the latter described in one military study as "often terrifying nightmares with technicolor clarity… vividly remembered days later"[6].

Contrary to the claims of Dr. Howie-Willis that such effects generally resolve after several weeks, in one study, 21% of those reporting nightmares with use of mefloquine reported this symptom persisting for three years or longer[7]. Researchers at the Walter Reed Army Institute of Research, where both mefloquine and tafenoquine were developed, have consequently warned that "the significant overlap in symptoms associated with mefloquine toxicity and PTSD obscures the distinction between these diagnoses"[8]. There is thus a risk that chronic adverse effects from mefloquine could be misattributed to PTSD, despite existing diagnostic exclusions. Indeed, in the recent large retrospective cohort study cited by Dr. Howie-Willis[9], non-combat-deployed U.S. military personnel prescribed mefloquine had a significant — and nearly doubled — risk of subsequent PTSD diagnosis than those prescribed atovaquone-proguanil[9]. As described elsewhere, this study has several significant methodological limitations that limit the validity of its other negative findings[10].

Mefloquine, like other quinolines, is an idiosyncratic neurotoxicant that appears to adversely affect only certain people, the risk factors for which are not yet known. A key point made by the Australian antimalarial drug safety community, that is not cited or acknowledged by Dr. Howie-Willis, is that for this reason, the manufacturer of mefloquine has long warned that the drug must be discontinued at the onset of neuropsychiatric symptoms, which are described as prodromal to "a more serious event" — arguably a euphemism for the lasting effects associated with the drug's idiosyncratic neurotoxicity[2]. As the recent meta-analysis concludes, despite the fact that a considerable minority of those who use mefloquine experience prodromal symptoms, only 6% of users discontinue the drug as directed by the manufacturer[5]. As the Australian Army's own policies which deprioritise the drug underscore, mefloquine is thus poorly suited for military use[2]. The reluctance of certain AAMI staff to concede this point — and to concede further that the use of mefloquine in military settings outside of the manufacturer's directions has resulted in lasting harm to some veterans — is nowplainly evident from this work.

Dr. Howie-Willis concedes that it is "still too early to write an historical account of the dispute" related to mefloquine and tafenoquine, and that "another decade might need to elapse before such an history can be written". Ironically, as the issues in this dispute are further clarified in the coming years, Dr. Howie-Willis's work stands to serve more as a record of the institution failings of the AAMI in relation to

these drugs, then as a successful rearguard defence of its actions.

Yours sincerely

Remington L. Nevin, MD, MPH, DrPH
Executive Director
The Quinism Foundation
P.O. Box 145
White River Junction, VT 05001
United States of America

*To whom correspondence should be addressed at:
rnevin@quinism.org

Conflict of Interest Statement

Dr. Nevin is a former U.S. Army medical officer and serves as consultant and expert witness in legal cases involving claims of adverse effects from antimalarial drugs.

References

1. Howie-Willis I. Australian Military Malariology Comes of Age (Part 5 of "Pioneers of Australian Military Malariology"). J Mil Vet Health. 2017;25(3):42–60.
2. McCarthy S. Malaria Prevention, Mefloquine Neurotoxicity, Neuropsychiatric Illness, and Risk-Benefit Analysis in the Australian Defence Force. J Parasitol Res. 2015;2015:287651.
3. Agboruche RL. 529.3 In-Vitro Toxicity Assessment of Antimalarial Drug Toxicity on Cultured Embryonic Rat Neurons, Macrophage (RAW 264.7), and Kidney Cells (VERO-CCl-81). FASEB J. 2009;23(1 Meeting Abstract Supplement):529.3.
4. Nasveld PE, Edstein MD, Reid M et al. Randomized, double-blind study of the safety, tolerability, and efficacy of tafenoquine versus mefloquine for malaria prophylaxis in nonimmune subjects. Antimicrob Agents Chemother. 2010 Feb;54(2):792–798.
5. Tickell-Painter M, Maayan N, Saunders R, et al.. Mefloquine for preventing malaria during travel to endemic areas. Cochrane Database Syst Rev. 2017 Oct 30;10(10):CD006491.
6. Boudreau E, Schuster B, Sanchez J, et al. Tolerability of prophylactic Lariam regimens. Trop Med Parasitol. 1993 Sep;44(3):257–265.
7. Ringqvist Å, Bech P, Glenthøj B et al.. Acute and long-term psychiatric side effects of mefloquine: A follow-up on Danish adverse event reports. Travel Med Infect Dis. 2015;13(1):80–88.
8. Livezey J, Oliver T, Cantilena L. Prolonged Neuropsychiatric Symptoms in a Military Service Member Exposed to Mefloquine. Drug Saf - Case Rep. 2016 Dec;3(1):7.
9. Eick-Cost AA, Hu Z, Rohrbeck P, et al. Neuropsychiatric Outcomes After Mefloquine Exposure Among U.S. Military Service Members. Am J Trop Med Hyg. 2017 Jan 11;96(1):159–66.
10. Nevin RL. Misclassification and Bias in Military Studies of Mefloquine. Am J Trop Med Hyg. 2017;97(1):305.

Surgeon Captain Richard Tadeusz 'Rick' Jolly OBE RN Rtd [1]

Commander Neil Westphalen, Royal Australian Navy Reserve

Rick Jolly (29 October 1946 – 13 January 2018, of complications from a heart condition) was the only serviceman to be honoured by both the British and the Argentinians for his service in the 1982 Falklands War. This reflected his leadership of the field hospital that successfully treated over 1,000 casualties during the conflict (including 300 Argentinians), and his subsequent reconciliation of the erstwhile combatants.

A large jovial extrovert, Richard Tadeusz Jolly was born in Hong Kong, the son of a Polish gunner held as a prisoner of war by the Japanese for five years; his mother was an ambulance driver. He was educated at Stonyhurst College, Lancashire, and studied medicine at St Bartholomew's Hospital, London, qualifying as a doctor in 1969. He joined the Royal Navy on a five-year short-service commission, and completed the Royal Marine commando course in 1972.

As a young medical officer attached to 42 Commando in Belfast during 'The Troubles', he insisted on going out on street patrols to be on hand if casualties occurred. He then completed two tours with the Fleet Air Arm as an AvMO, followed by medical officer Royal Naval College, Dartmouth. After a short break in service, he took over the Royal Marine Medical Squadron in 1980.

In April 1982, the then Surgeon Commander Jolly was the Senior Medical Officer of 3 Commando Brigade, a force of around 5,500 Royal Marines. He began his central role within hours of the Argentinian invasion, as part of a team that secretly flew to Gibraltar to assess how the requisitioned cruise liner SS *Canberra* might be adapted for military purposes. Later, as *Canberra* sailed south, he organised first aid classes for the embarked marines and paratroopers, although his enthusiasm for gory trauma slides was apparently not always to their taste.

His plan to use *Canberra* as a floating field hospital in San Carlos Water, on the western coast of East Falkland, was abandoned after her vulnerability to air attack became apparent. Instead he was directed, with only 90 minutes' notice, to set up a field hospital in a derelict meat-processing plant at Ajax Bay. Over the next three weeks, the 'Red and Green Life Machine' performed more than 200 operations on casualties from both sides, often working through the night by torchlight in freezing surroundings. As a nearby ammunition dump meant a Red Cross could not be displayed, the plant was hit by two 240kg bombs, which remained unexploded in the roof throughout the campaign.

Surgeon Commander Jolly (right), Ajax Bay Field Hospital, May-June 1982.[2]

On 21 May, while Argentinian jets continued to attack the British Task Force in San Carlos Water, he set out in a Wessex helicopter to evacuate casualties from the frigate *Argonaut*. En route, three survivors from the burning frigate *Ardent* were spotted, one in danger of drowning. Despite not wearing an immersion suit, Jolly insisted on being winched down to rescue them from the freezing water. Later that day, he flew three young Argentinian conscripts to *Canberra* for surgical treatment. Like many of their comrades in the weeks ahead, they had expected to be tortured, and found it difficult to accept that they were being cared for with the same dedication as their foes.

As the British advanced towards the capital, Stanley, Jolly's team established smaller medical stations at

Surgeon Commander Jolly (right), Hospital Ship *Uganda*, May-June 1982.[3]

Teal Inlet, to the north, and Fitzroy, to the south. In all, over 650 combat casualties from both sides passed through their hands, of whom only three died of wounds. He brooked no interservice nonsense, by making it clear that their 5000 'potential customers' didn't care who treated them.

Having been awarded an OBE, Jolly retired from the Navy in 1996. That year, with a former paratrooper, Denzil Connick, he co-founded the South Atlantic Medal Association (SAMA), which launched a campaign to highlight the problems of post-traumatic stress disorder among Falklands veterans. He also took up a defence fellowship at University College London, to study the effects of biological and chemical warfare on ships' crews.

In 1999, Jolly stood in Buenos Aires in front of more than 50 Argentinian veterans, some of whom he had personally treated, to receive the Orden de Mayo, one of the country's highest honours.

His bestselling account of the South Atlantic conflict, *The Red and Green Life Machine: A Diary of the Falklands Field Hospital*,[4] was published in 1983. His other books include *For Campaign Service*,[5] a novel about British service personnel in Northern Ireland (under the pseudonym Christopher Hawke); *Jackspeak: A Guide to British Naval Slang and Usage*,[6] and *In-Confidence: The Jackspeak Triservice Guide to Staff Reporting*.[7] The latter two are hysterical – if at times perhaps rather close-to-the-bone – examples of contemporary Service humour.

Notwithstanding his lack of contact with the Australian Navy or broader ADF, Jolly's participation in the 'Falklands Campaign: Medical Lessons' Symposium at the Royal College of Surgeons. London, on 17-18 February 1983, had a profound effect on the RAN's seagoing surgical capability, following the decommissioning of the aircraft carrier *Melbourne*. These lessons were instrumental for the deployment of the three RAN Task Group Medical Support Elements to USNS *Comfort* for the 1991 Gulf War.

Although it was not possible to meet Rick, the author had the privilege of speaking to him during a visit to London in 2013, by phone to his home in Cornwall. His practical advice regarding health support for amphibious operations personally proved exceptionally helpful, with respect to the then-imminent entry into service of the LHDs *Adelaide* and *Canberra*.

Perhaps most importantly, Rick Jolly should be considered an internationally-recognised exemplar of military medical ethics. He told Britain's *Sunday Mirror* in 2012:

"Our attitude was simple: to treat the injured Argentinians in a way we would like to be treated. Before the battle of Trafalgar Nelson wrote a prayer in his cabin, saying: 'May humanity after victory be the predominant feature in the British Fleet'. As a naval officer those words meant a lot to me, so looking after the enemy's wounded as though they were your own was instinctive.

People assume you've got to hate your enemy but that couldn't be further from the truth. The only people who know what you're going through are the people on the other side.

Over the years I've been asked what I'd do if I had to choose who to treat first, an Argentinian or a Brit. My answer was always whoever needed attention more urgently. As far as I am concerned you have to be able to look into your soul and like what you find there."

Rick is survived by his wife Susie (nee Matthews), a former children's nurse, whom he married in 1970. Their son, James, predeceased him aged 17.

Surgeon Commander R.T. Jolly, c1983.[8]

Authors: N Westphalen[1,2]
neil.westphalen@bigpond.com
Author Affiliations:
1 Royal Australian Navy Reserve
2 Navy Health Service - C/O Director Navy Health

References

1. This article is based on 'Surgeon Captain Rick Jolly obituary', The Guardian, available from https://www.theguardian.com/uk-news/2018/jan/24/surgeon-captain-rick-jolly-obituary.
2. 'Surgeon Captain Rick Jolly obituary', The Guardian, available from https://www.theguardian.com/uk-news/2018/jan/24/surgeon-captain-rick-jolly-obituary.
3. 'Surgeon Captain Rick Jolly obituary', The Guardian, available from https://www.theguardian.com/uk-news/2018/jan/24/surgeon-captain-rick-jolly-obituary.
4. Jolly, R.T, 1983, The Red and Green Life Machine: A Diary of the Falklands Field Hospital, London: Century Publishing.
5. Hawke, C, 1979, For Campaign Service.
6. Jolly, R.T, 2000 (2nd edition), Jackspeak: A Guide to British Naval Slang and Usage, Torpoint UK: Palamanando Press.
7. Jolly, R.T, 1997, In-Confidence: The Jackspeak Triservice Guide to Staff Reporting, Torpoint UK: Palamanando Press.
8. Boyle, D, 'Falklands war hero surgeon who was honoured by both British and Argentine authorities has died aged 71' Daily Mail Australia, available from http://www.dailymail.co.uk/news/article-5266965/Falklands-war-hero-surgeon-died-aged-71.html

Examining Moral Injury Awareness in a Clinical Setting

M Kopacz, G L Charpeid, L A Hollenbeck, J Lockman

Abstract

Moral injury is a relatively novel clinical construct recognized as a focus of concern in some military veteran populations. This short communication presents findings from a descriptive survey examining awareness of moral injury in a clinical setting specialized in veteran health services and treatment. An online survey was distributed to personnel (n=900) at a Department of Veterans Affairs Medical Center. This survey yielded n=106 (11.8%) responses. Self-perceived awareness was about evenly divided between developed and under-developed. Respondents saw moral injury as being chiefly the domain of mental hygiene service providers, followed by chaplains, medical, and nursing staff. Respondents overwhelmingly saw moral injury as relevant to the health of veterans, yet felt that not enough is being done to address this issue. The findings highlight a critical need for continued efforts at increasing awareness of moral injury in clinical settings as well as developing support options.

Keywords: moral injury; veterans; awareness

Introduction

An emerging literature has described moral injury (MI) as a focus of clinical concern in some veteran populations. MI represents a clinical state of psychological distress manifesting as "a syndrome of shame, self-handicapping, anger, and demoralization."[1(p. 408)] It is thought to arise in military personnel following a morally injurious experience, defined as "an act of transgression that severely and abruptly contradicts an individual's personal or shared expectation about the rules or the code of conduct, either during the event or at some point afterwards."[2(p. 700)]

As a focus of clinical concern, one could reasonably argue that MI awareness among clinical service providers is critical, especially in settings responsible for veteran health services and treatment. In simple terms, awareness ensures that providers remain attentive to the needs of their patients/clients. One author went so far as to underscore "the need for clinical focus on the establishment and maintenance of postdeployment social support for military personnel" in moderating the negative effects of moral injury.[3(p.198)] Yet MI awareness in clinical settings has never previously been examined.

United States Department of Veterans Affairs (VA) Medical Centers (MCs) represent a unique clinical setting for examining MI awareness. The VA oversees the largest integrated healthcare system in the United States, with the stated mission of supporting the health of America's veteran population. In this short communication, we present the findings of a descriptive survey examining MI awareness which was recently distributed to personnel at a VAMC in upstate New York. Such preliminary findings could serve to facilitate discussion and future research with regards to supporting veterans affected by MI.

Methods

A survey was organized in anticipation of an upcoming local MI education campaign and was intended to gauge baseline self-perceived awareness of MI among staff at the VAMC. Considering the diversity of professions at this VAMC, awareness was broadly conceptualized as familiarity with MI as well as its perceived impact on the health of service members and veterans. This confidential and anonymous survey was developed by clinicians and researchers at the data collection site. Responses were collected over a six-week period (August-September 2016).

The survey was uploaded to a third-party website specializing in online surveys, which assigned a unique internet link connecting directly to the survey. This link was included in an invitation e-mail sent out to all personnel through this VAMC's listserv as well as posted on the local intranet. As a non-research activity, this survey was exempt from IRB approval and informed written consent. Survey responses are presented here descriptively – n (%). Questions and answer options are respectively detailed in the results.

Results

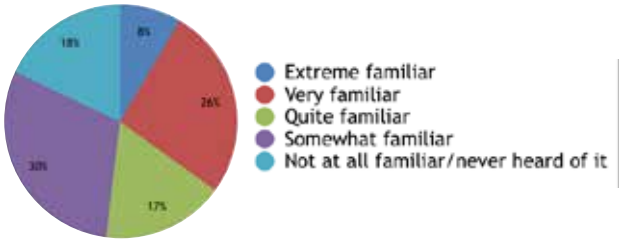
At the time of the survey, the center-wide listserv included n=900 personnel. This survey yielded n=106 (11.8%) responses.

Q1 – "In gauging your familiarity, please consider your understanding of what moral injury might mean. The more you know about moral injury, the higher you would rate it. The less you know, the lower you would rate it."

Respondents chose one answer from five options. A total of n=9 (9%) reported being "extremely familiar", n=28 (26%) "very familiar", and n=18 (17%) "quite familiar" with MI. Taken together, these responses suggest n=55 (52%) had what could generally be described as a developed level of MI awareness.

Further, a total of n=32 (30%) reported being "somewhat familiar" with MI and n=19 (18%) "not at all familiar/never heard of it". Taken together, these responses suggest n=51 (48%) had what could generally be described as an under-developed level of MI awareness.

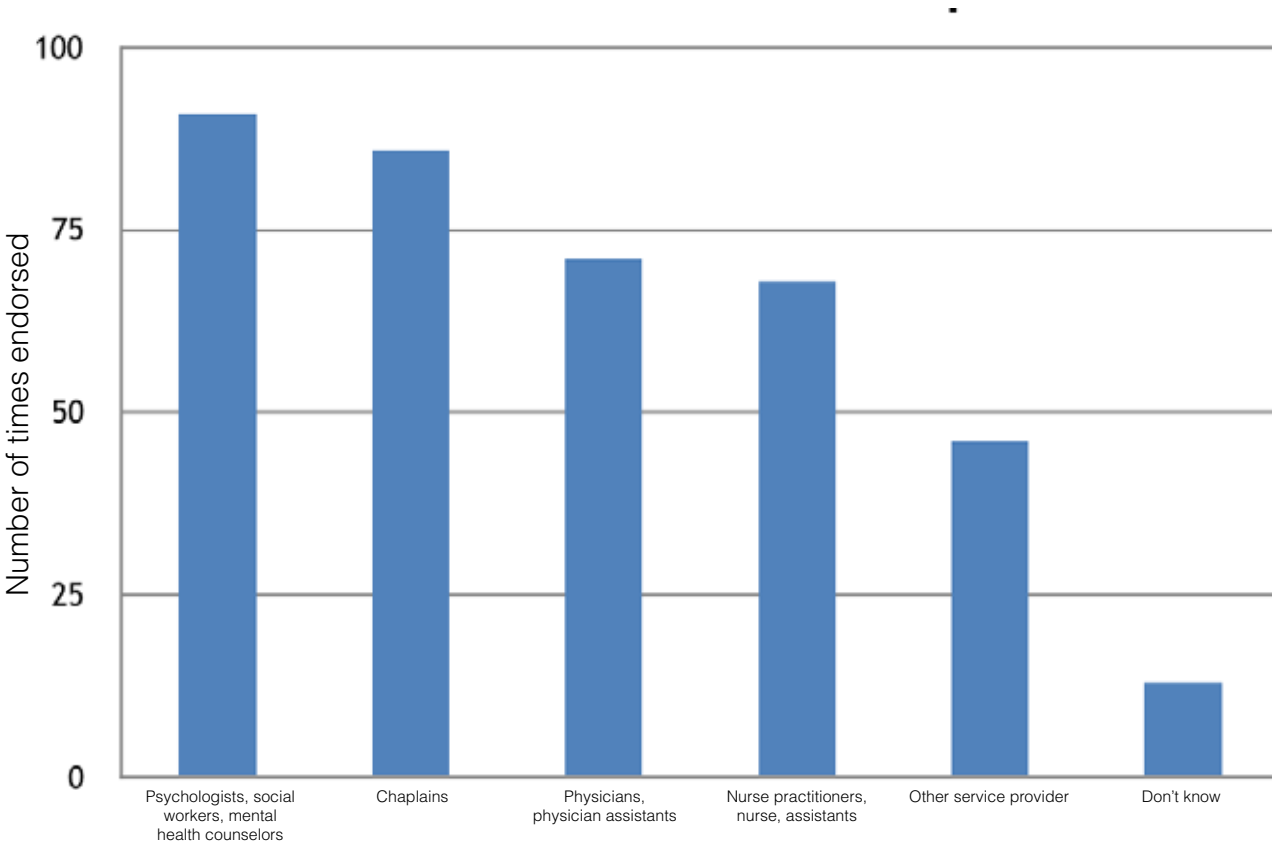
Figure1: Self perceived familiarity with moral injury



Q2 – "Moral injury should be considered the domain of which service provider(s)? Check all that apply."

Respondents chose from six answer options. Q2 was left blank by one respondent. A total of n=91 (87%) respondents identified MI as the domain of "psychologists, social workers, mental health counselors", followed closely by n=86 (82%) who identified "chaplains". Next, n=71 (68%) identified "physicians, physician assistants", n=68 (65%) saw MI as the domain of "nurse practitioners, nurses, LPNs", n=46 (44%) suggested "other service provider", while n=13 (12%) answered "don't know".

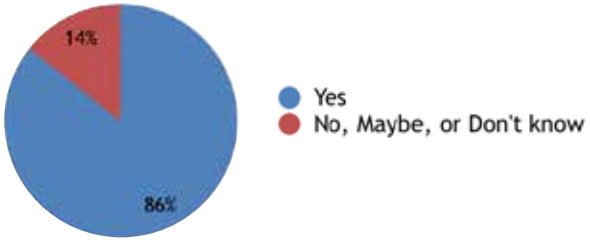
Figure 2: Moral Injury should be considered the domain of which service providers?



Q3 – "Is moral injury relevant to the health of veterans?"

Answer options included: yes, no, maybe, and don't know. Q3 was left blank by one respondent. To ensure meaningful interpretation, "no", "maybe", and "don't know" responses were grouped into a single cell. A total of n=90 (86%) responded "yes" to MI being relevant to the health of veterans, only n=15 (14%) responded either "no", "maybe", or "don't know".

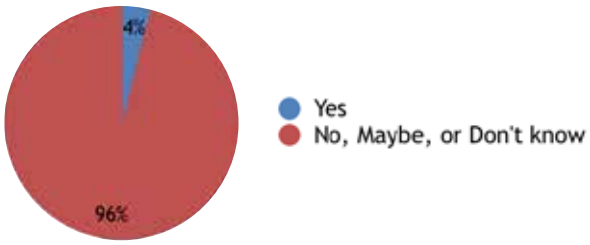
Figure 3: Is moral injury relevant to the health of veterans?



Q4 – "Is enough being done in the VA to address moral injury in veterans?"

Answer options included: yes, no, maybe, and don't know. Q4 was left blank by two respondents. To ensure meaningful interpretation, "no", "maybe", and "don't know" responses were grouped into a single cell. Only n=4 (4%) responded "yes" to enough being done to address MI in VA settings, whereas n=100 (96%) responded either "no", "maybe", or "don't know".

Figure 4: Is enough being done in the VA to address moral injury in veterans?"



Discussion

In a survey distributed to personnel at a VAMC, self-perceived MI awareness was about evenly divided between developed and under-developed. Respondents saw MI as being chiefly the domain of mental hygiene service providers, followed by chaplains, medical, and nursing staff. Further, respondents overwhelmingly saw MI as relevant to the health of veterans, yet felt not enough is being done to address this issue in VA settings.

The findings suggest a mixed degree of MI awareness among respondents. It should, however, be noted that MI remains a relatively novel clinical construct and has only in recent years been identified as a focus of clinical concern. Interestingly, respondents identified MI as the domain of diverse service providers, including chaplains, reinforcing the view of MI as having a religious/spiritual dimension.[4] This gives pause to consider what role interdisciplinary collaboration might play in effectively supporting veterans affected by MI.

These preliminary findings could serve to inform future research into MI. Possible research avenues might include a more detailed examination of MI awareness across service providers. Also, one qualitative line of inquiry might include examining the experiences of professionals who support veterans thought to be dealing with MI, the experiences of which might differ across disciplines. Recognizing any similarities and differences in these experiences could inform ongoing work into effectively supporting veterans found to be dealing with MI as well as serve to increase MI awareness in clinical settings.

There were several limitations associated with this survey which was, by design, descriptive and not part of a validated outcome measure. While all respondents were duly affiliated with the data collection site, presumably not all respondents were clinical service providers. The survey was also limited to a single VAMC. Further, the familiarity with MI reported by respondents was only self-perceived. As such, no causal or generalizable inferences can be made from the findings.

Notwithstanding these limitations, this survey provided preliminary insight into MI awareness among personnel at a clinical setting specialized in veteran health services and treatment. The findings highlight a critical need for continued efforts at increasing awareness of MI as well as developing support options which could be applied in health care settings. Increased awareness coupled with effective support options could ensure that VAMCs remain attentive to the needs of the veterans they serve as well as provide a consistent veteran experience practice standard.

Acknowledgements

The views expressed are those of the authors and do not reflect the official policy or position of the US Department of Veterans Affairs or Federal Government. Dr. Lockman is supported by the Office of Academic Affiliations, Advanced Fellowship Program in Mental Illness Research and Treatment,

Department of Veterans Affairs, VISN 2 Center of Excellence for Suicide Prevention (Canandaigua, New York). The authors do not declare any conflicts of interest. Institutional support for this study was provided by the Canandaigua VA Medical Center and VISN 2 Center of Excellence for Suicide Prevention. This survey was conducted independent of any external funding mechanism.

Corresponding author:
Marek Kopacz marek.kopacz@va.gov
Authors: M Kopacz[1], G L Charpeid[2], L A Hollenbeck[3], J Lockman[1,4]
Author Affiliations:
1 US Department of Veterans Affairs – VISN 2 Center of Excellence for Suicide Prevention
2 Department of Veterans Affairs Medical Center, Canandaigua, New York.
3 Department of Veterans Affairs Medical Center, Cincinnati, Ohio
4 VISN 2 Center of Excellence for Suicide Prevention

References

1. Gray MJ, Schorr Y, Nash W, et al. Adaptive disclosure: an open trial of a novel exposure-based intervention for service members with combat-related psychological stress injuries. Behav Ther 2012; 43: 407-15.
2. Litz BT, Stein N, Delaney E, et al. Moral injury and moral repair in war veterans: a preliminary model and intervention strategy. Clin Psychol Rev 2009; 29: 695-706.
3. Houtsma C, Khazem LR, Green BA, et al. Isolating effects of moral injury and low post-deployment support within the U.S. military. Psychiat Res 2017; 247: 194-9.
4. Carey LB, Hodgson TJ, Krikheli L, et al. Moral injury, spiritual care and the role of chaplains: an exploratory scoping review of literature and resources. J Relig Health 2016; 55:1218-45.

Psychological Development of Emerging Adults in the Military and Transition to the Civilian Workforce

C C Hicks, E Bell, D Gray

This paper considers the unique role that serving in the Australian Army may have on shaping the psychological development of emerging adults. Emerging adulthood is defined as the development period from the late teens through the twenties, with a focus on ages 18-25. For most young people in industrialised countries it is suggested that this period involves profound change and significance for the transition from adolescence to adulthood[1]. It is argued that the unique environment of the army culture has a positive influence on the psychological development of the emerging adult, yet consideration needs to be given as to how this may impact on transition from the Australian Army to the civilian workforce. We combine the lived experience of the authors with existing research with an aim to raise awareness for the need for more research in this area. Specifically, with a focus on supporting the transition from the Australian Army to the civilian workforce.

Fundamentally, the strength of a country is determined by its military prowess and the army culture is shaped by its focus on war. This is nurtured through unique military training that differentiates the combatant from their civilian counterparts[2]. Therefore, upon joining the military, a recruit very quickly comes to understand the effectiveness of being a part of a team. Army recruits are subjected to the rules and regulations of the military which require the shedding of their former identities. This process in implemented in a way that is unique to military culture where initial and ongoing training comprises of intense challenges within a highly structured program[4]. Military service during late adolescence enhances educational opportunities, employment progression, psychological wellbeing and life accomplishments[2].

The enforced regulations and standards normalise the values of the individual and peer group, aimed at developing mutual respect and understanding, which capitalises on the formation of their sense of identity during this later stage of adolescence development.

This is achieved by creating a strong foundation where an individual is shown the way to behave by the provision of clear instruction with repercussions for non-adherence[5,6]. As individuality can tend to disrupt and hinder the realisation of this common purpose, each recruit is treated the same regardless of age, gender or socioeconomic status, indoctrinated by military customs and traditions. The key purpose is to create a sense of belonging within the individual as an integral member of the team and that together any objective is possible. Camaraderie is developed and reinforced by the basic premise of trust, loyalty and unity. It fosters a team mentality and faith in peers that allows for an absolute reliance upon each other, which is facilitated by every serviceman completing the same basic training and abiding the same values and ethos. To be successful in the military culture the emerging adult needs to have adapted to what was previously a foreign culture and environment and it is important to look at how this affects a person's personal beliefs and values. The Australian Army values courage, initiative, respect and teamwork[7]. Military values are tools used to unite and develop individuals who come from different socio-economic backgrounds. Identity development therefore is significant as it creates a sense of purpose that each person can share to achieve military objectives[4].

Undertaking basic training and continuous service within the Australian Army shapes the way in which an individual interprets and interacts with their environment[4]. Upon completion of basic military training, an individual has been nurtured and socialised into the military culture and hierarchy. Bureaucracy, doctrine and organisational structure all work to preserve social order in the Australian Army by reducing the potential for conflict[7]. Former Chief

of Army, Lieutenant General Morrison AO, referred to the importance of integrity, culture, values and ethical standards in the modern day Australian Army [7]. The hierarchy of the military helps to define the identity of a service person through making explicit the link between a person and the organisation. This is described as a Personal-Organisation (PO) relationship and is characterised by the ability to share similar fundamental characteristics such as values[8].

The processes of recruitment, selection, training, promotion, education, performance appraisal and discharge all contribute to building a collective workforce ethic. Career success relies on the application of standard procedures and drills with the expectation of prompt, visible and measurable results. After basic training, continuous service, annual performance appraisal and mandatory advancement within the military, continues to shape the way in which an individual views the world[4].

Military service provides emerging adults the opportunity to effectively negotiate age-graded developmental tasks and experience hardships that individuals outside the military may find demanding or never experience[3,6]. The development required in emerging adulthood is undertaken without close relationships with family, civilian peers and partners. Although the military environment is demanding, many individuals successfully complete initial training, adjust to the environment, handle the difficult situations effectively, and find these experiences rewarding and of value[6]. The structured military environment forces individuals to come together as a group and form bonds to overcome obstacles as they adjust to a new and structured environment. This shows the importance of intimacy within the military context and how the gains of comradery, friendship and career development can influence an individual's development.

The importance of strong cohesion, shared values and teamwork regardless of socioeconomic background is evident through research conducted in Australia, Israel and North America[3,4,9,10]. Service in the Australian Army shapes and changes values and social functioning throughout the lifespan of an individual and enhances educational opportunities, employment progression, psychological wellbeing and life accomplishment[3]. The Australian Army has a hierarchy that allows people to climb and compete but function effectively within the expected social construct[9]. The military is structured by divisions, each focused on achieving a specific militarised mandate working towards achieving an overarching strategic objective.

A key feature of successful attainment of the strategic objective is the expectation that every individual will perform at their maximum capability. This culminates in a cohesive workforce that produces a result that would have been unattainable without the individual efforts. In peacetime this is no different to many civilian organisations, however during war time, this is crucial to maintain life and secure a successful mission in dangerous and life changing environments. Therefore a team focus with unfaltering trust in your peers is essential to prevent loss of life and promote everyone arriving home to their families alive and well. There is no room for individual conflicts or disagreements, or spontaneous actions incongruent with the mandate as established by the hierarchy. This can only be achieved through highly structured and focused basic and ongoing training that develops skill, competence and confidence while adopting shared values and an unwavering ethos of trust and loyalty.

The impact of transitioning from a military to civilian workforce upon the individual, is not fully understood and more research is needed, especially considering that the Australian Prime Minister hosted an event in November 2016 with the aim of finding better ways to "use the valuable skills and leadership of former service personnel into our modern economy"[10]. Given that comprehensive military structured training results in highly skilled individuals who embody courage, initiative, trust, loyalty, adaptability and teamwork, transition should be seamless.

More research using mixed method research to explore the transferable skills when transitioning from the military to the civilian workforce is needed. Research that explores the lived experience of the Army soldier embarking on this transition along with longitudinal studies that are retrospective and prospective. This will promote a greater awareness of the theoretical foundations of the psychological development that occurs within the military culture when considering the emerging adult, and the impact this has on self-identity, transferable lifelong skills and knowledge.

Corresponding author: Elaine Bell
elaine.bell@flinders.edu.au
Authors: C C Hicks[1], E Bell[2], D Gray[3]
Author Affiliations:
1 University of South Australia Division of Education, Arts, and Social Sciences, School of Creative Industries
2 Flinders University of South Australia, College of Nursing and Health Sciences
3 University of South Australia, Division of Education, Arts, and Social Sciences, Behaviour-Brain-Body Research Centre

References

1. Arnett JJ. Emerging adulthood: A theory of development from the late teens through the twenties. Am Psychol. 2000 May;55(5):469-80. DOI: 10.1037//0003-066X.55.5.469.
2. Elder GH Jnr. The life course as developmental theory. Child Dev, 1998 Feb;69(1):1-12.
3. Meir A, Allen G. Intimate relationship development during the transition to adulthood: Differences by social class. In: Mortimer JT, editor. Social class and transitions to adulthood. New Dir Child Adolesc Dev. 2008;119:25-29. DOI: 10.1002/cd.207
4. Ahmad KZ, Muhammad MA, Hassan MJ. Aligning military and soldiers' values hierarchy. Int J Manag Bus. 2010 Mar;5(3):62-9.
5. Caspi A, Moffitt TE. When do individual differences matter? A paradoxical theory of personality coherence. Psychol. Inq 1993 4(4):247-71.
6. Scharf M, Mayseless O, Kivenson-Baron I. Adolescents attachment representations and developmental tasks in emerging adulthood. Dev Psychol. 2004;40(3):430-44. DOI: 10.1037/0012-1649.40.3.430
7. Small MW. Culture, values and integrity in contemporary society. J Bus Syst Gov Ethics, 2004:9(2):66-71.
8. Kristof AL. Person-organisation fit: An integrative review of its conceptualisations, measurement, and implications. Pers Psychol, 1996;49:1-49.
9. Li YS. The concept of primary society and secondary society. United States: Author House; 2010
10. Al Bawaba Australia : Government supports veterans and ADF personnel." Mena Report, 12 Aug. 2016. Expanded Academic

Factors Associated with Lower Extremity Training-Related Injuries Among Enlisted Women in U.S. Army Operational Units

C Rappole, M C Chervak, T Grier, MK Anderson, BH Jones

Abstract

Background: The lower extremity is consistently the most injured body region among U.S. Army soldiers. However, there has been limited research on risk factors for lower extremity injuries, particularly among women.

Purpose: The purpose of this investigation was to assess factors associated with lower extremity training-related injuries among enlisted women from two Army light infantry brigades.

Materials and Methods: Female U.S. Army soldiers (n=369) completed a survey, including questions on personal characteristics, physical fitness, and physical training (PT). Medical encounter data were obtained from the Defense Medical Surveillance System and analyses were limited to training-related lower extremity injuries.

Results: In total, 54.7% (n=202) of women experienced one or more injuries in the previous 12-month period; more specifically, 27% (n=100) of women sustained a lower extremity training-related injury. Higher injury incidence was associated with "heavy" occupational physical demand, low muscular endurance (sit-ups), performing resistance training during unit PT, mileage for personal PT runs, and not performing interval training for personal PT. In the multivariable analysis, greater frequency of resistance training during unit PT was associated with a higher incidence of lower extremity training-related injury (OR: 1.75, 95% CI: 1.01-3.01, p=0.05) and lower frequency of interval training during personal PT was associated with a higher incidence of lower extremity training-related injury (OR: 2.08, 95% CI: 1.17-3.68, p=0.01).

Conclusion: While prospective studies are needed, results suggest that ensuring recommended guidelines for resistance training are followed during unit physical training and adding interval training to personal training routines may lower risk of lower extremity training-related injury among female soldiers.

Key Words: women, military, occupational, injuries, physical training

Introduction

In 2012, almost 14% of U.S. Army soldiers were women.[1] With the opening of combat arms occupations to women, female soldiers who choose to enter these military occupational specialties (MOS's) will face a variety of new roles and potential injury risks.[2] Given the physically-demanding nature of many military occupations, it is important to investigate differences in injury rates and risk factors between men and women.[3]

Several factors have been associated with risk of any injury among women in the military: low physical fitness (as measured by Army Physical Fitness Test (APFT) scores and/or peak VO_2 max),[4-6] higher body fat percentage (≥ 23.7%),[5] history of injury,[7] not participating in unit runs,[7] and participating in personal resistance training sessions once or twice a week compared to no personal resistance training.[7] Much of the research on these risk factors has been conducted among soldiers in controlled training environments where all soldiers perform the same activities.

Previous studies that have not controlled for fitness have found women in the military experience higher rates of injury than men (18% to 70% higher).[8] However, risk of injury is often confounded by physical fitness level. Studies that control for physical fitness level have found there is no difference in injury risk between male and female soldiers,[3, 4, 9] i.e., men and women of similar fitness levels have similar risks of injury.

In military populations, the lower extremity is consistently the most injured body region.[6, 9-12] Previous studies suggest that lower extremity injuries account for 28% to 85% of all injuries in military populations.[6, 9, 11, 12] There has been limited investigation of risk factors for lower extremity injuries, in particular among female soldiers. The purpose of this study was to determine the association of personal characteristics, physical fitness, and physical training factors with lower extremity training-related injury among enlisted female US Army soldiers.

Materials and Methods

Surveys were completed by US Army as part of an ongoing evaluation of a physical training program. Subjects for this analysis were enlisted (E1-E9) female soldiers from two light infantry Army brigades. The brigades consisted of six battalions: infantry, cavalry, field artillery, brigade support, brigade special troops battalion, and headquarters. At the time of data collection (2010-2011), women were eligible to serve in non-combat occupations only. The project was reviewed and approved by the U.S. Army Public Health Center Public Health Review Board.

The paper survey obtained information on the soldiers' personal characteristics, including their current height and weight, most recent APFT scores, unit PT participation, and personal PT participation. BMI was calculated from self-reported height (m) and weight (kg) (kg/m^2). If self-reported data were missing, height and weight were extracted from unit records where available. BMI was categorised according to the Centers for Disease Control and Prevention (CDC) classifications for "underweight" (≤ 18.5 kg/m^2), "normal" (18.5 – 24.9 kg/m^2), "overweight" (25.0 – 29.9 kg/m^2) and "obese" (≥ 30.0 kg/m^2).[13] The "overweight" category was split into two categories: "low overweight" (25.0 – 27.4 kg/m^2) and "high overweight" (27.5 – 29.9 kg/m^2).[14] The "underweight" and "normal" categories were condensed into one "normal" category due to a small number of underweight soldiers. Body fat percentage was estimated from BMI, age, and gender using the following equation: body fat percentage = (1.20 x BMI) + (0.23 x age) – (10.8 x sex) – 5.4, where sex=0 when female.[15] Current cigarette smokers were identified as those who had smoked at least 100 cigarettes in their lifetime and smoked at least one cigarette in the previous 30 days from the survey administration date, consistent with the CDC current smoker definition.[16]

Military occupational specialties (MOSs) were grouped by occupational structure and assigned a physical demand level.[14] Physical demand levels were categorised as "Very Heavy" (constant lifting in excess of 50 pounds (lbs.) or occasional lifting over 100 lbs.), "Heavy" (constant lifting of 50 lbs. or occasional lifting maximum of 100 lbs.), "Moderately Heavy" (constant lifting of 40 lbs. or occasional lifting maximum of 80 lbs.), "Medium" (constant lifting of 25 lbs. or occasional lifting maximum of 50 lbs.), or "Light" (constant lifting of 10 lbs. or occasional lifting maximum of 20 lbs.).[17] The "Medium" and "Light" MOS groups were consolidated into "Medium-Light" due to small numbers.

Physical fitness was measured by self-reported performance on the most recent Army Physical Fitness Test (APFT). The APFT consists of a timed (2 minute) push-up event, a timed (2 minute) sit-up event, and a two-mile run for time.[18] If self-reported data were missing, the APFT measures were extracted from unit records where available. APFT scores were converted into tertiles (T) where T3 = lowest one third (33%) performance and T1 = highest one third (33%) performance.[6, 18] Predicted VO_2max was estimated from two-mile run times using the Mello formula as follows: predicted VO_2max = 72.9-(1.77 x (two-mile run time)).[19] High correlations have been found between actual APFT performance and self-reported APFT performance as well as actual and self-reported height and weight among soldiers in operational units.[20] Unit PT survey questions included frequency and duration of the following performed in the last 6 months: cross-training, distance running, sprint or interval training (henceforth "interval training"), calisthenics, resistance training, agility drills, and road marches. Personal PT survey questions included current frequency and duration of the following: distance running, resistance training, and interval training. Cross-training was defined as a program that involves a variety of exercises, such as strength training, agility drills, sprints, plyometrics, etc.; distance running was defined as running continuously for 1 mile or greater; sprints were defined as short bursts of speed that cannot be sustained for more than a few minutes; intervals were defined as short periods of high speed running mixed with periods of jogging or walking; calisthenics were defined as jumping jacks, windmills, mountain climbers, etc.; resistance training was defined as weight lifting using free weights, dumbbells, kettlebells, hammer-strength machines, etc.

Medical encounter data were obtained from the Defense Medical Surveillance System (DMSS), a data system maintained by the Armed Forces Health Surveillance Branch (AFHSB) containing all records of inpatient and outpatient medical encounters at military treatment facilities or paid for by the military health system.[21] Medical encounter data

included race, visit dates, and International Classification of Diseases 9th Revision Clinical Modification (ICD-9-CM) diagnosis codes for all outpatient and hospitalised injury medical encounters for the 12 months before survey administration and fitness testing. Injuries were identified using the primary (first) diagnosis. Injuries included ICD-9-CM codes associated with both overuse and traumatic injuries, consistent with prior studies of injuries in military populations.[7, 14, 22, 23] Selected lower extremity injuries commonly due to overuse during military training have been monitored as part of ongoing Army training-related injury reports since 2003[24]; this injury definition was used for this analysis. Diagnoses included sprains and strains, tendinitis, lumbago, and joint pain; body parts included lower back, hips, pelvis, leg, knee, ankle, and foot. See Appendix A for a list of specific ICD-9-CM codes.

Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS), Version 19.0. Summary statistics for categorical variables include frequencies and percentages. Summary statistics for continuous variables include means and standard deviations. Univariate logistic regression was employed to calculate unadjusted odds ratios and 95% confidence intervals (95% CIs) to assess the association of personal characteristics, physical fitness, unit physical training, and personal physical training with injury risk. Provided there were sufficient data, the variable level with the lowest injury risk was selected as the referent group and was used to compare the injury risk at other variable levels. To identify independent predictors of injury risk, variables with a $p \leq 0.10$ in univariate logistic regression models were included in a backward elimination multivariable logistic regression model. Odds ratios and 95% CIs are presented for the final multivariable logistic regression model. Variables with a $p \leq 0.05$ were considered significantly associated with lower extremity training-related injuries in the multivariable model.

Results

There were 369 enlisted female soldiers in the two brigades, who had an average age of 29.9 ± 6.1 years (range: 22 to 52 years) and average BMI of 24.7 ± 3.1 kg/m^2 (normal). The highest proportion of women were Caucasian (35%), in combat service support MOS's (67%), in occupations with very heavy (37%) or moderately heavy (31%) occupational physical demand ratings, and were not current smokers (66%) (Table 1). A majority of women reported participating in both unit physical training (93%) and personal physical training (77%).

Table 1. Personal characteristics of enlisted female US Army soldiers in two light infantry brigades (n=369)

Variable	Categories	Total n (%)
Age (Years)	22-26	138 (37.4)
	27-31	124 (33.6)
	≥ 32	107 (29.0)
Race/Ethnicity	Caucasian	130 (35.2)
	Black	83 (22.5)
	Hispanic	56 (15.2)
	Unknown/Other	100 (27.1)
Battalion	Brigade Support Battalion	141 (38.2)
	Special Troops Battalion	128 (34.7)
	Infantry	32 (8.7)
	Armor	29 (7.9)
	Cavalry	17 (4.6)
	Field Artillery	16 (4.3)
	Headquarters	6 (1.6)
MOS	Combat Arms	0 (-)
	Combat Support	120 (32.7)
	Combat Service Support	246 (67.3)
Occupational Physical Demand Level	Very Heavy	134 (36.6)
	Heavy	101 (27.6)
	Moderately Heavy	112 (30.6)
	Medium-Light	19 (5.2)
BMI (kg/m^2)	Normal (< 25.0)	198 (55.2)
	Low Overweight (25.0 – 27.4)	98 (27.3)
	High Overweight (27.5 – 29.9)	43 (12.0)
	Obese (≥ 30.0)	20 (5.6)
Body Fat Percentage (Tertiles)	≤ 29.05	116 (32.3)
	29.06-32.50	123 (34.3)
	≥ 32.51	120 (33.4)

Table 2. Association of personal characteristics, physical training, and physical fitness with lower extremity training-related injury, enlisted female US Army soldiers in two light infantry brigades (n=369)

Variable	Categories	n	Injured (%)	Odds Ratio (95% CI)	Uncorrected X^2 p-value
Race/Ethnicity	Caucasian	130	26.2	1.28 (0.66-2.46)	0.46
	Black	83	21.7	1.00	
	Hispanic	56	23.2	1.09 (0.49-2.46)	0.83
	Unknown/Other	100	35.0	**1.94 (1.00-3.78)***	**0.05**
Occupational Physical Demand Level	Very Heavy	134	23.9	1.00	
	Heavy	101	36.6	**1.84 (1.05-3.25)**	**0.03**
	Moderately Heavy	112	25.0	1.06 (0.59-1.90)	0.84
	Medium-Light	19	11.8	-	-
APFT† Sit-Ups (Repetitions)	Lowest Performing Two-Thirds (< 69)	222	28.8	**1.68 (0.96-2.93)**	**0.07**
	Highest Performing Third (≥ 69)	108	19.4	1.00	
Unit PT‡ Resistance Training Frequency (per Week)	Do not perform / < 1 time per week	252	22.6	1.00	
	≥ 1 time per week	107	36.4	**1.96 (1.20-3.21)**	**< 0.01**
Personal PT‡ Average Distance per Run (Miles)	Did not perform / 1 mile	185	31.4	**1.57 (0.98-2.52)**	**0.06**
	> 1 mile	173	22.5	1.00	
Personal PT‡ Interval Training Frequency (per Week)	Did not perform / < 1 time per week	233	30.5	**1.64 (1.00-2.71)**	**0.05**
	≥ 1 time per week	133	21.1	1.00	

Note: The following variables were tested and not significantly associated with lower extremity training-related injury (p>0.10): Age, Battalion, MOS, BMI, Body Fat Percentage, Smoking Status, APFT Push-Ups, APFT 2 Mile Run Time, Unit PT Distance Run Frequency, Unit PT Average Distance Per Run, Unit PT Sprint/Interval Training Frequency, Unit PT Road Marching Frequency, Unit PT Average Distance Per March, Personal PT Distance Runs Frequency, Personal PT Resistance Training Frequency

* *Bold indicates p≤0.10 and included in multivariable model*

† *Army Physical Fitness Test*

‡ Physical training

In total, 55% (n=202) of women experienced one or more injuries in the previous 12-month period. Of those who were injured, 50% (n=100) sustained a lower extremity training-related injury. Of the lower extremity training-related injuries, 76% (n=76) were classified as musculoskeletal conditions (ICD-9-CM codes 710-739) and 24% (n=24) were classified as traumatic injuries (ICD-9-CM codes 800-999).

Odds ratios for variables possibly associated with lower extremity training-related injury are found in Table 2. Higher unadjusted odds of injury (p≤0.10) was associated with unknown/other race, "heavy" occupational physical demand, low APFT sit-up performance, resistance training one or more times per week for unit physical training, not performing or only completing an average of 1 mile for personal

Table 3. Unit PT, personal PT, and personal characteristics risk factors for lower extremity training-related injury among enlisted female US Army soldiers using multivariable logistic regression (n=295)

Variable	Categories	n	Odds Ratio (95% CI)	p-value
Unit PT* Resistance Training Frequency (per Week)	Do not perform / < 1 time per week	202	1.00	
	≥ 1 time per week	95	1.75 (1.01-3.01)	**0.05**
Personal PT* Interval Training Frequency (per Week)	Did not perform / < 1 time per week	183	2.08 (1.17-3.68)	**0.01**
	≥ 1 time per week	114	1.00	
Variables entered into the model (p<0.10 in unadjusted models):				
Race/Ethnicity	Unit PT* Resistance Training Frequency per Week			
Physical Demand	Personal PT* Average Distance Per Run			
APFT† Sit-Ups	Personal PT* Sprint / Interval Training Frequency			

* *Physical Training*

† *Army Physical Fitness Test*

physical training runs, and not performing interval training or performing interval training less than once per week for personal physical training. The unadjusted odds ratio was not calculated for the "medium-light" occupational physical demand group due to the low count. The two lowest performing tertiles in each of the APFT measures were combined due to similar odds of injury.

Table 3 displays the results of a backward elimination multivariable logistic regression analysis that examined factors associated with lower extremity training-related injuries related to personal characteristics, unit physical training, and personal physical training. Variables entered into the model included: race/ethnicity, occupational physical demand, APFT sit-up performance, unit PT resistance training frequency per week, personal PT average distance run, and personal PT interval training frequency per week. Variables that remained statistically significantly associated with injury ($p \leq 0.05$) are reported. Resistance training one or more times per week was associated with nearly double the odds of lower extremity training-related injury compared to those who did not perform resistance training or who performed it less than once per week (OR: 1.75, 95% CI: 1.01-3.01, p=0.05). Not performing interval training or performing interval training less than one time per week during personal PT was associated with twice the odds of lower extremity training-related injury compared to those who performed interval training one or more times per week during personal PT (OR: 2.08, 95% CI: 1.17-3.68, p=0.01).

Post hoc descriptive analysis of the enlisted female soldiers included in the unit and personal physical training regression models are shown in Table 4. Overall, women who participated in unit resistance training one or more times per week appear to be less physically fit based on measures of body composition, but were no different with regard to push-up, sit-up, run time performance, or estimated VO_2max. Female soldiers who did not incorporate interval training into their personal PT program or who did so less than once per week performed fewer push-ups and sit-ups than those who conducted interval training once or more per week.

Discussion

In these operational units, 27% of female soldiers experienced a lower extremity training-related injury in the previous 12 months. Considering a variety of personal characteristics, physical fitness, and physical training, this study indicated that resistance training one or more times per week for unit PT was associated with lower extremity training-related injuries among women. Lack of interval training or performance of interval training less than once per

Table 4. Personal characteristics and physical fitness among enlisted female soldiers in the multivariable model (n=297)

Variable	Unit PT* Resistance Training Frequency		T test p-value†	Personal PT* Interval Training Frequency		T test p-value†
	Do not perform and < 1 time per week	≥ 1 time per week		Do not perform and < 1 time time per week	≥ 1 time per week	
BMI (kg/m²)	24.4 ± 2.9 (n=197)	25.4 ± 3.1 (n=92)	**0.01**‡	24.7 ± 3.0 (n=180)	24.8 ± 3.0 (n=109)	0.78
Body Fat Percentage	**30.6 ± 3.9 (n=197)**	**32.1 ± 4.3 (n=92)**	**0.01**	30.8 ± 4.07 (n=180)	31.1 ± 4.2 (n=109)	0.99
APFT§ Push-Up (repetitions)	38.0 ± 11.7 (n=198)	36.9 ± 11.5 (n=92)	0.46	**36.5 ± 11.8 (n=178)**	**39.5 ± 11.2 (n=112)**	**0.03**
APFT§ Sit-Up (repetitions)	63.5 ± 12.8 (n=202)	63.3 ± 11.3 (n=95)	0.92	**62.3 ± 11.6 (n=183)**	**65.3 ± 13.2 (n=114)**	**0.04**
APFT§ 2-mile Run (minutes and fraction of a minute)	18.26 ± 2.0 (n=179)	17.87 ± 2.2 (n=83)	0.17	18.31 ± 2.1 (n=154)	17.89 ± 2.0 (n=108)	0.11
Estimated VO_2max	40.6 ± 3.6 (n=179)	41.3 ± 3.8 (n=83)	0.17	40.5 ± 3.8 (n=154)	41.2 ± 3.6 (n=108)	0.11

* *Physical training*

† *Assuming equal variances*

‡ *Bold indicates p≤0.05*

§ *Army Physical Fitness Test*

week during personal PT was also associated with lower extremity training-related injury. Previous studies of initial entry military populations have usually found that low physical fitness among women and men is a primary risk factor for injury, so the finding that physical training is a stronger risk factor among women in operational units offers an important new insight.

The personal characteristics of the population under study were similar to that of previous investigations of female soldiers.[3-5, 7, 9, 12] Other investigations of women reporting the incidence of lower extremity training-related injuries vary from 9.8% to 36%.[12, 25] The lower extremity training-related injury incidence in this study is lower than the rate among U.S. Army female wheel vehicle mechanics, though only 43 female wheel mechanics were screened.[12] Female soldiers of the 1st Cavalry Division experienced an incidence of 9.8% to 11.8% lower extremity training-related injuries prior to their 2006 deployment to Iraq, while post-deployment, the women experienced lower extremity training-related injury incidence between 22.4% and 28%.[25] The lower injury incidence among women in the 1st Cavalry Division prior to deployment may be attributed to unmeasured factors such as different physical training or MOS duties than those in the current study, given that the same lower extremity training-related injury definition was used.

Resistance training has previously been found to be a protective factor against injury among male soldiers[22] and to increase female soldiers' performance on combat-related tasks,[26] however, this study found that resistance training for women was a risk factor. Roughly 30% of the women who participated in this investigation performed resistance training with their units, and it may be that the resistance training itself caused injuries.

Resistance training is important to build lean mass and muscle strength in women,[26] but women may have a different risk for musculoskeletal injuries from resistance training than men due to physiologic differences.[27] Women in their twenties have higher body fat relative to their mass compared with men (20-25% compared with 13-16% for men) and they also have approximately 30% less lean body mass than males.[27] Differences in body composition can mean different performance abilities in the context of an MOS, as men generally have greater absolute muscular endurance and power.[27] A study by Roy *et al.* indicated that female soldiers who participated in resistance training 1 to 2 times per week were at a greater risk for any injury compared to those who did not perform resistance training.[7] Roy *et al.* also demonstrated there was an upside down U-shaped relationship between resistance training and risk of injury among women in the military, because those who did not perform any personal weight training for 3 or more sessions a week were neither significantly protected nor harmed.[7] The current study is the first to identify an association between resistance training (e.g. weight lifting using free weights, dumbbells, kettlebells, hammer-strength machines, etc.) and lower extremity injury among female soldiers.

Soldiers may reduce the risk of injuries during resistance training by following training regimens such as the RESET, TRAIN, and READY phases described in the US Army "Building the Soldier Athlete" manual.[28] By focusing on resistance training form, gradually increasing intensity, and ensuring adequate rest and recovery, soldiers can prevent training-related lower extremity injuries.[28] Field Manual 7-22 "Army Physical Readiness Training" also recommends training schedules and resistance training drills that allow leaders to adapt physical readiness training to occupational requirements.[18]

Women who did not perform interval training as part of their personal exercise routines or performed interval training less than once per week had a higher risk of lower extremity training-related injuries than those who performed interval training one or more times per week for personal PT. Interval training appears to be a marker for fitness in general, as evidenced by the women who perform interval training one or more times per week having higher APFT push-up and sit-up scores on average than those who did not perform interval training. Low levels of physical fitness have previously been associated with higher injury risk in other military populations,[6, 8] so it may be that interval training is a marker for a more intense personal training regimen leading to higher fitness levels which may be protective.

Other studies have found associations between interval training, fitness, and injury. A study of male US Air Force servicemen tested the association of interval training and injury by replacing approximately half of traditional running with interval running and agility training during the combat controller training program.[29] The authors attributed an increase in soldier fitness (e.g. VO_2max and time-to-exhaustion) and 67% decrease in overuse injuries to the use of interval training instead of distance running.[29] This is similar to the findings of the current study, where women who did not perform interval training sustained a higher risk of lower extremity injury. A study of female soldiers from the Combat Fitness Instructor Course of the Israel Defense Forces found that injured soldiers tended to have slower initial 10 metre sprint times than soldiers who did not report any injury.[5] Though this Israel Defense Forces study did not find that sprint time predicted injury, it demonstrates the potential relationship between lack of interval training (with slower sprint time as a proxy measure) and risk of injury in a female military population.

Prior research has shown that the least fit soldiers, regardless of gender, are at the highest risk for injury.[3, 4, 9] While not statistically significant with two-tailed chi square tests, this study nevertheless found that women who performed in the lowest two-thirds of APFT events (sit- ups, push-ups, and two-mile run) had higher risks of lower extremity training-related injury than the highest performing one-third. The directionality of the findings regarding fitness measured by push-ups, sit ups, and two-mile run time from this study are consistent with the literature.[4, 6, 22, 24]

Additionally, women in MOS's with "heavy" physical demands had higher risk of injury before controlling for other factors. A previous study of male soldiers found an association between heavier physical demands and musculoskeletal hospitalisation.[30] Physical demands are related to load lifted, and Roy *et al.* have found that higher frequency of lifting objects and higher height of objects lifted were associated with injury among a population of deployed soldiers.[10] The lack of association between

job physical demands and lower extremity training-related injury in the multivariable model in the current study may be due to lack of power; therefore, future analyses would benefit from greater sample sizes.

There were some limitations in this investigation. Twenty percent of women were of "unknown/other" race/ethnicity, suggesting a need to improve recording of race/ethnicity in the medical records data. Injury data and physical training behaviours were simultaneously assessed in this study; therefore the causality of injury was unable to be determined. It is possible that women reporting resistance training at least once per week were already on profile, unable to perform aerobic exercise, and were executing reconditioning programs involving strength training as described in US Army physical training doctrine.[18] The higher BMI and body fat percentage seen in those reporting resistance training may be a result of limited ability to perform aerobic exercise. Future studies should investigate resistance training as an injury risk factor for female soldiers prospectively.

Personal characteristics, physical fitness, and physical training data were self-reported by survey, which can be subject to recall bias as well as concerns about honesty in answers and lack of comprehension of the questions. However, prior analyses have found high correlations between actual and self-reported height, weight, and APFT data[20] in US Army personnel in operational units. In this analysis, body fat percentage was estimated using the Deurenberg formula, which has been found to have less than 2% mean difference between reported and predicted body fat percentage.[15] Even though the Deurenberg formula[16] is validated with regard to its accuracy, it remains an estimation tool only. In addition, CDC BMI cut points may not be appropriate for all persons due to evidence showing varying correlations between BMI, percentage of body fat, and body fat distribution among different ethnicities.[13] Use of electronic medical records ensured that all injuries receiving medical treatment from within and outside the Military Health System were captured; however, minor injuries are likely underestimated. Use of external cause of injury coding in the medical records was not sufficient to provide information on the activity associated with the injury or the mechanism of injury, and therefore could not be reported. Future studies would benefit from inclusion of injury history, more detailed assessment of training volume and progression, and a prospective review of injuries relative to risk factors.

This study suggests that physical training levels are more significantly associated with injury than personal characteristics and fitness level among women in operational units. Lower extremity training-related injury was associated with more exposure to resistance training and less exposure to interval training. Resistance training is recommended at least 2 to 3 times per week for soldiers.[28] Soldiers may benefit from additional guidance to ensure proper resistance training technique. With more instruction, women who perform more resistance training might not have a higher injury risk than those who do not perform resistance training. Interval training has previously been associated with increased fitness and lower injury risk,[5, 29] and it is recommended that soldiers conduct interval training at least once per week.[28]

Acknowledgements

This research was supported in part by an appointment to the Postgraduate Research Participation Program at the U.S. Army Public Health Center (APHC) administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the U.S. Department of Energy and APHC. This study is approved for public release, distribution is unlimited. The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or reflecting the views of the U.S. Army or the Department of Defense.

Corresponding author: Catherine Rappole
catherine.a.rappole.ctr@mail.mil
Authors: C Rappole[1], M C Chervak[1], T Grier[1], MK Anderson[1], BH Jones[1]
Author Affiliations:
1 Army Public Health Center - Injury Prevention Division

Appendix A: ICD-9-CM codes included as lower extremity training-related injuries[23]

ICD-9-CM Code	Type of injury
717.7	Chondromalacia of patella
719.00	Effusion of joint, site unspecified
719.05	Effusion of joint, pelvic region and thigh
719.06	Effusion of joint, lower leg
719.07	Effusion of joint, ankle and foot
719.08	Effusion of joint, other specified sites
719.09	Effusion of joint, multiple sites
719.40	Pain in joint, site unspecified
719.45	Pain in joint, pelvic region and thigh
719.46	Pain in joint, lower leg
719.47	Pain in joint, ankle and foot
719.48	Pain in joint, other specified sites
719.49	Pain in joint, multiple sites
724.2	Lumbago
724.5	Backache, unspecified
724.9	Other unspecified back disorders
726.5	Enthesopathy of hip region
726.6	Enthesopathy of knee
726.60	Enthesopathy of knee, unspecified
726.61	Pes anserinus tendinitis or bursitis
726.62	Tibial collateral ligament bursitis
726.63	Fibular collateral ligament bursitis
726.64	Patellar tendinitis
726.65	Prepatellar bursitis
726.69	Other enthesopathy of knee
726.7	Enthesopathy of ankle and tarsus
726.70	Enthesopathy of ankle and tarsus, unspecified
726.71	Achilles bursitis or tendinitis
726.72	Tibialis tendinitis
726.73	Calcaneal spur
726.79	Other enthesopathy of ankle and tarsus
726.8	Other peripheral enthesopathies
726.9	Unspecified enthesopathy
726.90	Enthesopathy of unspecified site
726.91	Exostosis of unspecified site
727.2	Specific bursitides often of occupational origin
727.3	Other bursitis
727.65	Nontraumatic rupture of quadriceps tendon
727.66	Nontraumatic rupture of patellar tendon
727.67	Nontraumatic rupture of achilles tendon
727.68	Nontraumatic rupture of other tendons of foot and ankle
728.71	Plantar fascial fibromatosis
729.1	Myalgia and myositis, unspecified
733.10	Pathologic fracture, unspecified site
733.14	Pathologic fracture of neck of femur
733.15	Pathologic fracture of other specified part of femur
733.16	Pathologic fracture of tibia or fibula
733.19	Pathologic fracture of other specified site
733.60	Tietze's disease
733.93	Stress fracture of tibia or fibula
733.94	Stress fracture of the metatarsals
733.95	Stress fracture of other bone
843	Sprains and strains of hip and thigh
843.0	Iliofemoral (ligament) sprain
843.1	Ischiocapsular (ligament) sprain
843.8	Sprains and strains of other specified sites of hip and thigh
843.9	Sprains and strains of unspecified site of hip and thigh
844.0	Sprain of lateral collateral ligament of knee
844.1	Sprain of medial collateral ligament of knee
844.2	Sprain of cruciate ligament of knee
844.3	Sprain of tibiofibular (joint) (ligament) superior, of knee
844.8	Sprains and strains of other specified sites of knee and leg
844.9	Sprains and strains of unspecified site of knee and leg
845	Sprains and strains of ankle and foot
845.0	Ankle sprain
845.00	Sprain of ankle, unspecified site
845.01	Sprain of deltoid (ligament), ankle
845.02	Sprain of calcaneofibular (ligament) of ankle
845.03	Sprain of tibiofibular (ligament), distal of ankle
845.09	Other sprains and strains of ankle
845.1	Foot sprain
845.10	Sprain of foot, unspecified site
845.11	Sprain of tarsometatarsal (joint) (ligament) of foot
845.12	Sprain of metatarsophalangeal (joint) of foot
845.13	Sprain of interphalangeal (joint), toe
845.19	Other sprain of foot
846	Sprains and strains of sacroiliac region
846.0	Sprain of lumbosacral (joint) (ligament)
846.1	Sprain of sacroiliac ligament
846.2	Sprain of sacrospinatus (ligament)
846.3	Sprain of sacrotuberous (ligament)
846.8	Sprain of other specified sites of sacroiliac region
846.9	Sprain of unspecified site of sacroiliac region
847.2	Sprain of lumbar
847.3	Sprain of sacrum
847.4	Sprain of coccyx
847.9	Sprain of unspecified site of back
848.5	Sprain of pelvic
848.8	Other specified sites of sprains and strains
848.9	Unspecified site of sprain and strain

References

1. Defense Medical Surveillance System [Internet]. Department of Defense. 2016. Available from: http://afhsc.army.mil/Home/DMSS.
2. Vergun D. Army opening infantry, armor to women. Army Archives [Internet]. 2016. Available from: https://www.army.mil/article/165231/Army_opening_infantry__armor_to_women/.
3. Canham M, McFerren M, Jones B. The Association of Injury with Physical Fitness Among Men and Women in Gender Integrated Basic Combat Training Unit. Medical Surveillance Monthly Report. 1996;2:8-10.
4. Bell NS, Mangione TW, Hemenway D, et al. High injury rates among female Army trainees: A function of gender? American Journal of Preventive Medicine. 2000;18(3, Supplement 1):141-146.
5. Kodesh E, Shargal E, Kislev-Cohen R, et al. Examination of the Effectiveness of Predictors for Musculoskeletal Injuries in Female Soldiers. J Sports Sci Med. 2015;14(3):515-521.
6. Knapik J, Sharp M, Canham-Chervak M, et al. Risk factors for training-related injuries among men and women in basic combat training. Med Sci Sports Exerc. 2001;33(6):946-954.
7. Roy T, Songer T, Ye F, et al. Physical Training Risk Factors for Musculoskeletal Injury in Female Soldiers. Mil Med. 2014;179(12).
8. Department of the Army. Prevention and control of musculoskeletal injuries associated with physical training. Washington, D.C.: Department of the Army, 2011 Technical Bulletin Medical 592.
9. Jones BH, Bovee MW, Harris JM, et al. Intrinsic risk factors for exercise-related injuries among male and female army trainees. Am J Sports Med. 1993;21(5):705-710.
10. Roy T, Ritland B, Knapik J, et al. Lifting tasks are associated with injuries during the early portion of a deployment to Afghanistan. Mil Med. 2012;177(6):716-722.
11. Jones BH, Canham-Chervak M, Canada S, et al. Medical surveillance of injuries in the U.S. Military descriptive epidemiology and recommendations for improvement. Am J Prev Med. 2010;38(1 Suppl):S42-60.
12. Knapik JJ, Jones SB, Darakjy S, et al. Injury Rates and Injury Risk Factors among U.S. Army Wheel Vehicle Mechanics. Mil Med. 2007;172(9):988-996.
13. Centers for Disease Control and Prevention. About Adult BMI: Division of Nutrition, Physical Activity, and Obesity 2016 [updated May 15, 2015March 1, 2016]. Available from: http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html.
14. Anderson MK, Grier T, Canham-Chervak M, et al. Occupation and other risk factors for injury among enlisted U.S. Army Soldiers. Public Health. 2015;129(5):531-538.
15. Deurenberg P, Weststrate JA, Seidell JC. Body mass index as a measure of body fatness: age- and sex-specific prediction formulas. Br J Nutr. 1991;65(2):105-114.
16. Jamal A, Homa D, O'Connor E, et al. Current Cigarette Smoking Among Adults — United States, 2005–2014. Morbidity and Mortality Weekly Report. 2015;64(44):1233-1240.
17. Department of the Army. Smartbook DA PAM 611-21. In: Department of the Army, editor.: Department of the Army; 2012.
18. Department of the Army. Army Physical Readiness Training: Field Manual 7-22. Washington, DC2012.
19. Mello R, Murphy M, Vogel J. Relationship between a two mile run for time and maximal oxygen uptake. Journal of Applied Sport Science Research. 1988;2(1):9-12.
20. Martin RC, Grier T, Canham-Chervak M, et al. Validity of Self-Reported Physical Fitness and Body Mass Index in a Military Population. J Strength Cond Res. 2016;30(1):26-32.
21. Rubertone MV, Brundage JF. The Defense Medical Surveillance System and the Department of Defense serum repository: glimpses of the future of public health surveillance. Am J Public Health. 2002;92(12):1900-1904.
22. Grier T, Canham-Chervak M, McNulty V, et al. Extreme conditioning programs and injury risk in a US Army brigade combat team. US Army Med Dept J. 2013:36-47.
23. Knapik J, Darakjy S, Scott S, et al. Evaluation of two Army fitness programs: the TRADOC Standardized Physical Training Program for Basic Combat Training and the Fitness Assessment Program. Aberdeen Proving Ground, MD: US Army Public Health Center (Provisional), 2004 Technical Report No. 12-HF-5772B-04.

24. Knapik J, Hauret K, Jones B. Primary prevention of injuries in initial entry training. In: DeKoning B, editor. Textbooks of Military Medicine. Falls Church, VA: Office of the Surgeon General United States Army; 2006.
25. Knapik JJ, Spiess A, Grier T, et al. Injuries before and after deployments to Afghanistan and Iraq. Public Health. 2012;126(6):498-506.
26. Kraemer WJ, Mazzetti SA, Nindl BC, et al. Effect of resistance training on women's strength/power and occupational performances. Med Sci Sports Exerc. 2001;33(6):1011-1025.
27. Nindl BC, Jones BH, Van Arsdale SJ, et al. Operational Physical Performance and Fitness in Military Women: Physiological, Musculoskeletal Injury, and Optimized Physical Training Considerations for Successfully Integrating Women Into Combat-Centric Military Occupations. Mil Med. 2016;181:50-62.
28. Iverson C, Anderson J. Building the Soldier Athlete. U.S. Army Medical Department, 2009.
29. Walker T, Lennemann L, Zupan M, et al. Adapatations to a New Physical Training Program in the Combat Controller Training Pipeline. Brooks City-Base, TX: Air Force Research Laboratory, 2010 AFRL-RH-BR-TR-2010-0067.
30. Lincoln AE, Smith GS, Amoroso PJ, et al. The natural history and risk factors of musculoskeletal conditions resulting in disability among US Army personnel. Work (Reading, Mass). 2002;18(2):99-113.

Comorbidity Risks of a Cohort of Vietnam Veterans Diagnosed with Post-Traumatic Stress Disorder

T Bullman, A I Schneiderman

Abstract

Background: Research has demonstrated that posttraumatic stress disorder (PTSD) is associated with increased risk of other mental diseases. Studies have also reported increased risk for cardiovascular diseases associated with PTSD.

Purpose: This study examined cause-specific comorbidity risks among a cohort of Vietnam veterans diagnosed with PTSD.

Material and Methods: Study subjects were selected from the Department of Veterans Affairs (VA) Agent Orange Registry (AOR). The AOR records diagnostic and demographic data for Vietnam veterans who come to VA for a health exam. The comorbidity of 2,874 veterans with PTSD was compared to that of 8,537 veterans not diagnosed with PTSD. Risks of comorbid diseases were assessed using adjusted odds ratios (OR)s.

Results: PTSD was associated with increased risk for several mental diseases including alcohol and drug dependence, adjusted (OR = 4.51; 95% C.I., 4.09, 5.00) and various depressive disorders. Compared to veterans with no diagnosis for mental diseases, those with a mental disease diagnosis, excluding PTSD, had increased risks for all cardiovascular diseases (OR=1.35; 95% C.I., 1.19, 1.52).

Conclusion: Mental disease in general, and to a lesser degree PTSD, are related to risk of cardiovascular disease among Vietnam veterans.

Keywords: veterans, posttraumatic stress disorder, cardiovascular disease, comorbidity

Introduction

Estimates of posttraumatic stress disorder (PTSD) among Vietnam veterans include: 18.7% for a subset of Vietnam veterans, who were part of the National Vietnam Veterans Readjustment Study (NVVRS)[1] and 15% for Vietnam veterans included in the Vietnam Experience Study.[2] A 2015 follow-up of a sample of the NVVRS cohort reported a lifetime war zone prevalence of 17% for PTSD more than 40 years after the Vietnam War.[3] Veteran studies have reported a variety of mental diseases as being associated with PTSD. These comorbid diseases include; anxiety disorders, affective disorders, and substance abuse.[2,3,4] In addition to the well-established link between PTSD and other psychiatric or adjustment problems, research has identified an association between PTSD and chronic diseases. [5,6] Specifically, PTSD has been linked with increased risks of cardiovascular diseases, including hypertension, digestive diseases, and musculoskeletal diseases.[7,8,9]

The nature of the association between PTSD and increased risk for other diseases has been assessed by several studies. Examining how PTSD might impact physical health, two review articles of previous research cite the following mechanisms through which PTSD effects physical health; 1) PTSD increases risk for other comorbid mental disorders that are themselves risk factors for poor physical health, such as comorbid depression and panic disorder; 2) those with PTSD may employ coping strategies that are in themselves risk factors for poor health, such as smoking, alcohol and drug dependency, poor diet and lack of exercise; and 3) PTSD is associated with neurobiological system changes that impact physical health. [5, 10] A specific example of a neurobiological change among

those diagnosed with PTSD compared to those not diagnosed with PTSD, is poorer endothelial function, which may increase risk for cardiovascular disease. [11] Examining the association of cardiovascular disease risk factors and mental health diagnoses among a cohort of Iraq and Afghanistan veterans, a study reported that those with a mental health diagnosis, both including and excluding PTSD, had higher prevalence of cardiovascular risk factors than those with no mental health diagnosis. [12]

This current study was designed to further assess the long-term physical and mental health consequences of PTSD among a cohort of Vietnam veterans.

Material and Methods

Participants

The initial pool of 4,150 veterans diagnosed with PTSD and 113,808 not diagnosed with PTSD were selected from the 117,958 Vietnam veterans who received a Department of Veterans Affairs (VA) Agent Orange Registry (AOR) exam between calendar years 1982-1989. The years 1982-1989 were chosen as computerised data for AOR exams occurring post-1989 were not readily available and for years prior to 1982 diseases were not recorded using International Classification of Disease (ICD) codes. The AOR is a computer database containing diagnostic, demographic, and military service data for Vietnam veterans who have received a voluntary AOR medical examination at a VA Medical Center. The AOR was established in mid-1978 to monitor veterans' complaints and health problems that may have resulted from their exposure to herbicides used in Vietnam, including Agent Orange. However, any veteran who had active military service in Vietnam between 1962 and 1975 is eligible for the AOR. Veterans who report for an AOR exam are initially seen by a VA environmental health clinician who conducts a medical exam and screening. Based on the veteran's medical record and self-reported health history the clinician may refer the veteran to VA specialists, including a psychiatrist. Since 1982 all diagnostic data recorded on the AOR is coded using ICD-9 codes. A diagnosis of PTSD (ICD-9, 309.81) would have been assigned based on the diagnostic criteria in use at the time of the exam according to the DSM-III, DSM-III-R, or DSM-IV criteria.

To validate both the diagnosis of PTSD and absence of PTSD the 4,150 PTSD veterans and 113,808 non-PTSD comparison group veterans were first matched against VA's inpatient treatment records (PTF), 1982-2014, and outpatient treatment records (OPC). 1997-2014, PTF and OPC are computerised files of diagnostic data for veterans who sought medical treatment at a VAMC as either an inpatient or outpatient. To be considered further as study-eligible all veterans had to have at least one record in either PTF/OPC that was on or after the date of their AOR exam. Reviewing eligible PTF/OPC records, only those PTSD subjects who also had a diagnosis of PTSD recorded in either PTF/OPC after the date of AOR exam were retained as study subjects. Veterans in the initial comparison group who were found to have a subsequent diagnosis of PTSD in either PTF/OPC post AOR exam date were excluded from further consideration as study participants. This secondary screening process yielded 3,364 PTSD veterans and 49,967 non-PTSD comparison group veterans. Next, PTSD veterans were frequency matched with non-PTSD veterans on facility where AOR exam took place. This matching by facility was an attempt to adjust for a variety of factors related to place of residence. These factors include socio-economic and environmental differences potentially found in rural vs. urban locations. It was hoped that facility matching would also adjust for any variation in quality and availability of treatment. PTSD veterans from facilities where there were an insufficient number of comparison group veterans from the same facility to satisfy a 1:3 match were excluded from the study. The final group of veterans included in this study consisted of 2,874 PTSD study subjects and 8,622 frequency matched comparison group veterans. A review of the data for the non-PTSD veterans revealed 85 individuals who had no diagnoses recorded in the PTF or OPC other than the recording the AOR exam itself. These 85 veterans were excluded from the study, resulting in a final comparison group of 8,537 veterans. The final cohort for this study included 2,874 veterans diagnosed with PTSD and 8,537 comparison group veterans with no diagnosis of PTSD recorded in VA treatment records.

Data Sources

Demographic and military service characteristics were obtained from each veteran's AOR record. Diagnostic data was obtained from VA's PTF and OPC files, as well as from the veteran's AOR record, which includes diagnostic data obtained at the time of the AOR exam. All diagnostic data recorded during the AOR exam, or recorded in the PTF and OPC post AOR exam date were included in the study. All diagnostic data from either the AOR or PTF/OPC data files were coded using International Classification of Diseases 9th Revision (ICD-9) codes. [13]

Table 1. Demographic and Military Service Characteristics Among Agent Orange Registry (AOR) PTSD Cases and Controls

	PTSD (Exposed) (n=2874)		PTSD (Unexposed) (n=8537)	
Demographic/ Military Service Characteristic	**#**	**%**	**#**	**%**
Age at Exam				
27-36	797	27.7	1986	23.3
37-39	969	33.7	2207	25.8
40-43	824	28.7	1845	21.6
44-+	284	9.9	2499	29.3
Mean age at Exam	39.0		42.0	
Race				
White	2205	76.7	6375	74.7
Non-White	669	23.3	2162	25.3
Sex				
Male	2869	99.8	8527	99.1
Female	5	0.2	10	0.1
Branch				
Army	1955	68.0	5625	65.9
Marines	694	24.1	1106	13.0
Navy	148	5.1	734	8.6
Air Force	75	2.6	1049	12.3
Other	2	0.1	23	0.2
Date of Agent Orange Registry Exam				
1982-1983	326	11.4	1229	14.3
1984-1985	1145	39.9	4595	53.7
1986-1987	601	20.9	1289	15.1
1988-1989	802	27.8	1424	16.9
Number of Visits to VA for Healthcare Post AOR Exam				
1-9	211	7.3	2420	28.3
10-59	393	13.7	2540	29.8
60-199	904	31.4	2441	28.6
>200	1366	47.5	1136	13.3
Mean Visits to VA for Healthcare Post AOR Exam	250.2		89.3	

Table 2. Adjusted Odds Ratios of Selected Diagnoses for Veterans With a Diagnosis of PTSD on the Agent Orange Registry

Major Diagnostic Category (ICD-9)*	OR (95% C.I.)**
Cardiovascular Diseases (390-459)	0.69 (0.59, 0.80)
Hypertension (401-405)	0.71 (0.63, 0.80)
All Vascular Diseases (440-448)	0.77 (0.68, 0.86)
Atherosclerosis (440)	0.79 (0.65, 0.96)
Depressive Disorder Single Episode (296.2)	7.32 (6.32, 8.48)
Depressive Disorder Recurrent (296.3)	11.46 (9.98,13.16)
Dysthymic Disorder (3004)	5.87 (5.16, 6.67)
Alcohol/Drug Dependence (303-304)	4.51 (4.09, 5.00)

**ICD-9 = International Classification Disease Codes 9th Revision*

***OR = adjusted odds ratio; CI = 95% confidence interval Adjusted Odds Ratios were derived from logistic regression models (SAS® PROC LOGIST) and included the covariates; diagnosed with PTSD, Age at AOR Exam, Race, Sex, Branch of Service. Stepwise regression with an alpha level of 0.05 for entry into model was used to enter and remove a covariate from the model. Not all covariates met 0.05 criteria for entry into model for all diagnoses. For those diagnoses where PTSD did not meet 0.05 criteria to be entered into model NE (Not Entered) is recorded in the table.*

Data Analyses

Morbidity data were gathered from the date of the veteran's AOR exam through December 31, 2014. Based on earlier research, this study focused primarily on risk of cardiovascular diseases and mental diseases. Cause-specific morbidity risks associated with PTSD were assessed using adjusted Odds Ratios (OR)s, and their associated 95% confidence intervals (CIs). All ORs were calculated using logistic regression models, generated by SASv.9® "PROC LOGIST" [14] The ORs were used to examine the nature of the association between PTSD and comorbid diseases, by comparing those diagnosed with PTSD to those not diagnosed with PTSD. To arrive at the best fit model, stepwise regression was used whereby effects, i.e. covariates, were entered into and removed from the model in such a way that each forward selection step was followed by one or more backward elimination steps. The stepwise selection process terminated if no further effect was added to the model or if the current model was identical to a previously visited model. This study required a $p < .05$ significance level of the chi-square for a covariate to be entered into and remain in the model. Covariates assessed for each disease specific model were: diagnosed with PTSD (0 = no/1 = yes), age at time of AOR exam, race (0 = white/1 = non-white), sex (0 = female/1 = male), branch of service, and number of times seen as either an inpatient or outpatient on/after date of AOR exam.

Results

Table 1 has demographics and military service characteristics of both PTSD and non-PTSD veterans. Generally, veterans diagnosed with PTSD were younger than those not diagnosed with PTSD, with mean ages of 39 and 42, respectively. Both groups of veterans were similar regarding race (76.7% and 74.7% white, respectively) and sex, (99.8% and 99.1% male, respectively). A higher percentage of PTSD veterans served as ground troops, i.e. Army/Marines, than did non-PTSD veterans, 92.1% vs. 78.9%. The greatest contrast between the two groups of veterans was in the number of inpatient and outpatient visits. The mean number of inpatient and outpatient visits combined for VA healthcare throughout the follow-up period for PTSD veterans was 250.2 compared to only 89.3 for non-PTSD veterans. Forty-seven percent of PTSD veterans had 200 or more visits, compared to only 13.3% of non-PTSD veterans with 200 or more visits.

Table 2 has adjusted ORs for cause-specific morbidity of a priori interest associated with PTSD. As expected, PTSD was associated with statistically increased risks for other mental diseases including; depressive disorders single occurrence, (OR= 7.32,

Table 3. Adjusted Odds Ratios of Selected Diagnoses for Veterans By Mental Health Diagnosis for Veterans on the Agent Orange Registry

	Model 1* **Mental Health DiagnosiS Excluding PTSD**	**Model 2**** **PTSD With or Without Other Mental Health Diagnosis**
Major Diagnostic Category (ICD-9)***	Adjusted OR (95% CI) (N=5461)	Adjusted OR (95% CI) (N=2874)
Cardiovascular Diseases (390-459)	1.35 (1.19,1.52)	NE
Prevalence,% (Mental Dxs/Referent)	(85/70)	(89/70)
Hypertension (401-405)	1.25 (1.12,1.38)	NE
Prevalence,% (Mental Dxs/Referent)	(72/56)	(77/56)
All Vascular Diseases (440-448)	1.60 (1.40,1.83)	1.53 (1.29,1.82)
Prevalence,% (Mental Dxs/Referent)	(24/13)	(25/13)
Atherosclerosis (440)	1.66 (1.34-2.06)	1.76 (1.33,2.33)
Prevalence,% (Mental Dxs/Referent)	(8/4)	(7/4)

Note. ICD-9 = International Classification Disease Codes 9th Revision; OR = adjusted odds ratio; CI = 95% confidence interval; NE = not entered. Diagnostic data compiled from AOR records and VA inpatient and outpatient records thru 2014.

***Model 1 Adjusted Odds Ratios (OR)s associated with mental disease, excluding PTSD, were derived from logistic regression model (SAS® PROC LOGIST) and included the covariates; mental disease diagnosis (excluding PTSD) , Age at AOR Exam, Race, Sex, Branch of Service. Stepwise regression with an alpha level of 0.05 for entry into model was used to enter and remove a covariate from the model. Model only included those with a mental disease diagnosis, excluding PTSD and those with no mental disease diagnosis (Referent). Not all covariates met 0.05 criteria for entry into model for all diagnoses. For those diagnoses where mental disease did not meet .05 criteria model NE (Not Entered) is recorded in the table. Referent group were those 3076 with no mental diagnosis.*

*** Model 2 Adjusted Odds Ratios (OR)s associated with PTSD were derived from logistic regression model (SAS® PROC LOGIST) and included the covariates; PTSD, Age at AOR Exam, Race, Sex, Branch of Service. Stepwise regression with an alpha level of 0.05 for entry into model was used to enter and remove a covariate from the model. Model included all those diagnosed with PTSD and those with no mental disease diagnosis (Referent). Not all covariates met .05 criteria for entry into model for all diagnoses. For those diagnoses where PTSD did not meet .05 criteria NE (Not Entered) is recorded in the table. Referent group were those 3076 with no mental diagnosis.*

**** ICD-9 = International Classification Disease Codes 9th Revision*

95% C.I., 6.32, 8.48); depressive disorder recurrent episodes, (OR=11.46, 95% C.I., 9.98, 13.16); dysthymic disorder, (OR= 5.87, 95% C.I., 5.16, 6.67); and alcohol/drug dependence (OR= 4.51, 95% C.I., 4.09, 5.00). However, PTSD was not associated with an increased risk for any of the cardiovascular diseases examined. In fact, those with PTSD had a statistically significant decreased risk for all cardiovascular diseases, (OR= 0.69, 95% C.I., 0.59, 0.80). Those with PTSD also had decreased risk for specific cardiovascular diseases including; hypertension, (OR=0.71, 95% C.I., 0.63, 0.80); all vascular diseases, (OR= 0.77, 95% C.I., 0.68, 0.86); and atherosclerosis, (OR=0.79, 95% C.I., 0.65, 0.96).

The role that mental diseases other than PTSD may have in assessing whether PTSD is associated with risk of cardiovascular disease is examined in Table 3. Model 1 assesses the risk of cardiovascular diseases among veterans with mental disease diagnoses, excluding PTSD, compared to veterans with no mental disease diagnosis. Model 2 assesses the

risk of cardiovascular diseases among all veterans diagnosed with PTSD relative to that of veterans with no mental disease diagnosis. Compared to those with no mental disease diagnosis, veterans with mental diseases other than PTSD had statistically significant increased risk for all cardiovascular diseases, (OR=1.35, 95% C.I., 1.19, 1.52); hypertension, (OR=1.25, 95% C.I., 1.12, 1.38); all vascular diseases, (OR =1.60, 95% C.I., 1.40, 1.83); and atherosclerosis, (OR=1.66, 95% C.I., 1.34, 2.06). Compared to veterans with no mental disease diagnosis, those diagnosed with PTSD did not have an increased risk of all cardiovascular diseases or hypertension (Model 2); however, there were increased risks of all vascular diseases, (OR=1.53, 95% C.I., 1.29, 1.82) and atherosclerosis, (OR=1.76, 95% C.I., 1.32, 2.33).

Discussion

As reported in other studies, PTSD among Vietnam veterans on the AOR is associated with an increased risk for other mental disorders. [2,3,4] Unlike other studies [7,8,9], this study did not find an increased risk of cardiovascular diseases among those diagnosed with PTSD. In fact, those with PTSD had statistically decreased risks for all cardiovascular diseases; including hypertension, all vascular diseases, and atherosclerosis when compared to veterans with no diagnosis of PTSD. A potential explanation for the decreased risk of cardiovascular diseases among those diagnosed with PTSD, may be related to the presence of mental diseases other than PTSD among the comparison group veterans. Non-PTSD veterans were selected only on the basis of not having a diagnosis of PTSD, veterans were not excluded from the potential comparison group if they had mental diseases other than PTSD. Among non-PTSD veterans in this study, 64% had a diagnosis for mental disease. While two of the previous studies reporting an association between PTSD and cardiovascular disease did not adjust for effects of potential confounding by mental diseases other than PTSD, [7,8] the third study adjusted for depression and the association between PTSD and risk of cardiovascular disease persisted. [9] In addition, two meta-analytic reviews of studies examining risk of coronary heart diseases specifically, rather than cardiovascular disease in general, also concluded that independent of depression, PTSD was associated with an increased risk of coronary heart disease. [15,16]

As studies have shown that mental disease, primarily depression, is related to risk of cardiovascular disease, [17,18] this study's comparison group may have also been at risk for cardiovascular diseases, which in turn may have diminished any detectable risk among this study of PTSD veterans, when they were compared to non-PTSD veterans. To address what effects if any the presence of mental diseases among controls may have had on the results reported in Table 2, additional analyses were conducted to adjust for the effects of mental diseases other than PTSD. The findings presented in Table 3 appear to support the contention that Table 2 findings were due to mental diseases among the original group of comparison veterans. This finding also suggests that mental health in general, and to a lesser extent PTSD specifically, are both related to risk of cardiovascular diseases. However, mental diseases other than PTSD may be better predictors of cardiovascular disease. The lack of an association between PTSD and risk of cardiovascular diseases might also be due to exposure to trauma by both those diagnosed with PTSD and those not diagnosed with PTSD. Findings from the "Heart and Soul Study" reported that exposure to psychological trauma was associated with an increased risk of recurrent cardiovascular events and mortality, independent of psychiatric comorbidities, including PTSD and depression. [19]As all those in this study served in Vietnam, both PTSD and non-PTSD veterans may have been exposed to trauma and therefore their risks for cardiovascular disease would have been similar.

This study's primary limitation is the reliance on veterans from the AOR. The AOR is a self-selected cohort, and may not be representative of all Vietnam veterans with PTSD. If PTSD veterans are more likely than non-PTSD veterans to use VA for healthcare, reliance on VA treatment data may under-report diagnostic data for non-PTSD veterans. However, it is hoped that by including the number of times seen by VA as a covariate in the regression model, the effects of lower utilisation of VA healthcare by non-PTSD veterans may be minimised. This study also did not examine diagnostic data for veterans that preceded their diagnosis of PTSD. However, this study did not attempt to establish causation between PTSD and other diagnoses. Instead, the stated purpose was to examine the risk of co-morbid diseases. Finally, this study also did not assess the relative importance of specific mental diseases other than PTSD on the risk of cardiovascular diseases. Instead it adjusted for the effects of all other mental diseases in general, rather than individual diagnoses.

The findings reported here provide additional insight into the nature of the relationship between PTSD and other mental diseases on physical health co-morbidities in a cohort of Vietnam veterans. The associations between cardiovascular outcomes and PTSD or other mental health diagnoses in the Vietnam cohort require careful consideration, as

previous research has demonstrated the biological plausibility of exposure to Agent Orange and the contaminant 2,3,7,8-terachlorodibenzo-p-dioxin (TCDD) functioning as a contributor to cardiovascular morbidity.[20] Research on cellular pathways associated with development of cardiometabolic dysfunction and cardiovascular or other disease endpoints provides increasing evidence about the complex web of physiological responses to stress and trauma. Research in veterans who served after Vietnam, and non-military populations, that is focused on the natural history of disease through examination of cellular and physiological responses may provide increased tools for recognising vulnerability to disease and targets for assessing efficacy of treatment.

The increasing evidence that mental diagnoses, especially depression, are an important risk factor for cardiovascular disease outcomes suggests that early and regular screening and intervention for risk reduction is important. Regardless whether patients are in a mental health or primary care setting, consistent reinforcement of the importance of risk reduction strategies aimed at improving physical and mental health should be delivered in tandem.

Corresponding author: Tim Bullman
tim.bullman@va.gov
Authors: T Bullman[1], A I Schneiderman[1]
Author Affiliations:
1 Post-Deployment Health Epidemiology Program - U.S. Department of Veterans Affairs

References

1. Dohrenwend BP, Turner JB, Turse NA, et al. The psychological risks of Vietnam for U.S. veterans: A revisit with new data and methods. Science. 2006; 313(5798), 979-982.
2. Kulka RA, Schlenger WE, Fairbank JA, et al. (1990). Trauma and the Vietnam War generation: Report of findings from the National Vietnam Readjustment Study. New York: Brunner/Mazel, Inc.
3. Marmar CR, Schlenger W, Henn-Hasse C, et al. Course of Posttraumatics Stress Disorder 40 Years After the Vietnam War; Findings from the National Vietnam Veterans Longitudinal Study. JAMA Psychiatry. 2015; 72(9), 875-881.
4. Zatzick DF, Marmar CR, Weiss DS, et al. Posttraumatic stress disorder and functioning and quality of life outcomes in a nationally representative sample of male Vietnam veterans. American Journal of Psychiatry. 1997; 154(12), 1690-1695.
5. Schnurr PP, Green BL. Understanding relationships among trauma, posttraumatic stress disorder, and health outcomes. Advances in Mind Body Medicine. 2004; 20(1), 18-29.
6. Weisberg EA, Bruce SE, Machan SE, et al. Non-psychiatric illness among primary care patients with trauma histories and post-traumatic stress disorder, Psychiatric Services. 2002; 53(7), 848-854.
7. Boscarino JA. Diseases among men 20 years after exposure to severe stress: implication for clinical research and medical care. Psychosomatic Medicine. 1997; 59(6), 605-614.
8. Boscarino JA. Posttraumatic stress disorder and mortality among US army veterans 30 years after military service. Annals of Epidemiology. 2006; (16), 248-256.
9. Kubzansky LD, Koenen KC, Spiro A, et al. Prospective study of posttraumatic stress disorder symptoms and coronary heart disease in the Normative Aging Study. Archives of General Psychiatry. 2007; 64(1), 109-116.
10. Schnurr PP, Jankowski MK. (1999) Physical health and post-traumatic stress disorder: review and synthesis. Seminars in Clinical Neuropsyshiatry. 1999; 4(4), 295-304.
11. Grenon S, Owens C, Alley Hm et al. Posttraumatic stress disorder is associated with worse endothelial function among veterans. Journal of American Heart Association. 2006; (5), 1-7.
12. Cohen BE, Marmar C, Ren L, et al. Association of cardiovascular risk factors with mental health diagnoses in Iraq and Afghanistan aw veterans using VA health care. Journal of American Medical Association. 2009; 302, 489-492.
13. World Health Organization (WHO). International Statistical Classification of Diseases and Related Health Problems, 9th Revision (ICD-9). Geneva: WHO; 1979.
14. SAS Institute (SAS). (2011). SAS/STAT® 9.3 Users Guide. Cary, NC:SAS Institute Inc.
15. Edmondson D, Kronish I, Shaffer J, et al. Posttraumatic stress disorder and risk for coronary heart

disease: A meta-analytic review. American Heart Journal. 2013; 166(5), 806-814.

16. Akosile W, Young R, Colquhoun D, et al. Post-Traumatic stress disorder is a risk factor for coronary heart disease: Results of meta-analysis of nine prospective studies. Heart, Lung, and Circulation. 2017; 26,S90.
17. Meng L, Chen D, et al. Depression increases the risk of hypertension incidence : a meta-analysis of prospective cohort studies. Journal of Hypertension. 2012; 30: 842-851.
18. O'Connor C, Gurbel P, Serebruany V. Depression and ischemic heart disease. American Heart Journal. 2000; 140: 63-69.
19. Hendrickson L, Neylan T, Na B, et al. Lifetime trauma exposure and prospective cardiovascular events and all-cause mortality: Findings from the heart and soul study. Psychosomatic Medicine. 2013; 75(9): 849-855.
20. National Academies of Sciences, Engineering, and Medicine. Veterans and Agent Orange: Update 2014. Washington, DC: The National Academies Press; 2016

Operational Test and Evaluation, HMAS Canberra: Assessing the ADF's New Maritime Role 2 Enhanced Capability

Commander Neil Westphalen, RANR

Introduction

The first of two Landing Helicopter Dock (LHD) ships commissioned into the Royal Australian Navy (RAN) as HMAS *Canberra* (L02) on 28 November 2014. Among their other attributes, the LHDs bring a Maritime Role 2 Enhanced (MR2E) seagoing health capability to the Australian Defence Force (ADF) for the first time, and with a significantly greater capacity, since the Landing Platform Amphibious (LPA) Fleet units HMA Ships *Kanimbla* and *Manoora* decommissioned in 2011.

HMAS *Canberra*, August 2015

HMAS *Manoora*, May 2008

However, although *Canberra*'s commissioning formally transferred responsibility for the ship from her builders to the RAN, she still required an Initial Operational Capability (IOC) evaluation. The purpose of the evaluation was to assess the ADF's ability to undertake amphibious Humanitarian Aid / Disaster Relief (HA/DR) and Non-combatant Evacuation Operations (NEO), at a level of capability that was generally analogous to what had previously been provided by the LPAs. This entailed an escalating series of exercise-based and other assessments over 12 months, which culminated in an Operational Test and Evaluation (OT&E), conducted off Cowley Beach QLD, from 30 September to 05 October 2015.

Canberra's IOC evaluation was the prelude to a Full Operational Capability (FOC) evaluation, which was conducted in October 2017. The purpose of the FOC evaluation was to assess the ADF's ability to undertake a range of higher level combat-related amphibious operations.

Purpose

This paper describes the methodology used to evaluate HMAS *Canberra*'s MR2E capability, as part of her OT&E.

Scope

This paper does not address the medical OT&E findings. Subject to approval, these may be obtained from the Directorate of Navy Health (DNH).

Terminological Clarifications

Confusion regarding the interchangeable use of the terms 'MR2E' and 'Primary Casualty Receiving Facility' (PCRF) necessitated the need to specify how they are used. For this reason, the ADF's MR2E capability is the sum of the capabilities and limitations of:

- the 'PCRFs' provided by the LHDs and the Landing Ship Dock (LSD) HMAS *Choules* (L100), and

HMAS *Choules*, April 2012

- the health staff provided for the ship's PCRF by the RAN's Maritime Operational Health Unit (MOHU), based at HMAS *Penguin* in Sydney NSW.

Maritime Operational Health Unit (MOHU) building, September 2016 *(LCDR Rob Bryant)*

The ADF defines the levels or 'roles' of health care provided by its deployable health assets in accordance with Australian Defence Doctrine Publication 1.2 *Health Support for Operations*, which are summarised as follows:

Role 1 (R1): R1 health facilities manage minor sick and wounded from the point of injury/onset of illness, for immediate return to duty. They provide primary health care, triage, resuscitation and stabilisation, and preparation for evacuation.

Role 2 (R2): R2 health facilities are based on formed mission-dependent health teams, which can provide casualty triage, resuscitation and treatment, with more capability than R1 facilities.

Role 2 Light Manoeuvre (R2LM) health facilities provide a limited but highly mobile R2 capability ashore, which typically includes advanced triage, resuscitation and resuscitative surgery. R2LMs are generally only used by Army for the initial phases of deployments, where direct evacuation to a primary surgical facility is not feasible.

Role 2 Enhanced (R2E) health facilities provide higher capacity and/or capability secondary health care, which is typically based on scalable triage, resuscitation, primary surgery, intensive care, and inpatient services. R2E facilities also have their own health materiel and administration capability.

Role 3 (R3): R3 health facilities provide comprehensive specialist secondary health care, consistent with the theatre holding policy. The ADF's R3 health capability is not intended to have a seagoing role.

The IOC Evaluation Process

Canberra. The IOC evaluation process began immediately after *Canberra* commissioned, with an escalating series of overlapping assessments as follows:

- A series of Departmental Management Audits (DMAs) covering the entire ship, which assessed her ability to safely leave the wharf. *Canberra*'s medical DMA was conducted by Fleet Health Division (FHD), which is part of Fleet Headquarters (FHQ), located at HMAS *Kuttabul* in Sydney. FHD has a dedicated staff member to manage and conduct DMAs on all Fleet units approximately annually. The fact that this was the first DMA for a vastly expanded medical capability posed the main challenge: *Canberra*'s medical DMA tool will take another couple of years to fully mature.
- The Mariner Skills Evaluation (MSE) assessed *Canberra*'s ability to get to sea and back alongside safely under normal conditions. The medical MSE was conducted by Sea Training Group (STG) health staff, who assessed the ship's ability to deal with the more common seagoing medical emergencies, such as fires, floods, toxic gas hazards, and man overboard incidents.

WOMED William Bee and WOMT Anthony Booby from STG compare notes during a damage control exercise aboard NUSHIP *Canberra*, October 2014

- The Unit Readiness Evaluation (URE) assessed *Canberra*'s ability to safely disembark and re-embark her landing force. The URE was conducted with some input from STG, but was predominantly managed by umpires from the Amphibious Task Group (ATG), based at FHQ. It consisted of an escalating series of exercises designed to prepare the ship for her Mission Readiness Evaluation.
- The Mission Readiness Evaluation (MRE) was the 'final exam' to certify *Canberra*'s ability to undertake an 'LPA-like' level of capability (limited to HA/DR and NEO) over the following 12 months. The MRE was conducted by ATG personnel, during a series of exercises grouped together as Exercise SEA RAIDER in September 2015. Future MREs will be conducted approximately annually.

MOHU. The unit responsible for Navy's PCRF / MR2E capability for the LPAs was renamed MOHU in early 2014. MOHU's ability to act as Navy's people provider for its MR2E capability also underwent an escalating series of assessments as follows:

- A DMA also conducted by FHD, to assess MOHU's ability to provide the right number of the right people with the right skill sets and the right level of currency. Once again, the fact that this was also the first DMA for a medical 'people capability' rather than a ship posed the main challenge: the MOHU DMA tool will also take another couple of years to fully mature.
- As MOHU did not require a MSE, the next step was to conduct a series of simulated casualty exercises (SIMEXes), in the old theatre suite at HMAS *Penguin*. The SIMEXes used umpires from the RAN Medical School, and Navy reservists with civilian experience and expertise in medical simulation training.

MOHU SIMEX, HMAS *Penguin*, June 2015

- MOHU then joined *Canberra* for SEA RAIDER. The medical component of the MRE was assessed by the aforementioned Navy reservists, led by the Officer-In-Charge MOHU as the medical adviser to the ATG.

OT&E. The final step was to validate the DMA/MSE/URE/MRE process, by conducting an OT&E, which entailed a separate assessment of *Canberra*'s 'LPA-like' capability, to be reported directly to Chief of Navy (CN) who would use it to inform his advice to Government. The OT&E was conducted at the end of SEA RAIDER by the RAN Test, Evaluation and Acceptance Authority (RANTEAA). The author provided medical support to RANTEAA in his role as Fleet Medical Officer (FMO).

RANTEAA OT&E – Medical Aspects

What to Assess. Specific direction as to what the PCRF and MOHU are meant to provide was limited. Version 5.2 of the Australian Amphibious Concept (AAC) document dated March 2010 anticipated that:

- R1 support would be provided for the landing force by a Combat Health Platoon (CHP).
- R1 plus support for the landing force would entail providing the CHP with additional health elements.
- R2LM would include a short duration damage control surgery capability ashore.
- R2E was to be provided by the LHD PCRF, and would be principally staffed by Navy Health Service personnel.

Although the AAC referred to forward aeromedical evacuation (AME) from ashore back to the LHD, and to strategic AME from the Area of Operations back to Australia, it had no guidance regarding the tactical AME of post-surgical patients from the LHD to the strategic AME departure airhead. Furthermore, the AAC had no guidance regarding the health support requirements for up to 1000 personnel aboard the Fleet units escorting the LHDs, which has important implications should an escort be damaged or sunk during combat operations.

In view of the lack of any other references to base the level of MR2E capability to be assessed, it was decided that the medical OT&E would be baselined on the LHD PCRF as built. These include:

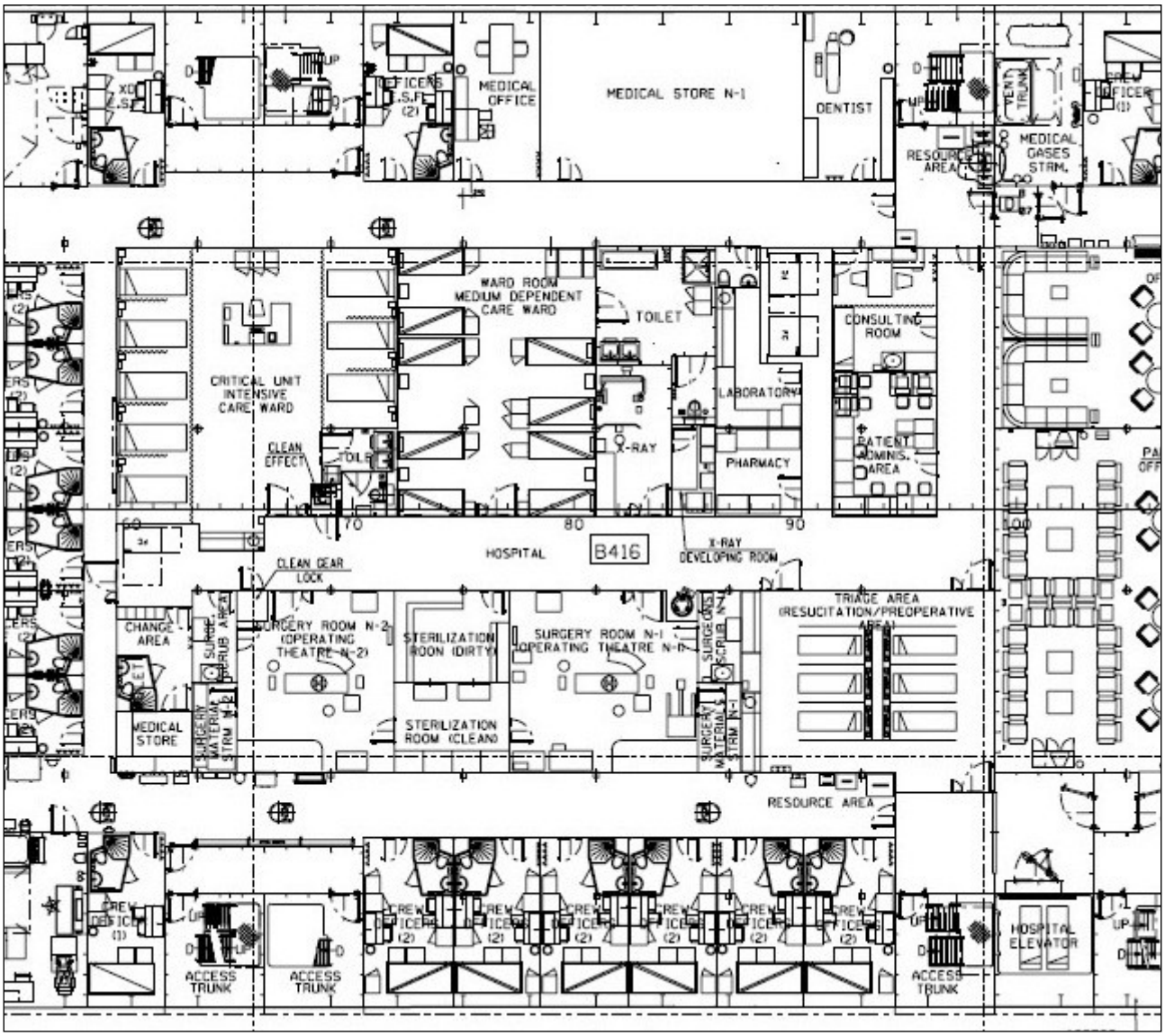
- Resuscitation / treatment room with six patient trolleys.
- Two operating theatres, scrub rooms and CSSD.

- Eight-bed High Dependency Unit (HDU).
- 20-bed Medium Dependency Unit (MDU).
- 28-bed Low Dependency Unit (LDU).
- Portable and fixed x-ray imaging.
- Pathology.
- Pharmacy.
- Medical Officer consultation room, patient admin area, dental, and designated PCRF office space.
- 45-day Class 8 medical store capacity whilst at sea. The embarked landing force requires additional Class 8 stores for an additional ten days if they go ashore. Deployments exceeding these timeframes require resupply.

It was also decided that assessing this baseline would be based on the MR2E's ability to undertake the following list of functions and roles:

Operational Health Support, including:

- The ship's ability to implement and monitor the relevant Deployed Joint Force Headquarters (JTFHQ) Health Support Order (in this case, for SEA RAIDER).
- Ensuring MOHU and ship's company health staff are supported by the CHP whilst embarked, and
- Vice versa when the CHP is disembarked.



Plan, LHD PCRF

Casualty Evacuation, in particular:

- Movement of casualties from ashore to the ship (either by helicopter or landing craft), and
- from the ship to a suitable airfield ashore, pending strategic AME home.

Humanitarian Aid / Disaster Relief. In accordance with the interim requirement for the ship to provide a 'LPA-like' level of capability (limited to HA/DR and NEO), it was assumed the MR2E will normally only be required to provide:

- Health support for disembarked personnel who are engaged in HA/DR operations ashore, and
- Health care for embarked civilian evacuees.

Military Medicine Capabilities. This referred to ensuring that embarked ADF aircrew and divers (whether Navy clearance divers or Army special forces personnel) were medically suitable to undertake their respective duties, with particular reference to:

- Ensuring their Specialist Employment Stream Annual Health Assessment (SESAHA) currency was being maintained by garrison health staff;
- Ensuring that their Specialist Employment Classification (SPEC) currency was being maintained by garrison health staff;
- Providing on-board aviation and diving medicine-specific health care as required, and
- Managing embarked Temporarily Medically Unfit (TMU) aircrew and divers.

Medical Suitability for Employment and Deployment

This referred to ensuring that all ship's company and embarked force personnel are medically suitable for amphibious operations, with particular reference to their:

- Periodic Health Assessment (PHA) currency, and
- Medical Employment Classification (MEC) currency.

This also referred to ensuring that the ATG and subordinate Commands were kept informed of:

- Personnel requiring admission to the PCRF (and if necessary, evacuation);
- Excused Duty (ED) personnel who are unfit for work but do not require admission, and
- Restricted Duty personnel who can work, subject to employment restrictions.

Occupational and Environmental Health:

This referred to:

- Ensuring that the whole-of-ship occupational and environmental health (as opposed to safety) hazards were adequately managed, and
- Summarising the health and safety hazards topatients and staff within the PCRF.

Health Promotion. This referred to the ability to enhance ATG capability, by ensuring that personnel are provided with relevant health advice and information that they can use to improve and/or maintain their health whilst deployed.

Treatment Services. This referred to ensuring that the MR2E could provide all the treatment services that it is required to provide, not only the embarked force, but also ship's company, escorting Fleet units, and embarked civilian evacuees. These include:

- Sick Parade / primary health care;
- Shipboard medical emergencies;
- ATG casualty reception / triage (whether from ashore or afloat);
- Theatre services, with particular reference to:
  - Surgery (general and orthopaedic);
  - Anaesthetics;
  - Central Sterile Supply Department (CSSD);
- HDU;
- MDU;
- LDU;
- Imaging;
- Pathology;
- Pharmacy;
- Dental;
- Medical Waste;
- Medical Linen;
- Medical equipment support;
- Medical stores.

How to assess. These 29 items were assessed using the following list of Fundamental Inputs to Capability (FiCs) per the *Defence Capability Manual*:

- **Personnel:** Did the MR2E capability have the right numbers of the right people with the right skills sets, who had the right level of currency to undertake each of these functions?
- **Organisation:** Did the MR2E capability have the right organisational structure?
- **Collective Training:** Have each of the MR2E sub-departments undergone the relevant training, and can they all work together as a single team?
- **Facilities:** Is the PCRF and all the other medical spaces on board suitable?
- **Supplies:** Is the MR2E capability receiving / providing the medical and other stores required?
- **Major Systems:** Does the MR2E capability have all the relevant medical IT and other systems required?
- **Support:** Is the MR2E capability receiving the relevant support from the rest of the ship and the embarked force, and vice versa?
- **Command and Management:** Does the MR2E capability have the relevant SOPs and management procedures in place?

Outcome

The medical OT&E assessment tool therefore comprised a list of eight FiCs for each of the preceding 29 items, which were in turn based on eight health service functions and roles. The list was followed by a comments section, a list of issues considered relevant to CN, whether the item had been achieved with caveats, and – in particular – whether the item had been achieved in a sustainable manner.

The OT&E therefore entailed using the assessment tool to interview all the relevant personnel from MOHU, *Canberra* ship's company health staff, the CHP, and other stakeholders. In addition, two casualty exercises were observed, one from the Joint Operations Room and other from the PCRF.

Casualty exercise, HMAS *Canberra* PCRF, October 2015 *(Author)*

Particular attention was made in the report to limit any 'can do' tendencies by MOHU and ship's company health staff, in order to avoid 'overselling' the current MR2E capability: in other words, not promising a level of capability that cannot in fact be delivered when called upon.

Ten days after the end of the OT&E, RANTEAA had a 51-page report for CN, which indicated that as of October 2015, *Canberra* could provide MR2 with limited surgery, but not MR2E. Of the 29 items, the ship achieved 13, did not achieve 15, plus one not fit for service. The medical OT&E report (and that provided by OIC MOHU as the ATG lead assessor) also formed the basis of an action plan to address the shortfalls, as preparation for the LHD FOC evaluation held in October 2017.

Conclusions

Firstly, participation in the MR2E OT&E process validated the relevance and usefulness of the health functions and roles listed in this article, to guide health service management decision-making.

Secondly, it also validated the use of the FiCs, as used by the rest of Defence, to assess each of these functions and roles, with specific reference to the health setting.

Thirdly, combining the list of functions and roles with the list of FiCs facilitated the production of a report generally independently of the DMA/MSE/URE/MRE process, which was systematic, reproducible, comprehensive enough to be useful by health SMEs, yet short enough to be readable by senior-non-health officers for whom health is not their first priority.

Finally, it is considered that the methodology used for this OT&E has potential applicability beyond the MR2E, not only to assess other deployable ADF health assets, but also 'garrison' health services.

Acknowledgements

The author gratefully acknowledges the Permanent and Reserve personnel at FHD, MOHU, *Canberra*, STG, ATG, RANTEAA and the RAN Medical School.

Disclaimer

The views expressed in this presentation are those of the author, and do not represent those of Navy, Joint Health Command, or the ADF.

Commander Neil Westphalen graduated from the Adelaide University School of Medicine in 1985, and joined the RAN in 1987. He is a RAN Staff Course graduate, and a Fellow of the Australasian Faculty

of Occupational and Environmental Medicine, the Australasian College of Aerospace Medicine, and the Royal Australian College of General Practitioners. He also has a Diploma of Aviation Medicine and a Master of Public Health.

His seagoing service includes HMA Ships Swan, Stalwart, Success, Sydney, Perth and Choules. Deployments include Operations DAMASK VII, RIMPAC 96, TANAGER, RELEX II, GEMSBOK, TALISMAN SABRE 07, RENDERSAFE 14 and KAKADU 16. His service ashore includes clinical roles at *Cerberus, Penguin, Kuttabul, Albatross* and *Stirling,* and staff positions at Headquarters Australian Theatre, Joint Health Command, Director Navy Occupational and Environmental Health, Director of Navy Health, and Fleet Medical Officer. Commander Westphalen transferred to the Active Reserve in July 2016.

Corresponding author: Neil Westphalen
neil.westphalen@bigpond.com
Authors: N Westphalen[1,2]
Author Affiliations:
1 Royal Australian Navy Reserve
2 Navy Health Service - C/O Director Navy Health

MilTeenChat™ App to Promote Coping Resilience in Military Youth

K Puskar, R Sun, A Gleeson, T Lampl, D Nichols, N Khan

Abstract

Military adolescents face unique challenges in military families including frequent relocations and parental deployment. Around 30% of military adolescents report feeling sad or hopeless, and one in four has considered suicide. There are limited resources available for military adolescents coping with stresses. Our study aims to understand stresses faced by adolescents in military life, to obtain input from military adolescents, and to develop a mobile app to help youth cope with stresses. A qualitative study using focus groups with 31 military adolescents was applied. Adolescents ages 12 to 18 were recruited in the Pittsburgh and San Diego USA communities in collaboration with the Military Children's Collaborative Group (MCCG). Four focus groups were held at designated community sites. Themes generated from the focus groups sessions were used to develop the MilTeenChat™ App design. Common stresses were loneliness, frequent relocation, missing special events in life, feeling isolated, and difficulty communicating with peers and teachers. The MilTeenChat™ App was created to empower the adolescents with educational information, encourage mutual learning about coping with stresses, and promote resilience in the military adolescents.

Keywords: military deployment, military reintegration, military transitioning, mobile technology, adolescents, eHealth, telehealth

Introduction

Since 2001, over two million American children have had a parent deployed at least once in the United States.[1] Data have shown that 42.1% of military personnel had children in 2014, nearly 24% between 12 and 18 years of age.[2] Adolescents have experienced the longest and highest number of wartime deployments in the U.S. history.[3(p5)] Deployment is not new to military families. Some parents have been deployed on multiple tours for months or more at a time. Separation has become a way of life for these families, which increases the burden on children who frequently face the strain of a parent's absence. Mental health issues are more prevalent among adolescents in military families compared to civilian peers. Around 34% of adolescents with military connections report feeling sad or hopeless for over two weeks during the past year, compared to 31% of teens with non-military-connected peers.[4] Similarly, approximately 25% of military-connected adolescents reported having considered suicide, compared to 19.1% in non-military-connected adolescents.[4] However, according to the U.S. Department of Defense (2010), this population has not been the primary subject of assessment or research.[5 (p2)]

Teaching Kids to Cope (TKC) is a government-reviewed educational program for adolescents ages 12–18 for the purpose of increasing their ability to cope by using strategies that address self-esteem, stress, negative thinking, healthy coping, and support resources. TKC was originally developed at the University of Pittsburgh School of Nursing;[6] it has been rigorously reviewed and selected by a panel of experts for inclusion in the prestigious governmental National Registry of Evidence-based Programs and Practices (NREPP) at the Department of Health and Human Services, Substance Abuse Mental Health Services Administration (SAMHSA). Since its development in the early 1990s, TKC has been widely disseminated as an evidence-based practice tool throughout the United States, where it has reached over 2,000 youths, and internationally in Jordan. TKC has been successfully adapted to help youth cope with the specific stresses of several particular contexts, including geographic mobility and relocation. In this study, we have adapted the original TKC program to meet the unique needs of military adolescents and support coping resilience among military adolescents when their parents are deployed. The purposes of this study were 1) to adapt the original TKC program and use it to support

coping resilience among military adolescents, 2) to understand the stresses experienced by military adolescents when parents are deployed, and 3) to describe designs for a mobile app that will meet the needs of military adolescents.

Methods

Data for this study was collected qualitatively using focus groups. Adolescents were recruited both in the Pittsburgh community, as well as in San Diego, California in collaboration with the Military Children's collaborative Group (MCCG). Adolescents were recruited using multiple approaches, including distributing the study information to organisations that serve military families and sending out flyers to potential military families. Eligible adolescents were those between ages 12 and 18, having parents who were deployed at least once in the past.

Focus groups were conducted between May and October in 2016. Each focus group session followed a one-hour schedule led by the research team. To facilitate the discussion, we prepared several guiding questions regarding the stresses adolescents encountered in military life, successful or unsuccessful coping strategies they have used, and how the app design based on the TKC model would be useful to them and their military peers. Each adolescent was encouraged to participate in the discussion. Notes were taken during the focus groups by members of the research team and were reviewed for accuracy after each session. Follow-up individual interviews with three to five adolescents were performed to present to them the strategies we identified from all focus groups. Recruitment was stopped when saturation was reached.[7] Approval for this study was received from the University of Pittsburgh Institutional Review Board, and written parent consent and child assent were obtained before conducting each focus group. The mobile app design was informed based on the themes generated from the focus group.

Findings

A convenience sample of 31 military adolescents from two cities representative of the east and west coast of US were recruited with 16 from San Diego, California and 17 from Pittsburgh, Pennsylvania. Adolescents were averaged 14.58 ± 1.65 years old with 45.2% female. The number of parent deployments adolescents experienced ranged from one to eleven times, with the majority between one to three times. Two focus groups were held at each site. Themes identified from the session are described below.

Stresses in military life

Focus group adolescents were asked to identify two significant stresses they encountered during parent deployment. Adolescents described that they felt lonely, worried, and anxious when parents went away. When a parent was deployed, they were always fearful of the uncertainty about whether parents will come back. One participant mentioned, "I worried that he wouldn't be able to come see me because he was injured. Also, the other girls at school would visit their dads every other weekend and complained about it, it stressed me out because I wished I could see mine." A potential outlet for these feelings is to misbehave for attention since there may be no parents or guardians at home to give them the attention they need. One adolescent said: "I was acting out to get grandma's attention in bad ways."

Another commonly mentioned theme in the focus groups was the difficulty in communication, not only with the parent, but also with civilian classmates and teachers. An adolescent stated that, "I was not able to talk to dad, I just want to talk to him and know he is ok." The majority of the participants in this study are in high school; adolescents expressed that classmates did not understand what deployment means to them and teachers provided little help to address their concerns. Some classmates would continually tease and demean military children for being different. Other classmates don't understand that these kids' parents left for positive reasons. They only see military children as teens with no parents which becomes especially hurtful when classmates prey on the negative idea of having a father who abandoned his family. Adolescents mentioned that discussing their feelings with someone who has had the same or similar experiences would be very helpful since there would be an increased level of understanding and empathy.

Three teens said that their stress came from constant moving during the school year, as they must continuously cope with relationships due to the multiple school transitions. One adolescent said, "I lack friends and neighbours since we moved a lot." Another said: "we have to move every 3 years to a new place, and leave friends/school and go to a new school." Parents also struggle to deal with moving homes frequently just as much as their children, which can cause additional tension within the family.

Family events become struggles with the children feeling scared or alone and unable to really participate. Twelve teens reported feelings of sadness and disappointment that their parents missed special events in their lives. Just like one said, "he missed some social events such as birthdays or holidays."

Adolescents expressed that they would like to have their parents on their side and share all the cheerful moments with parents in their life. Although they feel worried or anxious when parents are gone, they know parents are serving the country and they feel very proud of their family service. They understand that they are heroes of the country.

Suggestions for mobile app design

Adolescents were asked about their thoughts on the development of an app to support them through military life. Common expectations for the app allowed us to draw themes that the program should be user-friendly, easy to use, and most importantly, fun. All of these criteria were deemed to be vital when developing the mobile app as a helpful and desirable support platform. Six teens stated that they want the app to be colourful, bright, and vibrant to be attractive. They expressed that 'the TKC brochure is like a textbook, it is boring to look at it.' Fifteen adolescents said that developers should make the app more appealing, and include a game with rewards or a story book. Strategies to promote engagement need to be applied using different approaches. Setting goals before they begin and earning quick rewards would make the app fun and attractive.

Most importantly, subjects requested that the app allow them help their peers build their own extended support systems. The adolescents would like to tell their own stories and listen to others' stories on the app. "I would like to communicate with other military kids who experience the same things as we are, and asking them how they are doing." By sharing their articles of military life with teachers and school counsellors, they can better understand what these adolescents have been going through and to provide encouragement for them.

Dealing with the multiple deployments of parents is not easy for children. Teens experienced negative emotions, so the app should also provide information and skills to help cope in healthy ways with their negative feelings and emotions related to a military deployment. A wide variety of education resources should be available to adolescents who are at a different phase of deployment including pre-deployment, deployment, and post-deployment. The app should be able to answer questions from adolescents, such as "how to speak with my grandparents about how I am feeling sad, or how to talk about the military in class".

MilTeenChat™ Mobile App

The app was created to help teens with parents in the military to create a community, where teens with similar experiences can provide support to each other and share knowledge. Support is also provided through professional support tools. Regular interactions in the app are rewarded in order to motivate children to interact with the app, and as a result other children can contribute their thoughts. The app has six components: 1) newsfeed, 2) chat with peers, 3) resources/articles library, 4) reward bank, 5) notification, and 6) profile. The Flow Chart of the MilTeenChat™ App is presented in Figure 1. Screen shots of the app can be found in Figure 2. An associated website for the MilTeenChat™ App was developed, which is available at: https://www.milteenchat.com/.

Newsfeed Newsfeed allows children to share stories, 'Like' posts, and upload pictures. The Newsfeed will also have a pop-up of a 'Featured Profile' that will allow other children to see other users' profiles and connect with them. The Featured Profile will display information about the user's experience and background, creating a bond with other children.

Chat with peers The app allows teens to send messages to peers and create their own group of teens. A secure messaging system is used to support direct user-to-user communication and community. The user composes a message on the phone that is sent to another users' phone.

Resources/articles library Professional resources will be available in three categories: Family, Friends and School. The users can search the categories and 'Like' articles, creating a scoring system of most useful article and tools.

Reward bank An algorithm in the system will release a coin as a reward for interacting with the app. When a user posts and likes articles the algorithm is triggered. This bank can be viewed by accessing 'Coins' in the Profile page.

Notification Notifications prompt users when their articles are liked and when they receive a message.

Profile The profile page allows users to personalise their account. They can upload a picture and add or modify the following: posts, coins, heroes, locations, favorites, challenges, tips, featured profile, military branch, deployments in the last year, and lifetime deployments.

Admin portal

The admin portal is a secure Website that can be accessed from a computer, tablet, or smartphone. Administrators can use the portal to add/delete/modify articles/documents and to view data from the

app. The admin portal also collects user-generated data, and the administrator is able to access this data for academic research.

Ensuring a positive online community

An algorithm to identify certain languages that may indicate possible suicidal thoughts, bullying, or sexting among teens was developed. These negative phrases were determined based on the literature and consultation with psychologists for assessing adolescents at risk for suicidal behaviours. Phrases included are "I want to cut myself", "I feel life is not worth living", "I have a plan to hurt myself", "I feel like hurting myself", "I feel hopeless", "I feel that no one cares about me", and "I feel I am no good". Abbreviations, phrases and negative emojis related to bullying and sexting are also integrated into the algorithm. Once these predetermined languages are used by adolescents, parents are notified automatically via an email and if needed, a national suicide lifeline number will be provided via the app in order for the teens to seek immediate assistance.

Discussion

Adolescents in military families are a unique group of people who must cope with the developmental milestones of adolescence, such as establishing a sense of identity or development of autonomy, while they also adjust to the challenges of military life during the wartime, including relocation and the deployment of a family member.[8] The need to teach coping resilience and recovery in military adolescents is timely and essential. This study provides insights into what military adolescents are suffering from and which strategies can be employed to support military teens through a mobile application.

The MilTeenChat™ app has been developed with a focus on communication and relationship building. Children from military families often have difficulty finding others who can relate to their experience and provide support. The app will function as a resource to bring these children together and foster a sense of community among its users. Creating the app as a platform for communication between teens in military families is a start, but it does not directly address the issue that some of these children may perceive there aren't others in positions like themselves. The MilTeenChat™ app allows teens to share stories of themselves and their families and to respond to others with how they cope with their own stresses. Furthermore, adding the option to include photos will add a more personal flair to their stories and reinforce to the kids that they are not alone.

Teens can also access educational resources provided through the app regarding coping with challenges unique to military everyday life, such as how to speak with parents about how they are feeling, or how to deal with changes in life when a family member is deployed. Additional resources to support military youth are provided in the resources section (see Table 1).

In order to make the MilTeenChat™ app appealing and engaging, coins were designed as a tangible reward system for performing certain tasks in the app, similar to military challenge coins in recognition of special achievements. Teens will receive a coin when they post a story, share coping tip to others, or update profiles.

Conclusion

TKC-Military will provide a mobile app that is focused on coping and resilience among military adolescents to enable them to decrease negative coping and forge positive and healthy futures. The MilTeenChat™ app was created and will be disseminated to military community groups as a free platform that will teach coping, resilience, recovery skills to enhance mental health of adolescents in military families.

Acknowledgement

This study was supported by the Infinite Hero Foundation (IHF). We would like to acknowledge the Center for Military Medicine Research (CMMR) and Military Childrens Collaboration Group (MCCG) for their assistance with this project, and Pt Pal for the development of the mobile application. We would also like to acknowledge the adolescents who participated in our focus group sessions, as well as all the research staff, students, and community advisory board members involved in our study.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

This study was sponsored by the Infinite Hero Foundation (IHF).

Corresponding author: Kathryn Puskar
krp12@pitt.edu
Authors: K Puskar[1], R Sun[1], A Gleeson[2], T Lampl[2], D Nichols[3], N Khan[4]
Author Affiliations:
1 University of Pittsburgh - Nursing
2 University of Pittsburgh - Center for Military Medicine Research
3 Military Children's Collaborative Group
4 PT PAL

References

1. Aranda MC, Middleton LS, Flake E et al.. Psychosocial screening in children with wartime-deployed parents. *Mil Med.* 2011;176(4):402–407. doi:10.7205/MILMED-D-10-00202.
2. Defense Manpower Data Center. *2014 Demographics: Profile of the Military Community.* Washington, DC; 2014. http://www.militaryhomefront.dod.mil.
3. Tanielian TL, Jaycox L. *Invisible wounds of war: psychological and cognitive injuries, their consequences, and services to assist recovery.* Santa Monica, CA : RAND; 2008.
4. Cederbaum JA, Gilreath TD, Benbenishty R,. Well-being and suicidal ideation of secondary school students from military families. *J Adolesc Heal.* 2014;54(6):672–677. doi:10.1016/j.jadohealth.2013.09.006.
5. Department of Defense. *Report on the Impact of Deployment of Members of the Armed Forces on Their Dependent Children.*; 2010.
6. Puskar KR, Lamb J, Tusaie-mumford K. Teaching Kids to Cope: A Preventive Mental Health Nursing Strategy for Adolescents. *J Child Adolesc Psychiatr Nurs.* 1997;10(3):18–28. doi:10.1111/j.1744-6171.1997.tb00410.x.
7. Krueger RA, Casey MA. Focus groups: a practical guide for applied research. *Thousand Oaks CA Sage.* 2000.
8. Milburn NG, Lightfoot M. Adolescents in Wartime U.S. Military Families: A Developmental Perspective on Challenges and Resources. *Clin Child Fam Psychol Rev.* 2013;16(3):266–277. doi:10.1016/j.immuni.2010.12.017.Two-stage.

Lessons Learned: The Australian Military and Tropical Medicine

P Leggat

*Quail GG. *Lessons Learned: The Australian Military and Tropical Medicine*. Newport: Big Sky Publishing, 2017. ISBN 978-1-925520-22-4. Hardback. 254 pp AUD34.99 (also available as an eBook)

Throughout the history of modern war, tropical diseases have played a significant role in determining the outcome of various military campaigns through the ages. For example, malaria has remained one of the leading concerns in Australian military involvement in conflicts and other actions and lead to the founding of the Australian Army Malaria Institute (AAMI), which was designated as a World Health Organization Collaborating Centre (WHOCC) for Malaria in 1980.[1] Lymphatic filariasis was another tropical disease that was also a significant burden during World War II.[2] Scrub typhus, a continuing problem for troops in north Queensland,[3] was also described in the book as having a significant impact on military campaigns during World War II. *Lessons Learned: The Australian Military and Tropical Medicine* is based on a PhD thesis with the same title submitted by the author, Geoff Quail, which was completed in 2013.[4] The PhD was undertaken in the Nossal Institute for Global Health, Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne, Australia. *Lessons Learned: The Australian Military and Tropical Medicine* traces the development of the (Royal) Australian Army Medical Corps (RAAMC), indicates the military links to the development of the discipline of tropical medicine, and examines the impact of and responses to tropical diseases on the Corps during wartime and peace actions. The conclusion in the abstract of *Lessons Learned: The Australian Military and Tropical Medicine* sends a clear message that the Australian Defence Force (ADF) needs to continue its commitment to and investment in research and training in tropical diseases.

Lessons Learned: The Australian Military and Tropical Medicine is presented as a 24 x 16 x 3 cm hardback publication. It has a dustcover, which has been illustrated. The front cover is simple in design with a photo of troops being immunised, presumably with the oral polio vaccine. It is a pity the cover is not captioned on the inside flap of the front of the dustcover. The back cover of the book gives a brief description of the book and the back and the inside flap of the back of the dustcover includes a more contemporary photo of a soldier (presumably an environmental health officer) undertaking fogging against potential disease vectors. There is a lost opportunity to include a picture and biography of the author on the inside flap of the back of the dustcover. The work contains an Abstract, Preface, Acknowledgements section, Table of Contents, List of Abbreviations, List of Illustrations, List of Tables, Introduction, 15 Chapters, a Glossary of Terms, Bibliography and Endnotes. There is no Foreword or Index. It is surprising that a Foreword by another senior military medicine historian or current or past senior or general officer of the RAAMC was not included.

The chapters contained in *Lessons Learned: The Australian Military and Tropical Medicine* include "Ch. 1. The Impact of Tropical Diseases on the Outcome of Military Campaigns"; "Ch. 2. The Contribution of the British Military to Tropical Medicine Formation of the Royal Army Medical Corps and School"; "Ch. 3. The Great War and Tropical Disease"; "Ch. 4. The Second World War – Were We prepared for War in the Tropics"; "Ch.5. Post-War Lethargy"; "Ch. 6. The Riechmann Era (1984-2005"; "Ch. 7. The Australian Military and Tropical Medicine – A Continuing Close Association"; "Ch. 8. The Ethics of Clinical Trials in the Military"; and "Ch. 9. Conclusion". The work is presented largely in the chronological order of major conflicts of the past century through to the early stages of the current century. While it is based on the research of a single author, it is clear that extensive information was sought from others, as mentioned in the acknowledgements. It is significant and appropriate that Karl Riechmann, former Director of the AAMI, was one of these sources and indeed, he rates his own chapter in the book. It would be fair to say that under his stewardship, the AAMI consolidated its position as a WHOCC and as one of the pre-eminent malaria research institutes globally. The preceding year, in 2016, another book, entitled *An Unending War: The Australian Army's Struggle Against Malaria 1885-2016*, was released by the same publisher and authored by Ian Howie-Willis.[5]

This latter book may appeal to those wanting to read more about the history of malaria in the Australian Army and its campaigns.

The author, Geoff Quail, is a doctor and a dentist and keen historian, having recently completed a PhD in the latter field. He has worked at both Monash University and the University of Melbourne and held the position of Head of Dental and Maxillofacial Surgury at Monash University for more than 30 years. He has also lectured at Oxford University. In addition, Professor Quail has had 40 years' experience in the Royal Australian Air Force Reserve and is regarded as a senior specialist in tropical medicine. He is currently the President-Elect of The Australasian College of Tropical Medicine and has served many years on their Council. In 2014, he was awarded a Medal of the General Division of the Order of Australia (OAM) for his service to medicine, particularly through his work in dentistry.

Lessons Learned: The Australian Military and Tropical Medicine is one of the first books to focus on tropical diseases and the Australian Military and it is a credit to the author. However, it is hard to ignore other reviews of the book that have been published. A recent review[6] alluded to extensive technical issues that often plague first editions of books. This review did also identify a number of gaps, such as the need to consider the role of military nurses,[6] but then this might need to be documented separately as part of the development of the Royal Australian Army Nursing Corps. Nonetheless, it is an easy reading book and it will broadly appeal to those interested in the medical aspects of Australian military history. It is likely that this book is a one off edition, so those doctors and medical historians wanting the book for their military medical history library are strongly encouraged to purchase a copy of *Lessons Learned: The Australian Military and Tropical Medicine*, while it is still widely available.

Reviewer: Peter A. Leggat, AM, MD, PhD, DrPH, FAFPHM, FFPH RCP(UK), FACTM, FACRRM, FFTM RCPSG, FFTM FFEWM ACTM, Hon.FFPM RCP(UK), Hon.FACTM, HonFFTM ACTM is Professor and Director, World Health Organization Collaborating Centre for Vector-borne and Neglected Tropical Diseases, College of Public Health, Medical and Veterinary Sciences, James Cook University, Townsville, Queensland, Australia. Email address: peter.leggat@jcu.edu.au

References

1. World Health Organization. WHO Collaborating Centres Global database. URL. http://apps.who.int/whocc/Detail.aspx?cc_ref=AUS-37&cc_code=aus (accessed 10 February 2018)
2. Melrose W, Leggat PA. Lymphatic filariasis: disease outbreaks in military deployments from World War II. *Military Medicine*. 2005; 170: 585-589.
3. Likeman RK. Scrub typhus: a recent outbreak among military personnel in North Queensland. *ADF Health*. 2006; 7: 10-13.
4. University of Melbourne. Minerva Access (University's Intellectual Repository). URL. https://minerva-access.unimelb.edu.au/handle/11343/38588 (accessed 10 February 2018)
5. Howie-Willis I. *An Unending War: The Australian Army's Struggle Against Malaria 1885-2016*. Newport: Big Sky Publishing, 2016.
6. Hobbins P. Book Review: Lessons Learned: The Australian Military and Tropical Medicine. *Health and History*. 2017; 19(2): 174-176.

INTERNATIONAL SOS

HEALTH SERVICES AND MEDICAL INTELLIGENCE SUPPORT ON BASE AND ON DEPLOYMENT

WORLDWIDE REACH. HUMAN TOUCH.

internationalsos.com

ARMISTICE TO AFGHANISTAN

EVOLUTION OF MILITARY HEALTHCARE

2018 AMMA CONFERENCE 12-14 OCTOBER NATIONAL CONVENTION CENTRE CANBERRA

BE A PART OF OUR ENGAGING PROGRAM BY SUBMITTING AN ABSTRACT

Each year we have a great program of presentations from all aspects of military medicine and veterans' health.

We welcome presentations from Defence personnel, as well as civilian academics and medical professionals.

Abstract submissions are now being accepted at: http://www.amma.asn.au/amma2018/abstract/

FAST FACTS

- 12-14 October 2018
- National Convention Centre, Canberra
- 350+ Australian and International delegates expected to attend
- 20+ Exhibitors expected to present in the Exhibition

JMVH call to authors

The Journal of Military and Veteran's Health is a peer reviewed quarterly publication published by the Australasian Military Medicine Association. The JMVH Editorial Board has identified the following themes and deadlines for future editions:

ISSUE DATES AND DEADLINES

Volume	No	Issue Date	Submission Deadline	Advertising Deadline
April 2018 – The Health Aspects of Chemical, Biological, Radiological and Nuclear Defence				
26	2	April 2018	1 January 2018	1 March 2018
July 2018 – The 100th Anniversary of the end of World War I – Military Medical Advances				
26	3	July 2018	1 April 2018	1 June 2018
October 2018 – Conference Abstracts				
26	4	October 2018	As per AMMA Conference Submission Process	1 September 2018

The Editor would be delighted to receive articles for consideration on these themes. However, please note that although these are the suggested themes, we encourage authors to continue to submit articles on a range of topics on military medicine and veterans' health including operational articles.

Categories for the above include: Original Research/Original Articles, Short Communication, Review Articles, Reprinted Articles, Case Studies, Abstracts from the Literature, Biographies, History, Book Reviews, Commentary and View from the Front.

Please submit via the JMVH website www.jmvh.org just click the 'Submit your article' button on the home page. Ensure you read the 'Instructions to Authors' that can also be found on the JMVH website by clicking on the 'AUTHORS' tab.

Should you have any queries in relation to submitting to JMVH, please do not hesitate to contact JMVH Editorial Office on +61 3 6234 7844 or editorial@jmvh.org

Do you have an article of interest to our readers?

Authors are invited to submit articles of relevance to the Editor for consideration for publication in the Journal of Military and Veterans' Health (JMVH)

Categories include:

Informative and commentary
Original Research/Original Articles
Short Communication
Review Articles
Reprinted Articles
Case Studies
Abstracts from the Literature
Letters to the editor
Biographies
History
Obituaries
Book Reviews
Commentary
View from the Front

See the JMVH website for authors' instructions and
Submit your article online at www.jmvh.org

JMVH

AMMA MEMBERSHIP

To become an AMMA Member or to renew your membership for 2018/2019 F/Y go to www.amma.asn.au

Or contact the AMMA Secretariat
Email: secretariat@amma.asn.au
Phone: 61 3 6234 7844

www.amma.asn.au

www.jmvh.org