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- Glimpses of future battlefield medicine
- Trial of iron supplementation attenuates fatigue and declining iron stores for female officers-in-training
- A study of alcohol consumption in a cohort of military nurses

The Journal of the Australasian Military Medicine Association





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*Cover Image is of 'Rex' porter robot, is courtesy of Israel Aerospace Industries (IAI).*

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# Journal of Military and Veterans' Health

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The Australasian Military 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.

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113 Harrington Street  
Hobart Tas 7000  
Australia  
Ph: +61 3 62347844  
Email: editorial@jmvh.org.au

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Journal of Military and Veterans' Health

# Inside this edition

As we completed the final touches on the September 2014 Journal, I was fortunate to receive an e-mail from Michael Dowsett, one of the former Directors General Naval Health Service, who reminded that it was the 100th Anniversary of an important Navy health event from the beginning on the First World War. A short summary is below:

'A hundred years ago, on the 30th August 1914, the Royal Australian Navy Hospital Ship GRANTALA departed Sydney. She had been quickly converted from the peacetime Adelaide Steamship coastal passenger ship to her role as a hospital ship with the inclusion of an operating theatre that had been specially built at Garden Island. In place of dining and music saloons, there were medical, surgical, observation and infectious disease wards. Without overcrowding, she could carry 250-300 patients; all fitted with Navy pattern cots that could swing with the motion of the ship.

She sailed with a complement of 8 medical officers, 7 nursing sisters and about 30 sick berth stewards. Sister Kirkcaldie recorded their departure:

"We passed down the harbour to the accompaniment of cheers and farewells from land and water and while we laughed at the excitement we created, our throats tightened as we thought of the dear ones we were leaving behind...as we entered the Heads a rousing cheer greeted us from the men already on duty at South Head. The flag at the fort dipped in salute."

"Our little ship - for all its brave array - boasted only of some 3000 tons and as we cleared the Heads we ran into rough seas. Half an hour before we left Sydney we had been told that our first port of call would be Townsville."

GRANTALA had been converted into a hospital ship to provide medical support for the Australian

Fleet, particularly if there was to be a confrontation between The Fleet and the German Pacific squadron, which was believed to be in the vicinity of Rabaul. Her first task was the support of the landings in Rabaul that captured German New Guinea.'

In this issue, we have a range of articles that highlight the complex nature of military health, including original articles on anaemia, alcohol consumption, physical training and a glimpse of future battlefield medicine; review articles on sexually transmitted illnesses, and post-traumatic stress, and an excellent promyelocytic leukaemia case study. 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.

Dr Andy Robertson, CSC, PSM Captain, RANR

Editor-in-Chief



# Letter to the editor

Dear Editor

Recently, while reading Sherwin Nuland's Doctors: The Biography of Medicine in relation to the impacts on medicine of Rene Laennec's invention of the stethoscope, Nuland writes about four milestones in a medical student's education.<sup>1</sup> First is the introduction to the cadaver. Second is buying your first stethoscope at the medical society bookshop. Third is being allowed to examine your first live patient. Lastly is passing your final medical exams, "and no balance remaining on the bursar's bill".

Yours sincerely, Dr John Frith

Reference:

1. Nuland SB. Doctors: The Biography of Medicine. New York; Vintage Books: 1988.

# Glimpses of future battlefield medicine - the proliferation of robotic surgeons and unmanned vehicles and technologies

*Flying Officer Gary Martinic, Australian Air Force Cadets*

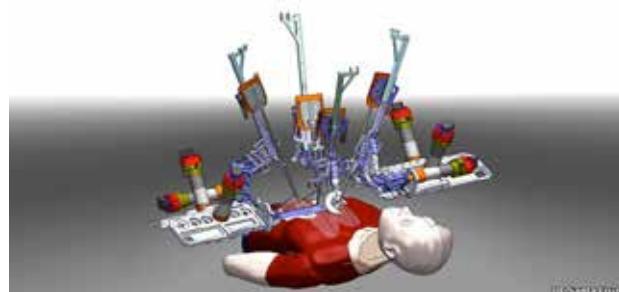
## Introduction

The rescue of severely wounded soldiers, while under fire, is itself a major cause of military death and traumatic injury.<sup>1</sup> Some sources estimate that up to 86% of battlefield deaths occur after the first 30 minutes post-injury.<sup>1,2</sup> Hence life saving training techniques<sup>3</sup> and treatments, and more recently, the application of robotic surgical systems (RSS; Fig.1), technologies and unmanned vehicles (UVs), have been developed to provide battlefield casualty extraction, critical life-saving interventions, and physiological monitoring, in order to reduce this incidence. Although not invincible themselves, when it comes to enemy small arms fire, UVs and RGPs can sustain a lot more direct fire than can the average human soldier, hence their utility in combat first responder scenario's.

Just as unmanned aerial vehicles (UAVs)<sup>4</sup> have continued to provide grounds troops with timely intelligence, surveillance and reconnaissance capabilities, and when armed, with the ability to bomb enemy targets using precision-guided bombs, today, unmanned ground vehicles (UGVs) and robotic ground platforms (RGPs), are increasingly being developed. Not only to search for improvised explosive devices, but also as important battlefield life-saving technologies. With today's battlespace domination by various 'life-taking' weaponised robots, which can achieve 'lethality via remote-control', it has been encouraging to see the recent proliferation and availability of new 'life-preserving' technologies and unmanned platforms.

Over recent years, these technologies have grown smaller, lighter, faster, more agile and sophisticated. While UAVs to date have featured most prominently in the air, state-of-the-art RSS, UGVs and RGPs are proliferating, and are being increasingly used. Such technologies include surgical robots, 'porter' or load-carrying UVs and battlefield casualty extraction devices (both air and ground). The latter include the development of UAVs specifically designed for casualty air-lift evacuation (though these are not covered here). This article describes the advances,

variety and utility of some RSS, UGVs and RGPs that have potential application for use in battlefield medicine, and outlines some current systems and prototype models in the testing phases.



*Figure 1. Diagrammatic representation of RSS. Sourced from: [www.economist.com-Jan192012](http://www.economist.com-Jan192012)*

## On-site Robotic Surgical Systems

The idea of RSS, or technologies that use robotic systems to aid in surgical procedures on-site, have been around for over three decades. In 1992, Dr. Senthil Nathan of Guy's and St. Thomas hospital in London successfully carried out the first robotic surgical procedure (prostatectomy) in the world, using 'Probot', developed at Imperial College London. Since then, RSS development was advanced further by two companies working together, SRI International and Intuitive Surgical, who had introduced the 'da Vinci' surgical system as well as 'Computer Motion' with the 'AESOP' and 'ZEUS' RSS.<sup>5</sup> The ZEUS was later used to perform a Fallopian tube reconnection (July 1998), a beating heart coronary artery bypass graft (Oct. 1999), a closed-chest beating heart cardiac hybrid revascularisation (Nov. 1999) and the 'Lindbergh' (cholecystectomy)operation which was performed remotely (Sept. 2001).<sup>6</sup>

With grant support from both NASA and DARPA (US Defence Advanced Research Projects Agency), and thanks to the years of pioneering work of Dr. Robert M. Satava, the original telesurgery robotic system was developed, based on the da Vinci design.<sup>7</sup> It turned out to be more useful for on-site minimally invasive surgery (MIS), than remotely-performed

surgery on the battlefield and other environments. Today, both on-site and remotely-operated RSS have been developed in various shapes and sizes to overcome the limitations of MIS and to enhance the capabilities of surgeons performing open surgery.<sup>8</sup> This has also provided the ability to perform 'remote surgery' or 'unmanned surgery', though at this point in time, this still requires a human operator assisting at the robot end. Of course, this may provide useful applications in settings where highly skilled medical resources are not available such as the battlefield, isolated enclaves, and even space travel.

Robotic surgery is a method to perform surgery using small surgical instruments attached to robotic arms. RSS can be divided into three separate categories contingent upon the level of surgeon interaction during the procedure; these include Supervisory-Controlled, Telesurgical and Shared-Control methods.<sup>8</sup> The Supervisory controlled method exclusively employs a robot to perform the entire procedure, which it does in accordance with the computer program loaded into it by the surgeon pre-operatively. The disadvantage of this system is that it must be individually programmed, making it expensive as several images and data for patients are often required. Also known as 'remote surgery' the telesurgical method is where a (human) surgeon directly manipulates the robotic arms during a procedure, as opposed to the robotic arms working themselves from pre-loaded software. Using telesurgery, the surgeon can operate from a remote location using sensor data, and real-time image feedback from the robot.<sup>8</sup> As an example of this, in 2001, using Computer Motion, the first transatlantic remote surgical intervention was performed by a doctor in New York, who had removed the gallbladder from a patient located in Strasbourg, France.<sup>9</sup> This operation demonstrated that surgery over long distances was indeed possible. The shared-control RSS allows for jointly performed tasks to be undertaken. For example, the robot steadies manipulation of the fine instruments while the surgeon carries out the procedure.<sup>8</sup>

The da Vinci RSS comprises three components; a surgeon's console, a patient-side robotic cart with 4 arms (one to control the camera and the other three to manipulate the instruments) and a high definition 3D vision system. Da Vinci senses the hand movements of the surgeon and electronically translates them into scaled-down micro-movements so it can manipulate miniature surgical instruments. Any tremors of the surgeon's hand movements are also easily detected and filtered out so they are not reproduced by the unit. The beauty of da Vinci, is that the surgeon's console is provided with a realtime stereoscopic image beamed to it from the

camera built into da Vinci. Proponents assert that the advantages of RSS, are that they result in less blood loss and pain and faster recovery times, as any incisions made are smaller and are more precise.<sup>8</sup> Other users also report that RSS result in shorter hospital stays, less need for transfusions, and pain relievers post-operatively.<sup>10</sup>

According to critics of RSS, there are a lack of studies that indicate that long term results are superior, there is often a steep learning curve, requiring additional surgical training to operate the system.<sup>11</sup> Whether the purchase of RSS are cost effective (between \$1.75-1.8M), surgeon's opinions vary widely, mostly because some surgeons consider the learning phase too intensive, as they need to complete at least 12-18 procedures before they comfortably adapt to the RSS.<sup>8</sup> During the training phase, some surgeons suggest that MIS can be twice as long as traditional surgery, resulting in patients being kept under anaesthesia longer and ORs open longer. Though, based on patient surveys, RSS provide for lower morbidity outcomes.<sup>10</sup>

Regardless of the mixed opinions of surgeons, today on-site RSS have a multitude of applications which include general surgery, cardiothoracic, cardiology/ electrophysiology, gastro-intestinal (GIT) surgery, gynaecology, neurosurgery, orthopaedics, paediatrics, urology and vascular surgery.<sup>8</sup> Many examples can be cited where RSS have set new precedents in the field of robotic surgery, such that today they have become common tools in the field. For example in 2000, da Vinci was used to perform oesophageal and pancreatic surgery for the first time in the world.<sup>12,13</sup> Later a pancreatectomy and the first fully robotic Whipple surgery was performed. Later, in 2008, the world's first fully MIS liver resection for a living donor transplant was performed.<sup>14</sup> Since the first robotic cardiac procedure in the U.S. in 1999 at Ohio State University, the same group of doctors (Michler, Crestanello & Vesco) have gone on to perform coronary artery bypass graft, mitral valve, oesophagotomy, lung resection, tumour resection, and other procedures, and today their institution serves as a training site for other surgeons.<sup>8</sup> Similarly, RSS are being used today to perform three types of heart surgery, those being; atrial septal defect repair, mitral valve repair and coronary artery bypass.<sup>15</sup>

RSS, using 'Zeus' or 'da Vinci' have been used in GIT surgery to perform colonic resection and oesophagotomy. This has been echoed in the gynaecology field, where RSS have been used to treat fibroids, abnormal periods, endometriosis, ovarian tumours, pelvic prolapse and female cancers via the transvaginal approach for a number of years. Gynaecologists now also routinely perform

hysterectomies, myomectomies and lymph node biopsies using RSS. No doubt, as surgical experience and robotic technologies develop further, it is expected that the repertoire of on-site RSS procedures may expand even further.

Most Da Vinci units are located in major centres of capital cities, and it is estimated that they are commonly used in up to 450,000 operations per year globally.<sup>16</sup> Though, while they currently dominate the RSS landscape, they are not without their problems. Firstly, they use proprietary software, and post-installation, each machine collects more than \$100K in maintenance service agreements, plus the costs of ongoing, expensive surgical consumables.<sup>16</sup> They are also heavy kits of machinery, weighing more than half a tonne. This from a military point of view of course, renders them somewhat 'immobile' and limits their deployability.<sup>19</sup> However, from the 'base' model of da Vinci, modifications have been made to develop robots with other military applications. It should be noted that most public hospitals in Australia have not acquired the 'da Vinci' RSS, due to the high consumable costs of operation, and also to the belief that the evidence for their use is not strong. Having said that, there are currently 10 da Vinci machines in use in Australia, in both major public and some private hospitals, including three in Sydney and three in Melbourne, two in Brisbane, and one each in Adelaide and Perth. While there is an evident polarity regarding the usefulness of da Vinci among many surgeons, those that favour the machine are strong supporters of this technology, whom believe that the da Vinci RSS is an excellent tool that can produce amazing patient outcomes, but which ultimately requires its surgeons to be well trained and experienced, otherwise complications could be caused by the actions of the surgeons themselves.<sup>17</sup> Also, it should be taken into account that each new version of the robot incorporates several small but significant improvements to reduce risk of patient harm.

### 'Remote' Robotic Surgical Systems

As far as remotely-applied RSS, and although they still have some way to go, they are starting to make their way into reality.<sup>16</sup> This is the kind of technology that could provide remote surgical care in the field, and the military and private companies are investing in this idea, to make remote surgical interventions possible, thus providing a semi-autonomous technology that can provide attractive options for situations with limited access to medical care.

Envision a scenario of the future in which a "man down, man down" message comes across a military radio. Almost immediately, a casualty extraction UAV is despatched and collects the injured soldier

from the battlefield and accommodates him in a mini-OR (inside the UAV itself) while flying away to a safe zone.<sup>16</sup> An assessment and diagnosis are reached after scanning the soldier's body for injuries, and surgery begins to control the injuries. Once those injuries are effectively treated, the soldier is evacuated via casualty extraction UAV to a base hospital.<sup>16</sup>

Although the above scenario may probably be deemed 'too futuristic' a system known as 'Trauma Pod', actually exists and it is being developed in incremental stages by DARPA.<sup>17</sup> 'Trauma Pod', is a project designed to develop robotic diagnosis, life support and surgical capabilities to remotely provide medical care to soldiers injured in the field, which involves the equivalent of a futuristic operating room, in which the only human present in the room is the patient.<sup>16</sup> The demonstration of this system, consisting of a surgical robot, robotic assistants, an integrated life support system and an intra-operative imaging system, is to perform procedures common to the battlefield, on a full-sized mannequin patient.<sup>16</sup> The feasibility of this project has been demonstrated by the dynamic 'choreography' of a team of robots moving around a patient while exchanging tools and supplies.<sup>16</sup>

Interestingly, another new RSS, called 'Raven' has recently (2012) appeared. Originally designed for the US Army as a prototype for robotic surgery on the battlefield, this RSS, unlike da Vinci, is the first surgical robot to use open-source software (Linux-based operating system which allows modification of the original code), and in stark contrast, is compact, light and significantly cheaper (\$250K).<sup>18</sup> The Raven RSS has the disadvantage though that it is not yet approved by the US FDA for use in human surgery, so essentially, at this stage, it is still only an 'experimental' RSS, limited to perform operations on human cadavers and animals. It is expected though, that having put enough of these new RSS through their paces, and over time, they will overcome the hurdles of registration for human procedures. One significant dilemma that Raven will face is that its main competitor, Intuitive Surgical, holds the patents to these technologies, thereby risking the possibility of a legalistic issue in the future.

Another remote RSS, developed by SRI International consists of two lightweight 6-degrees-of-freedom arms, each weighing 4.5 kg, that can be carried in small rugged cases and quickly deployed in the field. Such systems are designed as smaller, portable, surgical systems that can function in rugged environments, such as SRI's 'M7' RSS.<sup>16</sup>

Of course there are also other robotic systems, not necessarily RSS, but rather robotic 'life support'.

One such system in this category is known as 'Life Support for Trauma & Transport System' (or LSTAT), which is a snake-like robotic arm attached to a high tech stretcher designed to medically attend to injured soldiers.<sup>19</sup> This 'snakebot' is wirelessly controlled by a human operator with a joystick, and using its sensors and camera, it can monitor a soldier's condition. Containing a ventilator, defibrillator and other physiological monitors (oxygen saturation rate) to perform preliminary diagnostics, the stretcher attached to snakebot is basically a small, portable intensive care unit.<sup>19</sup> The serpent-like flexibility of LSTAT allows this robot to easily manoeuvre over any point of a soldier's body, making it a useful tool to conduct an initial medical assessment in the field, being particularly useful where casualties cannot be easily evacuated when under fire. Using this system, a doctor can move the robot anywhere over a soldier's body to assess his injuries, until he can be evacuated.<sup>19</sup> One of the drawbacks of LSTAT is that casualties still need to be loaded onto the stretcher, thereby increasing the risk to medics, but once loaded, medics can use the onboard equipment to attend to injuries. Further development is continuing to fully automate the system so that sensors move to immediately work on the casualty, while the stretcher is evacuated by UGVs. Another drawback of LSTAT, as opposed to a human operator, is the lack of tactile information. Some military trauma physicians feel that there is no evidence that robots perform better than human operators with respect to medical assessments, particularly in patients with severe trauma. While opinions vary as to the effectiveness of LSTAT, it is imperative that such systems, at the very least, do not slow the process of diagnosis, treatment and transport, when compared to human operators. Carnegie Mellon University, who initially developed the Snakebot concept, in association with the U.S. Army's Telemedicine and Advanced Technology Research Centre, who developed LSTAT are currently collaborating to address these issues.

Despite the huge strides made in the development and sophistication of RSS, particularly as they relate to both efficiency and accuracy of surgical robots, there are still many technical issues which need to be ironed out. The first relates to the delay in transmission, known as 'latency', (time taken between what happens at one end and what happens at the other). The second relates to the interrupted transmission of the electronic signal, known in the field as jitter, which can make the difference between a successful surgical procedure and an unsuccessful one.<sup>19</sup> Inevitably these hurdles will be overcome. Ultimately, the concept of remotely controlled medical care is moving toward one of human-supervised autonomous operations, in which robotic devices are

capable of interpreting and acting on sensor data to provide better feedback to the surgeon.<sup>16</sup> However, mostly due to bandwidth limitations, it is likely that semi-autonomous or 'supervised' procedures may enter this field much quicker than remotely-controlled RSS. Having said that, humans will always remain behind the decision-making process.

### Classification of Ground-based Unmanned Vehicles and Platforms

UGVs are by definition, UVs that operate on the ground, however when armed, they are commonly referred to as unmanned weapons systems (UWS). Under the UV category, though in a class of their own, also under the RGPs, which are either quadrupedic or bipedic 'robots', and unlike their UGV 'cousins' they use robotic limbs, rather than a wheel or tracked-chassis, to achieve movement. In general, UGVs and RGPs were designed specifically for dangerous missions, where a human operator could not be used. Similarly to UAVs, UGVs generally have onboard sensors to scan and monitor their environment, usually achieved either completely autonomously or via a human 'controller' located in another location. This distinction provides the two main categories under which UGVs and RGPs generally operate, those being; remotely-operated and autonomous.



Figure 2. Battlefield Extraction Assist Robot (Source: <http://www.vecna.com/innovation/bear> accessed 6 August 2013)

### Battlefield Casualty Extraction Robots

An important semi-autonomous (remote) RGP, designed to locate, lift (scoop) and rescue people out of harm's way, is the 'Battlefield Extraction Assist Robot' or BEAR (Figure 2). Developed by Vecna Technologies of Cambridge MA, and funded by the US Army Medical Research and Material Command, BEAR was designed as a powerful, highly agile, mobile robot.<sup>20,21</sup> Standing at 6ft high when extended, its upper torso has two arm actuators which are extremely strong, whereas its lower body base consists of highly manoeuvrable tank tracks,

which can separate out as thighs and calves, giving BEAR extra height when required.<sup>20,21</sup>

Designed to negotiate rough and uneven terrain, in its kneeling position, it travels over rubble using its tracked 'legs'. The robot's sense of balance and coordination are controlled gyroscopically using Dynamic Balance Behaviour technology and computer-driven motors which enable it to stand and carry loads upright on its ankles, knees or hips for up to an hour at a time.<sup>21</sup> Interestingly, it can even negotiate stairs while carrying a wounded soldier, as well make its way through most standard doorways. With a top speed of approximately 10 km/hr, and a hydraulic upper body having the capability to lift up to 227kg (500lb), this robot is very well placed to carry out its core mission of casualty extraction.<sup>20,21</sup>

BEAR 'sees' via use of its inbuilt cameras, and 'hears' via use of its inbuilt microphones. While the early prototype (vers. 6) essentially can carry out all of the above functions, the latest model (vers. 7) has undergone a number of improvements. One of the most significant of these has been to give BEAR a 'friendly' face, which its designers felt was important, so as to re-assure casualties and allay their fears. Other design modifications include a stronger and sleeker, 'humanoid' upper torso, Actin software integration (from NASA) for controlling and coordinating limb movement, 'finger-like' end effectors, and inbuilt detectors for chemical, biological and explosive agents, using Laser-Induced Breakdown Spectroscopy.<sup>20</sup> The latest efforts include implanting pressure sensors in the effectors to ensure that human casualties are handled with 'sensitivity'. One can easily deduce that this RGP would also have useful applications in the civilian area of emergency medicine, such as the retrieval of victims from hazardous road accident environments, from damaged buildings after an earthquake, or simply to move immobile patients in a hospital.

Another robotic casualty extraction system to come onto the military market recently is the 'First Responder Robot' from Hstar cRONA. The beauty of this RGP is that it provides the 'traditional' functionality of mobility, telepresence and casualty lifting capabilities, but also diagnostic capabilities including 'in-field' ultrasound.<sup>22</sup> According to its developers, future upgrades will include autonomous ultrasound image acquisition, 3D ultrasound imaging and visualization, infra red scanning and autonomous traumatic injury assessment and desired treatments will be possible via a medic operating the system remotely.<sup>22</sup> Of course, 'First Responder' has, similarly to BEAR, the same capabilities to operate in hazardous conditions including fire, biological, chemical and even radioactive environments.

### Load-Carrying or 'Porter' UGVs and RGPs

In recent years the task of carrying logistic loads (medical supplies; munitions; weapons) has become an 'automated' function, and lately it has been greatly enhanced by the array of 'porter' UGVs and RGPs, which have become available. Not only having the ability to carry heavy loads (227kg) over long distances and over rough terrain, but also to act as 'escorts' to accompany small squads (3-10) soldiers on both operational and logistical missions.<sup>23,24</sup> This they can do quietly, for up to 72hrs without refueling, and one example is the 'REX' porter UGV (Figure 3).<sup>23</sup>

Essentially, the REX UGV follows the soldier or medic that operates it remotely. Alternatively REX can be programmed to trail soldiers up to 6 metres away, via use of a small remote control device.<sup>23</sup> The functionality of these systems has not only enhanced the performance of infantry combat units in the field (as soldiers can carry more supplies to accomplish their mission) but it has also enhanced the 'mobility' of field medical missions, particularly where the REX UGV has an RSS on board. In terms of operability, the REX UGV is hard-wired to move at the same pace as that of the soldiers or medics on patrol, to come to a stop when required, and to either reduce or increase its operating speed.<sup>23,24</sup>



Figure 3. 'Rex' porter UGV. Photo courtesy of IAI

Currently, a series of UGVs and RGPs are in development, each being designed with a function in mind. For example, REX, and other similar prototypes (designed to accompany combat infantry units) are being armed with an array of lethal weapons, an example of one of these being the 'CaMEL' UGV.<sup>25</sup> The core mission of these armed UGVs is to serve two purposes, to manoeuvre with small units and conduct ISR, and secondly, to close in on and destroy the enemy.<sup>25</sup> Interestingly, the CaMEL UGV can carry 200kg of supplies over a 72 hr mission, while maintaining a 4km/hr steady march speed for 8 hrs, and with the ability to jump from zero to 38 km/hr bursts for up to 200 metres, and on slopes between 30-60 degrees.<sup>25</sup>

Some UGV and RGP models are being designed exclusively for ISR whereas others are purely as medical logistics and treatment platforms. Aside from military applications, the civilian 'Remote Package Handling System' (or RPHS) from the Provectus company, has been exclusively designed to operate at airports where its core function is to assess and quickly remove 'suspect' packages from airport terminal buildings, thus reducing risk to airport employees, as well as minimizing both loss of revenue and downtime.<sup>26</sup>

An innovative autonomous RGP is the US Army's 'Big Dog' (Figure 4),<sup>27</sup> which is a robotic quadruped, designed to carry equipment for ground troops and medics over difficult or rough terrain. Also known in the US Army as the 'Multifunctional Utility/Logistics and Equipment' robot or 'MULE'. Weighing 110kgs and standing 0.76m tall, it can carry 154kgs at an average speed of 6km/h, and climb hills at an incline of up to 35 degrees.<sup>27</sup> Big Dog has the capability to jump over low obstructions, climb over low vertical obstacles, walk on ice and importantly, it never falls off its feet.<sup>27</sup>



Figure 4. BigDog Robot image courtesy of Boston Dynamics

### Current limitations of UGVs and RGPs

While some of the autonomous functions of UGVs are well advanced (such as mobility, endurance, communications and navigation), the development of behavioural functions relating to their adaptability and employment in complex tactical scenarios is still at an early stage. One particular issue is whether to limit UGVs (and other robotic technologies) to adaptive control solutions or whether to incorporate artificial intelligence, ultimately seeking UGVs capable of complete and 'responsible' autonomous operation.

What are the advantages of RSS and UVs for the ADF?

Undoubtedly, the most valuable advantages of RSS is their ability to perform critical life-saving surgical interventions and physiological monitoring, whereas UVs can facilitate combat casualty extraction and evacuation. UVs can also do ISR tasks, and aid and complement the mobility of medics and doctors on the battlefield, while at the same time, protect the operator from direct fire using their own self-defence mechanisms. Such features have made both RSS and UVs attractive to armed forces and law-enforcement agencies alike, including unconventional warfare and counter-terrorism operations.

UGVs and RGPs are versatile, agile and relatively rugged. Moreover, with the ability to perform repetitive tasks with speed and precision—and being devoid of human emotion—they are tenacious, tireless and fearless. This makes them extremely useful for a range of mundane, tedious and dangerous tasks on the modern battlefield, especially ones that would otherwise expose human operators to higher-than-normal risk of injury or death. Similarly today, with the rapid pace of research and development in this area, it is hoped that small portable RSS will be able to provide the capability of remote surgical interventions, as well as advanced life support in the field, in the near future.

Moreover, as the development and proliferation of RSS, UGVs and RGPs continues, their acquisition costs will reduce, making them more affordable for militaries around the world, particularly where their employment can reduce overall manpower requirements or, it is hoped, minimise the risk of death or injury to service personnel. These attributes have been recognised by the US Congress, which mandated in 2000 that one in every three future US combat systems should be unmanned.<sup>28</sup>

For the ADF, the potential utility of these technologies—and ultimately their effectiveness and reliability on the future battlefield—will need to be weighed against specific mission requirements and detailed cost benefit analyses. However, the drawbacks of these technologies which include significant expense, the question of how to provide an ongoing power supply for prolonged missions, and reliable evidence for the efficacy of these technologies all need to be considered. On the one hand, it is relatively easy to justify the acquisition of a particular UV to meet a specific, existing capability. The considerably more difficult exercise is to contemplate the required force structure for a future battlefield involving a combination of manned and

unmanned platforms and systems, operating as an integrated combat and medical battlefield network.

The other challenge, which has been addressed by a number of commentators—in earlier issues of the Australia Defence Force Journal as well as other scholarly publications—is the complex question of the ethical, legal and political implications of employing increasingly autonomous robotic technologies in operations.<sup>29,30,31</sup> While some might argue that issue is overblown and the stuff of science fiction novels, it seems inevitable that in the long term future, UGVs and RGPs will progressively incorporate artificial intelligence systems, giving them increasing levels of autonomy, but not complete autonomy from the human operator. Remote RSS however (unlike on-site RSS) are still at an experimental stage of development, hence they may provide potential future advantages in the field, though these are currently only 'experimental' at best.

### Conclusion

While the possibility of using robotics on the battlefield to conduct warfare operations has long been envisaged by military planners, it has not until recently been recognised that these very same technologies can also be developed to enhance the practice of battlefield medicine and trauma care. It seems certain that RSS, UGVs and RGPs will continue to proliferate in ground medical operations, where they have the potential to greatly improve the life-saving effectiveness of medical interventions and casualty extraction, thereby reducing human fatalities on the battlefield.

In the longer-term, it seems inevitable that the battlefield of the future will be dominated by increasingly-autonomous UWS and platforms, operating across the environments of air, sea, land and space. It is now also evident that such technologies designed and purpose-built for medical applications, will also dominate the battlefield of

the future. How those platforms and systems are integrated into future force structures—including for the Australian Defence Force—is a complex issue, requiring considerable analysis and planning.

This article has provided some vision of what the future battlefield medicine and associated logistics, potentially holds. Aside from RSS, in some ways, UGVs and RGPs are perhaps the 'perfect orderly' in the sense that they are mission-driven, highly-survivable, easily-repairable and, if required, disposable. Their effectiveness will only be enhanced further when questions regarding the human-robot interface are solved, as will be their repertoire of uses within the military medical organisation, as increasing levels of operating autonomy are achieved.<sup>32,33</sup> It seems that, as many futurists will argue, the 'age of the machines' has truly arrived.

### About the Author

In his role as Laboratory Manager and Supervising Scientist, the author manages the Centres for Transplant & Renal Research and Infectious Diseases & Microbiology, at the Westmead Millennium Institute for Medical Research (Westmead Hospital). He is also the Training Officer-Operations and an Instructor with the Australian Air Force Cadets (AAFC), based at 307 (City of Bankstown) Squadron, located at AAFC Headquarters, Lidcombe Multi-User Defence Facility, NSW. With a lifelong interest in military aviation and military history, and having served for a number of years in the Air Training Corps, as a serving AAFC Officer, he now dedicates a significant portion of his time to the supervision, training and mentoring of AAFC cadets. He has a strong interest in unmanned and future weapons systems of land, sea and air.

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*Author's affiliation:* Westmead Millennium Institute – CTRR, P.O. Box 412 Westmead Sydney New, South Wales 2145, Australia

*Corresponding author:* Dr. Gary Martinic  
email: gary.martinic@sydney.edu.au

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# Randomised double-blind, placebo-controlled trial of iron supplementation attenuates fatigue and declining iron stores for female officers-in-training

Christine K Booth<sup>1</sup>, Julia E Carins<sup>1</sup>, Iain K Robertson<sup>2</sup>

## Abstract

**Background:** Physical training by female military trainees can put them at risk of iron deficiency and inferior health and performance.

**Purpose:** To determine the effect of iron supplementation on iron status, fitness, fatigue, and leisure activities.

**Material and Methods:** In this randomised, double-blind, placebo-controlled trial, female officers-in-training were randomly allocated to treatment ( $n = 25$ , 18 mg iron) or placebo tablets ( $n = 24$ ). Outcomes were iron status, fitness, fatigue, and leisure activity at baseline, seven weeks and 13 weeks.

**Results:** Ferritin declined by midpoint in the placebo group ( $P = 0.001$ ). There was a treatment effect in the second half of the trial in emotional fatigue (-4.2 to -0.6 95% CI,  $P = 0.04$ ). There was a negative relationship with iron intake for emotional fatigue (OR 0.61; 0.44 to 0.87 95% CI;  $P = 0.006$ ) and positive for vigour (OR 1.51; 1.08 to 2.11 95%CI;  $P = 0.016$ ) and small negative association between initial dietary iron intake and initial serum ferritin (0.2 to 9.2  $\mu\text{g/L}$  95% CI;  $P = 0.042$ ).

**Conclusion:** Officer training affects iron status and iron supplementation improves indicators of iron status and emotional fatigue in female officers-in-training.

**Conflict of Interest:** There was no conflict of interest.

**Keywords:** Nutrition, iron status, females, military, iron supplement.

## Introduction

Low dietary iron intake is common in many developed nations, particularly amongst women. A survey of Australian adults revealed that 50% of women aged 19–24 years had a daily iron intake below the recommended level of 12–16 mg<sup>1</sup>. Iron deficiency might affect 8% of all Australian women<sup>2</sup>, with the prevalence of anaemia being approximately 2–5%. Other evidence has shown prevalence of iron deficiency in Australian women in the 15 to 30 year age group as high as 12.5% (as indicated by low serum ferritin)<sup>3</sup>.

There is some evidence that iron deficiency (without anaemia) can have a negative effect on physical performance, particularly on endurance<sup>4</sup>. For example, the iron status of a group of British Royal Engineers was positively associated with aerobic fitness (multistage fitness test) during adventurous training in the hot wet tropics<sup>5</sup>. Many other non-specific symptoms such as fatigue, lethargy, weakness, headaches, irritability and dizziness

have been associated with iron deficiency<sup>2</sup>. These symptoms all have the potential to affect general health and reduce the quality of life in terms of work, leisure, social activities and family responsibilities.

The proportion of women suffering iron deficiency and anaemia increased after basic officer training in the United States<sup>6,7</sup>, so the commencement of physical training by Australian Defence Force (ADF) female officers-in-training may put them at risk of iron deficiency. If they do become iron deficient they may fail to complete training or may fail essential fitness tests. Further, they may suffer non-specific symptoms such as fatigue that may interfere with work duties, social and family life<sup>2</sup>. All these problems increase the likelihood that female officers-in-training will be lost from the ADF.

The recruitment and retention of women in the ADF is a matter of concern with the proportion of women in the ADF as low as 12.8%<sup>8</sup>. Defence has stated that 20% of recruits are women, so the figures suggest that retention may be a problem. Women can bring

valuable skills to the ADF, which in turn cannot afford the risk of losing them due to a preventable nutritional deficiency.

This study aimed to determine whether the iron status of female officers-in-training declines during military training, whether the iron status affects fitness, fatigue, health and leisure activities and whether a low dose daily iron supplement would prevent adverse changes in iron status, fitness, fatigue or leisure activities.

Iron supplementation is not without risk. Increased dietary iron intake is a risk factor for the development of haemochromatosis (iron overload) in subjects homozygous for the C282Y allele of the HFE gene [9]. High doses of iron supplements are associated with gastric upset, the severity and occurrence of which depends upon the formulation of the supplement [10]. Iron is also believed to play a role as catalyst for oxygen free radical-induced tissue damage<sup>11</sup>. A low-dose iron preparation of ferrous gluconate (18 mg elemental iron) was chosen for this study. Guidance states that a daily supplement of 17 mg ferrous iron would not be expected to produce adverse effects in the majority of people, other than those with haemochromatosis<sup>10</sup>. Folic acid was added to the capsules to minimise the risk of folate-deficiency anaemia during the study.

This was an exploratory study because this type of study had not previously been conducted with ADF trainees.

## Materials And Methods

### Subjects

This study was conducted through the Canberra Area Medical Unit and was approved by the Australian Defence Human Research Ethics Committee (ADHREC protocol 314/02). Written, informed consent was obtained from all participants. First and second year female officer cadets (Army, Navy and Air Force) from the Australian Defence Force Academy (ADFA) and female staff cadets (Army) from the Royal Military College (RMC) participated in the study. The initial date of recruitment for the study was February 2003. On each occasion testing was conducted over two consecutive mornings.

Exclusion criteria included current medical problems, recent blood donation, pregnancy in the previous 12 months, breast-feeding, anaemia (haemoglobin < 120 g/L), iron overload (serum ferritin > 300 µg/L), or a positive Helicobacter pylori antibody test. Participants were asked to refrain from taking supplements containing iron throughout the study.

University contact hours and time spent in organised physical training varied greatly between students and weeks. A typical week for ADFA students consisted of around 20 hours of classes (mainly lectures) with 2–7 hours of organised physical training (PT). PT involved either sporting activities, or military PT such as pack marching, fire and movement, battle training, rock climbing and obstacle courses. The training conducted with RMC students was scheduled in blocks, so students would either be in the field (conducting simulated exercises) or back at base performing predominately PT with a number of lectures. Mean academic class attendance per week over the 13 weeks totalled 12.4 h (range 0–47.5 h) and mean time spent in PT was 10.4 h per week (range 0–42 h) for the two groups.

### Study Design

After completion of baseline blood tests, participants were divided into two groups, those above and those below the median serum ferritin concentration for all participants.

Participants within each group were then randomly allocated to either treatment (1 capsule per day, iron supplementation) or placebo (1 capsule per day) by use of an on-line random number generator. The study was conducted in a double blinded fashion, with capsule codes being broken and revealed to the researchers only after all measurements were completed and reported.

All capsules (Gold Coast Laboratories Pty Ltd, Burleigh Junction, Australia), contained 0.5 mg folic acid (range 0.465–0.535 mg). The treatment capsule also contained 18 mg elemental iron as ferrous gluconate (range 16.7–19.4 mg), while the placebo contained glucose. The contents of the capsules were confirmed by an independent accredited laboratory (ConMac Laboratory Services, Bethania, Australia).

Capsules in coded bottles were issued to individual participants at each testing point. Participants were instructed to consume 1 capsule with water each day immediately before eating breakfast. To allow estimation of compliance, participants were required to return their coded bottles containing the remaining capsules at the mid-point, (to obtain a re-issue of treatment/placebo capsules) and at the final point. By recording the number of capsules issued, and the number returned, compliance and iron intake from supplements could be determined.

Outcome measures (iron status, fitness, fatigue and leisure activity) and potential confounding factors (body mass index, dietary iron intake and menstrual bleeding index) were measured at the beginning of the academic semester (baseline), the end of 7 weeks

(mid-point) and again after 13 weeks at the end of the academic semester (final-point). To determine dietary iron consumption, participants completed a food frequency questionnaire (FFQ) (Anti Cancer Council of Victoria, Melbourne, Australia)<sup>12</sup> at baseline and at the final point. To determine any possible effect of menstruation on iron status measures, the initial health screening questionnaire was used to calculate a Menstrual Bleeding Index (MBI). The MBI was calculated using the following formula:

$$\text{MBI} = \text{bleeding length (days)} * \text{bleeding intensity (rating)}/\text{cycle length (days)}$$

where intensity is a perceived 3-point rating of 1 = light, 2 = medium, and 3 = heavy. This method is a modified version of that used in a previous study on iron status in female endurance athletes<sup>13</sup>.

### Biological sample collection and analysis

Blood from each participant was collected after an overnight fast by using antecubital venipuncture and collection tubes containing the appropriate anticoagulant. Serum and whole EDTA blood samples were collected at the three time points. A basic haematological profile (haematocrit, haemoglobin concentration, red and white cell counts and counts of neutrophils, monocytes and lymphocytes) was performed on whole EDTA blood within 5 hr of collection by routine methods (Beckman Coulter MaxM automated analyser, Miami, Florida, USA). Frozen serum and plasma samples were air-freighted to the DSTO-Scottsdale laboratory. Standard commercial methods were used in the analyses: ferritin, soluble transferrin receptor and transferrin (ProSpec autoanalyser, Dade Behring Diagnostics, Marburg, Germany) and serum iron (Cobas Bio clinical analyser, Roche Diagnostics, Germany). *H. pylori* IgG antibodies were detected in fasted serum at the baseline by use of a commercial enzyme-linked immune assay (DTect ELISA,

Diagnostic Technology, Belrose, NSW, under licence from the School of Microbiology and Immunology, University of NSW, Sydney). The percent saturation of transferrin (TS) was calculated as:

$$\text{TS} = [\text{Fe } (\mu\text{mol/L}) / (25 \times \text{transferrin } (\text{g/L}))] \times 100\%$$

Female officers-in-training with iron deficiency (ID) were identified using the criteria recommended by the Australian Iron Status Advisory Panel (Table 1)<sup>14</sup>.

### Fitness, fatigue, leisure activity measures

Aerobic capacity and endurance was measured using the multistage fitness test<sup>15</sup>. The tests were completed under the supervision of a physical training instructor during the officer or staff cadets' usual physical training classes. Results were presented as the stage reached before volitional exhaustion (i.e. the higher scores indicate a better fitness level).

The concept of fatigue is ill defined and can constitute symptoms such as tiredness, lethargy, lack of vitality, lack of energy, sleepiness, decreased strength and poor concentration. This suggests that fatigue might be measured by assessing a range of symptom domains<sup>16</sup>. We used the Multidimensional Fatigue Symptom Inventory—short form (MFSI-SF) which recognises the multidimensional nature of fatigue<sup>16</sup>. It is a validated questionnaire that is sensitive enough to detect changes in fatigue over short periods<sup>17</sup>. It comprises 30 items; participants rate their experience of each symptom as not at all, a little, moderately, quite a bit or extremely. The item scores combine to produce five subscales, each producing a score ranging from 0 to 24, measuring different dimensions of fatigue—general fatigue, physical fatigue, emotional fatigue, mental fatigue and vigour. Higher scores on the MFSI-SF subscales other than for vigour are indicative of more fatigue.

TABLE 1. Stages of iron deficiency\*

Measurement	Normal	Stage 1	Stage 2	Stage 3
Ferritin (mg/L)	30–250	<30	<15	<5
Transferrin Saturation (%)	16–49	16–49	<16	<16
Soluble Transferrin Receptor (mg/L)	0.4–1.8	0.4–1.8	>1.8	>1.8
Haemoglobin (g/L)	120–180	120–180	120–180	<120

\* Iron deficiency can be classified into three stages depending upon severity: iron depletion (stage 1) with decreased ferritin reflecting loss of iron stores; iron-deficient erythropoiesis (stage 2) indicated by a further decrease in ferritin concentration and/or an increase in soluble transferrin receptor concentration and decreased transferrin saturation; and finally a significant decrease in circulating haemoglobin indicating iron-deficiency anaemia (stage 3)<sup>14</sup>.

A Leisure Activity Questionnaire was devised to obtain a score of leisure activity. Participants noted the amount of time they spent on leisure activities, in various categories over the previous three days. The categories were self maintenance, demanding sports, medium level sports, low level sports, social, solitary hobbies, personal improvement, relaxation, sleeping/resting, and purposeful. Each category was assigned an energy rating, based on metabolic equivalent intensity levels<sup>18</sup>. Examples were given in each category, including exercise, social and household activities. From this questionnaire a score representing the level of leisure time activity per day was obtained by multiplying total minutes by an energy rating.

## Calculations and statistics

Sample size calculations indicated that 215 female officers-in-training were needed in each group (placebo and treatment) in order to detect a clinically significant ( $\alpha = 0.05$ ) change in ferritin concentrations (i.e. 5 µg/L ferritin) with 80% power based on a repeated measures design and an SD of 22.2 µg/L ferritin measured at baseline ( $n = 76$ ). The total number of female officers-in-training available for our study was around 100.

The change in outcome measures of iron status and fatigue scale scores from the beginning to the end of the study in each treatment group separately, and the difference in means in the intervention compared to placebo groups at each separate measurement time point were estimated using mixed-methods linear regression, corrected for repeated measures and adjusted for age, BMI, alcohol intake, dietary iron intake and menstrual bleeding index. The possibility of violation of the assumptions of linear regression was tested using Cameron & Trivedi's decomposition of information matrix test (to test for heteroskedasticity, skewness and kurtosis of regression residuals) and Ramsay's reset test (to test for missing power values). In a number of cases, such violations were identified. Also, the fatigue scale scores are inherently rank-ordered in nature rather than as continuous interval data. All primary analyses were repeated using repeated-measures mixed-effects ordered logistic regression (a "non-parametric" equivalent of the mixed effects linear regression analysis), which estimates odds ratios as effect sizes (which are not simple to interpret). Despite the assumption violations and the rank-ordered nature of the fatigue scales, the "parametric" and "non-parametric" analyses appeared to give equivalent result interpretations. Therefore, the analyses are expressed as means ( $\pm$  standard deviations) for placebo and intervention groups at

each measurement time point, mean difference (95% confidence intervals, p-values) between initial and subsequent measurements in the placebo and intervention groups separately, and the mean difference (95% confidence intervals, P-values) between the placebo and intervention groups in those measurements at each time point separately (adjusted for the placebo-intervention difference at the initial time point). The P-values for the fatigue scale result, however, were those derived from the mixed-effects ordered logistic regression analyses. P-values were corrected for multiple comparisons using the Holm method. The effect of missing outcome data points was assessed using multiple imputation. Additional analyses were conducted to test whether the effect of the supplement, if any, varied between the 'high' and 'low' iron status groups (based on initial ferritin concentrations). All statistical analyses were performed using Stata MP2/13.0 (Statacorp LP, College Station TX, USA).

## Results

Seventy-seven participants were recruited in the study, of whom five were excluded because of a positive Helicobacter pylori test and one because of anaemia. Seventy-one healthy female officers-in-training commenced the study and forty-nine completed all elements of the study. The age, anthropometric characteristics and other potential measured confounding variables of the participants did not differ between the trial groups, as shown in Table 2. There were no differences in either class hours or PT hours between the treatment and placebo groups.

Although there were no reports of side effects due to taking the capsules, compliance with the daily capsule supplement was not perfect. Placebo and treatment groups had similar compliance and dropout rates. Mean compliance (placebo = 24, treatment = 25) excluding those who ceased entirely, was six days per week or 85% (range 52%–100%) which corresponded to a mean supplementation of  $16.8 \pm 2.1$  mg elemental iron (range 12.8–19.4 mg,  $n = 25$ ).

## Dietary intake

There was no reduction in energy intake in the placebo group. In the intervention group initial energy intake was 10% higher than the placebo then fell below the placebo group by the final-point (Table 3). In particular, the mean daily differences for energy and iron intakes over the second half of the trial were -960 kJ (-1862 to -58 kJ 95% CI,  $P = 0.07$ ) and -1.9 mg (-3.3 to -0.4 mg 95% CI,  $P = 0.026$ ), respectively.

TABLE 2. Initial characteristics of trial subjects\*

		Placebo (N=34)	Intervention (N=35)	Comparison		95%CI	P-value
Age	Mean $\pm$ SD†	20.0 $\pm$ 2.0	20.0 $\pm$ 3.1	Mean Diff†	0.1	(-1.2 to 1.3)	>0.90
BMI	Mean $\pm$ SD†	23.3 $\pm$ 2.2	22.8 $\pm$ 2.0	Mean Diff†	-0.5	(-1.5 to 0.5)	0.32
MBI§	Median & IQR‡	0.29 (0.16 to 0.37)	0.29 (0.14 to 0.40)	OR‡	1.02	(0.44 to 2.33)	>0.90
Smoker	N‡	1	2	OR‡	2.00	(0.17 to 23.6)	0.58
Alcohol (g/ day)	Median & IQR‡	9.7 (5.6 to 16.7)	8.1 (3.1 to 14.5)	OR‡	0.66	(0.28 to 1.51)	0.32
Blood Donor	N2	2	2	OR‡	0.97	(0.13 to 7.41)	>0.90

\*Seventy-one healthy female officers-in-training commenced the study, sixty-nine completed at least two time points and forty-nine completed all elements of the study

†Continuous variables (age and BMI—body mass index) were summarised (mean  $\pm$  standard deviation) and compared using unadjusted general linear modelling (mean difference; 95% confidence intervals; P-values)

‡ Other variables were summarised (median & inter-quartile range—IQR, or number) and compared using unadjusted ordered logistic regression (odds ratio—OR; 95% confidence intervals; P-values)

§MBI: menstrual bleeding index has a range of 0 to 1.

## Iron status

A small negative association was found between initial dietary iron intake and initial serum ferritin (a rise of 4.2mg/day dietary iron—1 SD—was associated with a 4.7 $\mu$ g/L fall in serum ferritin; 0.2 to 9.295% CI; P = 0.042). For female officers-in-training in the placebo group there was evidence for a decline in iron status over the first half of the trial with a mean decline in serum ferritin concentration of 30% at mid-point (mean difference -9.2  $\mu$ g/L; -14.4 to -4.4  $\mu$ g/L 95% CI; P = 0.001) and no evidence of recovery in the second half of the trial (Table 4). For female officers-in-training in the treatment group a small mean decline in serum ferritin across the trial was not significant and there was evidence for improved iron status over the second half of the course, with significant mean increase in TS (mean difference = 22.8 %; 12.6 to 33.0 95% CI; P < 0.001) and mean decrease in sTfR concentration (mean difference = -0.27 mg/L; -0.41 to -0.14 mg/L 95% CI; P < 0.001) at the final-point. There was weak evidence for a treatment effect in the second half of the trial with mean improvements in TS (mean difference = 3.2 %; -1.2 to 27.5 % 95% CI; P = 0.14) and sTfR (mean difference -0.13 mg/L; -0.32 to 0.07 mg/L 95% CI; P = 0.2) (Table 4).

For those female officers-in-training who had iron status measured at each testing point, there was no change in the prevalence or severity of iron deficiency across the testing period (Figure 1).

## Fatigue, fitness and leisure activity

Female officers-in-training in both groups showed improved fitness over the first half of the trial, which appeared to be lost by the final-point, as measured by the multi-stage fitness test (Figure 2, Table 5). There was no evidence for a treatment effect due to the iron supplement.

Female officers-in-training in the placebo group had a greater initial general fatigue score (GFAT) than those in the treatment group (mean difference = -3.5; -5.6 to -1.3 95% CI; P = 0.006) and across the trial both groups displayed improved general fatigues scores. There was some evidence that female officers-in-training in the placebo group felt less vigorous (VFAT score) by the final-point than at the beginning of the trial (mean difference = -2.0; -3.6 to -0.4 95% CI; P = 0.08). There was no evidence for a treatment effect due to the iron supplement for either GFAT or VFAT. There were no significant changes in either group or treatment effects for physical fatigue (PFAT), mental fatigue (MFAT) or leisure activity (LAC).

There was evidence that treatment with the iron supplement improved emotional fatigue (EFAT) (mean difference = -2.4; -4.2 to -0.6 95% CI; P = 0.04). Female officers-in-training in the treatment group had a mean EFAT score 20% less than female officers-in-training in the placebo group at the final-point (Table 5). There was no evidence of a relationship between improvements in emotional

TABLE 3. Comparison of dietary intake of nutrients during the trial

Intake*	Placebo				Intervention				Placebo vs Intervention					
	Period†	N‡	Mean ± SD	Diff§	95%CI	P-value	N‡	Mean ± SD	Diff§	95%CI	P-value	Diff	95%CI	P-value#
Energy	0	34	6,792 ± 2,658				35	7,966 ± 2,657				1,174	(66 to 2,283)	0.11
	2	24	6,901 ± 2,840	109	(-531 to 0.74 749)		25	7,115 ± 2,478	-851	(-1,483 to -219)	0.06	-960	(-1,862 to -58)	0.07
Total Fat	0	34	62.1 ± 29.0				35	73.5 ± 28.3				11.3	(-1.3 to 24.0)	0.24
	2	24	63.0 ± 31.1	0.9	(-6.4 to 8.1)		25	66.3 ± 28.9	-7.2	(-14.3 to 0.0)	0.12	-8.1	(-18.3 to 2.2)	0.24
Protein	0	34	71.4 ± 31.6				35	86.5 ± 31.6				15.1	(1.0 to 29.3)	0.11
	2	24	71.2 ± 33.1	-0.2	(-7.7 to 7.3)	>0.90	25	76.3 ± 26.7	-10.2	(-17.6 to -2.8)	0.06	-10.1	(-20.6 to 0.5)	0.12
Carbo	0	34	174 ± 62				35	204 ± 62				29	(1 to 57)	0.13
	2	34	180 ± 66	6	(-11 to 23)	>0.90	35	179 ± 62	-24	(-42 to -7)	0.10	-30	(-55 to -6)	0.031
Alcohol	0	34	11.5 ± 16.2				35	8.6 ± 13.1				-2.9	(-9.4 to 3.6)	0.75
	2	24	12.5 ± 13.4	1.0	(-2.1 to 4.0)	0.53	25	6.6 ± 10.4	-2.0	(-4.9 to 1.0)	0.59	-2.9	(-7.2 to 1.3)	0.36
Iron	0	34	9.94 ± 4.17				35	11.86 ± 4.62	0.0			1.92	(-0.10 to 3.95)	0.19
	2	24	10.18 ± 4.47	0.24	(-0.80 to 1.27)	>0.90	25	10.24 ± 4.20	-1.62	(-2.64 to -0.59)	0.10	-1.86	(-3.32 to -0.39)	0.026

\* Nutrient intake measures: Energy (kJ/day); Total Fat (g/day); Protein (g/day); Carbohydrate (g/day); Alcohol (g/day); Iron (mg/day)

† Trial period: 0=Start of trial; 2=End of trial (13 weeks)

‡ Seventy-one healthy female officers-in-training commenced the study, sixty-nine completed at least two time points and forty-nine completed all elements of the study

§ Changes in nutrient intakes from the start to the middle and end of the trial were estimated within each treatment group separately; results were expressed as mean ± standard deviation (for illustrative purposes only), and compared formally expressed as difference of means (Diff, 95% confidence intervals, p-values) estimated by repeated-measures random-effects mixed methods linear regression, adjusted for age, body mass index, menstrual bleeding index, alcohol intake, dietary iron intake and blood donation.

The differences in nutrient intake between placebo and intervention groups were compared at each time point; results were compared formally expressed as difference of means (Diff, 95% confidence intervals, p-values) estimated by repeated-measures random-effects mixed methods linear regression, adjusted for age, BMI, menstrual bleeding index, alcohol intake, dietary iron intake and blood donation.

# P-values were corrected for multiple comparisons using the Holm method.

TABLE 4. Comparison of iron status measures during the trial

Iron status*	Period†	Placebo			Intervention			Placebo vs Intervention					
		N‡	Mean $\pm$ SD	95%CI	P-value#	N‡	Mean $\pm$ SD	Diff§	95%CI	P-value#	Diff	95%CI	P-value#
Hb	0	34	136.8 $\pm$ 0.0	9.5	>0.90	28	135.0 $\pm$ 7.7	0.0	(-3.0 to 3.1)	>0.90	1.7	(-2.6 to 6.0)	0.43
	1	29	135.1 $\pm$ -1.7	(-4.6 to 1.3)	>0.90	25	135.8 $\pm$ 8.3	0.8	(-2.4 to 4.1)	>0.90	0.9	(-3.7 to 5.4)	>0.90
Ferritin	0	34	27.9 $\pm$ 0.0	8.6	>0.90	35	27.8 $\pm$ 19.6	0.0	>0.90	-0.1	(-10.6 to 10.3)	>0.90	
	1	29	18.7 $\pm$ 20.3	-9.2 (-14.0 to -4.4)	0.001	27	22.2 $\pm$ 12.7	5.6	(-10.6 to -0.6)	0.14	3.6	(-3.3 to 10.6)	0.62
TS	2	24	18.4 $\pm$ 17.5	-9.5 (-16.0 to -2.9)	0.019	25	25.4 $\pm$ 15.8	-2.4	(-9.1 to 4.4)	>0.90	7.1	(-2.4 to 16.6)	0.44
	0	34	24.9 $\pm$ 11.8	0.0	>0.90	33	24.6 $\pm$ 6.5	0.0	>0.90	-0.3	(-5.5 to 4.9)	0.90	
sTfR	1	29	26.4 $\pm$ 11.2	1.4 (-4.7 to 7.6)	<0.90	27	31.1 $\pm$ 12.0	6.4	(0.2 to 12.7)	0.13	5.0	(-3.8 to 13.8)	0.53
	2	24	34.6 $\pm$ 17.1	9.7 (-0.3 to 19.7)	0.18	23	47.4 $\pm$ 30.9	22.8	(12.6 to 33.0)	<0.001	13.2	(-1.2 to 27.5)	0.14
sTfR	0	34	1.34 $\pm$ 0.40	0.00	>0.90	35	1.30 $\pm$ 0.28	0.00	>0.90	-0.04	(-0.22 to 0.14)	0.67	
	1	29	1.41 $\pm$ 0.50	0.07 (-0.05 to 0.19)	0.77	27	1.28 $\pm$ 0.36	-0.01	(-0.14 to 0.11)	0.83	-0.09	(-0.26 to 0.09)	0.35
#	2	24	1.19 $\pm$ 0.38	-0.15 (-0.28 to -0.02)	0.11	25	1.03 $\pm$ 0.36	-0.27	(-0.41 to -0.14)	<0.001	-0.13	(-0.32 to 0.07)	0.20

\* Iron status measures: Hb = Haemoglobin (g/L); Ferritin = Serum ferritin ( $\mu\text{g/L}$ ); TS = Transferrin saturation %; sTfR = Soluble transferrin receptor (mg/L)

† Trial period: 0 = Start of trial; 1 = Middle of trial (about 7 weeks); 2 = End of trial (13 weeks)

‡ Seventy-one healthy female officers-in-training commenced the study, sixty-nine completed all elements of the study.

§ Changes in iron status from the start to the end of the trial were estimated within each treatment group separately; results were expressed as mean  $\pm$  standard deviation (for illustrative purposes only), and compared as a difference of means (Diff, 95% confidence intervals, p-values) estimated by repeated-measures random-effects mixed methods linear regression, adjusted for age, BMI, menstrual bleeding index, alcohol intake, dietary iron intake and blood donation.

The difference between placebo and intervention groups in iron status were compared at each time point; results were compared as a difference of means (Diff, 95% confidence intervals, P-values) estimated by repeated-measures random-effects mixed methods linear regression, adjusted for age, BMI, menstrual bleeding index, alcohol intake, dietary iron intake and blood donation; the estimates for the middle and end of trial periods were corrected for differences between the placebo and intervention groups in initial iron status measures.

# P-values were estimated by repeated-measures random-effects mixed methods linear regression, adjusted for age, BMI and oral iron intake, and corrected for multiple comparisons using the Holm method.

TABLE 5. Comparison of effect of iron supplementation on measures of fatigue during the trial

Fatigue	Placebo				Intervention				Placebo vs Intervention				
	Scale*	Period†	N‡	Mean ± SD	Diff§	95%CI	P-value	N‡	Mean ± SD	Diff§	95%CI	P-value#	
GFAT	0	34	18.3 ± 4.8	0.0				35	14.8 ± 4.3	0.0		-3.5 (-5.6 to -1.3)	0.006
	1	29	17.0 ± 4.9	-1.3 (-2.8 to 0.3)	0.10			28	12.4 ± 3.3	-2.4 (-4.0 to -0.8)	0.011	-1.1 (-3.3 to 1.1)	0.62
	2	24	15.7 ± 4.4	-2.6 (-4.4 to -0.8)	0.009			25	12.9 ± 4.2	-2.0 (-3.8 to -0.2)	0.10	0.6 (-2.0 to 3.2)	>0.90
PFAT	0	34	12.3 ± 3.2	0.0				35	11.5 ± 3.6	0.0		-0.8 (-2.3 to 0.7)	>0.90
	1	29	12.7 ± 3.3	0.5 (-0.7 to 1.7)	0.89			28	11.0 ± 2.7	-0.5 (-1.7 to 0.8)	>0.90	-0.9 (-2.6 to 0.8)	0.89
	2	24	11.8 ± 2.8	-0.4 (-1.8 to 0.9)	0.55			25	11.3 ± 3.8	-0.2 (-1.5 to 1.2)	0.82	0.2 (-1.7 to 2.2)	>0.90
EFAT	0	34	11.5 ± 4.0	0.0				35	11.5 ± 3.7	0.0		0.0 (-1.8 to 1.8)	>0.90
	1	29	11.5 ± 4.7	0.0 (-1.1 to 1.2)	>0.90			28	9.8 ± 3.0	-1.7 (-2.8 to -0.5)	0.033	-1.7 (-3.3 to 0.0)	0.15
	2	24	12.1 ± 3.6	0.6 (-0.6 to 1.8)	>0.90			25	9.7 ± 3.3	-1.8 (-3.0 to -0.5)	0.028	-2.4 (-4.2 to -0.6)	0.040
MFAT	0	34	12.4 ± 4.0	0.0				35	11.1 ± 3.2	0.0		-1.3 (-3.2 to 0.5)	0.46
	1	29	12.7 ± 4.6	0.2 (-0.8 to 1.3)	>0.90			28	10.9 ± 3.7	-0.2 (-1.3 to 0.9)	0.70	-0.5 (-2.0 to 1.1)	>0.90
	2	24	12.2 ± 3.4	-0.2 (-1.6 to 1.1)	0.72			25	10.1 ± 3.2	-1.0 (-2.3 to 0.4)	0.50	-0.7 (-2.6 to 1.2)	>0.90
VFAT	0	34	18.4 ± 3.5	0.0				35	19.9 ± 3.7	0.0		1.5 (-0.3 to 3.3)	0.22
	1	29	17.0 ± 4.0	-1.4 (-2.6 to -0.2)	0.11			28	20.1 ± 4.1	0.2 (-1.0 to 1.5)	>0.90	1.6 (-0.1 to 3.4)	0.21
	2	24	16.4 ± 4.2	-2.0 (-3.6 to -0.4)	0.08			25	19.7 ± 4.5	-0.2 (-1.8 to 1.5)	0.85	1.8 (-0.5 to 4.1)	0.25
FIT	0	32	8.37 ± 1.19	0.00				35	8.72 ± 1.39	0.00		0.36 (-0.20 to 0.91)	0.63
	1	20	8.85 ± 0.92	0.48 (0.20 to 0.04)	0.77)			19	9.10 ± 1.45	0.38 (0.08 to 0.68)	0.06	-0.10 (-0.52 to 0.31)	0.62
	2	19	8.34 ± 1.02	-0.03 (-0.39 to 0.34)				17	8.64 ± 1.64	-0.08 (-0.47 to 0.31)	to 0.67	-0.06 (-0.60 to 0.49)	>0.90
LAC	0	34	81.9 ± 35.7	0.0				35	80.9 ± 31.6	0.0		-1.0 (-18.3 to 16.4)	>0.90
	1	29	96.0 ± 47.7	14.1 (-0.2 to 28.4)	0.26			28	86.3 ± 43.1	5.4 (-9.3 to 20.2)	>0.90	-8.7 (-29.3 to 11.9)	0.81
	2	24	85.7 ± 31.5	3.8 (-11.5 to 19.2)	>0.90			25	87.6 ± 31.4	6.7 (-8.9 to 22.3)	>0.90	2.9 (-19.1 to 24.9)	>0.90

\* Fatigue scales: GFAT = General fatigue; PFAT = Physical fatigue; EFAT = Emotional fatigue; MFAT = Mental fatigue; VFAT = Vigour; FIT = Multi-stage fitness test; LAC = Leisure activities.

† Trial period: 0 = Start of trial; 1 = Middle of trial (about 7 weeks); 2 = End of trial (13 weeks)

‡ Seventy-one healthy female officers-in-training commenced the study, sixty-nine completed at least two time points and forty-nine completed all elements of the study

§ Changes in fatigue scale scores from the start to the middle and end of the trial were estimated within each treatment group separately; results were expressed as mean ± standard deviation (for illustrative purposes only), and compared as a difference of means (Diff, 95% confidence intervals, P-values) estimated by mixed-effects ordered logistic regression, adjusted for age, BMI, menstrual bleeding index, alcohol intake, dietary iron intake and blood donation.

The difference between placebo and intervention groups in the fatigue scale scores were compared at each time point; results were compared as a difference of means (Diff, 95% confidence intervals, P-values) estimated by mixed-effects ordered logistic regression, adjusted for age, BMI, menstrual bleeding index, alcohol intake, dietary iron intake and blood donation; the estimates for the middle and end of trial periods were corrected for differences between the placebo and intervention groups in initial fatigue scale scores.

# P-values were estimated by repeated-measures random-effects ordered logistic regression, adjusted for age, BMI and oral iron intake, and corrected for multiple comparisons using the Holm method

### FIGURE 1.

Prevalence of iron deficiency. Seventy-seven participants were recruited in the study, of whom five were excluded because of a positive Helicobacter pylori test and one because of anaemia. Seventy-six participants completed the baseline blood testing and forty-nine completed all elements of the study. The frequency distribution includes all female officers in-training; baseline n = 76, midpoint n = 57 and final point n = 49. Stages of iron deficiency were classified as iron deficiency or stage 1, iron deficiency erythropoiesis or stage 2, and iron deficiency anaemia or stage 3, as defined in Table 1. From left to right the bars indicate the numbers of female officers in-training with normal, stage 1, stage 2 and stage 3 iron deficiencies at each test point. Logistic regression analysis was used to compare the proportions of subjects in the treatment and placebo groups who showed a decrease in stages of iron deficiency. In this analysis age was employed as a covariate. There was no evidence for changes in prevalence and severity of iron deficiency between testing points or between treatment (n = 24) and placebo (n = 25) groups.

### FIGURE 2.

Vigour as a function of total iron intake (from all sources). Vigour is a dimension of the Multidimensional Fatigue Symptom Inventory-short form. Iron intake had a positive relationship with vigour (OR 1.51; 95%CI 1.08 to 2.11; P = 0.016). The positive association is illustrated here by use of linear regression (Pearson r = 0.24, P = 0.008, 125 observations). The 95% confidence interval for the linear regression fit is indicated as a dotted line.

fatigue and either the initial levels or the changes in the iron status variables. However iron intake had a negative relationship with emotional fatigue (OR 0.61; 95% CI 0.44 to 0.87; P = 0.006) and a positive relationship with vigour (OR 1.51; 95%CI 1.08 to 2.11; P = 0.016, Figure 2).

Correction for missing measurements using multiple imputation analysis (in order to perform an approximation of an intention-to-treat analysis) did not result in any substantial change in the estimates of the effects. There was a minor reduction in the estimate of the intervention on emotional fatigue (e.g. -2.36 95%CI -4.16 to -0.57; P=0.042 to -1.99 95%CI -4.38 to 0.40; P=0.1), compatible with a mild increase in variance due to the substituted imputed values for real but missing values.

### Discussion

The major finding of this randomised, double-blind, placebo controlled trial is that low-dose iron supplementation, while not attenuating the decline in iron stores (ferritin), improved other indicators of iron status (TS and sTfR) and emotional fatigue observed during 13 weeks of female officer training. Female officers-in-training with the lowest intakes of dietary iron experienced more emotional fatigue and felt less vigorous.

One possible explanation for the changes in iron status seen in the present study is that iron was mobilised to the tissues at the expense of iron stores (ferritin), most likely in response to a high level of physical activity early in the semester. By the end of the trial some general improvements in iron status were observed for female officers-in-training in the treatment group but not in the placebo group with a small decrease in serum sTfR concentration and an increase in TS, but iron stores (serum ferritin) in both groups remained depressed.

Although there is little evidence for an association between iron deficiency and fatigue, these findings and those of a randomised placebo controlled trial involving Swiss women suggest iron supplementation may improve fatigue for non-anemic women<sup>19</sup>. A previous iron-intervention study of young Australian women<sup>2</sup> found fatigue responded positively to a high dose iron supplement (105 mg elemental iron as ferrous sulphate per day) and to an iron-rich diet. A common finding is that improvements in fatigue do not follow changes in iron status. However these findings and those of the earlier Australian study<sup>2</sup> suggest that fatigue is negatively associated with dietary iron consumption. It may be that symptoms related to iron deficiency resolve more quickly than accompanying improvements in iron status measures<sup>19</sup>.

Military studies show that a decline in iron status is a common outcome for males and females after periods of intense physical training<sup>5,7,20,21,22,23</sup>. A definitive mechanism for these observations has not been described. Insufficient dietary iron is part of the cause with other mechanisms including proinflammatory processes<sup>24</sup>, gastrointestinal bleeding, increased loss of iron in sweat and exercise-induced haematuria potentially contributing to the outcome<sup>25</sup>. This may not have long-term health or performance issues if iron stores are then replenished by a period of good diet and less physical activity. However, for military women who have been shown to have chronically low iron stores<sup>7,26,27</sup>, this study supports the recommendation for iron supplementation to prevent or restore declining iron status. US military

studies have also shown iron supplementation to attenuate the decline in iron status seen in female soldiers during military training<sup>22,23</sup>. However in the case of the more recent US study where the supplement was in the form of an iron-fortified food bar, the improvement was only seen in iron-deficient anemic women<sup>22</sup>.

Consistent with the US military studies was the observation that iron supplementation provided to female officers-in-training at concentrations close to the recommended daily intake (Australia: 18 mg/day)<sup>28</sup> did not alter the prevalence or severity of iron-deficiency. It is possible that the recommended daily dietary intake of 18 mg iron is not sufficient to maintain iron status for female officers-in-training<sup>23</sup>.

Clearly there is a strong argument for female officers-in-training to improve their dietary iron intake. Furthermore, the poor compliance with iron supplementation demonstrated in this study argues against single-nutrient supplementation as the only strategy to improve the iron status of women in the military<sup>29</sup>. Combined strategies of testing the iron status of female soldiers/officers embarking on intense physical training; ensuring sufficient availability of highly bioavailable iron-rich foods in barracks and field catering, including combat rations; providing low dose iron supplementation during physical training courses, and nutritional education should be implemented to improve the iron status of women in the military. It is likely that these findings and recommendations apply to other young women, particularly college or university students engaged in physical training programs.

### Limitations of the study

Thirty percent of baseline participants withdrew from the study. It is unknown as to whether this may have affected the study outcomes. However, based on actual sample size ( $n = 25$ ) for each group and the SD for baseline ferritin concentrations, the estimated power to find a clinically significant treatment effect of 5 µg/L ferritin was only 20%. To

achieve the required sample size ( $n = 215$  for each group) the study would need to be repeated over a number of years, or performed in collaboration with larger military populations. There was a 24% rate of missing data in the follow-up of subjects. Attempted correction for this by multiple imputation did not clarify whether the missing data might have altered the estimates of the effects of intervention, although no such alteration was apparent.

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The authors responsibilities were as follows—CKB and JEC designed and conducted research. IKR analysed data with assistance from CKB. CKB wrote the paper, and had primary responsibility for final content. All authors provided input, read and approved the final manuscript. The authors did not have a conflict of interest.

This study conducted through the Canberra Area Medical Unit was approved by the Australian Defence Human Research Ethics Committee (ADHREC protocol 314/02) and was registered under the Therapeutic Goods Administration Clinical Trail Notification Scheme (trial number 2003/146, protocol number 314/02, iron and folic acid supplement). A copy of the trial protocol can be obtained from the corresponding author. The trial was funded through the Defence Science & Technology Organisation's annual tasking.

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*Authors' affiliations:* <sup>1</sup> Defence Science & Technology Organisation, Land Division, <sup>2</sup> Human Life Sciences, University of Tasmania

*Corresponding author:* Christine K Booth PhD,  
email: christine.booth@dsto.defence.gov.au

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# A study of alcohol consumption in a cohort of military nurses

Maree Sheard<sup>1</sup>, Annette Huntington<sup>2</sup>, Jean Gilmour<sup>2</sup>

## Abstract

**Background:** Alcohol consumption in defence populations exceeds those of civilians across all age groups with stress associated with operational deployments thought to be a contributing factor. Civilian nurses drinking patterns mirror those of the general population, however alcohol consumption in military nurses as a discrete group has yet to be studied.

**Purpose:** This investigation aimed to examine alcohol consumption in a cohort of military nurses.

**Material and methods:** A cross-sectional study of a sample of 44 defence nurses from the United Kingdom, Australia and New Zealand extracted from a large electronic longitudinal survey.

**Results:** Over 20% of respondents consumed more than the recommended daily limit for their gender with over 24% of females exceeding safe daily consumption rates. Fifteen per cent drank more than their recommended weekly limit. Defence nurses in their fifties and sixties drank every day more often and consumed more drinks over a week than younger nurses.

**Conclusion:** Many respondents drank more than is recommended with older nurses engaged in higher alcohol consumption. Older nurses have been exposed to military drinking cultures for longer and are more likely to have deployed and experienced the stressors associated with this. Loss or impairment of individuals in this select group has the potential to impact disproportionately upon health capability. The study results highlight the need for further research with this population given the small sample size.

**Key words:** military, defence, nurses, alcohol, drinking

## Introduction

### Alcohol consumption in military populations

There is a long tradition of drinking in military forces. Alcohol has been used to motivate soldiers and manage stress throughout history with many of today's rituals and ceremonies having their foundation in that past. Ritual and ceremony are an important part of defence cultures providing context and motivation for operational success. Values such as comradeship and commitment contribute to the military culture as does a focus on the importance of team cohesion. Social activities provide the opportunity for the development of team cohesion and allow for debriefing with colleagues in a semi-work environment. Military messes and clubs have been established for these purposes and traditional rituals and behaviours involving heavy drinking in mess environments continue despite official policy in many defence forces banning them<sup>1,2,3</sup>.

Research confirms that heavy drinking is endemic in western militaries. In the UK and the USA alcohol consumption rates in military personnel exceed those of civilian populations across all age groups<sup>1,4</sup>. Military leaders are aware of the negative impact

that excessive drinking has on the health of their populations, the reputation of armed forces and military capability<sup>1,2,3</sup>. Research into patterns of alcohol use will enable safe drinking interventions to be targeted at those groups most at risk.

While in general defence personnel consume alcohol at higher rates than civilians, there are certain military subgroups that stand out as heavy drinkers<sup>4,5</sup>. Young, single males of low educational achievement and lower rank drink significantly more than older people in defence forces and more than young civilian males<sup>1,3,4</sup>. Young military females drink at higher rates than other military women and more than women in the general population with one study finding that this group binge drink at rates that are even higher than young men in the civilian population<sup>4</sup>. Personnel who serve in combat units drink more than personnel who perform combat support and combat service support roles. Members who hold positions in medical and welfare units drink the least of all military personnel. However, even these people drink more than their colleagues in the civilian sector<sup>4</sup>.

Servicemen and women who have deployed on operational missions are heavier drinkers than those

who have not served overseas<sup>4,5,6</sup>. A longitudinal study undertaken in the UK found alcohol consumption in both deployed and non-deployed personnel increased during a period of significant military commitment for the British Armed Forces. However, the increase was greater for those who had deployed and even higher for those who had been exposed to traumatic events<sup>6</sup>. It is known that patterns of heavy drinking continue for veterans of deployments long after their retirement from service<sup>5</sup> but there is a reluctance for people to seek help for problems associated with drinking while they are still in uniform due to stigma and a perceived and sometimes warranted concern that the impact of seeking help may have on their careers<sup>3</sup>.

### Alcohol consumption in nursing

Nursing is a stressful profession<sup>7</sup>. Studies on the health and wellbeing of nurses have found an association between reported low levels of health and work stress<sup>8,9</sup>. Stress on nurses can lead to lost productivity through time off work, increased staff turn-over and nurses presenting to work when sick. Presenting to work when sick can affect performance, have a negative flow-on effect for colleagues and increase the risk for patients<sup>10</sup>.

Occupational stress in nursing is common<sup>11,8</sup>. McGrath, Reid and Boore<sup>11</sup> found that complex organisational structures, frequent changes, environmental risk and high stress compound challenges for nurses' professional and psychological wellbeing. Older and experienced nurses have been found to experience more stress than younger colleagues with this stress negatively impacting upon nurses' motivation and job satisfaction<sup>9</sup>. These factors can then lead to burn-out<sup>12</sup> and ultimately attrition for nurses<sup>7</sup>. Stress therefore has significance for the maintenance of the nursing workforce and the delivery of healthcare.

The ways in which nurses manage their own health has an impact upon patients<sup>13</sup>. In a study conducted in the UK, Callaghan<sup>13</sup> found nurses' beliefs in the value of health practices, and the extent to which nurses apply health behaviours in their own lives translates into how readily the same nurses are likely to raise associated health-related behaviours with patients. Additionally, nurses who do not demonstrate healthy behaviours are poor role models for patients<sup>14</sup>.

Despite the ongoing high levels of stress experienced by the profession, only recently has a body of evidence begun to develop that examines the relationship between stress and the health behaviours of nurses. The link between stress and alcohol is

recognised,<sup>15</sup> however little research is available to demonstrate a link between nurses using alcohol and experiencing stress. Researchers report that nurses' alcohol consumption rates mirror those of matched populations<sup>7</sup>. However, nurses who do drink to excess may be unlikely to be challenged in the workplace about their drinking or to seek help voluntarily due to stigma and possible repercussions on their careers<sup>16,17</sup>.

### Alcohol consumption in military nurses

Stressors experienced by nurses in the civilian sector may be compounded for nurses who serve in the military. Pressure to maintain physical fitness, military duties additional to those of nursing, and the challenges encountered while serving on operational missions all contribute to stress<sup>18</sup>. Operational deployments are known to pose risk to psychological wellbeing for all personnel, but for nurses the risk may be increased with challenges posed by moral dilemmas when mission goals conflict with professional values<sup>19</sup>. Griffiths and Jasper<sup>18</sup> note that in a cohort of British military nurses, this dichotomy was able to be reconciled. However an American review of the psychological impact of moral distress on military nurses found them to be at particular risk, a risk that requires addressing to prevent ongoing negative effects<sup>20</sup>.

Emotional exhaustion is common among military nurses<sup>18</sup>. Social dislocation associated with postings, power disparities related to rank, and exposure to traumatic events have been found to be contributing factors<sup>17</sup>. While research points to operational service increasing the military nurse's risk of work-related stress<sup>18,19,20</sup>, there is evidence to suggest that nurses employed in garrison settings can also experience significant stress. An American study found nurses working in a static military hospital in the United States suffered higher levels of emotional exhaustion than nurses serving on operational missions overseas<sup>21</sup>. These findings were related to those at home being required to carry out officer responsibilities additional to nursing duties; nurses on deployment performed nursing functions only. Many defence forces, including New Zealand and Australia, recruit registered nurses exclusively into their officer corps. Responsibilities that come with officer rank, irrespective of the profession of the service person, are known to increase the complexity of the employment context<sup>22</sup> which in turn, increases stress<sup>23</sup>.

There has been little research into the drinking patterns of military nurses. Examination of alcohol use in other military cohorts may have some application to military nurses, as might alcohol

consumption rates in civilian nurse populations. However, military nursing places unique demands upon those who serve which may impact differently upon how this group of nurses drink. The aim of this study was to explore the drinking behaviours and the alcohol consumption for this group of nurses.

## Materials and methods

### Design

Data for this study was drawn from the Nurses and Midwives e-Cohort Study (NMeS). The NMeS is a web-based longitudinal cohort study comprised of nurses and midwives from the United Kingdom and Australia and nurses only from New Zealand, recruited for the study between April 2006 and March 2008<sup>24</sup>. Demographic, employment and health information was collected to elicit how the impact of the interrelationship between these factors affects the overall health and wellbeing of nurses and midwives. Further information about the NMeS can be found in Huntington et al.<sup>24</sup> and Schluter et al.<sup>7</sup>.

Participants provided demographic information, professional classifications and employment data at registration. Three surveys were conducted on the study themes of Staying Healthy and Work/Life Balance. The first survey coincided with recruitment and registration, the second survey was held between the 30 August 2008 and 26 September 2009, and the third between May 2010 and May 2011<sup>24</sup>. This sub-study examining the alcohol consumption of military nurses is a cross-sectional analysis of information taken from the second survey.

### Ethical approval

Confidentiality was maintained through the allocation of personalised identification codes. There is strictly limited access to participants' personal information in accordance with ethical requirements. Ethical approval was provided by the University of Queensland Behavioural and Social Science Ethics

Review Committee (2005000696) and the Massey University Human Ethics Committee (Southern B application 05/71).

### Participants

To be included in this study, participants were required to be registered nurses serving as enlisted members of the United Kingdom, Australian or New Zealand Defence Forces, and have been working in a defence facility at the time the second survey was conducted. Civilian nurses working in defence establishments were excluded as were registered nurses who were in the military at the time of the survey but not employed in nursing roles. A number of nurses who identified themselves as members of a defence force when registering for the NMeS failed to respond to invitations to engage with the second survey. This may be explained in part by defence nurses being posted to new locations which can involve a change in email address, or by overseas deployment where internet access can be problematic.

### Measures

Instruments used in the NMeS comprise of a range of internationally validated research questionnaires that collectively cover the study themes. Questions related to alcohol consumption were derived from the Food Frequency Questionnaire developed by Willett et al. (as cited in Schluter et al.<sup>7</sup>) and sought to determine drinking/teetotaller status, change in drinking status, the number of days per week participants consumed alcohol and the number of standard drinks consumed on drinking occasions. Responses were assessed using the recommendations of the New Zealand Health Promotion Agency (HPA) for reducing long-term health risks associated with drinking that are based on research commissioned by the Agency<sup>25</sup>. Table 1 describes these recommendations as they are presented by the HPA's "Drink Check" brochure<sup>26</sup>.

Table 1 HPA safe drinking recommendations for reducing long-term health risks<sup>26</sup>

	Females	Males
Frequency	Drink no more often than 5 days per week	Drink no more often than 5 days per week
Numbers of standard drinks per week	No more than 10	No more than 15
Number of standard drinks per occasion	No more than 2	No more than 3

Guidelines for reducing the risk of long-term harm from alcohol consumption in the UK and Australia are similar to those in New Zealand. The UK government's guidelines state that men should not regularly exceed three to four units of alcohol per day and women should not exceed two to three<sup>27</sup>. Australian guidelines for reducing the risk of alcohol-related harm over a lifetime recommend neither men nor women drink more than two standard drinks on any day<sup>28</sup>. The New Zealand guidelines were selected for this research based on their similarity with those of Australia and the UK, and with the authors' familiarity with the New Zealand version.

Unsafe drinking is defined by the HPA as when an individual drinks more often than five days per week or when a female consumes in excess of two standard drinks on any drinking occasion, three for males. In addition, the HPA assesses females as falling into a category of unsafe drinking if they consume more

than 10 standard drinks per week. For males this is if they drink in excess of 15 standard drinks in a week. As weekly alcohol consumption rates were not established in the survey, these were determined by multiplying the number of standard drinks individuals consumed on drinking occasions by the number of days they drank each week.

### Statistical analysis

All data was processed using SPSS version 21 (SPSS, Chicago, IL, USA). Descriptive, frequency and exploratory analyses were undertaken using variables categorised as nominal, ordinal or categorical. Tests of significance were not undertaken as the cohort was not large enough for generalisations to be made to wider defence nurse communities.

*Table 2 Defence nurses' drinking patterns data Total N=44 Males n=15 Females n=29*

		All	%	Male	%	Female	%
Current drinker	No	3	6.8	-	-	3	10.3
	Yes	40	90.9	14	93.3	26	89.7
	Missing	1	2.3	1	6.7	-	-
History of drinking	Have never drunk	1	2.3	-	-	1	3.4
	I don't drink now but I have in the past	2	4.5	-	-	2	6.9
	I drink now and I have in the past	41	93.2	15	100.0	26	89.7
Frequency of drinking	Never	4	9.1	1	6.7	3	10.3
	1 day per week	8	18.2	2	13.3	6	20.7
	2 days per week	7	15.9	2	13.3	5	17.2
	3 days per week	11	25.0	5	33.3	6	20.7
	4 days per week	2	4.5	-	-	2	6.9
	5 days per week	3	6.8	1	6.7	2	6.9
	6 days per week	3*	6.8*	1*	6.7*	2*	6.9*
	Every day	2*	4.5*	1*	6.7*	1*	3.4*
	Missing	4	9.1	2	13.3	2	6.9
Total who drink more than 5 days per week		5*	11.3*	2*	13.4*	3*	10.3*
Number of drinks consumed in a session	None	4	9.1	1	6.7	3	10.3
	1 drink	17	38.6	5	33.3	12	41.4
	2 drinks	11	25.0	4	26.7	7	24.1
	3 drinks	6	13.6	4	26.7	2*	6.9*
	4 drinks	4*	9.1*	-	-	4*	13.8*
	5 drinks	1*	2.3*	-	-	1*	3.4*
	6 drinks	1*	2.3*	1*	6.7*	-	-
Total who drink more than recommended daily limit (no more than 3 for males, no more than 2 for females)		8*	21.9*	1*	6.7*	7*	24.1*
Total who consume more drinks than recommended weekly limit (no more than 15 for males, no more than 10 for females)		7*	15.9*	2*	13.4*	5*	17.1*

\* indicates unsafe drinking as per HPA guidelines

## Results

Forty four military nurses met the inclusion criteria of which 15 were male and 29 female. Twenty six nurses held nursing registrations in Australia, 11 were registered in New Zealand and five in the United Kingdom. The remaining two eligible nurses failed to respond to this question. Five nurses drank more than 5 days per week and 8 consumed more than the recommended daily limit for their gender. One male nurse drank in excess of daily recommendations while 7 females exceeded their safe daily consumption rates. It was found that 7 of the cohort consumed more than their recommended weekly limit; 2 males and 5 females. Table 2 describes the breakdown of drinking patterns.

Dates of birth were elicited at NMeS registration with nurses' ages calculated from the date of the closure of Survey 2. Relationships between nurses' ages and the mean number of drinks consumed per day, numbers of drinking days per week and number of drinks consumed per week were calculated. Participants were also grouped into categories in accordance with their decade of life. Relationships between decades of age and alcohol consumption variables were then calculated.

The median number of drinks consumed in a session for each age group ranged between 1 and 2, however a maximum of 6 drinks were reported for nurses in their forties. The median number of drinks consumed per week ranged between 0.5 drinks for nurses in their thirties up to 16.5 for the 2 nurses in their sixties. The maximum individuals reported drinking per week was by nurses in their sixties followed by those in their fifties then nurses in their forties. Nurses in their fifties and sixties drank every day of the week more often than their younger colleagues. Nurses in their twenties drank at the most, 3 days a week. The results of the frequency of drinking and the median and maximum numbers of drinks consumed per day along with the median and maximum numbers of drinks consumed by each age group per week appear in Table 3. Figure 1 illustrates how the number of standard drinks consumed per week increases with age.

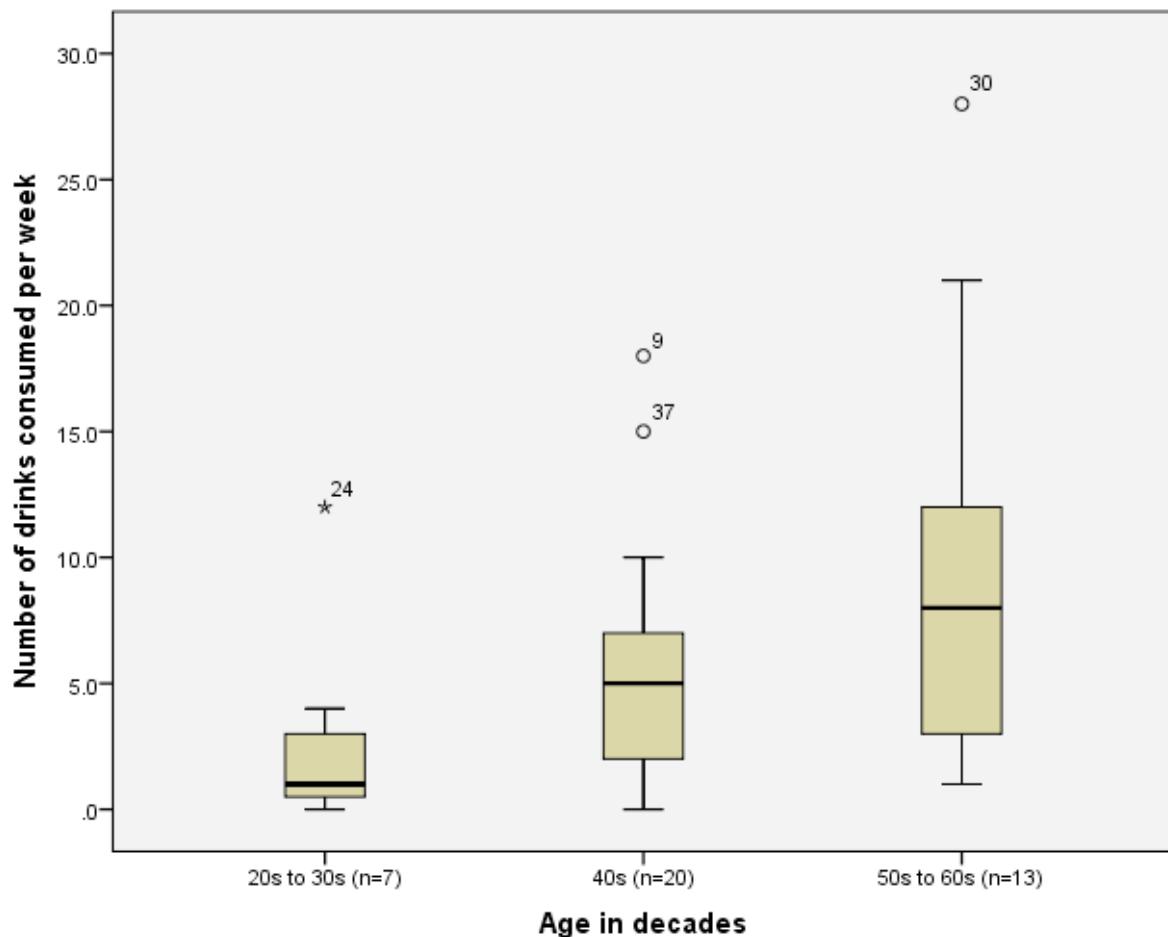
## Discussion

While this study into the drinking patterns of defence nurses is small, there are some indicators that may be cause for concern. Some nurses in the study who were older drank more alcohol more frequently than younger nurses. The older nurses also reported drinking to unsafe levels more than

*Table 3 Numbers of drinks consumed by nurses grouped by decades of age*

Decade of age		Number of drinks consumed per week	Number of drinks consumed per day	Frequency of drinking -days per week.
Twenties	Number of cases in group	3	3	3
	Maximum	12	4	3
	Minimum	1	1	1
	Median	2.000	2.000	1.000
Thirties	Number of cases in group	4	6	4
	Maximum	4	1	4
	Minimum	0	0	0
	Median	.500	1.000	.500
Forties	Number of cases in group	20	20	20
	Maximum	18	6	6
	Minimum	0	0	0
	Median	5.000	2.000	2.500
Fifties	Number of cases in group	11	13	11
	Maximum	21	4	7
	Minimum	1	1	1
	Median	8.000	2.000	3.000
Sixties	Number of cases in group	2	2	2
	Maximum	28	4	7
	Minimum	5	1	5
	Median	16.500	2.500	6.000
Total	Number of cases in group	40	44	40
	Maximum	28.0	6	7
	Minimum	0	0	0
	Median	4.500	2.000	3.000

*Figure 1 Age and number of drinks consumed per week*



younger nurses. This is particularly the case for nurses in their fifth decade of life but also pertains to a lesser extent, to nurses in their forties. Nurses in their sixties drank the most in all measures. Findings that older nurses in this study drink more than younger nurses is unexpected and is the inverse of previous studies where unsafe drinking has been found to be significantly more common in younger military people, both male and female. Factors that may contribute to older nurses' increased alcohol consumption in relation to their younger colleagues revolve around the length of time nurses serve and the nature of that service.

The longer nurses are exposed to the defence culture the more likely they may become inculcated to military norms and values. Like other personnel, the military nurse operates in an environment where their work is blended with their personal life and where alcohol is readily available and accepted as part of that life<sup>29</sup>. Socialising with personnel who use alcohol as a means of managing stress will expose

defence nurses to the extremes of these norms and the association between alcohol consumption and operational deployment will become more evident the more time they spend in that environment.

Older military nurses are more likely to have deployed than younger nurses as there are more opportunities for deployment over time. Longer serving nurses may have undertaken a range of operational tours that could involve peacekeeping and disaster response as well as combat missions. All occupational groups are reported to use alcohol to manage stress that results from deployment with those who serve in medical units not being exempt<sup>4</sup>. Military nurses most frequently serve in medical units.

Alcohol consumption has been found to increase most significantly over time in those who have been exposed to life-threatening traumatic events and those who have experienced hostility from civilians during missions<sup>6</sup>. However, there has been little research into the stress experienced by military nurses working with those who have been injured

as a result of combat, and little into the relationship between military nurses' stress and alcohol consumption. This area requires research to inform the way ahead for improvements in the health of this group.

Iverson et al.<sup>3</sup> note that peacekeeping presents unique challenges where service personnel experience significant frustration associated with their inability to act against human rights violations. Peacekeepers in this study were found to consume alcohol at higher rates than personnel who had deployed on other types of missions. Iverson's observations about possible causes of the relationship between alcohol consumption and peacekeeping have some resonance with the moral distress experienced by defence nurses when on deployment.

Defence nurses have described moral distress as their inability to practice in accordance with what they believe to be in the best interests of their patients<sup>18</sup>. Tension can exist between military orders driven by mission imperatives, and nursing judgement. This may result in nurses being compelled to compromise on best practice which in civilian settings has been found to lead to the inappropriate use of alcohol<sup>30</sup>. Whether military nurses turn to alcohol to deal with moral distress resulting from care rationing on operational missions is yet to be studied.

There are unique challenges for defence nurses seeking help with alcohol-related problems. Military nurses serve in the same units that facilitate and at times provide the care they themselves may require. Concerns surrounding the maintenance of confidentiality and the potential impact upon careers of disclosure of alcohol-related problems are very real for these nurses. There is a danger that if professional boundaries are not respected, line managers may be involved in care provision at the same time as being required to provide information to command about their patients' individual military effectiveness.

Defence nurses are expected to role model healthy behaviours. Callaghan<sup>13</sup> noted that the personal health habits of nurses impacts upon their ability to raise related health issues with their patients. This has significance for defence forces because as a condition of service, military personnel are required to obtain their healthcare through their employer. When military nurses find it difficult to raise issues with patients due to their own health behaviours, the impact may be greater because of a smaller population and smaller number of nurses providing that care. It is of course, incumbent on defence nurses as much it is with their civilian counterparts, to act as role models for their patients.

Defence nurses are a select group of highly skilled health professionals who receive significant investment in their professional development. Any loss or impairment of one of these individuals has the potential to impact disproportionately upon health capability. It takes time to recruit and develop military nurses to the level where they can become operationally effective so vacancies are problematic. Given the nursing profession is facing critical shortages as the general population ages<sup>7</sup>, strategies are needed to assist military forces to retain and optimise the effectiveness of those nurses already serving.

While alcohol consumption continues to provide a social screen behind which stress management is hidden, the imperative to create and provide safe and acceptable alternative approaches are not there. Any way forward will involve military forces continuing to work to change entrenched drinking cultures, as well as implementing systematic improvements so that stigma and fear of repercussions are no longer barriers to individuals seeking help for alcohol related problems.

At the commencement of this research expectations had been that military nurses would reflect the drinking patterns of their profession rather than those of their employing organisation. In this study, indications are that this group of defence nurses identify more closely with military forces than they do with their profession. This may be confirmation of the effectiveness of defence forces' efforts to impress their culture on service members or it may perhaps be a reflection of the nature of stress experienced by defence nurses. Military nurse leaders need to appreciate fully the dynamics in operation that may be leading to unsafe drinking in their nursing workforces and ensure that strategies that minimise or mitigate against stress are in place. There is a need for further research to inform these strategies such as a wider survey of a representative sample of defence force nurses.

**Study limitations:** Given the small numbers of nurses in the survey, no generalisations can be made about the application of the findings in this study to other groups of military nurses. Nurses in their sixties drank the most in all measures; however there were only two nurses in this group which hampers comment about any relationship between these two nurses and others. Additionally, the data is self reported so may not accurately portray alcohol consumption over time.

## Conclusion

Issues in this study raise the possibility that unique employment and social conditions in defence forces may, over time, contribute to nurses consuming alcohol in excess of recommended rates. Interdependencies between a culture of heavy drinking, nurses' health related behaviours and the impact of poor role modelling on patients should be of concern to defence leaders. The health of the wider defence population is influenced by military nurses through their ability to raise health related behavioural issues with their patients and the health of nurses is, of course, affected by their personal drinking patterns. Both effects impact upon defence capability.

While this study is small-scale and therefore cannot be used as a basis for generalisation, it has raised an important issue which, for the health of military nurses and for defence forces overall, needs further exploration.

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*Authors' affiliations:* <sup>1</sup>Royal New Zealand Nursing Corps and School of Health Sciences, <sup>2</sup>Massey University at Wellington.

*Corresponding author:* Maree Sheard  
email: philandmaree@xtra.co.nz

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# The Competency of the Military Fitness Training Leaders in the Hellenic Army

Dr. Kontodimaki Vasiliki

## Abstract

**Background:** The Military Fitness Training Leader (MFTL) is considered a parameter that affects the efficiency of the Hellenic Army Physical Readiness Training (APRT).

**Purpose:** The competencies of 5 different types of Greek MFTLs were assessed and compared according to the opinions of the Regular Army Personnel.

**Material and Methods:** ANOVA corrected by post hoc comparisons were used to compare the selected opinions coming from 2864 survey questionnaires. The statistical significance was indicated up to 0.05 to compare the differences for all 5 types MFTLs graded by 3 different groups: Senior Officers, Junior Officers, and Non-Commissioned Officers/Permanent Enlisted Soldiers.

**Results:** The Senior Officers scored the “Officer” as the best MFTL and the “Physical Education Graduate” as the highest contributors to the APRT’s effectiveness. Junior Officers and Non-Commissioned Officers/Permanent Enlisted Soldiers scored the “Physical Education Graduate” as being more useful as MFTL, although being seldom applied to APRT programs. The Officers’ military experience and leadership specialisation combined with the Physical Education Graduate’s professionalisation has been revealed as the main characteristics of an effective profile for a MFTL.

**Conclusion:** The results, reinforced by similar research in the field, indicate that the Hellenic army should focus on creating professional standards to achieve a more efficient MFTL training program.

**Conflict of Interest:** There were no financial or personal conflicts of interest for this study. The results of the present study do not constitute endorsement of the product by the author or the Journal.

**Key Words:** Army Physical Readiness Training, Regular Army Personnel, Military Fitness Training Leader, Army Organisation Efficiency, Survey Questionnaire.

## Introduction

The effectiveness of the military depends on the army's personnel quality resulting from their training and skills level rather than the quantity of men, weapons or materials. It refers to the soldiers' and officers' acquired skills and competencies needed to accomplish the required military missions by executing appropriate strategies.<sup>1</sup> The majority of the armies' Headquarters, as well as the Hellenic Army General Staff (HAGS) and their administrative sectors, declare that the organisation of the Army Physical Readiness Training (APRT) programs and its assessment is one of the basic factors to guarantee the armies' efficient readiness. APRT refers to the implementation of appropriate physical training programs aiming for the development of the physical abilities and competencies of the army personnel. All aspects of the army's mission may be accomplished based on the personnel's physical preparedness and strengthening, while remaining healthy and uninjured, which guarantees the operational

readiness of each Army Force.<sup>2</sup> The APRT consists of a set of army training exercises and drills as well as physical fitness training and sport activities. To achieve high levels of operational effectiveness and readiness, army members are required to be physically fit and meet the standards of various physical fitness tests, so that they are able to perform general military, defence and security duties brought by the demands of their military occupation. The higher the level of physical fitness and readiness the army achieves, the more it will develop into an agile, versatile, lethal, and survivable force, thus the APRT's effectiveness is one of the army's primary focuses.<sup>3,4,5,6,7</sup> The planning, the appropriate management and implementation mode constitute the basic requirements for the holistic efficiency of the APRT programs, taking into consideration all the parameters which influence (positively or negatively) the APRT's achievement.<sup>3,4,8,9,10,11</sup>

Based on the above statements further research was done to design a frame work indicating the parameters

influencing the organisation and implementation effectiveness of the APRT in the Hellenic Army. Thus, one of these parameters was the competency of the Military Fitness Training Leader (MFTL).<sup>12,13,14</sup>

A review of relative references concludes that every Fitness Leader had to be a qualified fitness specialist for planning, implementing and evaluating physical training programs aiming for the development of cardiovascular conditioning, muscle strengthening and endurance, stretching, relaxation of the body, etc. She/he had to have considerable expertise in a diversity of sports and had to demonstrate tactical and technical competences. She/he had to be able to explain and demonstrate all athletic activities, as well as know the best methods of presenting and performing them. In APRT, the MFTL has to be the Fitness Leader who has all the above necessary competencies and moreover, to be an expert of the army's physical fitness aims, programs and conditions needed for army training. Thus, the MFTL has to achieve the appropriate skills to demonstrate and lead all physical readiness army training exercises, drills and activities, as well as teach the appropriate techniques. The professional, the well-prepared and confident leader aiming for physical readiness training gains the respect and cooperation of all troops.<sup>5,15</sup> Consequently, for an effective management and implementation of APRT programs, it is essential to have well qualified personnel as MFTLs to whom the army administration entrusts the delivery of the APRT programs.<sup>15</sup> The majority of the armed forces in other countries conduct Army Fitness Schools which recruit army personnel and conduct courses that specialise in this duty.<sup>9,16,17,18,19</sup>

A primary measurement concerning the role of the Greek MFTL's competency showed that in the Hellenic Army there are 5 different army grades (types) of MFTLs: (a) the "Officer", (b) the "Permanent Commissioned Officer", (c) the "Cadet Army Reserve", (d) the "Physical Education Graduate", and (e) the "Permanent Enlisted Soldier".<sup>20</sup>

In the Hellenic Army, the troop personnel ordered by its unit or brigade commander to perform the duty of MFTL, come from different Regular Army Grades and usually have considerable experience in a variety of athletic sports and APRT requirements. At the same time the leader has to follow other duties in the troop or platoon in accordance with her/his rank. In the Hellenic Army there are three classes of personnel, the Regular Army Personnel, the volunteers (Army Reserve), and the Conscripts. Three classes are included in Regular Army Personnel. One of these classes includes the Senior Officers (professional officers, graduates of the Hellenic Military Academy). They are typically the army personnel who command

units and can be expected to operate independently for short periods of time (infantry battalions, cavalry or artillery regiments, warships, air squadrons, platoons or companies). Senior Officers commonly fill staff positions for the superior command. The next class is the Junior Officers (professional commissioned officers, graduates from the Hellenic Permanent Commissioned Officers' School). They are the third or fourth lowest ranks of the officers. The units under their command are generally not expected to operate independently for any significant length of time. Junior Officers usually fill staff roles as platoon leaders or subordinates of higher commands post. And lastly, the third class is that of the Non-Commissioned Officers and the Permanent Enlisted Soldiers. The Non-Commissioned Officers are often referred to as "the backbone" of the armed services because they are the primary and most visible leaders of most military personnel. They are the primary leaders responsible for executing a military organisation mission and for training military personnel to execute their missions. Their training and education typically includes leadership and management as well as service-specific and combat training. They begin their careers in a position of authority or by promotion through the enlisted ranks but generally lack practical experience. However their advice and guidance is particularly important for Junior Officers. The Permanent Enlisted Soldiers are volunteer enlisted soldiers that are enlisted for a certain period of time. The amount of time depends on the army engagement requirements in the Hellenic Army as well as their specialisation (profession) and competencies before and after recruitment. The Non-Commissioned Officers and the Permanent Enlisted Soldiers are considered the primary link between permanent army personnel (Senior Officers and Junior Officers) and Conscripts. The Hellenic military organisation currently, as in some other countries, has universal Compulsory Military Service for males 18 years of age and older, who serve for 9 months. Women may serve in the Hellenic Army as permanent members or Non-Commissioned Officers, but cannot be in Compulsory Service. Non-Commissioned Officers and Permanent Enlisted Soldiers wear special rank insignia to differentiate them from Conscribed soldiers and Army Reserve. The structure of the Hellenic Army Ranks has its roots with British military traditions and follows NATO standard rank scale.<sup>3,4,12,14</sup>

The study mentioned above conducted by Kontodimaki et al.<sup>20</sup>, also revealed that the MFTL's competencies are related to three MFTL's professional criteria points: (a) contribution, (b) frequency and (c) effectiveness. These criteria should demonstrate a

relative logical interrelationship. The MFTL who is considered the best qualified contributor, should also be the most frequent implementer of the APRT programs and consequently should be graded as the most adequate (effective) MFTL.<sup>20</sup>

Based on this logical perception, the purpose of the present study was to compare the Greek Regular Army Personnel groups' assessments on the 3 professional criteria of MFTL's effective competency measured as contribution, frequency and effectiveness for all types of MFTLs (five army grades most frequently assigned as MFTLs within the Hellenic Army's APRT programs). The responders (MFTLs and APRT's participants) had to grade each MFTL's competency on 3 points: (a) how much she/he is confident they can contribute as an MFTL to the APRT implementation, (b) how frequently she/he is applied to the position of MFTL and (c) how adequate she/he is to implement effectively the APRT programs as MFTL. To date, there are very few studies conducted on the APRT using Regular Army Personnel in the Hellenic Army's service (career officers, low-rank officers or soldiers) as sample groups. None of these studies measured the opinions of the sample groups in comparing the MFTL's effective competency.

## Participants and Method

### The Sample

Two thousand eight hundred sixty four (2864) Greek Regular Army Personnel filled out a specific questionnaire for this research. The sampling was conducted according to the stratified methods in order to include a wide spectrum of Greek Regular Army Personnel who participated in APRT programs daily. The sample was split into 3 groups of Regular Army Personnel: Senior Officers, Junior Officers, and professional Non-Commissioned Officers/permanent Enlisted Soldiers.<sup>21,22,23</sup> Each of the above Regular

Army Personnel has different professional duties and army career experience. Consequently, it seemed interesting to examine the potential differences which emerged from their opinions on the MFTL's competency. From the total sample of this research as shown in Figure 1, 13.3% (n=381) correspond to Senior Officers, 19.4% (n=557) correspond to Junior Officers and 67.3% (n=1928) to Non-Commissioned Officers/Permanent Enlisted Soldiers.

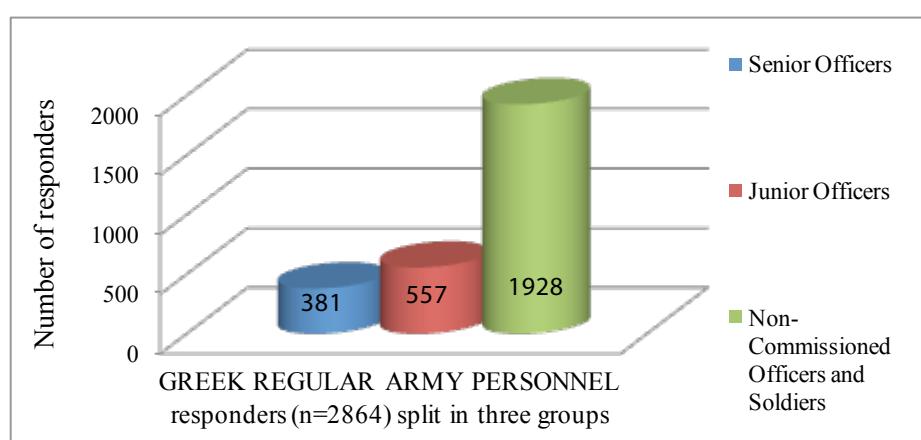
### Implementation

The whole process, step by step, was monitored through official correspondence amongst the HAGS, the Hellenic Military Academy and the researcher, to facilitate and smoothly implement the research plan. The questionnaires were sent from the Hellenic Military Academy, the higher military educational institution in Greece, to the Military Major Formations by military post. Every post package was accompanied by the HAGS's official permission, including a classified table indicating the necessary number and criteria of participants, calculated in accordance to the scientific process (number of personnel according to their military specialisation, military ranks and grades, etc.). A random sampling was conducted by anonymous and voluntary completion of the survey questionnaires which were received by the participants in sealed envelopes and which included a cover letter giving respondents all the instructions as to how to fill out the questionnaire.<sup>21,22,23</sup>

### Means of Assessment

For the assessment of the MFTL's competency on the APRT efficiency in the Hellenic Army, the appropriate part of the standardised Kontodimaki, Mountakis, Travlos, & Stergioulas questionnaire was used.<sup>24</sup> This questionnaire included ten parameters that influenced the effective organisation and

Figure 1.



implementation of APRT in the Hellenic Army.<sup>12,13,14</sup> It was drawn up in the Greek language and was adjusted to be used for investigation in Greek Forces.<sup>13,24</sup> The questionnaire used consisted of 15 closed-type questions with reliable and tested characteristics ( $\alpha= 0.80$ ) piloted before use in this study ( $\alpha= 0.86$ ).<sup>13,14,21,22,24,25,26,27</sup>

The troop personnel usually ordered to perform the duty of the MTFL in the Hellenic Army came from different Regular Army Grades: (i) "Officer", (ii) "Permanent Commissioned Officer", (iii) "Cadet Army Reserve", (iv) "Physical Education Graduate", and (v) "Permanent Enlisted Soldier" (5 researchable variables). All the above types of MTFL are measured along three (3) points of competency in performance and management of APRT programs: (a) the contribution of each one as MFTL to the efficient implementation of APRT programs, (b) each one's frequency of application as MFTL during the implementation of the APRT programs, and (c) the estimation of the adequacy of each one as MFTL when the implementation of APRT program had been completed. Each of the above main questions included five sub questions concerning the different troop personnel (5 Regular Army Grades) ordered to perform the duty of the MTFL, as mentioned before. There were 15 researchable variables in total.<sup>9,29,30</sup>

The five-graded *Likert* type scale was used for the responses to the questions, beginning with the lower point "1" which signified "not at all" and/or "never" up to the highest point "5" which signified "extremely" and/or "almost always".<sup>13,24</sup> Details of the questionnaire are given in Appendix A.

## Variables and Statistical Analysis

Means (M) and standard deviations (SD) for the total of the above fifteen (15) researchable questions (variables) were calculated. Subsequently, the one-way analysis of variance (ANOVA) corrected by Bonferroni post hoc comparisons were conducted to investigate if there were any differences among the three (3) groups of Regular Army Personnel's opinions (Senior Officers, Junior Officers, Non-Commissioned Officers/Permanent Enlisted Soldiers) against each one of the 15 researchable variables. SLPHAA statistical significance was set at  $p \leq 0.05$ .<sup>21,22,23,30,31</sup> All statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS, Chicago, Illinois, USA) version 17.0.

## Results

The Mean values (M), the Standard Deviations ( $\pm SD$ ) and the results of the one-way ANOVA (the F-ratio of two Mean Square values and the p-values) corrected

by the Bonferroni post hoc (\*) paired comparisons (which computes confidence intervals for all paired comparisons) among Regular Army Personnel's opinions are presented in Tables 1, 2 and 3.

### MFTLs' contribution

Statistically significant differences ( $p \leq 0.01$ ) were shown for all the MFTLs concerning their contribution to the efficient implementation of APRT programs amongst the Regular Army Personnel's evaluations (Table 1). The Senior Officers and the Non-Commissioned Officers/Permanent Enlisted Soldiers evaluated as the "Officer" and the "Physical Education Graduate" were the greatest contributors to the efficient implementation among all the MFTL types, whereas the Junior Officers assessed as the "Physical Education Graduate" and the "Permanent Commissioned Officer" were the greatest contributors to efficient implementation among all the MFTL types.

### MFTLs application frequency

Statistically significant differences among Regular Army Personnel evaluations were shown also for all the MFTLs concerning their application frequency during the implementation of APRT programs, except for that for the values of the "Cadet Army Reserves" ( $p > 0.05$ ). They are not reported, as very frequently MFTLs are assigned (Table 2). The Senior Officers and the Non-Commissioned Officers/Permanent Enlisted Soldiers declared that the most frequently assigned MFTL in the APTR programs are in the "Officer" and the "Permanent Commissioned Officer" category, whereas Junior Officers reported the "Permanent Commissioned Officer" as the most frequently applied MFTL and the "Officer" as the second most frequent.

### MFTLs' effectiveness/adequacy

Finally, the differences among the Regular Army Personnel's opinions on the MFTLs effectiveness/adequacy were not reached as statistically significant ( $p > 0.05$ ) for most of the pairs corrected by the Bonferroni post hoc test, except for that of the "Officers" effectiveness (Table 3). More specifically, the "Officer" was graded with the higher values mainly given by the Senior Officers. In contrast, Junior Officers and Non-Commissioned Officers/Permanent Enlisted Soldiers graded the "Physical Education Graduate" as the most effective/adequate MFTL, even if there was a significant difference between these values.

*Table 1. Comparisons on every Military Fitness Training Leader's Competency concerning their CONTRIBUTION TO IMPLEMENTATION of Army Physical Readiness Training Programs among 3 groups of Greek Regular Army Personnel (Senior Officers, Junior Officers, and Non-Commissioned Officers/Permanent Enlisted Soldiers) measured on a 5 point scale (Liker type) (degrees of freedom=2861)*

3 groups of Regular Army Personnel:			Senior Officers	Junior Officers	Non-Commissioned Officers/Permanent Enlisted Soldiers
Army grades as MFTLs:	F-ratio	p-value	Means ±SD		
Officer	36.307	0.000	3.98±1.2***	3.46±1.3***	3.32±1.4***
Permanent Commissioned Officer	19.091	0.000	3.59±1.2***	3.53±1.2***	3.25±1.3***
Cadet Army Reserve	11.238	0.000	2.69±1.3***	2.29±1.2***	2.4±1.3***
Physical Education Graduate	5.632	0.004	3.73±1.6**	3.67±1.6**	3.47±1.7**
Permanent Enlisted Soldiers	66.629	0.000	2.39±1.3***	2.23±1.2***	2.93±1.5***

According to ANOVA analysis and Bonferoni post hoc paired comparisons:

\*\*\*p<0.001 significantly different within all groups of Regular Army Personnel

\*\*p<0.01 significantly different within all groups of Regular Army Personnel

\*p<0.05 significantly different within all groups of Regular Army Personnel

*Table 2. Comparisons on every Military Fitness Training Leader's Competency concerning their APPLICATION FREQUENCY DURING THE IMPLEMENTATION of Army Physical Readiness Training Programs among 3 groups of Greek Regular Army Personnel (Senior Officers, Junior Officers, and Non-Commissioned Officers/Permanent Enlisted Soldiers) measured on a 5 point scale (Liker type) (degrees of freedom=2861)*

3 groups of Regular Army Personnel:			Senior Officers	Junior Officers	Non-Commissioned Officers/Permanent Enlisted Soldiers
5Army grades as MFTLs:	F-ratio	p-value	Means ±SD		
Officer	39.090	0.000	3.89±1.2***	3.29±1.3***	3.22±1.4***
Permanent Commissioned Officer	13.642	0.000	3.20±1.2***	3.48±1.2***	3.17±1.3***
Cadet Army Reserve	.169	0.845	2.47±1.2	2.42±1.3	2.45±1.3
Physical Education Graduate	7.185	0.001	2.23±1.6***	2.51±1.6***	2.58±1.6***
Permanent Enlisted Soldiers	66.126	0.000	2.11±1.3***	2.26±1.9***	2.83±1.5***

According to ANOVA analysis and Bonferoni post hoc paired comparisons:

\*\*\*p<0.001 significantly different within all groups of Regular Army Personnel

\*\*p<0.01 significantly different within all groups of Regular Army Personnel

\*p<0.05 significantly different within all groups of Regular Army Personnel

**Table 3. Comparisons on every Military Fitness Training Leader's Competency concerning their EFFECTIVENESS/ADEQUACY of IMPLEMENTATION of Army Physical Readiness Training Programs among 3 groups of Greek Regular Army Personnel (Senior Officers, Junior Officers, and Non-Commissioned Officers/Permanent Enlisted Soldiers) measured on a 5 point scale (Liker type) (degrees of freedom=2861)**

		3 groups of Regular Army Personnel:		Senior Officers	Junior Officers	Non-Commissioned Officers/Permanent Enlisted Soldiers
Army grades as MFTLs:		F-ratio	p-value	Means ±SD		
Officer	3.913	0.020	3.68±1.1*	3.30±1.2*	3.24±1.3*	
Permanent Commissioned Officer	3.581	0.028	3.13±1.1	3.27±1.2*	3.11±1.2*	
Cadet Army Reserve	3.874	0.021	2.34±1.1	2.24±1.1*	2.39±1.2*	
Physical Education Graduate	18.070	0.000	3.44±1.8	3.59±1.6***	3.37±1.7***	
Permanent Enlisted Soldiers	3.913	0.020	2.13±1.2*	2.25±1.2	2.87±1.7*	

According to ANOVA analysis and Bonferroni post hoc paired comparisons:

\*\*\*p<0.001 significantly different within all groups of Regular Army Personnel

\*\*p<0.01 significantly different within all groups of Regular Army Personnel

\*p<0.05 significantly different within all groups of Regular Army Personnel

## Discussion

Many interesting points emerged from the results according to the Regular Army Personnel assessment measuring the competency of every MFTL type responsible for military training management in the APRT programs, based on their contribution to the implementation of APRT programs, the frequency of their application as MFTL, and their efficiency/adequacy as MFTL when the implementation of APRT program had been completed.

Firstly, the MFTL's competency comparison amongst the opinions of the Regular Army Personnel (Senior Officers, Junior Officers and Non-Commissioned Officers/Permanent Enlisted Soldiers) seems worth noting because it constitutes a self-assessment study. The Senior Officers are the army personnel who command units, have important experience in army leadership and thus their opinion carries the biggest weight when assessing the MFTL's evaluation for competency and professional performance. Subsequently, it is essential to take into consideration the opinions of Junior Officers, because they are the platoon leaders, the main subordinates of leadership and training following the Senior Officers in army professional experience. Finally, the Non-Commissioned Officers/Permanent Enlisted Soldiers are the army personnel with the least army experience, but the majority of each troop or army training group consists of them (the backbone of each army unit) as shown in Figure 1.<sup>3,4,12</sup> In addition, all the above personnel are daily participants in the APRT programs within the Hellenic Army.

According to Senior Officers and Non-Commissioned Officers/Permanent Enlisted Soldiers, the "Officers" and the "Physical Education Graduates" contributions to the Fitness Leadership duty is very important because these MFTL types are reported as adequately trained for the efficient implementation of APRT programs. Although in practice, they are not reported as equally assigned to manage the APRT programs as MFTLs. This might be due to the fact that there are not many "Physical Education Graduates" in the Hellenic Army. In contrast, the most frequently assigned as MFTLs were the "Officer" and the "Permanent Commissioned Officer" as reported by all the responder groups, even though there were statistically significant differences among the related values. It is also worthy to mention that the Junior Officers agreed with the above groups by reporting the "Physical Education Graduate" as the best contributor to the APRT programs. However, they graded themselves as the second best contributors and that they were applied more frequently to the APRT programs among the other types of MFTLs.

Finally, by combining the results concerning the MFTLs' contribution to the Fitness Leadership duty and their effectiveness/adequacy, it is shown that the "Officer" and the "Physical Education Graduate" are the most indispensable and efficient MFTLs for the military organisation in the Hellenic Army. These findings might have come about from the professional skills (army leadership) and fitness specialty of each of these two types of MFTLs.

In reinforcement of the above findings, the results of a similar project which measured the professional

competency of each Physical Fitness Leader among the different Hellenic Army Units' oriented to the army demands seem to agree.<sup>32</sup> More specifically, the study showed the "Officers" and the "Permanent Commissioned Officers" were also applied as MFTLs in the APRT more frequently in the boot camp and combat training Army Units, and were mentioned as highly contributing and efficient. In contrast, the "Physical Education Graduate" was judged the most contributing, effective and adequate MFTLs in the rest of the Army Units, where the army basic training and army specialisations were completed. It seemed that the "Physical Education Graduates" were more efficient in giving additional type or training modes and maintenance of the acquired army physical fitness.<sup>32</sup>

Likewise, a study conducted at Land Forces Command units in the Canadian army regarding the organisation and conduct of Physical Fitness Training showed that the "Permanent Commissioned Officers" mainly delivered the APRT programs, although they had been inadequate in qualifications, knowledge and skills to ensure the APRT programs' efficiency.<sup>33</sup> Utilising the findings of that study, the Canadian Armed Forces developed military educational programs and seminars such as the "Military Fitness Training Instructor", the "Advanced Fitness Training Assistant" (AFTA) and the "Basic Fitness Training Assistant" (BFTA) promoting Fitness Leaders, Fitness and Sports Instructors, Physical Exercise Specialists, Regional Adaptive Fitness Specialists, Strength and Conditioning Specialists, and Fitness Coordinators to enrich the fitness qualification of their military personnel oriented to this specialty.<sup>17,18,34</sup>

The US Army (USAPFS) uses similar actions to implement the appropriate doctrine and military physical fitness training for their soldiers either through the Master Fitness Training program (Exercise Leaders Course) or through revisions of the Field Manuals, Training Circular's and Army Doctrine Reference Publications. These processes provide the necessary leadership skills, which address the importance of army fitness leadership as it applies to the APRT.<sup>9,32,35</sup> Moreover, many well organised armed forces have created Army Fitness Schools, and recruit the best qualified candidates to prepare appropriate personnel specialised in MFT Leadership.<sup>17,18,19</sup>

The Hellenic Army had created a few decades ago the Hellenic Army Fitness School, which was preparing candidates as MFTLs to apply the APRT programs in the Hellenic Army units. However it is no longer in operation.<sup>32</sup> In its replacement, the HAG upgraded the fitness curriculum in the Hellenic Military Academy where only the Senior Officers are allowed

to attend and graduate<sup>36</sup>. However, the MFTLs' education and knowledge seem to be indispensable for all the military organisations, provided that they have acquired specialisation in the APRT programs' objectives, implementation and effectiveness. Consequently, it would be in the best interest of the Hellenic Military Academy to develop an educational program for intermediate Officer and Senior Officer trainees including theory and practical skills focussed on MFT Leadership of APRT based on the military environment, the basic military skills and the army leadership and command<sup>19</sup>. The availability of advanced studies in MFT Leadership that leads to a postgraduate degree (i.e. military master's degree) to further the Regular Army Personnel's professionalisation (e.g. administration officer, supply officer, commanding officer and department head) seems important to enrich the fitness qualification for the Hellenic Army<sup>19</sup>. Finally, the recruitment of "Physical Education Graduates" as Soldier MFTL specialists, after having completed a relevant course on military training education and doctrine, could also be an interesting suggestion to help the APRT programs' application in the Hellenic Army units.<sup>18,33</sup> These kinds of studies, within the scope of assessing military physical training management, can be considered a blueprint for creating a body of fitness leaders in the Hellenic Army operating within given professional standards, something which requires a long term educational plan and a commitment on the part of the administration of the Armed Forces in regard to APRT effectiveness.

### Conclusions

One of the interesting points of the present study was that the MFTL competency's results were revealed through an internal assessment among leaders and trainees within the Regular Army Personnel. In the Hellenic Army, all the army personnel are required to take part in the APRT programs as trainees while in their training cycle of army specialisation, as well as in active duty and recruitment up to their retirement. Thus the leadership of the APRT programs is given to several Regular Army Grades (Officers or Non Commissioned Officers) within the troops considered to be more experienced in monitoring, managing and implementing these programs. The results did not confirm the expected logical interrelationship among the three competencies points referred to: contribution, implementation frequency and effectiveness among the MFTL's types. On the contrary, there were statistically significant differences among the Army Personnel's opinions on the above competency's points. Officers graded other Officers higher than Non Commissioned Officers graded Officers, and Soldiers rated Soldiers

higher than Officers rated Soldiers. Each responder group graded higher the relative MFTL type, whereas "Physical Education Graduates" appeared as the most competent and adequately qualified MFTL rated by all the responders. Troop commanders ("Officers" or "Permanent Commissioned Officers") seem to be less specifically trained in the management and leadership of Military Physical Fitness Training than "Physical Education Graduates". However, "Physical Education Graduates" were not equally posted as MFTL in the implementation of the APRT programs. These independent competency assessments among the different army groups and their uncorrelated results, reinforced by similar research, give the impression that the experience in performing APRT programs and the specialisation in the army training and doctrine are the main criteria of the MFTL competency in the Hellenic Army. Consequently, it seems that the personnel's appropriate preparedness and the duty selection system in the Hellenic Army are uncorrelated concerning the MFTL's adequacy. This fact indicates that this duty selection is not clearly oriented and determined as in other armed forces in other countries where the MFTL meets strict professional standards. Thus, it is suggested

that the Hellenic Army administration might consider focussing on these deficiencies by setting professional standards and appropriate MFTLs training specialty courses in the Hellenic Military Academy's curriculum.

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*Author's affiliation: Hellenic Military Academy - Faculty of Physical & Cultural Education, Varis - Koropiou Av., Attiki, 16673, Greece.*

*Corresponding author: Dr. Kontodimaki Vasiliki  
email: valikako@gmail.com*

### Appendix A

The responders were asked to answer on the following survey questions using the Likert type scale for grade each of the five types of Military Fitness Training Leader.		
CONTRIBUTION TO IMPLEMENTATION	(1) How confident are each one of the Regular Army Grades below when ordered to perform the duty of Military Fitness Training Leader (MFTL), and can contribute to the efficiency of the Army Physical Readiness Training (APRT) programs:  (i) Officer (ii) Permanent Commissioned Officer (iii) Cadet Army Reserve (iv) Physical Education Graduate (v) Permanent Enlisted Soldier	Likert type scale
APPLICATION FREQUENCY	(2) How often, do each of the Regular Army Grades below perform the duty of MFTL of the APRT programs:  (i) Officer (ii) Permanent Commissioned Officer (iii) Cadet Army Reserve (iv) Physical Education Graduate (v) Permanent Enlisted Soldier	Likert type scale
IMPLEMENTATIONAL EFFECTIVENESS / ADEQUACY	(3) How qualified are each one of the Regular Army Grades below to perform adequately and sufficiently the duty of MFTL of the APRT programs:  (i) Officer (ii) Permanent Commissioned Officer (iii) Cadet Army Reserve (iv) Physical Education Graduate (v) Permanent Enlisted Soldier	Likert type scale

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# Narrative Review of Barriers to the Secondary Prevention of Sexually Transmitted Infections: Implications for the Military Context and Current Research Gaps

*Kimberley Watkins & Jennifer E.C. Lee*

## Abstract

This paper presents a narrative review of research on barriers to the secondary prevention of sexually transmitted infections (STIs) in primary care, such as STI screening and treatment, from the perspective of individuals and health care providers. Limited work has been conducted on barriers to secondary prevention in the military context. However, research in other contexts shows that the success of secondary prevention may depend on knowledge about STIs, perceptions of risk or stigma attached to STIs, the availability of time and resources to seek testing and treatment, and the quality of exchanges between health care providers and their patients. For individuals, additional considerations may include their concern for health, fear of a positive diagnosis, and inconveniences associated with the screening process. As most studies in this area have been conducted in a civilian context, it is recommended that research be conducted on military personnel and health care providers to assess: knowledge and perceptions of STI risks, their impacts on health, and ways they can be prevented; the stigma and social norms associated with STIs; the availability and accessibility of testing; and the factors that influence the quality of patient-provider interactions in the military health care context.

## Introduction

Having been linked to a wide range of conditions, including pelvic inflammatory disease, chronic pain, reproductive problems and neurological disorders, as well as an increased risk of human immunodeficiency virus (HIV) infection, sexually transmitted infections (STIs; previously referred to as sexually transmitted diseases, or STDs) can pose a threat to individuals' long-term health and well-being<sup>1</sup>. Comprised primarily of younger adults, military populations may be at greater risk of STIs<sup>2</sup>. Indeed, STIs have, historically, been considered a problem in militaries<sup>3</sup>. Some recent findings pointing to increasing trends in the U.S. military have supported this view<sup>4</sup>.

Given the preventable and treatable nature of STIs, much emphasis has been placed on developing guidelines for their prevention. Many of the effective preventive strategies have relied on secondary prevention, rather than primary prevention through the promotion of reductions in high-risk behaviour. According to the World Health Organization (WHO) and the Joint United Nations Programme on HIV/acquired immunodeficiency syndrome (AIDS)

(UNAIDS), secondary prevention involves "the provision of treatment and care for infected and affected persons. The activities should include:

- the promotion of health care seeking behaviour directed not only at those with symptoms of STDs, but also those at increased risk of acquiring STDs, including HIV infection;
- the provision of clinical services that are accessible, acceptable, and effective, and which offer diagnosis and effective treatment for both symptomatic and asymptomatic patients with STDs, and their partners; and,
- support and counselling services for both STD and HIV patients<sup>5</sup>." (p.11)

Secondary prevention by health care providers within the primary care setting might thus include behaviours such as education of patients, particularly those at high risk for acquisition of an STI, routine or periodic screening for STIs, and treatment and/or counselling for infected persons and their partners. Nevertheless, the responsibility for secondary prevention is shared with individuals, who must seek testing and treatment themselves. A

number of psychosocial factors may act as barriers to the success of secondary prevention of STIs. This report provides a narrative review of research on such barriers from the perspective of both health care providers and individuals. Specifically, the review includes studies that investigated facilitators of and barriers to engagement in secondary STI prevention behaviours, specifically STI screening, risk assessment, and patient counselling for health care providers, and those studies that explored correlates of STI-screening seeking and acceptance among individuals. Based on some key findings, some existing research gaps and potential directions for future military personnel research are identified.

### Secondary Prevention Behaviours in Health Care Providers

Little research on adherence to STI prevention guidelines has been conducted in the military context. Research conducted in the civilian domain may nevertheless provide insight into the experiences of military health care providers. One study of British Columbian primary care physicians, for instance, found that many physicians did not adhere to the Canadian STI guidelines, even though most possessed a copy and perceived the guidelines to be useful<sup>6</sup>. Further, Australian providers have been shown to often fail to comply with certain components of STI prevention guidelines, such as sexual history taking and partner notification<sup>7</sup>.

Aside from adherence to guidelines, research has shown that health care providers in the general population often do not engage in STI prevention behaviours with their patients. In one study of family physicians in Quebec, less than half of the participants reported taking a sexual history during a general medical examination<sup>8</sup>. Research in the U.S. has found similar results, with providers often only eliciting sexual history among patients in high-risk groups and many failing to include prevention counselling in this discussion<sup>9-10</sup>. Moreover, even when providers are generally diligent about sexual history taking, a notable proportion still neglect to regularly screen their patients for STIs, such as chlamydia<sup>11</sup>. Low chlamydia screening rates, particularly among asymptomatic patients, have been reported in other U.S., Canadian, and U.K. research<sup>12-17</sup>.

### Secondary Prevention Behaviours in Individuals

Many individuals fail to engage in STI prevention behaviours. For instance, very few people report motivation to be tested for STIs in the absence of symptoms<sup>18</sup>. Even when convenient STI screening

is offered as part of a research project, often, more than a third of individuals recruited do not accept the opportunity to be screened<sup>12</sup>.

As well, patients' STI prevention behaviours may differ according to sex. Female patients have been shown to be more likely to be screened for STIs<sup>19-22</sup>, though males might be more likely to be tested for STIs with more serious health consequences, such as HIV<sup>23</sup>. These sex disparities may be due to more convenient opportunities for STI screening among females, such as during their annual Pap test.

### Barriers to Secondary Prevention in Health Care Providers

Some psychosocial characteristics have been found to affect health care providers' STI prevention behaviours.

#### **Education, Training, and Knowledge**

STI knowledge may be impacted by STI-related education and training during medical school or residency<sup>24</sup>, and many providers perceive this training to be inadequate<sup>25</sup>. These findings hold important implications for STI prevention practices, because providers with greater perceived education and training in STI care hold more positive attitudes toward STI prevention<sup>25</sup>. They are also more likely to assess STI risk<sup>10</sup>, screen for STIs<sup>19</sup>, and to engage in sexual health promotion activities<sup>26</sup>.

Regardless of the cause, research has identified some deficiencies in knowledge of STIs among health care providers. In one U.S. study, for example, a notable proportion of the providers surveyed failed to demonstrate good knowledge about the management of STIs in women based on their responses to questions on basic elements of diagnosing and treating patients in specific clinical scenarios<sup>24</sup>. Such knowledge gaps, in turn, have frequently been shown to act as barriers to STI prevention behaviours, including STI screening<sup>11,16,24,26-27</sup>.

#### **Lack of Time**

In one Irish study<sup>26</sup>, many of the health care providers interviewed cited a heavy workload or insufficient time due to other continuing education courses as reasons for not participating in sexual health training. Indeed, lack of time in health care appointments is commonly reported by providers as a barrier to engaging in STI prevention practices<sup>25</sup>, including proposing screening<sup>12,16-17,19,27</sup>. In particular, time constraints are reported to be barriers to the more time-consuming activities, such as sexual history taking, educating patients

on STI risks<sup>9,26,28-29</sup>, and counselling patients with a positive STI diagnosis<sup>30</sup>. In addition to individual appointment time constraints, insufficient staff for treating high patient demand may lower the priority of STI screening and counselling<sup>28</sup>.

### Perceived Patient Risk

Because of time constraints on care appointments, research has shown that providers may limit their STI prevention actions to patients who might be considered more at risk for STIs. For instance, some U.S. care providers of adolescents and young adults have stated that they would be more likely to counsel or test their patients for STIs if risky sexual behaviour was suspected<sup>29</sup>, and less likely if they perceived chlamydia to be uncommon in this population of patients<sup>14</sup>. Canadian health care providers, meanwhile, have been shown to be more likely to educate patients on condom use if they perceive these patients' STI risk to be high<sup>8</sup>. Moreover, if the patients do not consider themselves at risk for STIs, U.S. providers are less likely to suggest screening<sup>12,19</sup>. Because some STIs are asymptomatic, however, and because patients may not always be honest with providers about their STI risk-related behaviour, a practice of screening only those patients perceived to be most at risk may fail to meet the secondary prevention objective of detecting, treating, and stopping the spread of STIs.

### Provider Comfort and Confidence

Although most providers generally report feeling at ease in discussing sexual health issues with patients<sup>16,25,31</sup>, few actually like conversations of this nature<sup>25</sup>, and some feel uncomfortable having them with high-risk patients, such as intravenous drug users<sup>31</sup>. Providers also tend to feel more comfortable discussing sexual health topics with patients of the same sex<sup>8,26</sup>. Provider comfort in STI-related care is important, because feeling uncomfortable talking about sexual health with patients has been shown to be associated with a decreased likelihood of engaging in these discussions<sup>17</sup>, of taking sexual histories<sup>9,11,31</sup>, and in suggesting STI screening<sup>16,19,27</sup>.

Health care providers who feel uncomfortable providing STI care have lower self-perceptions of their ability to affect patients' STI risk-taking behaviour<sup>31</sup>. Most providers are confident in their abilities to discuss sexual history and STI screening with patients<sup>16</sup>, but many do not believe they are able to influence patients' risky sexual behaviours<sup>16,25</sup>. These perceptions can impact providers' STI prevention actions, as providers with lower feelings of self-efficacy in educating patients on STI risks are less likely to counsel patients about condom use<sup>8</sup>

and to screen patients for STIs<sup>16</sup>. Clearly, providers' feelings of comfort and confidence in providing STI care have an effect on their STI prevention practices.

### Perceptions of Patient Comfort and Stigma

In addition to their own feelings of comfort in discussing sexual health matters, the level of comfort health care providers perceive in their patients during these conversations also impacts upon their engagement in STI prevention behaviours. For example, the anticipation of adverse emotional reactions from patients when discussing sexual health issues has been cited as a barrier to providers' obtainment of sexual histories from their patients<sup>9</sup> and provision of STI diagnosis counselling<sup>30</sup>. These negative emotions are related to the stigma surrounding promiscuity and, thus, with the shame often associated with STIs. Consequently, the belief that patients will feel embarrassed or offended at the suggestion that they might be at risk for an STI can deter providers from STI prevention and counselling<sup>15,29</sup>, including providing STI education materials<sup>32</sup> and screening for STIs<sup>16,19,27</sup>. Reducing the stigma surrounding STIs has been suggested by providers as a method of improving screening initiation rates among health care providers<sup>27</sup>.

### Barriers to Secondary Prevention in Individuals

#### Lack of Time or Inconvenience

Some barriers to health care providers' STI prevention behaviour are also significant obstacles for patients. For instance, the time required to visit a clinic for STI testing and to complete the screening procedure has been cited by many individuals as a reason for not getting tested for STIs<sup>21</sup>. In addition, the time required to access STI services can make STI prevention challenging. Some people, for example, have said that they would be more likely to get tested for STIs if there were a screening site near their home or workplace<sup>33</sup>. Lack of transportation, particularly for patients residing in geographically remote areas, is also a substantial barrier to screening<sup>34</sup>. Furthermore, the inconvenience of some clinics' hours of operation or waiting times for appointments may prevent some individuals from seeking an STI test<sup>33,35-36</sup>.

#### Procedure Discomfort

Aspects of the screening procedure itself have also been shown to inhibit individuals from obtaining an STI test. People who perceive STI testing to be physically uncomfortable or even painful are less likely to undergo screening<sup>19,33,35,37-39</sup>. The requirement to remove one's clothing for the physical examination

element of some STI testing procedures is also a concern for some patients<sup>38,40</sup>. The apprehension and embarrassment associated with screening processes, such as urethral swabbing and pelvic examination, also appear to be influential in STI testing decisions, because most individuals would be much more likely to screen if more private and less invasive methods were available, such as home-based urine testing procedures<sup>18-19,21,33,37-39,41-42</sup>.

### Apprehension About Positive Diagnosis

Other psychological aspects of STI prevention can reduce the likelihood of STI screening. The negative emotions associated with a positive STI test result have been cited as a barrier to engagement in STI screening<sup>35</sup>, especially for potentially life-threatening STIs, such as HIV<sup>43</sup>. Waiting for test results<sup>38</sup> and having to notify sexual partners of an STI diagnosis<sup>37</sup> are also anxiety-inducing aspects of secondary STI prevention that discourage some individuals from testing. As a result, many people have stated that they would prefer not to know or think about whether they have an STI<sup>35,43</sup>.

### Lack of Knowledge

Beyond elective ignorance about STI status, many people lack information about important aspects of STI prevention. Research has shown poor awareness of certain types of STIs, such as chlamydia and genital herpes, particularly about their typically asymptomatic nature<sup>33</sup>. Knowledge of the importance of screening to detect asymptomatic STIs is essential in providing individuals with the motivation to be tested. The low public awareness of the facets of common, treatable STIs (due to media attention on HIV and AIDS)<sup>35</sup>, the existence of frequently asymptomatic STIs, and the methods of STI transmission and prevention have been associated with a reduced likelihood of screening<sup>37</sup>.

### Perceived Risk

Perhaps few people are motivated to be tested for STIs in the absence of symptoms because few people know that some STIs can be asymptomatic<sup>12,35,40-41</sup>. Low perceived risk is a commonly cited barrier to STI screening<sup>12,19-20,23,35,37,40-41,43</sup>. Engagement in risky sexual behaviours, such as having multiple partners, high-risk partners, and unprotected sex have been shown to increase STI testing intentions and behaviour, primarily due to augmented perceptions of susceptibility to STIs<sup>12,21,23,35,37-38,40</sup>. However, those with low perceived risk may still require screening, because many individuals lack accurate knowledge about their actual vulnerability to STIs (e.g., that STI

risk may still be high in the absence of symptoms; an underestimation of a partner's STI risk level).

### Stigma and Social Norms

The apprehension surrounding an STI diagnosis is at least partly attributable to the judgment society places on those with an illness of sexual aetiology. There appears to be a perceived negative stigma associated with even common, treatable STIs<sup>37,40,44</sup>. Even without a positive diagnosis, simply engaging in STI prevention actions seems to imply sexual promiscuity. The anxiety associated with the possibility of others discovering that one has attended a sexual health clinic or that one has been tested for STIs has been shown to inhibit some people from seeking screening<sup>19-20,33-35,39,45</sup>. Many people have indicated that normalizing STI prevention as an overall public health initiative—instead of it being seen as an action exclusively for those most at risk—would make them more likely to be tested<sup>33,44</sup>.

### Interactions with Health Care Providers

Because they are often responsible for suggesting STI prevention behaviours, such as STI screening, providers can contribute to the reduction of STI-related stigma. Some patients are hesitant to engage in STI prevention because they are embarrassed about discussing sexual health with health care providers and fearful that the provider will judge their sexual history<sup>34,40</sup>. Indeed, some aspects of the patient-provider relationship have been shown to increase the likelihood of STI screening: trust that the provider will maintain confidentiality<sup>39,46</sup>, projection of an empathic, non-judgmental attitude<sup>33-36,45-46</sup>, and the insistence that STI prevention is a common, health-promotion practice<sup>41,44</sup>. In other words, patients seem to be more likely to engage in secondary STI prevention when their provider is perceived as trustworthy, understanding, and concerned about their well-being.

### Concern for Health

The decision to be screened for STIs depends on the importance individuals place on their overall health maintenance and the extent to which they believe STIs will impact their well-being. Individuals who view the consequences of even common, treatable STIs as serious are more likely to be tested<sup>35,37</sup>. In addition, people who consider STI screening as part of total health protection are more likely to be screened<sup>23,40,47</sup>, because it allows for early detection and treatment<sup>41,44</sup> and because it could protect their future fertility<sup>40-41</sup>. Accordingly, individuals who use health services more often are also more likely to engage in STI prevention behaviours, such as

screening<sup>20</sup>. In short, people who do not consider the long-term health effects of STIs to be a serious or a crucial component of their health protection may not seek screening for STIs.

### Concern for Partner's Health

In addition to concern for their own well-being, individuals may be less likely to be screened if they are not concerned about the effects of an STI on their partner's health. People on brief visits to locations away from home are less likely to be tested for STIs due to a lack of attachment and concern for transmitting STIs to their casual partners, essentially strangers, in this region<sup>36</sup>. The desire to protect partners and maintain their trust is a common motivator for screening<sup>47</sup>, demonstrating that, in the absence of concern for partners' well-being, secondary STI prevention is less likely to occur.

### Military Implications and Current Research Gaps

Taken together, results point to factors that may impact decisions by health care providers and individuals to engage in secondary STI prevention. From both perspectives, the success of secondary prevention may rest on the level of knowledge about STIs, perceptions of the level of risk or stigma attached to STIs, the availability of time and resources for prevention, and the quality of exchanges between health care providers and their patients. For individuals, additional considerations may include overall concern for theirs or their partner's health, their apprehension of possible consequences of a positive diagnosis, and other possible inconveniences associated with the screening itself. While the majority of the research pointing to these factors was conducted in a civilian context, results have potential relevance for the military context.

Although limited research has focused on barriers to secondary prevention in the military context, the factors associated with primary prevention practices have received some attention. Russak and colleagues<sup>48</sup>, for instance, conducted a systematic review of HIV/AIDS behavioural prevention programs aimed at military personnel. Their review identified four prevention interventions that addressed knowledge about risk, high-risk behaviours, and prevention, in addition to providing prevention-skills building. These interventions demonstrated favourable effects by mitigating one or more psychosocial barriers, such as service members' knowledge about HIV/AIDS, their willingness to engage in preventive behaviours, and/or their attitudes toward prevention. Other work has examined female U.S. Army personnel's perceptions of a self-administered intervention designed to promote safer sexual practices during

travel<sup>49</sup>. This intervention also focused on knowledge about risk and STI prevention skills, but specifically targeted women. Though the effectiveness of the intervention was not examined, the intervention was rated favourably by Army women.

Even though prevention interventions aimed at improving knowledge and perceived STI risk—factors that could also act as barriers to secondary prevention—hold promise for enhancing the primary prevention of STIs in the military context, the role of secondary prevention must not be overlooked. A recent study of STIs among HIV-positive active duty U.S. military personnel revealed that over a third of individuals (34%) contracted an STI after receiving an HIV-positive diagnosis. In total, 157 individuals accounted for 186 incident cases of gonorrhoea, while 312 accounted for 364 incident cases of syphilis. Thus, a small proportion of HIV-positive service members obtained multiple STI diagnoses after having received HIV-positive diagnoses. These results show that high-risk behaviours may persist among military personnel, even after they have personal experience with and knowledge of the high-risk behaviour<sup>50</sup>. Such examples emphasize the importance of secondary prevention in overall efforts to reduce STI incidence.

Features of the military environment may facilitate secondary STI prevention. Relative to their civilian counterparts, U.S. military personnel have easy access to health care<sup>51</sup>. In addition, routine and periodic medical assessments provide other opportunities for screening and treating STIs among military personnel. Many points of entry for advanced training involve medical exams, screening, or vaccinations<sup>2</sup>. A few prevention initiatives have benefited from these aspects of the military environment. For example, in an effort to reduce rates of chlamydia, the U.S. Air Force, Navy, and Marine Corps incorporated screening into the processing of female recruits<sup>52-53</sup>. Evidence suggests that screening female military recruits results in significant cost savings<sup>54</sup>. Because screening and treating male personnel for STIs is a necessary component of prevention, some researchers have proposed STI screening for male recruit and active duty populations in the U.S. military<sup>52</sup>. A more recent analysis showed that both targeted and universal screening of male recruits could be cost-effective<sup>55</sup>.

While routine medical assessments and accessible health care could diminish the impact of inconvenience and lack of time on secondary STI prevention among military health care providers and personnel, frequent travel or deployments could make the prompt screening, treatment of STIs, and follow-up more difficult<sup>52</sup>. A study of transient

workers in northeastern British Columbia—whose work schedules and experiences might be comparable to those of military personnel deployed in remote areas—revealed that limited opportunities to access testing and prevention resources inhibited STI testing<sup>34</sup>. Research is needed to determine the circumstances under which lack of time and access to appropriate health services interfere with STI care in military personnel.

Since frequent travel and deployments have been linked to increased high-risk behaviour<sup>56</sup>, it is necessary for military personnel who have engaged in high-risk behaviour to seek testing regularly and actively. As well, it has been argued that routine screening (i.e., at annual periodic health assessments) may not be sufficient because risk of re-infection may be high and military personnel may be re-infected shortly after treatment<sup>57</sup>. Decisions to seek STI testing outside of routine medical assessments may be based, in part, on military personnel's knowledge of the risks and asymptomatic nature of STIs. Yet knowledge about STI risk may be insufficient. One study assessed U.S. Army recruits' knowledge of various STI-related facts as part of an evaluation of the feasibility and short-term effectiveness of a knowledge-based intervention for STIs. Results revealed that 30% of recruits were not aware that chlamydia and gonorrhoea could be treated with antibiotics. As well, 23% of recruits were not aware that oral sex placed them at risk of contracting an STI<sup>58</sup>. Interventions aimed at enhancing knowledge about STIs have been linked to reductions in high-risk behaviours, such as alcohol use, and increased safer sex practices, such as condom use<sup>48,58</sup>. However, it remains to be determined whether knowledge about STIs is related to decisions to seek STI testing in military personnel.

Notwithstanding the potential importance of improving knowledge of STIs, doing so may not impact individuals' perceptions of their own level of risk. A recent study found that female U.S. Marine Corps recruits demonstrated an optimistic bias regarding their perceived risk of contracting an STI and generally perceived themselves to be invulnerable. In turn, those who reported never using condoms reported lower perceived risk relative to occasional users<sup>59</sup>. Research has shown that perceptions of invulnerability may be greater in young men than in young women<sup>60</sup>. However, little research to date has explicitly examined perceptions of STI risks among male military personnel, who often comprise the majority of the military population. Furthermore, no studies have examined the relationship between perceptions of STI risk and STI testing decisions among military personnel.

Beyond knowledge and perceptions of risk, the perceived stigma surrounding STIs and a positive STI diagnosis may be especially important in decisions to seek STI testing among military personnel. Military personnel must often work and live in close quarters with colleagues, and coupling within interrelated communities may occur<sup>51</sup>. At the same time, health care providers in military facilities may have multiple relationships with patients: as providers, colleagues, and friends. Because of the close proximity and ties with colleagues, concerns about confidentiality could result in a reluctance to be screened for STIs among military personnel.

Finally, STIs may not be viewed by military personnel as an important health issue, because physical symptoms may not always occur and serious health impacts may be delayed. It has been noted that STI programs have not been prioritized by military leaders, due to other priorities and budgetary restrictions<sup>61</sup>. While the most prevalent STIs may not interfere with the ability of military personnel to carry out their duties<sup>61</sup>, some STI sequelae (e.g., pelvic inflammatory disease) could have serious ramifications for the health of female service members during deployments, especially because they may not have ready access to health care<sup>52</sup>. It remains to be determined, however, whether military personnel are aware of the potential impacts of STIs on their health and operational readiness.

### Conclusion

A considerable amount of research has focused on identifying barriers to the secondary prevention of STIs in civilian populations from the perspectives of individuals and health care providers. The bulk of research with military personnel has focused on determinants of risky sexual behaviour and the use of condoms. Efforts to enhance the secondary prevention of common STIs (such as chlamydia) in the U.S. military are believed to hold promise in reducing the burden of STIs among military personnel<sup>54</sup>. Still, it is necessary that at-risk military personnel regularly and actively seek STI testing. Given the dearth of research on secondary prevention behaviours among military personnel, little is known about factors that may facilitate or hinder such behaviour. The importance of developing STI prevention interventions that are culturally-sensitive and tailored to the target population has been noted by several authors<sup>48</sup>. In order to guide the development of such interventions, however, additional research is desperately needed in the following areas: knowledge and perceptions of STI risks, their impacts on health, and ways they can be prevented; stigma and social norms associated

with STIs; and the accessibility of testing. Further research into the factors that influence the quality of patient-provider interactions among military personnel and their health care providers would help with identifying the best policies and programs for

improving the secondary prevention of STIs in the military context.

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*Author's affiliation:* Canadian Department of National Defence

*Corresponding author:* Kimberley Watkins, M.A.  
email: [kimberley.watkins@forces.gc.ca](mailto:kimberley.watkins@forces.gc.ca)

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# Who Cares for the Carers? Literature Review of Compassion Fatigue and Burnout in Military Health Professionals

*Lieutenant Colonel Kerry Clifford*

## Abstract

The Dunt Review<sup>1</sup> into mental health services in the Australian Defence Force (ADF) enabled significant investment in programs and initiatives across the defence environment in Australia. The subsequent attention to long standing mental health issues for our veteran community is both timely and admirable, and has indeed begun to address mental health stigma, education and community support around this country. Arguably, the overwhelming focus of these programs has been on Post-Traumatic Stress Disorder as it relates to the physical and mental trauma of operational deployment. However, this paper will attempt to redirect at least some of this focus onto potential issues of compassion fatigue in uniformed health professionals arising from their care of traumatised (physical and/or psychological) clients. The paper will also highlight burnout as a similar possible consequence of stressful defence health work/life experience.

This literature review based paper identified myriad peer reviewed references relating to research and programs for international healthcare systems and overseas forces on these conditions. However, at least within the published domain, very little can be identified for the Australian military context or in the ADF's current mental health strategies to specifically address these mental health issues for our uniformed health professionals.

This paper introduces these relevant concerns for the broader military/veteran's health peer group, leadership and academic audience to consider as worthy of greater attention in Defence and Veteran's Affairs research and policy agendas.

The paper will encompass:

1. An introduction, background and definitions of 'Compassion Fatigue', being vicarious traumatisation of clinicians as a consequence of caring for traumatised people.
2. A similar discussion of 'Burnout' as a wider but still significant workforce issue that reduces the quality of care provided to patients, and the morale, quality of life and physical and mental health of sufferers.
3. A brief outline of a 'Four Stages of Burnout' model, being (1) Physical, Mental and Emotional Exhaustion, (2) Shame and Doubt, (3) Cynicism and Callousness and finally (4) Failure, Helplessness and Crisis.
4. Identified issues for military health services from compassion fatigue and burnout as identified in the literature.
5. Recommendations that individual practitioners and the defence health organisation should consider to address issues identified.

## Background

PTSD can occur after someone experiences or The Dunt Review<sup>1</sup> into mental health services in the Australian Defence Force (ADF) and related investments in programs and initiatives have begun to address mental health awareness stigma, education and support in Australia. Arguably, the explicit focus has been on Post-Traumatic Stress Disorder (PTSD) as it relates to operational deployment by members of the ADF. However, at least within the public and published domain, very little was identified for this

paper in the Australian military context regarding other potential mental health risks for uniformed caregivers that can arise from military workplace, organisational and/or systemic stressors.

Compassion fatigue is a particular type of vicarious mental health traumatisation in health professionals dealing with difficult and challenging issues in clinical practice. Factors common to most healthcare settings have been identified elsewhere as influencing risk of serious occupational stress, especially in high demand clinical workgroups<sup>2</sup>.

Similarly, research on burnout has extended beyond healthcare environments to other sectors where people-work is fundamental to the job<sup>3</sup>.

This paper will argue that these issues deserve considered attention within the ADF and Veteran's mental health policy, research and intervention agenda.

### Methodology

The predominant method of identifying suitable papers for reference was an online search of the ProQuest database. Initial search terms included 'military', 'uniformed', 'compassion fatigue' and 'burnout'. All relevant abstracts were downloaded for closer examination. An extended search for other relevant material was undertaken through following citations and references identified in earlier articles or alternative search terms when identified.

A hardcopy review of ADF health references available to the author was also undertaken as identified in the reference list.

Searches and subsequent selection of material was not deliberately limited to any one health professional group. The majority related to the nursing profession, with the extended search also finding relevant material relating to other caring professions such as social work and teaching. An initial 5 year timeframe was preferred but extended to older articles based on relevance and consistency with current discourse.

### Introduction

In 2012, the author worked with an ACT community mental health team at a time when the issue of compassion fatigue and burnout in mental health professionals was being researched in that jurisdiction<sup>4</sup>. Calear and O'Donnell's recommendations regarding further education and support measures for at-risk health professionals gained significant attention and generated system-wide education for mental health staff across ACT Health.

Professor Nel Glass of the Australian Catholic University presented a conference paper<sup>5</sup> in 2013 on development and implementation of a wellbeing and lifestyle program for Victorian health care organisations. After reporting systemic issues that limited program success, her concluding remarks cautioned that:

"given the context of health care professionals work it is imperative that health organisations recognise the need to lead and take responsibility

to develop wellness programs based on emotional and physical health that support practitioners' continuous lifestyle management intervention... as an actively shared responsibility between individuals and their work organisations".

### Definitions

#### **Compassion Fatigue**

'Compassion Fatigue' is described as emotional, physical, social and spiritual exhaustion that overtakes a person, causing a pervasive decline in his or her desire, ability, and energy to feel and care for others<sup>6</sup>. Compassion fatigue can arise as vicarious traumatisation or 'shared trauma' in clinicians as a consequence of caring for traumatised people. This is most commonly framed in military health settings as relating to exposure to physical combat related trauma but can equally occur when caregivers closely identify and therefore absorb patient's emotional or psychological trauma or distress, such as those working in mental health provision back home in garrison<sup>6,7</sup>.

Flemister<sup>8</sup> suggests that compassion fatigue mainly affects those in the care-rendering professions given dynamic tension between the professional care-provider role and personal empathetic responses absorbed from the medical and emotional needs of patients/clients. Identified consequences for care givers include an increased risk for depression, anxiety, sleep difficulties, relational conflicts and decline in physical and mental health. Tyson related how clinicians can experience a syndrome of symptoms paralleling their client's diagnosis of post-traumatic stress disorder (PTSD), and transcend to alterations in self-identity, cognitive schemas, interpersonal relationships, physical health, job morale, world view and spirituality<sup>7</sup>.

For military health organisations, a decline in job performance and efficiency, a rise in errors and sick time, and a disruption in morale in military units may also result<sup>6</sup>. These have obvious implications for health capability effectiveness and efficiency as well as the health and wellbeing of individuals. Therefore there is an urgent requirement for all military caregivers to understand the issues involved and receive appropriate education and intervention<sup>9</sup>.

#### **Burnout**

'Burnout' as constructed by Maslach and Jackson in the 1970s<sup>10</sup> is now well accepted as a multidimensional syndrome consisting of emotional

exhaustion, depersonalisation, and reduced personal accomplishment<sup>2</sup>.

Burnout is a common result of occupational stress prevalent among many service-oriented professions, such as law-enforcement, management, teaching and healthcare<sup>11</sup>. Burnout differs from stress in that stress involves too much, whereas burnout is about not enough as suggested by the following table<sup>12</sup>.

### *Stress versus Burnout*

Stress	Burnout
Characterised by overengagement	Characterised by disengagement
Emotions are overreactive	Emotions are blunted
Produces urgency and hyperactivity	Produces helplessness and hopelessness
Loss of energy	Loss of motivation, ideals and hope
Leads to anxiety disorders	Leads to detachment and depression
Primary damage is physical	Primary damage is emotional
May kill you prematurely	May make life seem not worth living

Source: Smith, Segal and Segal, 2012<sup>12</sup> citing Stress and Burnout in Ministry

Burnout speaks to issues in individual and collective resilience for healthcare systems across nations<sup>13</sup>. Flemister<sup>8</sup> suggests that anyone who experiences distress and aggravation in the workplace regardless of profession or position, even where there is no care-giver/recipient relationship, may experience burnout. Freudenberg<sup>14</sup> defined burnout as “to fail, wear out or become exhausted by making excessive demand on energy or resources”. Stewart<sup>15</sup> described how individuals suffering from burnout become withdrawn and less empathic, and display negative behaviours toward co-workers and sometimes patients. This can result in breakdown of work team communication and degrade the quality of healthcare delivery<sup>16</sup>.

Burnout is usually a cumulative process over time with a predictable course, although research by Dunford et al<sup>17</sup> suggests that there may be more dynamic implications for staff undergoing career related transitions<sup>15,17-18</sup>. The above has potential implications for health organisations undergoing restructuring, which will be explored later, or for ADF members moving between postings and/or deployments where the nature of work responsibilities, peer relationships and support significantly changes.

Whilst the literature clearly suggests that the risk of employee burnout is not limited to healthcare populations, issues impacting on self-determination and professional efficacy for health care

professionals, such as health system reorganisation and conditions of practice uncertainty can escalate stressors leading to burnout<sup>19</sup>. Burnout thereafter becomes particularly significant for health care settings as it reduces the quality of care delivered to patients as well as the morale, absenteeism, quality of life and physical/mental health of caregivers<sup>13,20</sup>. Work-related stress affects both physical and mental wellbeing and long term health, and may result in stress-related disease or end-organ dysfunction<sup>21</sup>. It can therefore be a pre-condition for other types of serious occupational stress, such as compassion fatigue and vicarious traumatisation<sup>2</sup>.

When considering employee health and well-being, it is inappropriate to frame burnout as a personal or private issue when organisational contributors such as long hours, little down time, and continual peer, customer, and superior pressures, demands and expectations are ignored<sup>22-23</sup>. Burnout goes beyond the usual scope of occupational health by making clear how workplace stressors impact as environmental pressures that degrade lived experience of health and wellbeing<sup>24</sup>.

### Four Stages of a Burnout Model

As identified above, the evolution of burnout is an insidious and cumulative process. The condition develops over time, often without the sufferer being aware until all physical, mental, emotional resources are exhausted and a crisis occurs. Gorkin<sup>25</sup> describes burnout as a progressive erosive spiral within a “Four Stages of Burnout” model:

1. **Physical, Mental and Emotional Exhaustion.** This initial phase may present as outward coping with the stressful work situation despite an increasing negative impact on internal feelings of wellbeing, energy and satisfaction with life. Caring about work or home life seems like a waste of energy. Eventually, the sufferer's reserves of energy and coping become depleted and serious doubts about self and the situation around them begin to mentally creep in.
2. **Shame and Doubt.** At this stage, negative self-talk and suspicions about one's suitability for their responsibilities or demands at hand begin to arise. Every day becomes a bad day. Previously successful people begin to doubt that they are the right person for their job. As self-confidence begins to plummet, feelings of being a fraud and an imposter begin to rise, and doubts about past success increase in line with feelings of anxiety, panic and depression.
3. **Cynicism and Callousness.** Serious feelings of vulnerability and insecurity now impact on

the sufferer's attitude to self and others. The majority of the day feels either mind-numbingly dull or overwhelming. Sufferers feel that nothing they do makes a difference or is appreciated, even in the presence of evidence to the contrary. People experiencing this level of burnout have developed a psychological shell in an attempt to protect themselves from further damage. At this stage, external behaviour such as short-temperedness and alienation from colleagues and family become evident. Interpersonal contact and social activity becomes difficult to maintain. Professional engagement becomes difficult and may be exhibited as decreasing work team involvement and absenteeism. Decisions may appear odd or hasty, being made in an attempt to just move the issue along. All of these are late warning signs for others to acknowledge and potentially raise with the sufferer given the need for this serious level of mental distress and coping exhaustion to be addressed.

4. **Failure, Helplessness and Crisis.** All previous and latter maladaptive coping strategies have now failed. The hard outer shell has cracked and even slight emotional challenges or stressors elicit incongruous and emotional reactions. Situations and issues previously easily managed are now major problems. And all interpersonal relationships become strained and difficult to maintain.

Health care professionals suffering from any of the above levels of burnout require workplace support and access to professional assistance in order to re-establish and develop new coping strategies leading to longer term resilience and recovery.

### International Context

In considering such issues in military health care systems, the literature reveals research and programs relating to overseas forces; as diverse as the United States, Canada, Slovenia and Peru<sup>7,15,26-30</sup>. A Canadian review of their operational stress support system formally raised concerns for the mental health of their military health carers, and other professional carers such as military chaplains and social workers, as long as a decade ago<sup>31</sup>. Unfortunately, a follow up review in Canada in 2008 found that ongoing shortages in health workforce numbers and increasing demands on their services had led to even greater instances of stress and burnout in that caregiver community<sup>32</sup>. This finding prompted a recommendation that:

"The Canadian Forces develop and implement a national program or initiative aimed specifically at assisting and preventing stress and burnout among the mental health care community".

The outcome of a further follow-on Canadian review commissioned in 2010 is not known, but the mental health of care providers in the Canadian military clearly remains firmly on their agenda<sup>33</sup>.

### Australian context

Unfortunately, no readily or publically available references expressing similar concerns for the wellbeing of Australian Defence Force Health Services were identified for this paper. No peer reviewed papers were identified in online catalogue searches. The widely circulated "Capability through mental fitness" document publicising the ADF mental health and wellbeing strategy in 2011 does not appear to directly address health workforce mental health issues other than as generic members of the ADF<sup>34</sup>. A word search of the Dunt Review Report<sup>1</sup> identified only one instance of "carers", being in the context of family and partners. There were no instances or even implied mention of compassion fatigue or burnout as issues for ADF personnel, let alone health care providers. Twenty instances of "health professionals" were identified, all in the context of staffing and training, consolidation into psychology support teams, as resources to enable follow up of Post Operations Psychological Screens (POPS), and as providers on the psychiatric health help line.

Unlike the Canadian Marin Review, it seems that little attention has been paid toward the mental wellbeing of military health carers as a specific at-risk group. The ADF Mental Health & Wellbeing Plan 2012-1535 only identifies a clinical supervision model as a priority deliverable for mental health practitioners. That is the only initiative in current plans and programs that approaches issues of service related mental health wellbeing for ADF healthcare providers.

As discussed later, assessments of overseas programs, and health workforce related data within mental health research is available but has not yet been analysed to any level of focussed detail. This paper is therefore intended to raise awareness for defence health policy, research and wellbeing promotion regarding potential impacts of service in the ADF on Australian military health professionals as a specific at-risk group.

### Issues for Military Health Organisations

**Capability and Retention.** Stewart<sup>15</sup> suggests that compassion fatigue can account for caregivers not only leaving the organisation but leaving the profession altogether. This is clearly an issue for military organisations where the retention of highly trained and experienced personnel is critical to the maintenance of capability. Ciftcioglu<sup>36</sup> investigated occupational commitment and turnover intention relating to burnout syndrome. The article suggested potential substantial costs for organisations and individuals alike given a positive association between burnout and turnover, absenteeism, reduced productivity and other human performance factors. Ballenger-Browning et al<sup>27</sup> cited similar studies correlating staff absenteeism, poor staff retention, ill-health and reduced job performance with burnout.

Aguis et al<sup>37</sup> reported high rates of suicide, early retirement, increased substance use, and marital problems in medical practitioners experiencing serious work related stress. Glass<sup>5</sup> raised similar issues with the support of emergency service workers in Victoria, with implications for individual health status, self-reported wellbeing, absenteeism and future work intentions.

**Restructuring and change fatigue.** The ADF health environment has changed significantly since the Alexander Review of 2008<sup>38</sup> and companion Army operational health restructuring. Changes in the career expectations and working conditions of uniformed health professionals have occurred across strategic, garrison and operational domains. The organisation as a whole must always be cognisant of potential impacts that such restructuring and related change fatigue may have on Defence health personnel.

Greenglass and Burke<sup>19</sup> examined similar issues in the Canadian public health care system. Their paper relates health service mergers or closures, service reductions and extensive job losses. In their study looking at predictors of burnout in nursing staff in particular from these changes, they identified:

- issues of cynicism towards the organisation arising from perceptions of psychological contract violation,
- negative reactions in organisational commitment if employees felt they had been treated unfairly or poorly informed during restructuring, and
- reductions of commitment in previously highly motivated individuals in times of staff downsizing.

The same paper also identified positive staff attributes, such as control coping that generally underpins organisational commitment, high job performance

and job change intentions. Both individual and group resilience, and therefore tolerance to ongoing or significant change, is a finite resource that erodes over time.

Greenglass and Burke concluded that health care organisations undergoing change need to consider the inherent stressors that are likely to impact on the delivery of services by employees. This includes possible psychological impacts that perceived job insecurity, workload and task distribution may have on individuals and workgroups. Such issues can impact on wider efficacy and resilience inherent in the social structures and culture of affected workplaces. Finally, they suggest that individual resource variables, such as self-efficacy, individual coping and prior organisational commitment also need to be assessed to avoid burnout in vulnerable individuals.

**Locus of Control.** Leading on from the above, Maslach et al<sup>39</sup> sought to identify which types of people might be at greater risk of experiencing burnout. As Leiter<sup>40</sup> advised, burnout is inconsistent with a sense of self-determination and diminishes the potential for subsequent effectiveness. Understanding such issues is of significance to military health organisations where hierarchical systems of top-down command and control are strictly maintained and higher authority cannot readily be challenged. Maslach et al<sup>39</sup> determined that the exhaustion dimension of burnout is higher for those who have an external locus of control (attributing events and achievements to powerful others) rather than those with a strong sense of their own efficacy, efforts or ability to influence circumstances (internal locus of control).

Toppinen-Tanner et al<sup>41</sup> defined burnout as a chronic stress syndrome caused by work-related overload and lack of resources. For lower level health managers and clinical leaders, a sense of higher support and adequate resourcing for self-determination to appropriately address and satisfy local demands and concerns within their direct responsibility and wider influence is critical. The demands for health unit performance and efficiency, and the associated resources, support and policies directing such services are often externally determined, directed and controlled. It is therefore likely that lower level workgroups and individuals may experience increased levels of unhealthy stress and reduced ability to adjust accordingly.

### ADF Mental Health Research

Without doubt the most significant recent research work undertaken by the ADF into the mental health

of its members has been the 2010 ADF Mental Health Prevalence and Wellbeing Study<sup>42</sup>. Whilst the study reported that the 12-month rate of mental disorders in the ADF was very similar to that of a matched sample from the Australian community, it also noted that the ADF has a different profile reflective of the unique demands of service.

Additional relevant data has been collected for the Middle East Area of Operations (MEAO) series of health studies:

1. The **MEAO Preliminary Study** conducted in 2009 gained stakeholder support and informed development of subsequent research programs.
2. The **MEAO Census Study**<sup>43</sup> is a retrospective, self-report survey of around 27,000 ADF members deployed to the MEAO between 2001 and 2009.
3. The **MEAO Prospective Study**<sup>44</sup> was a follow-up study that collected pre- and post-deployment data on about 3000 members who deployed in 2010/11. That study obtained self-reported surveys, with selected members also participating in physical and neuro-cognitive testing.
4. The **MEAO Mortality and Cancer Incidence Study** was based on linkages to national databases to compare MEAO personnel rates of morbidity and cancer incidence to general Australian population statistics.

The key findings of both the MEAO Census and Prospective Health Studies were released in Canberra on 8 August 2013. Clinically significant findings from the study across psychological, physical and social wellbeing domains were reported. Both datasets enable further analysis regarding military health care professionals as an at-risk cohort, but detailed work to that level has not yet been resourced.

### Mental Health Prevention and Promotion

Stewart<sup>15</sup> emphasised how prevention of compassion fatigue is more important than intervention. Just as in measures undertaken by military health organisations to prepare military forces for combat related impacts on mental well-being, health professionals who are at danger of developing compassion fatigue and burnout must also be prepared and supported through positive individual and organisational strategies to additionally deal with potential erosion of their professional and personal self-concept leading to mental health problems<sup>15,45</sup>.

The Department of Defence in the post-Dunt reform period has invested significantly in education programs and initiatives to build mental health

awareness, access, support and resilience in ADF members. Through a Military Occupational Mental Health and Wellbeing Model, the Department has adopted a holistic view of the multifactorial environment that supports and impacts on members<sup>34</sup>. At both organisational and individual levels, the model recognises the environment, culture, social support networks and impact on families as factors requiring attention. In addressing these domains, five key strategic foci are identified, being:

1. Foundation strengths
2. Risk reduction
3. Early intervention
4. Treatment and Recovery
5. Transition.

This comprehensive strategy is critical to supporting the mental health of ADF members across their service life. But despite such strategic level support, individuals and the defence health system alike will always need to maintain close attention to human issues such as anxiety, depression, compassion fatigue and burnout.

### Self-Care

Within the above framework, the ADF provides a number of mental health awareness events at strategic way-points in military careers. Individual ADF members, including military health care providers, are increasingly aware of mental health issues and initiatives in the military community. Gradually, this will displace cultural stigma and misperceptions about the impact of mental health issues on deployability and career longevity.

At the individual level, members have been provided with tools and initiatives that promote early identification of problems in themselves and their mates. Ready access to mental health services through a number of entry points also supports the command chain, family/social networks and support to full recovery. The most significant elements of individual support are promotion of self-awareness and encouragement to seek support early.

Rhodes<sup>46</sup> highlights the need for U.S military health providers to apply the basic elements of self-care to their own mental health whilst also recommending changes to U.S. Department of Defence policy to better balance workload and deployments with rest and recovery for military care providers.

Given the ubiquitous nature of smartphones and other online technologies, the launch in February

2013 of the PTSD Coach Australia smartphone application provides a ready source of information, self-assessment, support access and promotion of early intervention and recovery for serving members and veterans<sup>47</sup>.

Australian health care providers working in the military and/or with veterans can find more relevant practical support through a smartphone application developed by the U.S National Center for Telehealth & Technology. Their Provider Resilience application gives health care providers tools to guard against burnout and compassion fatigue as they help service members, veterans, and their families. Incorporating the ProQoL assessment model, the app provides ratings for compassion satisfaction, resilience and burnout. It also provides practical support through resilience building advice, timers to indicate when the last rest and recreation leave was taken, and daily shots of humour through Dilbert cartoons<sup>48</sup>.

As noted above, the Provider Resilience application incorporates the ProQoL self-assessment tool. This professional quality of life self-test is freely available for online at [www.proqol.org](http://www.proqol.org). The ProQoL tool is an attractive self-assessment measure for health professionals given its specific focus on the negative and positive effects of helping others who experience suffering and trauma<sup>49</sup>. Sub-scales for compassion satisfaction, burnout and compassion fatigue directly assess these issues for health care providers. As for the Provider Resilience app, the tool can be repeated at regular intervals, such as every few months, to assist individuals to monitor their own levels of distress and resilience over time.

In all such education and access initiatives aimed at individual self-care are three R's – Recognise, Reverse and Resilience<sup>12</sup>. The first challenge for health professionals experiencing mental distress from their work is to watch for early warning signs of burnout and recognise that they may benefit from the help of others. This can be difficult. Whilst most individuals can recognise they are under a lot of stress, burnout is more gradual and may not be noticed as a serious issue until a tipping point in coping is triggered.

The next challenge is to reverse as much as possible damage done by actively addressing factors that contributed to the breakdown in mental health and related wellbeing. As recommended by a Slovenian study of coping behaviours and personality traits relating to burnout in their military:

"All individuals who cope ineffectively should be trained to identify the most intense job stressors, observe the ineffective coping strategies they may

use in response, and substitute them with more active coping strategies"<sup>29</sup>.

Coping strategies may need to address work, lifestyle and personality traits that act together to degrade performance, motivation and self-concept. Considering and implementing changes in daily routines to maximise rest, time for recreation and exercise are fundamental to good health and wellbeing in all its forms. Changes in diet and a review of the use of alcohol or drugs as coping mechanisms should be undertaken. On the work front, the setting of boundaries and a review of tasking in frank consultation with supervisors are important to identify and agree on healthier work demands and peer support. On the spiritual level, stress management tips and strategies can be readily found online, through contact with medical services or accessing veteran support organisations.

The final concern is for individuals to regain a sense of control and rebuild resilience against future stressors and challenges. This goal is most likely to only be successful with the input of professional counselling. In regaining positive ways of thinking and coping, particularly for highly skilled and valuable health professionals, it may be necessary to acknowledge losses, re-evaluate goals and priorities, and re-establish a sense of purpose and self-efficacy<sup>12</sup>. This will require both time and significant family, peer and organisational support for optimal recovery to be realised.

### Workforce Research and Monitoring

**Action Orientated Strategies.** As previously outlined, the Department of Defence has established a comprehensive strategy to address capability through mental fitness<sup>34</sup>. Seven priority actions were identified within the mental health strategy, being:

1. Addressing stigma and barriers to care
2. Enhancing (mental health) service delivery
3. Developing e-mental health approaches
4. Upskilling health providers
5. Improving pathways to care
6. Strengthening the mental health screening continuum
7. Developing a comprehensive peer support network.

A readily available resource for Commanding Officers/Officers Commanding of ADF health units to consider is the ADF's Profile of Unit Leadership, Satisfaction and Effectiveness (PULSE) survey. Performance of the PULSE survey within a health

unit permits assessment of the collective workgroup in their service context. Undertaking this practical level of directly relevant action orientated research at the unit level allows for assessment of:

- reported levels of job stress, job satisfaction and work motivation
- perceived support, fairness and autonomy in the workplace,
- communication, commitment and turnover intention
- teamwork, confidence and leadership.

Given the significant recent reforms and organisation-wide stressors from Defence efficiency requirements and similar, it might be useful for the Defence senior leadership to encourage workplace based research such as the PULSE survey to identify whether burnout in particular is an issue requiring attention<sup>50-51</sup>. The attempt alone to quantify such issues at the local level would be seen by staff as a positive initiative<sup>52</sup>.

**The Canadian Experience.** Dedicated research funding for resilience based strategies for health care providers should be considered in line with initiatives overseas. For example, Canada faces similar issues as Australia given a similar experience of decade long operations in the Middle East. In the earlier cited Marin Review, the Canadian Ombudsman sought to investigate the prevalence and risks of compassion fatigue and burnout in Canadian military health carers. The review sought to make tacit identified issues in defence mental health policies, health promotions and education systems<sup>31</sup>. The report identified that:

“Other issues included staff burnout, staff and funding shortages, problems with civilian staffing, and a lack of time, money and direction to implement recommendations from focus groups”.

This finding no doubt contributed to Recommendation<sup>27</sup> suggesting that:

“The Canadian Forces take steps to deal with the issues of stress and burnout created by lack of resources and high caseloads among Canadian Forces caregivers”<sup>31</sup>.

Despite the above identified shortfalls, Zimmermann<sup>26</sup> describes a more positive Canadian military program called “Care for the Caregivers”. Zimmermann’s paper describes the structure and objectives of 4-day small group workshops offered to military chaplains as well as health care professionals in the Canadian forces. The program addresses topics such as post-traumatic stress disorder, vicarious traumatisation, coping techniques, spirituality, self-care, and family

issues. The paper reported positive feedback from participants and that the program had become a standard post-deployment activity for the Canadian military. The program has been conducted twice in Australia on an evaluation basis and is currently being considered within a wider spirituality and wellbeing strategy under development.

**Health Workforce Characteristics, Stigma and Gender.** Broader issues of workforce culture, particularly service life characteristics that reward constant high performance in challenging roles and environments, impact on potential compassion fatigue and burnout. Further research needs to consider the unique lifestyle demands and limitations of uniformed service life given their potential to increase burnout risk compared to civilian working environments. Data on potential predictors for burnout such as provider demographics, social support, institutional factors and beliefs about mental health service utilisation, treatment modalities and possible medication needs to be gathered<sup>27</sup>. As recommended by a Peruvian study of burnout in military nursing personnel, specific demographic groups that may require particular attention include younger/less experienced staff, those who are single, have children or work in the most critical or high intensity areas<sup>30</sup>.

Broader structural issues such as recruiting, career models and retention also require attention. Research and monitoring relating to career choices and underlying psychological contracts, as well as potential gender based differences in military health care service experience need to be considered<sup>53</sup>. Research into the Australian military context of potential gender differences in experiencing burnout, coping and recovery, as well as issues of mental health service utilisation, barriers and stigma amongst all levels and categories of military health care providers in general are recommended<sup>52-54</sup>. Comparison of staff burnout prevalence between garrison and deployed practice environments may also reveal relevant context based factors either supporting or degrading resilience and coping respectively<sup>28</sup>. Finally, issues of self-stigmatisation, confidence in health service and command chain confidentiality and other potential barriers to service utilisation by military health professionals should also be closely examined<sup>55</sup>.

In developing subsequent recommendations and initiatives to address issues identified by research into the above issues, measurement and ongoing monitoring standards sensitive to compassion fatigue and burnout within the unique nature of ADF health care employment will need to be considered<sup>46</sup>.

### Conclusion

Significant investment in mental health services for members of the ADF have come about following release of the Dunt Review findings and recommendations. Whilst increasing attention has been paid to long standing mental health issues in our veteran community, this paper argued that potential issues of compassion fatigue and burnout in our uniformed health professionals potentially require a similar investment in research, education and intervention. Burnout was identified as a possible cumulative consequence of stressful defence health work/life experience, with compassion fatigue being

a particular risk for health care providers who deal, or have in the past dealt with, the physical and/or mental pain of others.

It is sincerely hoped that this paper sufficiently raises relevant concerns about these issues for them to occupy an appropriate place within the broader Defence and Veteran's Affairs research and policy agenda.

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*Corresponding author: LTCOL Kerry Clifford  
55 Swanton Street, Chisholm, ACT 2905  
Kerry.clifford@internode.on.net*

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# Diagnosis and management of acute promyelocytic leukemia in an active duty Air Force space operator

Benjamin Eovaldi<sup>1</sup>, Harry Albaugh<sup>2</sup>, John Hyman<sup>1</sup>, Daniel Greenwald<sup>3</sup>

## Abstract

A 38 year-old United States Air Force active duty male in excellent health presented to the flight medicine clinic with a two week history of shortness of breath, fatigue, and unexplained bruising. Initial laboratory analysis was significant for pancytopenia with evidence of immature cells suggestive of leukaemia. The patient was admitted to hospital for emergency workup. Bone marrow biopsy and molecular analysis confirmed the diagnosis of acute promyelocytic leukaemia (APL). Induction therapy consisting of all-trans retinoic acid (ATRA) plus arsenic was promptly initiated and complete remission achieved after 35 days of treatment. Acute promyelocytic leukaemia, an extremely aggressive subtype of acute myeloid leukaemia, was considered to be one of the most deadly forms of cancer prior to the introduction of effective ATRA-based therapy in the late 1990s. Drawing parallels with the aviation environments' crew resource management (CRM), we discuss the importance of team work and collaboration in military medical resource management (MMRM). Because the military health care infrastructure in the United States is complex and relies heavily on civilian medical services, the implementation of MMRM is important to ensure good outcomes in cases that require rapid diagnosis and treatment such as APL.

## Introduction

Acute promyelocytic leukaemia, a subtype of acute myelocytic leukaemia (AML) that usually occurs in patients younger than 40 years of age, accounts for approximately 10-15% of AML cases. Acute promyelocytic leukemia is characterised by the chromosomal translocation t(15;17). The translocation occurs between the retinoic acid receptor a (RARA) gene on chromosome 17 and the promyelocytic leukaemia (PML) gene on chromosome 15<sup>1-3</sup>. This rearrangement results in a leukaemogenic PML-RARA fusion gene which alters the growth and differentiation of certain myeloid cells<sup>3</sup>. The hallmark of APL is the uncontrolled proliferation of abnormal promyelocytes and disseminated intravascular coagulopathy (DIC)<sup>1,4,5</sup>. Prior to the introduction of ATRA therapy, APL was the most aggressive form of AML with death resulting from severe coagulopathy and bleeding diathesis on average in one month<sup>1</sup>. Effective treatment for APL with ATRA was developed between the years 1983-1988<sup>1,6</sup>. Until recently therapy included ATRA plus chemotherapy as standard. However, recent trials support the non-chemotherapeutic ATRA + arsenic trioxide (ATO) combination<sup>7</sup>. Patients are stratified into low/intermediate risk, or high risk with a white cell count (WCC) less than 10,000 per microliter (mL), or greater than 10,000 per microliter (mL), respectively.

Patients with a high WCC are particularly at risk of fatal early haemorrhagic complications, and this risk is reduced with early ATRA therapy. Thus, rapid diagnosis and commencement of ATRA is vital in this disease to reduce the early mortality that used to occur. Arsenic trioxide improves event-free and overall survival for adults with acute promyelocytic leukaemia<sup>7-10</sup>.

The authors have looked to the aviation community for strategies to improve patient care in complex situations. Crew resource management (CRM) is a fundamental set of training procedures used in the aviation environment which aims to optimise the effectiveness of coordinated efforts to obtain shared goals. This case highlights the importance of team work and collaboration to ensure effective treatment and a good outcome when time is a critical factor. Because military health care infrastructure in the United States is complex and relies heavily on civilian medical services early implementation of military medical resource management (MMRM) enhances patient care especially in cases that require rapid diagnosis and treatment such as APL.

## Case Report

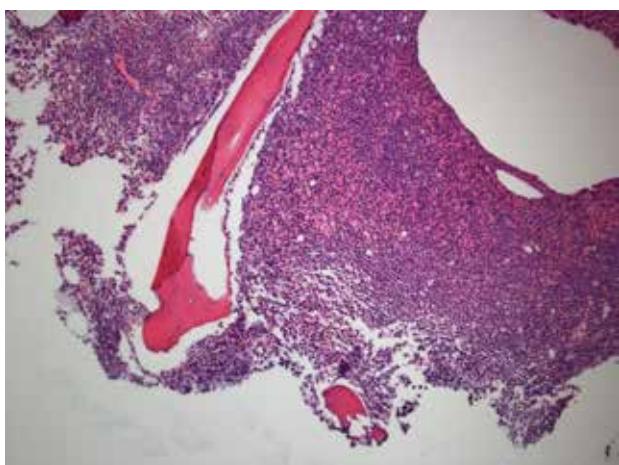
The patient, a 38 year-old Air Force active duty male, was in his usual excellent state of health until the

## Case Study

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end of April 2013 when he presented to the flight medicine clinic located in the continental United States with shortness of breath, fatigue, unexplained bruising of the legs, and mild bleeding of the gums. At that time complete blood count (CBC) revealed pancytopenia with a predominance of promyelocytes on peripheral smear which was indicative of leukaemia. White cell count  $2.32 \times 10^3 / \mu\text{L}$  with 48% promyelocytes, Hb8.6 g/dL, and platelets  $38 \times 10^3 / \mu\text{L}$ . During the repeat blood draw in the clinic lab, the patient began to feel weak and was taken to the emergency department via ambulance. In the emergency department the patient experienced an episode of haematochezia and the decision was made to transfer the patient to a nearby hospital with in-patient haematology services. The following morning, a bone marrow biopsy (Figures 1&2) was obtained and fluorescence in situ hybridization (FISH) using gene specific probe analysis confirmed the diagnosis of APL. The patient was promptly started on induction therapy with ATRA at 45 mg/m<sup>2</sup>/day plus arsenic at 0.15 mg/kg/day. Additional laboratory analysis was significant for early DIC which normalised within a week of therapy. Induction therapy was complicated by a minimally symptomatic transaminitis which required a 3 day break in therapy; complete remission was confirmed by bone marrow biopsy which showed complete cytologic remission at day 35 of induction therapy. Two weeks following the completion of induction therapy the patient started consolidation therapy which consisted of a continuation of arsenic trioxide (0.15 mg/kg/day IV daily for 5 days per week for 4 weeks every 8 weeks) for a total of 4 cycles and ATRA (45 mg/m<sup>2</sup>/day for 2 weeks every 4 weeks) for a total of 7 cycles. The patient tolerated the treatment extremely well and his prognosis is considered to be excellent.

*Figure 1: Low power slide which demonstrates hypercellular bone marrow comprised predominately of atypical promyelocytes.*

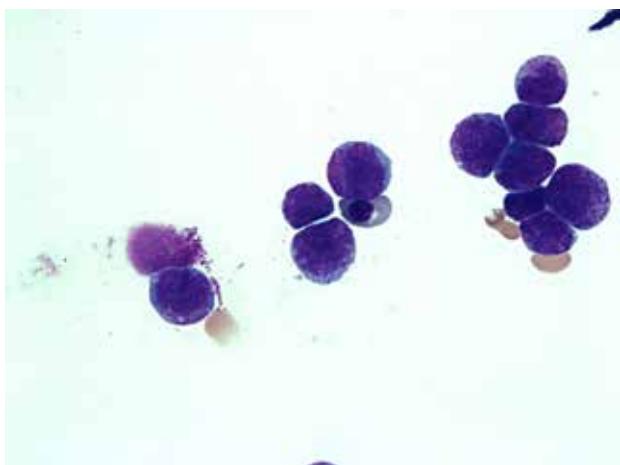


## Discussion

Acute promyelocytic leukaemia is a potentially fatal disease which requires prompt diagnosis and treatment at a facility that supports inpatient haematology services. Flight medicine cases such as this require aggressive resource management and coordination of care. Crew resource management (CRM) is an aviation term which relates to communication and efficient utilisation of flight equipment and crew<sup>11</sup>. Because of its effectiveness, CRM has been widely adopted across civilian and military aviation. It can be defined as a system which makes optimal use of all available resources, equipment, procedures, and people. Effective resource management promotes safety and enhances the efficiency of operations. Because the primary aim of military medicine is to maintain the health of military personnel so that they can carry out their mission, proper military medical resource management should be implemented especially in deployed locations or resource-depleted regions of the world.

The focus of MMRM is to ensure clear, efficient, and timely communication across disciplines which can be applied to flight medicine. While not every flight medicine case will require intense MMRM, APL is a good example of one that does. In this case, the primary flight medicine team served as the gatekeeper to the patient's access to timely diagnosis and definitive treatment. Prompt communication with the lab, emergency department physician, haematologist, insurance representatives, and the patient's commander were essential to effective management of the situation. Time was a significant factor and hours did matter. A barrier to the proper implementation of MMRM is delayed identification of

*Figure 2: High power slide which demonstrates atypical promyelocytes.*



## Case Study

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potentially fatal non-traumatic disease pathologies in an extremely healthy operator population. Communication with the clinic laboratory director about the initial peripheral smear allowed immediate engagement of a haematologist and activation of the referral management team. Keeping the referral team up to date facilitated insurance authorisations ensuring uninterrupted patient care. Continued communication with referral management, the haematologist, and the patient's military commander

were important throughout the duration of treatment. It is the author's opinion that regular implementation of MMRM will promote flight medicine's objective: to support the mission.

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*Authors' affiliations:* <sup>1</sup>30th Medical Group, Vandenberg AFB, CA, <sup>2</sup>146 Airlift Wing, Air National Guard, Port Hueneme, CA, <sup>3</sup>Cancer Center of Santa Barbara, Santa Barbara, CA.

*Corresponding author:* Eovaldi, Benjamin  
email: benjamin.eovaldi.1@US.AF.mil

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# JOURNAL OF MILITARY AND VETERAN'S HEALTH

## 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 JM VH Editorial Board has identified the following themes for future editions (please note these have been updated since previously communicated):

Edition	Theme	Publication Date	Manuscript Submission Deadline	Advertising Submission Deadline
Volume 22 No.4	Tropical Medicine	December 2014	1 September 2014	1 November
Volume 23 No.1	Conference Abstracts	January 2015	No manuscript submissions for this edition	1 December
Volume 23 No.2	Trauma Management - Past & Present	April 2015	1 January 2015	1 March

### Categories for the above include:

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**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.**

Please submit your articles via the JM VH website [www.jmvh.org](http://www.jmvh.org) where the 'Instructions to Authors' can also be found.

Should you have any queries in relation to JM VH, please do not hesitate to contact the Editor via the JM VH Editorial Office on +61 3 6234 7844 or [editorial@jmvh.org](mailto:editorial@jmvh.org)



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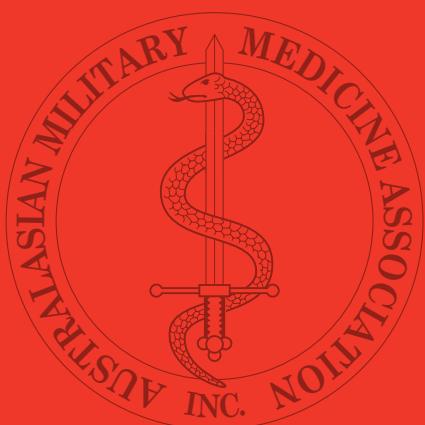
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