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JOURNAL OF MILITARY, VETERAN AND FAMILY HEALTH

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PERSPECTIVES

On the Cover

Top Left: From left: Nash Olfert, 7, Leila Olfert, 9, and Brighton Froehlich, 2, show off their Halloween costumes in October 2019. The costumes were a tribute to the Royal Canadian Air Force's Snowbirds Air Demonstration Team. *Photo by Jocelyn Froehlich*

Top Right: Master Warrant Officer Kim Jones carries the Eagle Staff during an Royal Canadian Air Force (RCAF) ceremony. *RCAF photo*

Bottom Left: Veteran Don White speaks with Canadian Armed Forces members during a ceremony for the 75th anniversary of the Italian Campaign at the Moro River Canadian War Cemetery in Ortona, Italy, on Dec. 2, 2019. *Photo by Cpl Matthieu Racette/ Canadian Forces Combat Camera*

Bottom Right: Canadian Armed Forces members competed against the world's best military athletes at the 7th CISM World Games in Wuhan, China, in October 2019. Here, a taekwondo athlete has their ankle taped during Day 3 of competition. *Photo by Lyndon Goveas/Canadian Forces Morale and Welfare Services*

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EDITORIAL

From research to impact

The *Journal of Military, Veteran, and Family Health* (*JMVFH*) is now in its sixth year and continues to advance in national and international importance. It achieved indexation in the prestigious behavioural and social science literature database, PsycINFO, in 2019. In January 2020, it was added to a catalogue of distinguished sources on military medical science developed by the NATO Centre of Excellence for Military Medicine. The editorial team is eager to build on this foundation of early success and propel *JMVFH* into the future – and to the forefront of military, Veteran, and family health research worldwide.

A cornerstone of realizing this intention is knowledge translation and mobilization. At the 10th annual Canadian Institute for Military and Veteran Health Research (CIMVHR) Forum in October 2019, in Gatineau, QC, the Opening Plenary panel examined how scholars, policymakers, granting agencies, lawmakers, and service providers define, measure, and communicate research impact. Approximately 750 Forum delegates attended the panel, entitled "Investing in Impact: The Role of Research in the Lives of Military Members, Veterans and their Families," to learn about the direct impact research has on clinical practice and the lived experiences of *JMVFH*'s beneficiary populations.

In her article, "Expediting research to practice for maximum impact," on Page 3 in this edition of the journal, Nora Spinks delves into the need for knowledge mobilization to be incorporated into research study designs. The effect of research on the end-user must no longer be an afterthought. It is critical knowledge translation be an intentional component of research in order to maximize impact and transform lives. Indeed, validating research impact has become an increasingly essential component of the scientific investigative process. It is key to the success of a project to be able to demonstrate its relevance to stakeholders and the health care system, as well as to make a tangible difference in the everyday lives of individuals.

In order to make a difference, however, research must be expedited to practice as quickly as possible. Estimates show that, depending on discipline and context, it can take as long as 17 years for research to go from discovery to application. This gap between knowledge generation and application must be addressed so that information reaches policymakers, service providers, clinicians, and end-users in a timely manner. In order to do this, government, industry, the not-for-profit sector, and academia must work together to facilitate the transfer of knowledge between researchers and health care professionals and remove barriers to collaboration for those serving the military and Veteran populations and their families.

In addition, *JMVFH* is looking forward to new partnerships with groups studying similar populations, such as public service personnel, as the beneficiaries face similar struggles and will, therefore, benefit from similar solutions. By removing the silos that typically exist in researching two similar, but distinct, populations, the potential to expedite research to practice – and increase overall research impact – improves dramatically.

Once the research is developed, and its impact is validated, the next challenge is ensuring it does not remain insulated within a single community. *JMVFH* has the advantage of being multidisciplinary in scope, which allows for variety in content regarding the biopsychosocial well-being of its beneficiaries. The editorial team, with CIMVHR's help, has worked hard to develop relationships with leading experts across the globe, bringing not only a uniquely Canadian perspective to the journal's pages but a growing international one as well. With the amount of research about military and Veteran families steadily increasing, *JMVFH* aims to capitalize on this as a new method of knowledge mobilization.

According to Lynda Manser's Info Brief (Pg. 12), "Fast facts on Canadian military families," there were approximately 37,000 spouses and 60,000 dependent children of 66,000 Canadian Armed Forces (CAF) Regular Force members in 2017. These families face unique challenges related to deployments, other operational absences, and emergency childcare requirements. Parental service can sometimes have a detrimental effect on young adults, as discussed by Victoria Williamson in her article (Pg. 106), "Youth offending in military-connected children." While the association between military connectedness and youth offending

is not clear-cut, Williamson's research shows military-connected children – particularly those with a deployed parent – report significantly more school-based physical fighting, gang membership, and weapons-carrying than civilian children.

Alla Skomorovsky's article, "Military to civilian transition challenges, caregiving activities, and well-being among spouses of newly-released Canadian Armed Forces Veterans," on Page 14 explains that the struggle for families does not end after service. Approximately 4,500 Regular Force members release from the CAF annually, resulting in challenges for their spouses related to caregiving, daily stress, and psychological distress. Left untreated, mental health problems of Veterans' spouses can impact the entire family. Dalal Alhomaizi's article (Pg. 26), "Adapting group interpersonal psychotherapy (IPT-G) for treating depression among military spouses at Naval Medical Center Portsmouth (NMCP): Formative qualitative phase," explains that the many interpersonal challenges faced by military spouses are the same problem areas that are treatment targets of IPT-G. This, therefore, increases the potential for engagement and a sense of compatibility with the treatment.

By ensuring *JMVFH* content is well written, high-quality research that is easily accessible, broadly communicated, and relevant to end-users (i.e., military members, Veterans, and their families), it is likely to be shared not only among members of the beneficiary population but also disseminated beyond this collective and into personal support networks and circles of care. Military and Veteran families are an ideal catalyst for knowledge mobilization, as they have already built the infrastructure – via welcome and resource centres, social media groups, neighbourhood gatherings, deployment support groups, and so on – and share a common bond as part of a special and exclusive community. The more a particular piece of research resonates with a person, the more likely they are to share it with others who may also benefit from its wisdom. Often, this key form of knowledge translation happens at the primary care level, where individual patient trust is high, and treatment is most frequent. Researchers are likely unaware of how frequently this occurs because they are largely invisible to the process. It does, however, speak to the purest form of impact, which is a researcher's ability to change the lived experiences and health outcomes of individuals.

JMVFH has a duty to advocate for its beneficiaries and a goal to ensure the content on its pages is viewed by as many people as possible in order to improve the timely recognition and treatment of issues and illnesses affecting the military, Veteran, and family health community.

Stéphanie A.H. Bélanger, CD, PhD, and
David Pedlar, PhD
Co-Editors-in-Chief, JMVFH

Expediting research to practice for maximum impact

Nora Spinks[a], Sanela Dursun[b], Jitender Sareen[c], Lacey Cranston[d] and Nathan Battams[a]

INTRODUCTION

At the 2019 Canadian Institute for Military and Veteran Health Research (CIMVHR) Forum on October 19, 2019, in Gatineau, QC, over 750 people who study, serve, or support serving military personnel, Veterans, and their families gathered for the Opening Plenary, "Investing in Impact: The Role of Research in the Lives of Military Members, Veterans, and their Families." The panel consisted of Dr. Sanela Dursun, Director of Research, Personnel and Family Support Research Division, at Director General Military Personnel Research and Analysis (DGMPRA), Dr. Jitender Sareen, CIMVHR Fellow and Head of the Department of Psychiatry at the University of Manitoba, and Lacey Cranston, Managing Editor of the *Journal of Military, Veteran and Family Health* (*JMVFH*), the official scholarly publication of CIMVHR. The panel examined how scholars, policy-makers, granting agencies, lawmakers and service providers define, measure, and communicate research to expedite research to practice to ensure maximum impact.

IMPACT: AN OVERVIEW

Impact is, ultimately, what research is all about. For stakeholders to be confident that they are making evidence-informed decisions, developing evidence-based policies and programs, and creating or scaling evidence-inspired innovation, they require access to reliable, unbiased, rigorous research. Some research has high visibility and monumental, high-profile impact – such as the discovery of insulin. Other research has incremental impact, with quick but powerful leaps based on new information, insights, or methods, such as the treatment for posttraumatic stress disorder (PTSD). For some research, the impact is gradual and incremental, slowly and steadily increasing understanding in an evolutionary manner through organic steps over a period of time. This impact is typically low-profile, garnering few headlines – such as studies about reducing the negative consequences of frequent moves on a military child's education, or a military teen's ability to form attachments and develop friendships.

Impact is diverse, complex, and multi-faceted, and so is measuring impact. Impact can be felt by individuals, families, service providers, communities, and society. Metrics and measurements are not always clear or simple. Impact can be direct or indirect. Impact can be immediate, or it can take place over time – sometimes both. Regardless, developing the right methodologies, metrics, and measures in order to understand impact is critical to reducing the gap between knowledge generation and application.

UNDERSTANDING THE "KNOW–DO GAP"

In medical research, it has been estimated that, on average, the development of health interventions takes approximately 17 years to go from discovery to application.[1] This "know–do gap" or delay in research to practice can be a result of siloed relationships, inaccessible communication, limited distribution of results, or limited access to scholarly journals. Several factors play a role in shaping the degree to which research has impact, such as its reach (number of people/organizations who learn as well as their decision-making capacity) and the pace at which it informs policies, programs, and practices – sometimes referred to as the "knowledge to practice gap."

The Opening Plenary panel discussed how research that aims to have a positive impact on policies, programs, and practices benefits from maximizing its reach among those who serve or support military and Veteran families. While estimates vary widely on the

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proportion of unread or uncited studies, a great deal of quality, peer-reviewed research does not make it far beyond its original source of publication.[2,3] This is largely due to availability, accessibility and relevance. Communication strategies may be limited to peer-reviewed publications and academic conferences. Knowledge mobilization strategies often rely on open access scholarly reports. Frequently, information does not reach lawmakers, policy-makers, granting agencies or service providers in a timely manner.

With an increasing emphasis on proving return on investment (ROI) for research funds, addressing the "know–do gap" now, more than ever, is critical. Validating the impact of research is becoming an increasingly essential part of the scientific investigative process in Canada, as is evidenced by the implementation of a knowledge translation component of grant awards provided by the Canadian Institutes of Health Research (CIHR) approximately 15 years ago. Impact is no longer an afterthought for investigators and presenting findings at conferences or publishing papers is no longer enough. Research projects regularly include a requirement to demonstrate impact, as well as stand out from the crowd by developing meaningful, relevant, applicable, scalable – and sometimes marketable – solutions.

THE IMPACT OF PERSONAL STORIES

Cranston's spouse is a retired Royal Canadian Air Force (RCAF) pilot with PTSD who recently navigated a medical release after 15 years of service. She discussed how impact, in the lives of military family members, often does not occur by way of big changes like policy amendments or new treatment protocols. It usually happens on a more intimate and individual level. When researching her husband's condition, Cranston came across an article written by Sareen, entitled "Posttraumatic Stress Disorder in Adults: Impact, Comorbidity, Risk Factors, and Treatment."[4] The article resonated with her because her husband's PTSD did not develop following combat, or as a result of a single traumatic event. It resulted from his daily duties, largely during the time he was a flight instructor. Sareen's study was the first paper Cranston found that specifically stated, "PTSD can be brought on by an accumulation of multiple exposures to various traumatic events." It also explained that PTSD symptoms can begin to manifest several months, or years, following those events, and confirmed that not everyone afflicted with PTSD begins experiencing symptoms immediately after a traumatic occurrence.[4]

Sareen's paper marked the first time Cranston recognized her husband – his experience, his illness trajectory, his daily struggles – in print. She immediately showed the paper to her husband, who responded with relief and a feeling of validation for the first time since his diagnosis. Seeing his experience in writing, in a legitimate scientific journal and written by a medical expert, was the authentication that Cranston's husband needed to move forward and accept that his illness was significant, debilitating, and recognized by professionals. It brought him comfort, knowing there were researchers studying how to make his life better. Because of this experience, Cranston shared Sareen's study with friends and family and those in her PTSD support groups. They, in turn, passed it on to others, as they also found the information valuable.

Sitting next to Cranston on the Opening Plenary panel, listening to her story, was study author Sareen. Prior to that day, he was unaware of the impact his work had on this small section of the Canadian military community. Sareen is not alone; the connection between researchers and those impacted by their work is often elusive, complex, and difficult to track. Knowledge mobilization that happens by chance, as in Sareen and Cranston's story, occurs almost daily, with most researchers being blind to the process.

THE IMPACT OF RESEARCH ON FAMILIES AND CAREGIVERS

For family, friends and caregivers of military members and Veterans with PTSD and other mental and physical injuries, information sharing occurs through unofficial spousal and family support networks. These networks are typically comprised of groups that meet in person or through social media (i.e., Facebook). Members often spend hours of their own time on the Internet searching sites like PubMed and reading medical journals to find the latest information on treatment protocols, research breakthroughs, and physicians and clinics in their area accepting new patients.

When they discover a useful article or information, group members readily share it with others so someone else may benefit. For example, Cranston told the audience Dr. Domenic Murphy's article, "Living alongside military PTSD: a qualitative study of female partners' experiences with UK Veterans,"[5] was shared and re-shared approximately 60 times in three different support groups after it was published in issue 3.1 of the *JMVFH* in 2017. She believes the article's popularity

was due to the fact it resonated with spousal caregivers because the comments by the UK partners were relatable and powerful. The study validated the experiences of many group members, with respect to relationship inequality, loss of personal identity and barriers to accessing support.[5]

Sharing useful articles and information also provides group members with strong, evidenced-based material that often has clinical applications. Scientific data shared among members is often also provided to primary care providers, psychologists, social workers and other health professionals. This can have a positive impact on their treatment and on the patient experience. This form of knowledge mobilization has a significant impact on individuals and their families and helps to further disseminate research at a grassroots level. Researchers are likely unaware of the impact this form of knowledge mobilization has, as it is difficult to capture or track. Knowledge transfer, at the primary care level, is key, however, as this is often where patient trust is high, and contact is most frequent.[6]

CULTIVATING RESEARCH RELATIONSHIPS ACROSS DISCIPLINES TO MAXIMIZE IMPACT

Research shows the high mobility associated with military life can affect multiple domains of family life associated with wellbeing, including health care,[7] educational experiences,[8] family finances,[9] and spousal employment and career development.[9]

> "*I have been attending the CIMVHR conference annually over the last 9 years, and had the opportunity to network with scientists, policy-makers and partners. These partnerships have led to success in research grants and contracts nationally. This conference certainly has accelerated the impact of research work on policy and practice.*" — Jitender Sareen

Calian Health and Military Family Services (MFS), in collaboration with CIMVHR and The Vanier Institute of the Family, formed a collaboration to expedite research to practice by making military and Veteran family research available, accessible and applicable to maximize impact. Leveraging the relationship between the respective organizations, the Innovation to Impact initiative builds awareness, facilitates communication, and provides targeted information to health care providers and military families through the Calian Military Family Doctor's Network.[10]

Launched in 2018, Innovation to Impact expedites research to practice by facilitating knowledge transfer from researchers to clinicians and health care teams. The success of the initiative is a result of the history of successful partnerships between the collaborators, a focus on organizational expertise and strengths, mutual respect, trust in the scholars, and support for family doctors in the network.

Comprised of individuals and organizations from industry, government, not-for-profit, and academia, the Innovation to Impact working group was created to leverage the expertise within these organizations to translate research into evidence-based reference guides designed to increase military cultural awareness among health care providers serving military families.

The Life After Service Study (LASS) is another example of collaborative research making an impact in a timely manner. LASS partners are Veterans Affairs Canada (VAC), the Department of National Defence (DND), Canadian Armed Forces (CAF) and Statistics Canada. This longitudinal research examines the transition from military to civilian life, assessing Veteran health and wellbeing over time. The LASS helps ensure VAC and DND programs and services are meeting needs and improving the health of Veterans in Canada.

One key impact has been the development of the screening tool for CAF members transitioning to civilian life. Based on data collected since 2010, questions were developed that can predict a Veteran's ability to adjust to civilian life. As of January 2019, approximately 10,000 people have been screened. The wellbeing framework, developed with an expert panel hosted by CIMVHR and other contributors, has since been adopted by VAC and DND.

ACCESS AND ENGAGEMENT MATTER

Dursun discussed how DGMPRA develops and nurtures relationships with societies and alliances nationally and internationally and facilitates the appropriate use of the best available research evidence for decision-making. DGMPRA has a mandate to conduct strategic and operational personnel research and analysis and is comprised of military researchers and civilian defence scientists. It provides an integrated personnel research program to the CAF and DND, as well as scientific advice to support evidence-based strategic and operational decision-making (e.g., human resource policies and programs). The DGMPRA research program is formulated through an annual call for research proposals that are

distributed to organizations within DND/CAF, to ensure they are addressing current research priorities.

The DGMPRA Military Family Research Program contributed to the development of the Comprehensive Military Family Plan (CMFP).[11] Developed by Canadian Forces Morale and Welfare Services (CFMWS), this action plan aims to "help stabilize family life for CAF members who constantly face the unique demands and conditions of military lifestyle including frequent relocations,"[11] Elements of the CMFP was informed by evidence generated through DGMPRA research. While impact is tracked and reported, it is not done systematically. DGMPRA is currently developing formal measurement metrics that will include a survey of clients and stakeholders and questions about key indicators of impact, such as timeliness of response, quality of research provided and focus of future studies.

The impact of DGMPRA research takes other forms, as well, such as when scientists provide testimony at Parliamentary and Senate Committees and engage lawmakers and policy-makers in dialogue during question and answer sessions, which can influence evidence-informed decision-making.

INTENTION AND ATTENTION MATTER

Sareen and Dursun spoke about the need to be intentional about the impact of research when conducting investigations. Researchers who aim to change or enhance policy may require a focal approach, such as conducting systematic reviews or engaging policy-makers and fellow researchers at events like the CIMVHR Forums. Those who aim to increase knowledge and impact practitioner behaviours, however, may prefer to engage in additional training or capacity building. It is important to design research that intentionally engages end-users (i.e., patients, family members, policy-makers, and others) from the beginning. Canada has been a leader in this regard, promoting and facilitating engagement and interaction between researchers and knowledge users.

Compared to measuring individual health outcomes, it can be difficult to determine what impact, if any, a research project has on an individual's beliefs or decisions. Investigators and research organizations often find out by happenstance if, for example, study results are included in presentations or discussions by decision-makers. Sometimes, the impact is indirect, such as when a study on recruitment and retention was used to support the creation of a mentoring program for women in defence. Although this kind of impact is important

to understand and measure, it is complex and hard to track. Research is one of many factors that contribute to decision-making. It intersects continuously evolving organizational, social, and political contexts, and this must be considered when distilling the effect of science and research.

PERSPECTIVE MATTERS

How impact is defined, measured and communicated depends on an individual's perspective, whether they are a funder seeking to determine ROI, a researcher demonstrating the value of their work, or an individual wanting to benefit from the best available information, all define impact differently. Historically, academics defined and measured impact by tracking publications in peer-reviewed journals, citations by other authors, invitations to present at conferences and receipt of funding for further research. Clinical researchers measure impact of pharmaceuticals, medical devices, and treatment protocols against rates of recovery. Measuring the efficacy of a drug or treatment protocol demonstrates impact on a patient's health outcome or quality of life. Epidemiologists measure impact by tracking the incidence or distribution of disease. Defining impact of social research is typically more complicated. For policy-makers, public health professionals and service providers, the complexity of determining impact on individual beneficiary and patient populations (i.e., military members, Veterans, and their families) can take several years. Data collection is challenging, and useful, relevant patterns are slow to emerge.

The panel stressed that information gleaned from researching the military, Veteran, and family populations should not remain siloed within this community. It is imperative that investigators leverage all available means, such as continuing medical education events, mainstream media, social media, conferences, and academic journals, to improve the recognition of issues and illnesses affecting this patient population, regardless of where they seek treatment.

FOUR DRIVERS OF RESEARCH IMPACT

There are four main drivers of impact for modern researchers: (1) The regular publication and presentation of new research in academic journals and at research-focused conferences and events. Publication and presentation of findings allows for the advancement of ideas; (2) The peer review process and peer-reviewed grants. Researchers must be tenacious and persevere through

the peer review process; (3) Personal contact between researchers and decision makers to facilitate science policy integration, which is key, along with timely relevance, the inclusion of summaries with policy recommendations (integrated and comprehensive advice to policy-makers), and ensuring that scientists are rewarded and recognized for the impact of their research; and (4) Mentoring of the next generation of scientists and knowledge users. This is perhaps the most important driver, from a longevity and generational perspective.

For the foreseeable future, certain constants will remain in academia with regard to measuring impact. The number of articles an investigator publishes, the number of citations a study receives, and the impact factor of the journal in which a study is published will remain important metrics for researchers to track. However, research and knowledge translation will continue to evolve, and the conception and measurement of impact will adapt and react in response.

The emergence and growth of online platforms for communicating and sharing research – as well as the development of consortia such as the Veterans and Families Research Hub – are only the beginning. There is an opportunity to regularly re-evaluate and redefine impact as it pertains to research, to continue to advance the field of scientific investigation, and to meet the needs of the military, Veteran, and family health population.

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AUTHOR INFORMATION

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COMPETING INTERESTS

None declared.

CONTRIBUTORS

Authors Spinks, Dursun, Sareen, and Cranston were panelists at CIMVHR Forum 2019. Spinks and Battams drafted the paper summarizing the panelist contributions.

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IN GRAPHICS

Canadian military family demographics

Lynda Manser, Canadian Forces Morale and Welfare Services

The Comprehensive Military Family Plan originated as part of the 2017 Government of Canada's Defence Policy and is intended to be a Joint Action Strategy to enhance the experiences of Canadian Armed Forces (CAF) members and their families. To inform the development of the Comprehensive Military Family Plan, it was essential to understand the scale of the issues facing military families by determining who they are and where they live. Canadian Forces Morale and Welfare Services analysed various military family personas using demographic data compiled by Chief Force Development[1], a summary of which follows.

KEY POINT 1

THE TOTAL NUMBERS

Demographic data detailed here is from August 2017. As military families frequently change – relocating due to postings, marrying, separating, having children, etc., – the information reflects a specific point in time. Minor daily fluctuations will occur. Demographics apply only to Regular Force personnel and their families currently posted in Canada. They do not include those posted outside of Canada or families of Reserve Force members.

Figure 1: 2017 Demographics of Military Families Posted in Canada

PROFILE OF MILITARY FAMILIES POSTED IN CANADA

DEMOGRAPHICS 2017

63,270 Regular Force Personnel

34,910 Spouses

57,640 Children
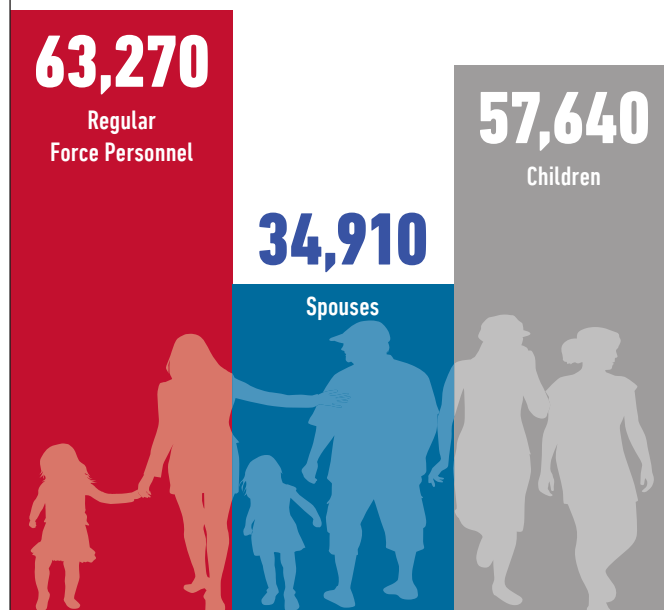
KEY POINT 2

AGE, MARITAL AND PARENTAL STATUS

More than half of Regular Force personnel posted in Canada are under the age of 35. More than half are married or in a common-law relationship. Almost half have children. CAF members aged 30-34 have the most 0 to 5-year-olds. Deployments and repeated operational tempo-related absences can affect this age group (e.g. emergency child care requirements, parentchild attachment).[2] Regular Force personnel aged 40-44 have the most adolescents. When relocating, adolescents may struggle more socially and academically.[3]

54% of RegF in Canada are under the age of 35 or have served 10 years or less

42% of all spouses are under the age of 34

● Average age of RegF with children aged 0–5 is 30–34 (33%)
● Average age of RegF with children aged 6–12 is 35–39 (34%)
● Average age of RegF with children over 13 is 40–49 (33%)
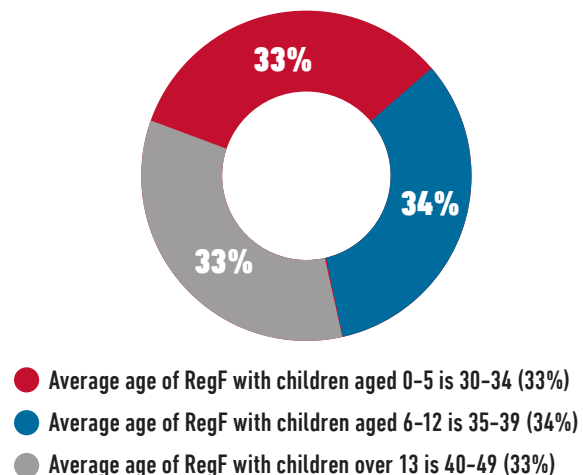
Figure 2: Ages of Military Family Members Posted in Canada

MARITAL STATUS

8%

36%

56%

- Single with dependants
- Single without dependants
- Married / common-law

44%
of all RegF posted in Canada are single
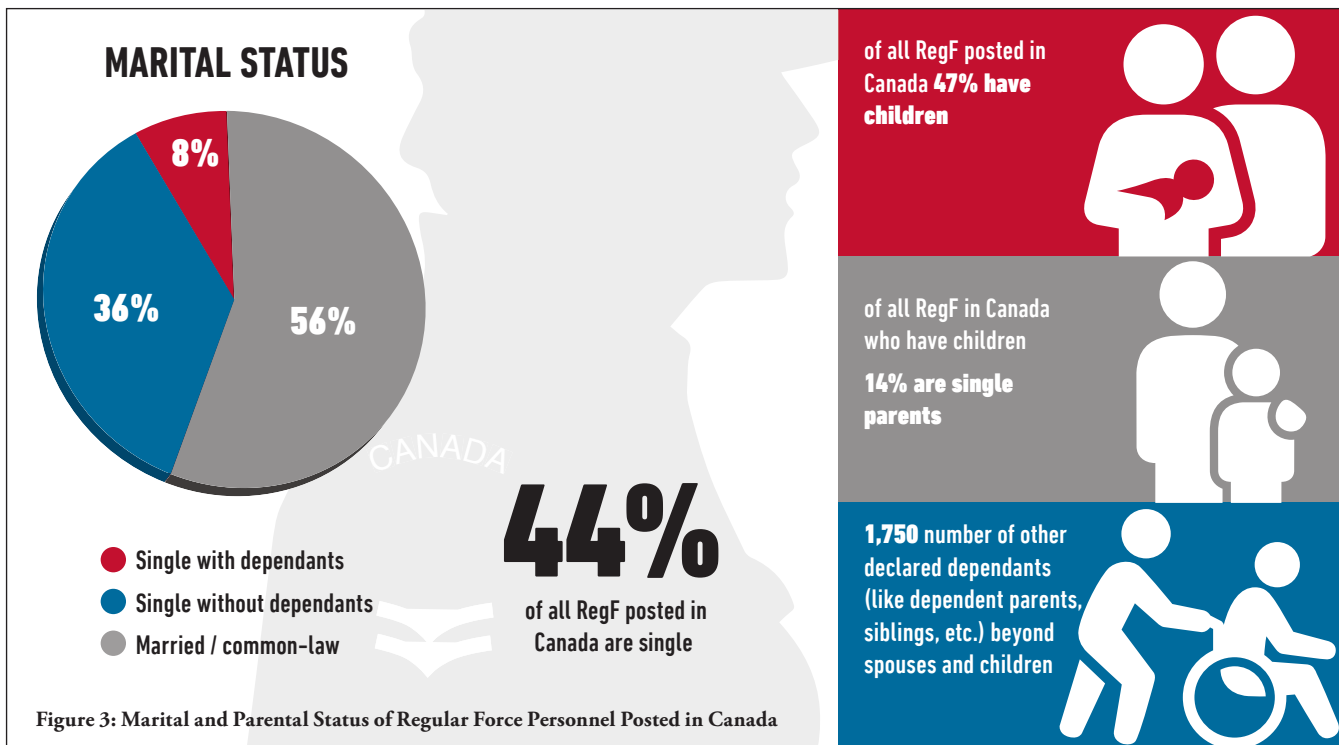
Figure 3: Marital and Parental Status of Regular Force Personnel Posted in Canada

of all RegF posted in Canada **47% have children**

of all RegF in Canada who have children **14% are single parents**

1,750 number of other declared dependants (like dependent parents, siblings, etc.) beyond spouses and children
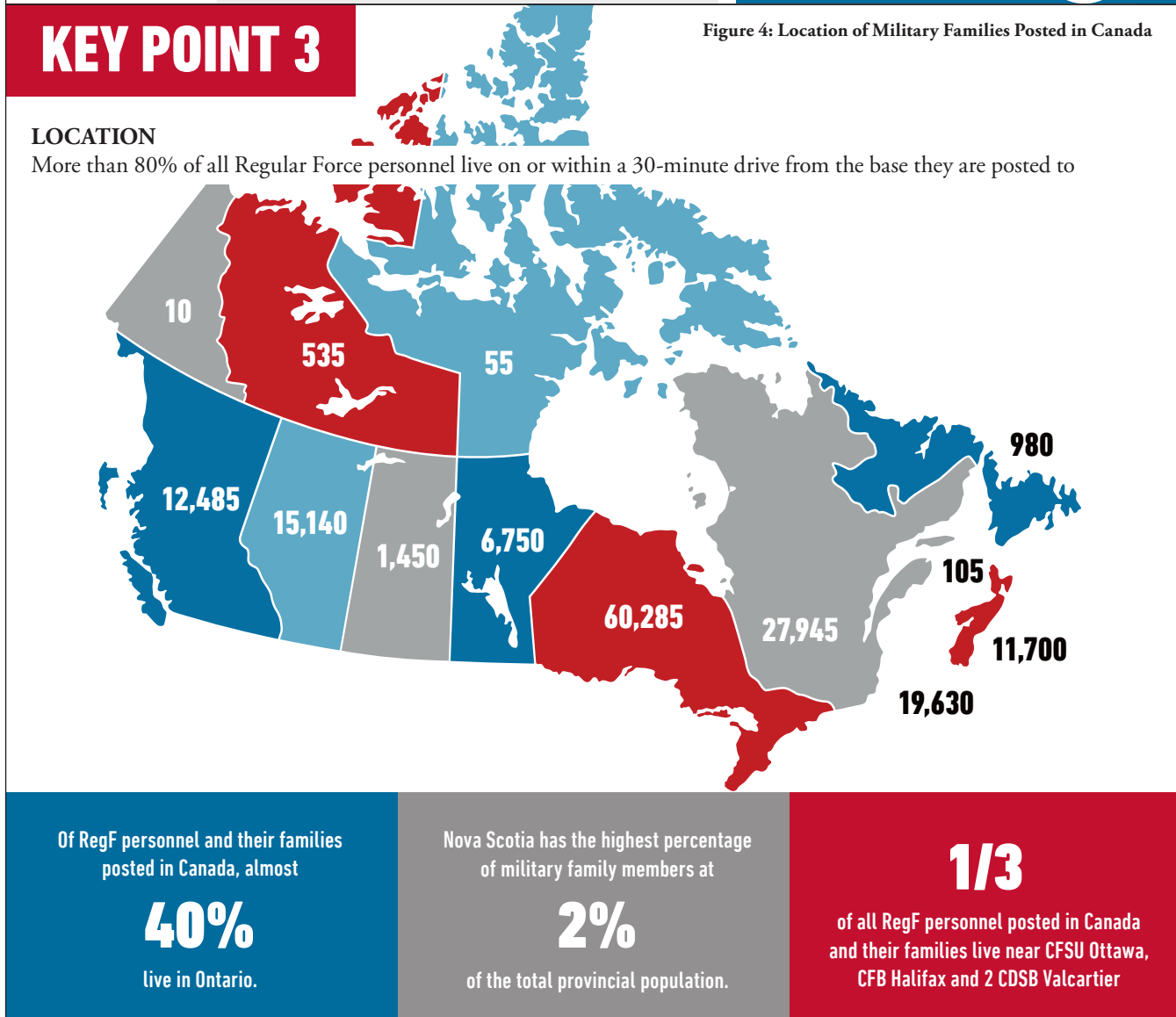
KEY POINT 3

Figure 4: Location of Military Families Posted in Canada

LOCATION
More than 80% of all Regular Force personnel live on or within a 30-minute drive from the base they are posted to

10

535

55

980

12,485

15,140

1,450

6,750

105

60,285

27,945

11,700

19,630

Of RegF personnel and their families posted in Canada, almost

40%

live in Ontario.

Nova Scotia has the highest percentage of military family members at

2%

of the total provincial population.

1/3

of all RegF personnel posted in Canada and their families live near CFSU Ottawa, CFB Halifax and 2 CDSB Valcartier

KEY POINT 4

GENDER

A higher proportion of female RegF members are single parents, caring for a disabled child or caring for an elderly parent compared to the total RegF proportional female to male ratio (15% : 85%). Further investigation would provide insight into these gender differences as compared to the civilian population.

Figure 5: Gender of Regular Force Posted in Canada in Relation to Family Types

RegF with children — Male 85%, Female 15%

RegF who are single parents — Male 76%, Female 24%

RegF with a disabled child — Male 72%, Female 28%

● Male ● Female

Single — Female 18%, Male 11%

Married to a civilian — Male 80%, Female 29%

Married to RegF/ResF — Female 53%, Male 9%

■ Male ■ Female
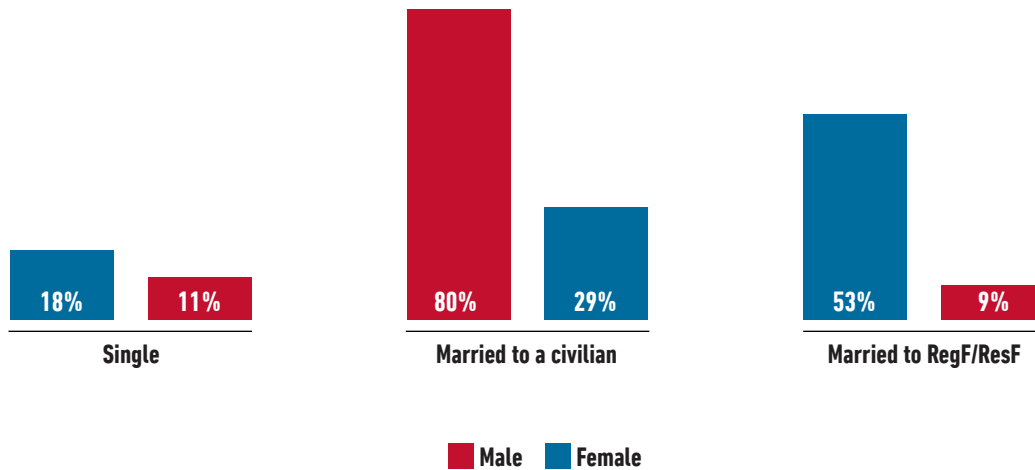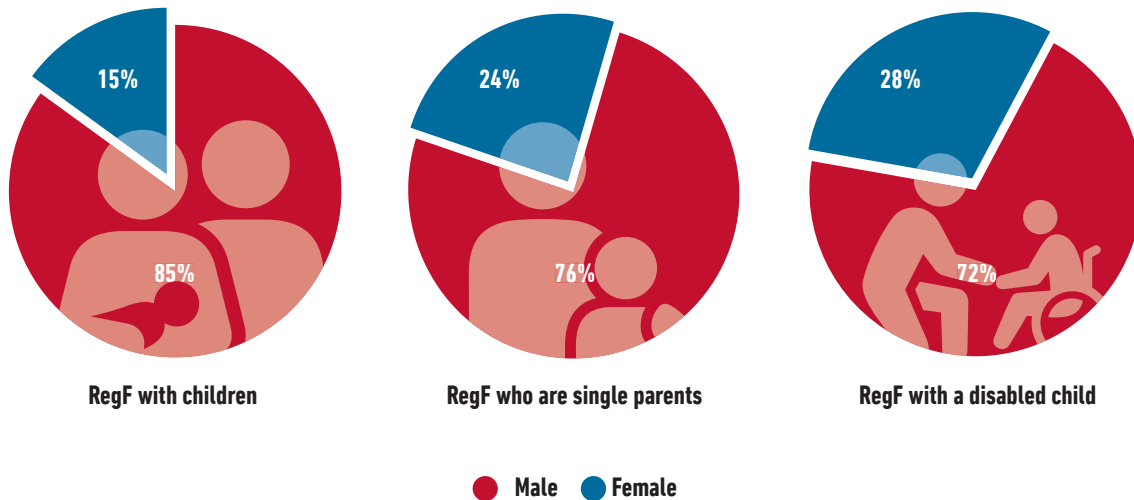
Female RegF members are much more likely to be in a legal relationship with another CAF personnel than their male counterparts

For more than half of all female RegF members, their family context is much more immersed in the military culture and reality, which may impact their eventual transition to Veteran status as a civilian, given neither partner may have spent much time in the "civilian" culture.

The full demographics report on Regular Force personnel and their families can be found at www.cafconnection.ca/cmfp[4].

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COMPETING INTERESTS

None declared.

DISCLAIMER

CONTRIBUTORS

The author conceptualized, designed, researched, and drafted the article and approved the final version submitted for publication.

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INFO BRIEF

Fast Facts: Canadian military families

Lynda Manser, Canadian Forces Morale and Welfare Services

Military families are the strength behind the uniform, but who are they? How many are there? What challenges do they face? What do they require to be resilient? The Comprehensive Military Family Plan originated as part of the 2017 Government of Canada's Defence Policy. It was intended to be a Joint Action Strategy to enhance the experiences of Canadian military members and their families. To inform the development of the Comprehensive Military Family Plan, a scoping review was conducted to better understand the issues facing Canadian military families[1]. This review and synthesis of approximately 100 Canadian reports from 2008 through 2018 summarized the following key findings:?

1 DEMOGRAPHICS[2]

There are approximately ? 66,000 Regular Force ? members, 37,000 spouses ? and 60,000 dependent ? children. Half of all Regular ? Force members are in a legal ? relationship and/or have ? children. Approximately ? 4,000 Regular Force ? members are single parents. ? 1 out of 2 Regular Force members posted in Canada is under the age of 35. 1 out of 2 has served in the military for less than 10 years. A third of all Regular Force members?and their ? families posted in Canada live near CFSU Ottawa, CFB Halifax and 2 CDSB Valcartier.

2 THREE MOST COMMON MEMBER JOURNEY CHALLENGES[3]

A member's typical military ? journey sometimes causes ? repeated and unavoidable ? challenges for the family. Career postings require geographic relocations, with approximately 10,000 families moving every year. Operational requirements demand that almost two-thirds of military members? spend time away from their families in varying frequencies and lengths. In a smaller number of cases, a? military career can result in illness, injury or death. These challenges can negatively affect family resilience.

3 THREE MOST COMMON FAMILY JOURNEY CHALLENGES[4]

Military families are also just families, and all families experience? journeys involving transitions and challenges. The review of research literature revealed three common challenges facing Canadian military families: 1) Approximately? 1 in 4 experience issues? with personal wellbeing and mental health; 2) ? About 1 in 10 families deal with financial stress; 3) ? Approximately 1 in 10 ? experience strain in their ? intimate partner ? relationships.

4 FAMILY RESILIENCE[5]

Resilience speaks to a? family's ability to respond positively to an adverse situation and emerge feeling stronger, more resourceful and more confident. Canadian research suggests? 4 out of 5 military families are resilient and supported within a healthy Canadian Armed Forces community. Further, 9 out of 10 believe they successfully meet the overall responsibilities in their lives. However, 1 in 10 feel they are not successfully meeting the challenges of a military family lifestyle and need additional supports to access systems of care.

5 SUPPORTS FOR MILITARY FAMILIES[6]

Only 1 in 3 spouses of Regular Force members believe the military looks after families. Another 1 in 3 spouses said the military does not look after families, while the remaining ?1 in 3? was neutral. Few families use services offered by the military or through Military Family Resource Centres. Those who did were satisfied with services received and believed they were of benefit.

The development of military services for families is informed by the current needs of families, as evidenced through this research synthesis, combined with the demographics of Canadian military families and evidence-based models of wellness and resilience. Ultimately, families will be more aware of, and able to advocate for, services that are available and aligned with when, where and how they need them.

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Military to civilian transition challenges, caregiving activities, and well-being among spouses of newly released Canadian Armed Forces Veterans

Alla Skomorovsky[a], Heather J. McCuaig Edge[a,b], Jennifer E.C. Lee[a], Cynthia Wan[a] and Sanela Dursun[a]

ABSTRACT

Introduction: Transition to civilian life may not only be highly challenging for service members, but also for their spouses, especially following a medical release. Often, the families of ill or injured service members must confront unexpected responsibilities related to caring for the member, while having to adjust to civilian life. This study was conducted to examine military to civilian transition challenges and engagement in caregiving among spouses of newly released Canadian Armed Forces (CAF) Veterans and their associations with spousal well-being. **Methods:** The Canadian Armed Forces Transition and Well-Being Survey (CAFTWS) was administered to spouses of CAF Veterans released in 2016 (N = 595). The survey assessed spouses' experiences with a range of military to civilian transition challenges and engagement in caregiving, as well as various indicators of their well-being (e.g., daily stress and psychological distress). Regression analyses were conducted to assess the associations of transition challenges and caregiving with well-being. **Results:** Results revealed that challenges related to finding educational opportunities and health care providers, and loss of military identity, as well as more frequent engagement in caregiving, were significantly associated with elevated levels of daily stress and psychological distress among spouses of Veterans. **Discussion:** This study is among the first to examine transition experiences, caregiving and well-being in a representative sample of Veterans' spouses. Findings outline key challenges experienced and underline important predictors of well-being. Recommendations on services that could help facilitate or improve the experiences of families during the transition process are discussed.

Key words: caregiving, military identity, military spouses, military to civilian transition, spousal well-being, Veterans, Veterans' caregivers

RÉSUMÉ

Introduction : La transition à la vie civile peut non seulement être un énorme défi pour les membres des forces armées, mais également pour leur conjoint ou conjointe, surtout lorsque la libération a lieu pour des raisons médicales. Souvent, les familles de membres des forces armées qui sont malades ou blessés doivent affronter des responsabilités inattendues à l'égard des soins, tout en devant s'adapter à la vie civile. La présente étude a été réalisée pour examiner les difficultés liées à la transition de la vie militaire à la vie civile, la participation des conjoint(e)s aux soins des vétérans des Forces armées canadiennes (FAC) qui viennent d'être libérés et l'association de ces facteurs avec le bien-être des conjoin(e)ts. **Méthodologie :** Les conjoint(e)s des vétérans des FAC libéré(e)s en 2016 ont participé à l'Enquête sur la transition à la vie civile et le bien-être après le service dans les Forces armées canadiennes (ETBFAC) (n=595). L'enquête a évalué les expériences des conjoint(e)s à l'égard d'une série de difficultés liées à la transition de la vie militaire à la vie civile et à la participation aux soins, ainsi que de divers indicateurs de bien-être (p. ex., stress quotidien et détresse psychologique). Des analyses de régression ont permis d'évaluer les associations entre le bien-être, les difficultés de la transition et les soins. **Résultats :** Les résultats ont révélé que les défis à trouver des occasions de formation et un professionnel de la santé, la perte de l'identité militaire et la participation plus fréquente aux soins avaient une corrélation significative avec des taux élevés de stress au quotidien et la détresse psychologique chez les conjoint(e)s des vétéran(e)s. **Discussion :** Cette étude est l'une des premières à se pencher sur les expériences de transition, de soins et de bien-être auprès d'un échantillon représentatif de conjoint(e)s de vétérans. Les résultats font ressortir les principales difficultés, de même que

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les prédicteurs importants du bien-être. Des services sont recommandés pour faciliter ou améliorer les expériences des familles pendant le processus de transition.

Mots-clés : bien-être des conjoint(e)s, détresse des conjoint(e)s, conjoint(e)s militaires, transition de la vie militaire à la vie civile, vétéran(e)s militaires, identité militaire, soins des vétérans

INTRODUCTION

Over 4,500 Regular Force members are released from the Canadian Armed Forces (CAF) annually, of which approximately 60% are married and almost half have children under the age of 18 years.[1] While there has been a growing number of studies on Veterans' experiences with military to civilian transition,[1–4] to date, limited research has investigated military to civilian transition from the perspective of the family members of Veterans, and its impact on their well-being. However, it is recognized that "the transition from military to civilian life is not done in isolation – the entire family unit is affected."[5(p.5)]

While about one-third of Veterans report experiencing a difficult adjustment to civilian life following transition from the military, evidence suggests the rate may be particularly elevated among Veterans who are medically released.[6] In some cases, these Veterans may have been released due to combat-related injuries, or a variety of combat-related psychiatric conditions or illnesses, such as traumatic brain injuries, polytrauma (and amputations), posttraumatic stress disorder or major depression.[7–9] Research has shown that families play a particularly important role in supporting Veterans who suffer from operational stress injuries.[5] Relatedly, spouses of medically released Veterans may encounter a number of added challenges during the military to civilian transition, including navigating health care and support systems to access their own benefits and services and relocating to access treatment facilities.[10] Other examples include financial strain due to loss or reduction of income, social isolation, inability to exercise self-care and difficulty managing the stress of added daily responsibilities, such as childcare, household chores and caring for an ill and/or injured Veteran.[11–14] In addition to such challenges, research has shown that additional caregiving responsibilities placed on the family due to a Veteran's illness or injury can negatively impact family well-being.[8] Family members may find themselves having to provide the Veteran with care and support because of their health condition, regardless of whether or not they are being medically released. Along with adjusting to civilian life, these additional responsibilities

have been found to cause a considerable amount of stress for Veterans and their families, affecting the overall family unit and spousal relationships.[11,15–18]

Although many military organizations provide support to Veterans and their families through various means, spouses typically assume the majority of the responsibility for providing care and assistance to their partners. A Veteran's reliance on a spouse for emotional, cognitive, and physical support has been found to contribute to psychological distress and caregiver burden.[11,12,19–22] Likewise, numerous studies have noted that spousal caregivers may experience a variety of physical, emotional, financial, and social challenges.[11,12,14,19,23–28] A recent qualitative study with spouses of soon-to-be, or recently released, CAF Veterans found that a Veteran's illness or injury negatively affected their spouse's psychological well-being and social and interpersonal relationships, and contributed to perceived caregiver burden.[13]

Together, the studies reviewed above underline some of the challenges that Veterans' spouses may encounter during their partners' military to civilian transition and emphasize the impact that caregiving may have on the overall well-being of spouses. However, the extent to which perceived military to civilian transition challenges and caregiving may impact well-being among Veterans' spouses has yet to be fully assessed. The Canadian Armed Forces Transition and Well-Being Survey (CAFTWS) was conducted in 2017 to address this gap. As part of the survey, spouses or partners living with a representative sample of newly released CAF Veterans were invited to complete a questionnaire on their perceptions of various military to civilian transition challenges, their provision of care and support, well-being, and their use of transition support programs and services. Through an analysis of the CAFTWS, the first objective of the present study was to examine perceived military to civilian transition challenges and engagement in caregiving among spouses or partners of newly released CAF Veterans. The second objective was to examine the associations of perceived transition challenges and caregiving, in combination, with various indicators of spousal well-being.

METHODS

Survey sampling and data collection

The CAFTWS was conducted by Statistics Canada between April 1 and June 30, 2017, under the provisions of the *Statistics Act*. Participation was voluntary, and those participating were required to provide informed consent. The first target population for the survey included CAF Veterans released in 2016, with a minimum of two years of service (730 days), excluding Veterans who were released for misconduct or unsatisfactory service. The second target population included spouses or partners (referred to hereafter as "spouses") living with a member of the first target population, who were identified through contact with the Veterans. The CAFTWS employed a stratified systematic random sample of individuals within the first target population. Spouses living with sampled individuals from the first target population were invited to complete the paper-and-pencil CAFTWS spousal questionnaire (70% response rate). The present study was based on this data only.

Survey instrument

The CAFTWS spousal questionnaire was developed by researchers at the Department of National Defence based on a pilot study,[29] with many items drawn and adapted from Statistics Canada surveys, such as the Life After Service Study (LASS)[30] and Canadian Community Health Survey (CCHS),[31] to enable comparisons. Details on items used to assess variables of relevance to the present study are provided below.

Perceived transition challenges

In line with a past study,[32] spouses were provided with a list of 10 items: financial preparation, personal employment, spousal employment, personal educational opportunities, spousal educational opportunities, relocation, health care provider status, understanding of Veterans Affairs Canada (VAC) benefits and services, loss of military identity, and loss of contact with the military community. They were asked to indicate the extent to which they perceived each of the 10 items as challenging during their partner's military to civilian transition on a five-point rating scale (1 = *not at all challenging*, 2 = *a little challenging*, 3 = *moderately challenging*, 4 = *very challenging*, or 5 = *extremely challenging*). They were also given the opportunity to respond with "not applicable." Indicators were created to distinguish spouses who reported each of the items as "very" to "extremely" challenging from other participants.

Caregiving activities

Using a measure adapted from the CCHS Activities of Daily Living module,[31] spouses were asked to indicate on a four-point scale (1 = *never*, 2 = *sometimes*, 3 = *often*, 4 = *always*) the frequency with which they helped their Veteran partner with the following activities because of their physical or mental health condition: meal preparation, everyday housework, heavy household chores, personal care, medical treatments, moving around at home, personal finances, and nursing/medical care. Indicators were created to distinguish spouses who reported engaging in each of the activities "often" or "always" from other participants. A composite caregiving variable was also created, which categorized spouses according to the frequency in which they engaged in any of the activities of daily living. That is, spouses who indicated they never engaged in any of the activities were assigned "not at all." Spouses who indicated they sometimes helped with one or more of the activities were assigned "somewhat." Spouses who indicated they often helped with one or more of the activities were assigned "often," and spouses who indicated they always helped with one or more of the activities were assigned "always."

Daily stress

One item drawn from the CCHS[31] was used to assess daily stress (i.e., "Thinking about the amount of stress in your life, would you say that most days are ...?"). Specifically, spouses were asked to indicate the amount of stress they experienced on most days using a five-point scale (1 = *not at all stressful*, 2 = *not very stressful*, 3 = *a bit stressful*, 4 = *quite a bit stressful*, 5 = *extremely stressful*). A dichotomized indicator was created to distinguish spouses who indicated their daily stress was quite a bit or extremely stressful, from those who indicated that their daily stress was not at all, not very, or a bit stressful.

Distress

Distress was assessed using the 10-item Kessler Psychological Distress Scale (K10),[33] of which each item represents a particular symptom of distress. Using a five-point scale (0 = *none of the time*, 1 = *a little of the time*, 2 = *some of the time*, 3 = *most of the time*, 4 = *all of the time*), spouses indicated the extent to which they experienced each symptom over the past month. The K10 has frequently been used in population health

surveys,[34–35] and has demonstrated good validity in military samples.[36] Total scores are computed by calculating the sum of item ratings, resulting in scores ranging from 0 (lowest level of distress) to 40 (highest level of distress).

Demographic and military characteristics

Demographic characteristics considered in the present study included sex, age (18–29 years, 30–39 years, 40–49 years, or 50 years or more), level of education (less than high school, trade/college education, at least some university), dependents age 18 years and under living in the household (no, yes), and partner's release category (medical release or non-medical release, excluding unsatisfactory service or misconduct).

Participants

A total of 595 spouses completed the CAFTWS spousal questionnaire. Participants were primarily female (88.3%), between the ages of 30 and 49 years (51.6%), and Anglophone (71.3%). Approximately half (47.4%) had one or more dependents living in the household and more than three-quarters had at least some post-secondary education (77.0%). More details on the

Table 1. Demographic characteristics, spouses of CAF Veterans

Socio-demographic characteristics	%	LL (95% CI)	UL (95% CI)
Sex			
Male	11.7	10.1	13.5
Female	88.3	86.5	89.9
Age (years)			
20–29	13.1	10.9	15.8
30–39	22.8	19.9	26
40–49	28.8	25.7	32.2
50+	35.2	32	38.5
Child dependents			
No	52.6	49	56.1
Yes	47.4	43.9	51
Education			
Up to high school	23	20	26.2
Trade/college	40.9	37.4	44.6
At least some university	36.1	32.7	39.7
Employment status			
Employed	68.7	65.3	71.9
Unemployed	3.8	2.6	5.5

(Continued)

Not in the workforce	22.6	19.8	25.6
Other	5.0	3.6	7.0
Veteran's release category			
Non-medically released	47.9	44.2	51.5
Medically released	52.1	48.5	55.8
Years in current relationship			
Less than 5	11.6	9.5	14.1
5 to 9	19.0	16.4	22.0
10 to 14	19.9	17.2	22.8
15–19	11.6	9.6	14.1
20–24	10.3	8.3	12.7
25–29	12.7	10.5	15.2
30 to 34	8.3	6.7	10.3
35+	6.5	5.0	8.4

CI = confidence interval; LL = lower limit; UL = upper limit

demographic, military, and health characteristics of participants are provided in Table 1.

Analyses

Analyses were conducted in Stata using the survey command. The population weight and 1,000 bootstrap weights supplied by Statistics Canada were applied to adjust for non-response and the complex survey design, respectively.

Prevalence estimates were generated to examine the spouses' levels of daily stress and psychological distress, to identify aspects of military to civilian transition perceived as most challenging, and to identify caregiving activities in which spouses engaged most frequently. Unadjusted and adjusted regression analyses were then conducted to examine the extent to which each perceived challenge and caregiving activity was associated with daily stress and psychological distress.

RESULTS

Prevalence estimates

The majority of spouses reported moderate levels of daily stress, indicating most days were not very/a bit stressful (63.4% [95% CI, 60.0%–66.7%]). While few Veterans reported their days were not at all stressful (10.3% [95% CI, 8.5%–12.5%]), over 25% reported their days were quite a bit/extremely stressful (26.3% [95% CI, 23.4%–29.5%]). Based on a cut-off score of 15 for the K10,[37] most spouses demonstrated low levels of psychological distress. Approximately 17.5% (95% CI,

14.9%–20.5%) were identified as exhibiting high psychological distress.

The estimated proportion of spouses who perceived various aspects of their Veteran partner's transition to civilian life as either "very" or "extremely" challenging is presented in Figure 1. Of note, spouses most commonly reported perceived challenges with understanding VAC services and benefits (33.5%), finding a health care provider (22.1%), being financially prepared (21.0%), and the CAF Veteran finding employment (19.8%).

Figure 2 provides estimates for the proportion of spouses who reported engaging in various caregiving activities "often" or "always" because of their Veteran partner's physical or mental health condition. As shown in Figure 2, only a minority of spouses reported engaging in these activities often or always. The proportion of spouses providing a high level of care was greatest for heavy household chores (29.9%), followed by everyday

housework (28.1%), running errands (22.8%), and preparing meals (22.4%).

Regressions

A series of logistic and linear regression analyses were conducted to examine the associations of perceived transition challenges and caregiving activities with daily stress and psychological distress, respectively. In these analyses, the composite caregiving variable was used, rather than the indicators for each caregiving activity. In addition, for these analyses, composite indicators were created by combining pairs of items related to finding employment ("finding employment for yourself" and "your spouse or partner finding employment"), items related to identifying educational opportunities ("identifying educational opportunities for yourself" and "your spouse or partner identifying educational opportunities"), and items related to the loss of military identity ("losing your military
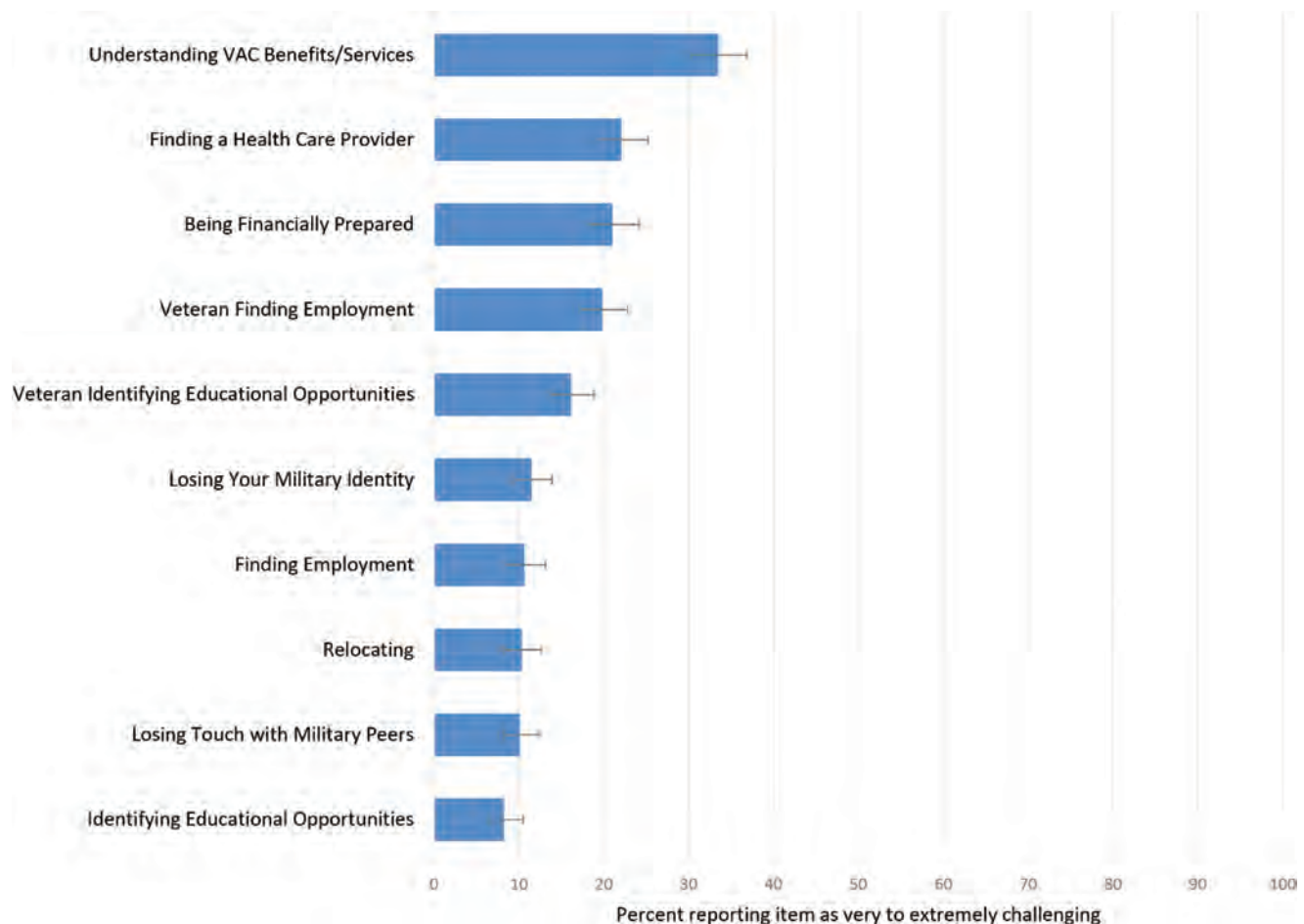

Figure 1. Spouses' perceived military to civilian transition challenges
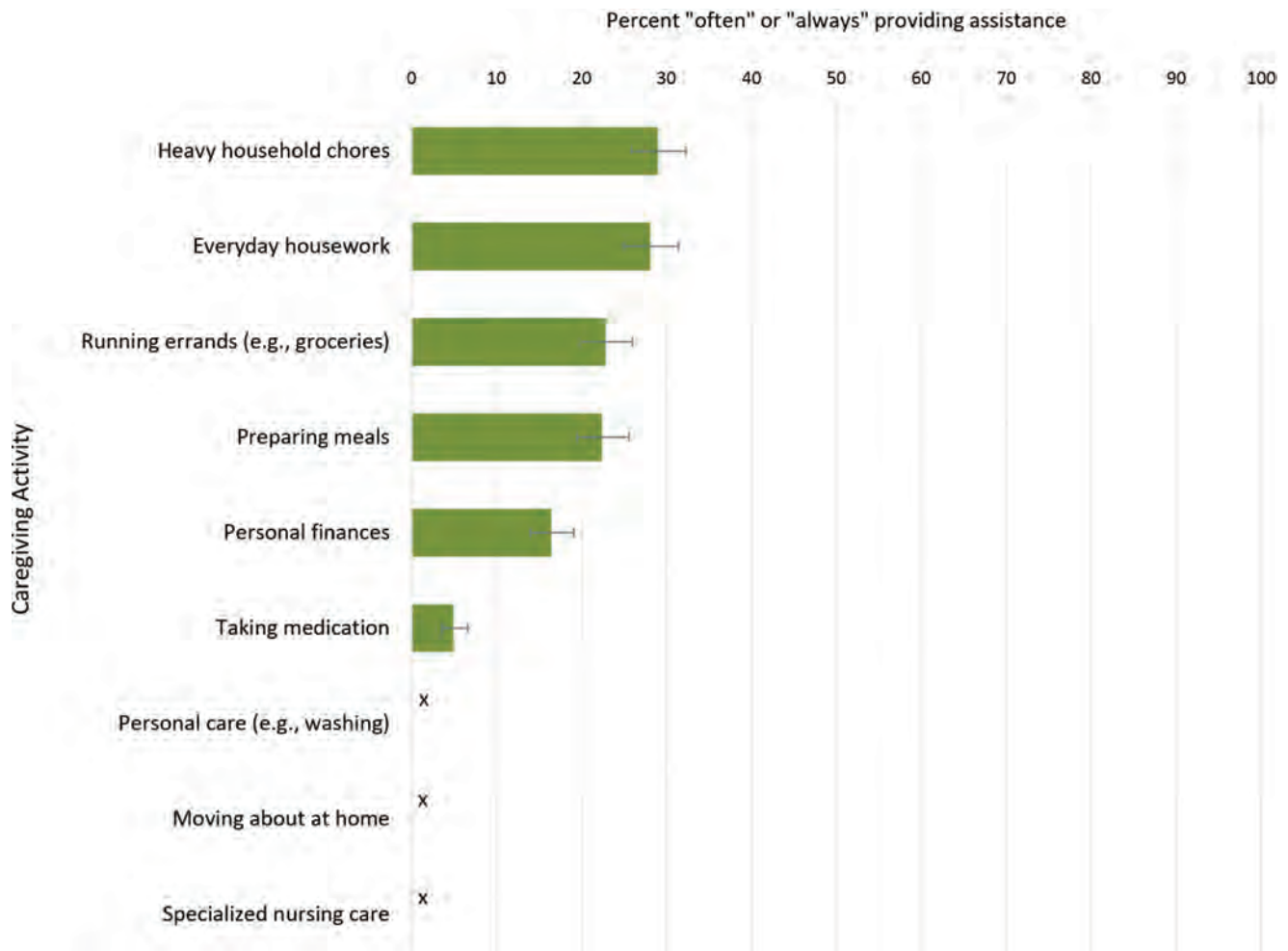
Figure 2. Spouses' engagement in caregiving activities

Note. X = too few cases to report

identity" and "losing touch with your military peers"). This resulted in the inclusion of 7, as opposed to 10, variables related to perceived transition challenges in the analyses.

Results of unadjusted and adjusted analyses predicting daily stress and psychological distress are presented in Tables 2 and 3, respectively. In the unadjusted regressions (Table 2), perceived challenges were significantly associated with both daily stress and psychological distress, and engaging in more frequent (i.e., often or always) caregiving was associated with daily stress and psychological distress. Adjusted regression analyses were subsequently conducted (Table 3), which controlled for demographic covariates that were meaningful and significantly associated with either daily stress or psychological distress in the unadjusted models (i.e., sex, age, dependents, and partner's release category).

In the final adjusted model for daily stress (Table 3), the perceived challenges with being financially prepared, finding educational opportunities, finding a health care provider, and losing one's military identity, as well as always engaging in caregiving activities, were significantly associated with increased daily stress. Of note, spouses who reported losing one's military identity as challenging or who always engaged in at least one caregiving activity had more than twice the odds of reporting more daily stress (i.e., odds ratios of 2.28 and 2.02, respectively).

In the final adjusted model for psychological distress (Table 3), the perceived challenges with finding educational opportunities, finding a health care provider, and losing one's military identity, as well as often or always engaging in caregiving activities, were significantly associated with increased psychological distress.

Table 2. Results of unadjusted logistic regression analyses predicting daily stress and psychological distress among spouses of CAF Veterans

Variable	Daily stress				Psychological distress			
		95% CI				95% CI		
	OR	LL	UL	p	b	LL	UL	p
Sex								
Male (Ref)	–				–			
Female	1.15	0.77	1.7	0.49	1.74	0.65	2.84	0.002
Age (years)								
20–29 (Ref)	–				–			
30–39	1.32	0.75	2.23	0.329	0.49	−1.4	2.37	0.611
40–49	1.11	0.64	1.91	0.72	0.26	−1.62	2.15	0.783
50+	0.47	0.27	0.83	0.009	−2.87	−4.42	−1.33	< 0.001
Child dependents								
No (Ref)	–				–			
Yes	1.81	1.31	2.52	< 0.001	2.32	1.2	3.44	< 0.001
Education								
Less than high school (Ref)	–				–			
Trade/college	1.14	0.73	1.78	0.561	0.68	−0.79	2.15	0.366
At least some university	1.23	0.79	1.93	0.355	−0.15	−1.63	1.32	0.838
Partner's release category								
Non-medically released (Ref)	–				–			
Medically released	2.5	1.79	3.52	< 0.001	3.14	2.04	4.23	< 0.001
Perceived challenges*								
Being financially prepared	4.07	2.77	5.99	< 0.001	3.95	2.42	5.49	< 0.001
Finding employment	3.88	2.72	5.53	< 0.001	4.17	2.86	5.49	< 0.001
Finding educational opportunities	4.79	3.28	6.98	< 0.001	5.29	3.76	6.81	< 0.001
Relocating	3.43	2.01	5.83	< 0.001	4	1.54	6.46	< 0.001
Finding a health care provider	2.68	1.84	3.9	< 0.001	3.37	1.71	5.03	< 0.001
Understanding benefits	2.19	1.54	3.09	< 0.001	2.91	1.62	4.19	< 0.001
Losing military identity	5.55	3.54	8.73	< 0.001	5.33	3.6	7.06	< 0.001
Caregiving activities (frequency)								
Not at all (Ref)	–				–			
Somewhat	1.56	0.9	2.71	0.111	1.12	−0.12	2.35	0.077
Often	1.98	1.22	3.22	0.006	4.2	2.68	5.72	< 0.001
Always	4.9	3.23	7.44	< 0.001	6.83	4.92	7.85	< 0.001

* For perceived challenges, spouses who *did not* report the item as "very" or "extremely" challenging served as the reference group.

OR = odds ratio; CI = confidence interval; LL = lower limit; UL = upper limit; Ref = reference group

Notably, spouses of Veterans who reported often or always engaging in caregiving activities were significantly more likely to also report greater psychological distress (i.e., observed coefficients of 3.00 and 4.45, respectively).

DISCUSSION

Using the CAFTWS, the objectives of the present study were to examine perceived military to civilian transition challenges and caregiving among spouses of newly released CAF Veterans and to assess their

Table 3. Results of adjusted logistic regression analyses of predicting daily stress and psychological distress among spouses of CAF Veterans

Variable	Daily stress				Psychological distress			
		95% CI				95% CI		
	AOR	LL	UL	*p*	A*b*	LL	UL	*p*
Sex								
Male (Ref)	–				–			
Female	1.17	0.71	1.94	0.536	2.31	1.16	3.46	< 0.001
Age (years)								
20–29 (Ref)	–				–			
30–39	1.98	0.98	3.99	0.056	0.87	−1.02	2.77	0.368
40–49	1.66	0.83	3.34	0.155	0.93	−0.8	2.66	0.293
50+	0.9	0.4	2.01	0.795	−0.63	−2.27	1.01	0.451
Child dependents								
No (Ref)	–				–			
Yes	1.2	0.75	1.93	0.448	1.05	−0.43	2.53	0.164
Partner's release category								
Non-medically released (Ref)	–				–			
Medically released	1.38	0.88	2.18	0.159	0.05	−1.2	1.3	0.94
Perceived challenges[*]								
Being financially prepared	1.76	1.08	2.86	0.022	0.48	−1.02	1.98	0.532
Finding employment	1.54	0.93	2.55	0.094	0.44	−0.98	1.86	0.549
Finding educational opportunities	1.84	1.09	3.1	0.022	2.02	0.17	3.88	0.033
Relocating	1.44	0.76	2.74	0.266	1.25	−1.06	3.57	0.289
Finding a health care provider	1.95	1.23	3.07	0.004	1.8	0.38	3.21	0.013
Understanding benefits	0.92	0.6	1.44	0.727	0.22	−0.98	1.42	0.721
Losing military identity	2.28	1.35	3.87	0.002	2	0.01	3.99	0.049
Caregiving activities (frequency)								
Not at all (Ref)	–				–			
Somewhat	0.96	0.49	1.91	0.916	0	−1.29	1.29	0.998
Often	1	0.55	1.83	0.999	3	1.36	4.62	< 0.001
Always	2.02	1.17	3.51	0.012	4.45	2.63	6.27	< 0.001

[*] For perceived challenges, spouses who *did not* report the item as "very" or "extremely" challenging served as the reference group.

AOR = adjusted odds ratio; CI = confidence interval; LL = lower limit; UL = upper limit; Ref = reference group

associations with spousal well-being. Consistent with the literature, findings indicated that spouses perceived various aspects of their partner's military to civilian transition as challenging.[11,15–18] Specifically, about one-third of spouses reported understanding transition services and benefits was very or extremely challenging during their partner's military to civilian transition, while approximately one-fifth perceived finding a health care provider, being financially prepared, and

their partner's ability to find employment to be very or extremely challenging. An equivalent proportion of spouses reported frequently assisting their partner with both heavy and everyday household chores, running errands, and meal preparation.

Notably, roughly 25% of spouses reported experiencing high levels of daily stress, and 18% reported high levels of psychological distress. Upon further investigation, results revealed that four factors were associated

with higher levels of daily stress and psychological distress among spouses – finding educational opportunities, finding a health care provider, losing one's military identity, and frequent engagement in caregiving activities. Spouses who reported loss of military identity as very or extremely challenging had more than twice the odds of reporting higher levels of daily stress as did those who reported always engaging in caregiving activities, relative to their counterparts.

The negative impact of loss of a military identity has also been the subject of past studies.[38–39] The military is typically viewed and described as a second family, and it can be a valuable source of social support, camaraderie, and community to military members and their families. While research on loss of military identity has gained momentum in recent years,[40] relatively little attention has been placed on understanding the phenomenon from the perspective of military or Veteran spouses. As such, this is among the first studies to document an association between loss of military identity and decreased well-being among the spouses of CAF Veterans. In light of this observation, military organizations may consider developing support groups for spouses of Veterans to provide them with opportunities to share their experiences and coping strategies with others and exchange ideas for how to best develop a post-military identity.

Financial strain has generated much interest in the military literature due to its commonality among both active military and Veterans.[41–43] Studies indicate military families experience a variety of unique financial stressors that may contribute to financial strain throughout the course of a member's career.[43] Military to civilian transition may also contribute to financial strain, particularly if members are not sufficiently prepared or trained for re-employment, affecting long-term financial sustainability. The importance of employment preparedness to the well-being of individuals transitioning from one institution to another (i.e., school to work, military to civilian) has also been noted in past research.[44–46] This underscores not only the value of financial counselling programs but also of education and retraining programs for families of Veterans or members anticipating release.

The association between perceived challenges with finding a health care provider and decreased spousal well-being was unsurprising. Like many Canadians, Veterans may find it difficult to secure a family doctor and access specialist care. Analyses based on the LASS have found that Veterans were more likely to report

an unmet need for health care, relative to the average Canadian.[6] Veterans without family physicians may rely on walk-in clinics and hospital emergency rooms to access care. This can result in a lack of continuity of care, which is essential to quality health care and contributes to better health outcomes.[47] Spouses may therefore have to assume caregiving responsibilities for a longer period of time while Veterans wait to receive care, resulting in a greater perceived burden among spouses.

In addition to the perceived military to civilian challenges, spouses of Veterans reported providing their partners with assistance in a number of different ways. Spouses who reported engaging in caregiving more frequently also reported higher levels of daily stress and distress. These findings align with the large body of work on *caregiver burden*, which refers to any negative life changes (e.g., decreased psychological and/or physical well-being) resulting from providing care to another person.[48] Within the military context, reliance on spouses and/or family for emotional, cognitive, and physical support has been found to contribute to caregiver burden and psychological distress.[11,12,19–22] Skomorovsky et al.[18] found spouses of military members or Veterans with more severe physical and mental health conditions experienced higher levels of psychological distress and tension in their spousal relationship, in part due to their experience of caregiver burden. Such findings emphasize the importance of ensuring support services are not only available for ill or injured Veterans, but also for the spouses providing them with care.

Limitations and future directions

A major strength of the present study is its inclusion of spouses of a representative sample of newly released CAF Veterans. Nevertheless, limitations must be acknowledged. First, due to the self-reported nature of the data, perceived challenges do not necessarily reflect the actual extent of problems experienced by spouses or Veterans during the military to civilian transition. As well, analyses were based on cross-sectional data and are subject to the limitations of this study design. Specifically, no inferences can be made on causality in relationships that were examined. In a related fashion, it is possible that patterns of associations between perceived transition challenges, caregiving, and well-being are more complex than those investigated here. Additional analyses of the CAFTWS are warranted to further

explore and disentangle the interrelationships between military to civilian transition stressors and well-being among spouses of Veterans. Furthermore, perceived transition challenges and caregiving activities were only examined from the perspective of spouses and may not capture the full scope of challenges Veterans and spouses face during transition. Spouses may not have been fully aware of the particular challenges faced by the Veteran during transition nor of the programs or services the Veteran used for support during this time. It is important to note that spousal caregiving activities were not necessarily an indication of the extent of the Veterans' health needs. Spouses may have relied on external supports to provide care, or they may have provided more or less care than is actually required for a variety of other reasons. Although spouses' psychological well-being is likely to be most closely linked to their own perceptions and experiences during military to civilian transition, it would be of value to explore how the perceptions and experiences of Veterans might also factor into this association.

CONCLUSION

This was the first study to examine military to civilian challenges from the perspective of spouses of recently released CAF Veterans in a representative sample. Together, findings helped outline key challenges spouses face throughout their partner's transition, in addition to shedding light on the extent to which these challenges are associated with well-being. These findings provide fruitful insights into the types of services and programs military organizations should offer to families to facilitate a more seamless transition and, ultimately, to maintain or improve their overall physical and mental well-being.

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COMPETING INTERESTS

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RESEARCH

Adapting group interpersonal psychotherapy (IPT-G) for treating depression among military spouses at Naval Medical Center Portsmouth (NMCP): Formative qualitative phase

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ABSTRACT

Introduction: Operation Enduring Freedom (OEF) in Afghanistan and Operation Iraqi Freedom (OIF) in Iraq have resulted in the deployment of nearly 2,000,000 troops, of which nearly 60% were married, and nearly half had dependent children. While great attention is being paid to the mental health of returning Veterans, we cannot neglect the mental health of this substantial population of military family members. Studies have found that spouses exhibit similar rates of mental health problems as soldiers returning from combat. Whereas rates of anxiety have been shown to drop significantly post-deployment, depression in military spouses appears to persist following deployment. Although a number of psychosocial interventions tailored to military families have been developed, to the knowledge of the authors, no evidence-based interventions have been adapted to specifically target clinical depression in military spouses. **Methods:** This case study is part of a larger pilot study that sought to adapt, test, and evaluate Group Interpersonal Therapy (IPT-G), an evidence-based treatment for depression, for depressed military spouses. A formative qualitative assessment is crucial to the intervention's long-term effectiveness, dissemination, and sustainability. This study aimed to understand military spouses' unique mental health needs and their experience with mental health services. Three focus groups were conducted – two groups of military spouses and a group of mental health care providers – and transcripts were generated using verbatim note-taking. Five independent coders then coded the transcripts for themes that emerged as most salient using an inductive thematic analysis approach. **Results:** The results identified were clustered under three main themes: (1) psychosocial stressors for depressed military spouses; (2) barriers to mental health care for military spouses; and (3) proposed services. **Discussion:** When implementing an intervention for a specific population, optimization of its fit to the needs, priorities, and help-seeking patterns of the population should take place to ensure that it is meaningful, ecologically valid, and sensitive to context and culture. Our analysis showed that the military culture presents unique psychosocial stressors, barriers, demands, and needs to mental health provision that should be accounted for in the adaptation of evidence-based mental health intervention. The interpersonal nature of many of the challenges faced by military spouses lend themselves readily to the problem areas that are treatment targets of IPT, therefore increasing the patients' potential for engagement and sense of compatibility with the treatment.

Key words: deployment stress, depression, interpersonal psychotherapy, military family, military spouse, navy, qualitative research, Veterans

RÉSUMÉ

Introduction : L'opération « Liberté immuable » (OLI) en Afghanistan et l'opération « Liberté en Irak » (OLI) ont suscité le déploiement de près de deux millions de membres des troupes, dont près de 60 % étaient mariés et près de la moitié avaient des enfants à charge. On s'intéresse beaucoup à la santé mentale des vétérans, mais il ne faut pas négliger celle de cette population importante, composée des membres de la famille des militaires. Selon des études, le taux de troubles de santé mentale des conjoints est semblable à celui des soldats qui reviennent du front. Il est démontré que le taux d'anxiété baisse considérablement après le déploiement, mais la dépression semble persister chez les conjoints des

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militaires. Plusieurs interventions psychosociales sont adaptées aux familles des militaires, mais à la connaissance des auteurs, aucune intervention fondée sur des données probantes n'a jamais été conçue expressément pour les conjoints des militaires. **Méthodologie :** La présente étude de cas s'insère dans un projet pilote plus vaste qui visait à adapter, mettre à l'essai et évaluer une thérapie interpersonnelle de groupe (TIP-G), qui est un traitement de la dépression fondé sur des données probantes, pour les conjoints des militaires. Il est essentiel de procéder à une évaluation qualitative formative pour établir l'efficacité, la diffusion et la pérennité à long terme de l'intervention. L'étude est conçue pour comprendre les besoins uniques des conjoints des militaires en santé mentale et leur expérience des services de santé mentale. Trois groupes de travail, soit deux groupes de conjoints de militaires et un groupe de dispensateurs de soins en santé mentale, ont été formés, et les échanges ont été transcrits textuellement. Cinq codeurs indépendants ont ensuite codé les transcriptions à partir d'une analyse thématique inductive pour en faire ressortir les thèmes fondamentaux. **Résultats :** Les résultats ont été regroupés en trois grands thèmes : 1) les facteurs de stress psychosociaux pour les conjoints dépressifs des militaires; 2) les obstacles aux services de santé mentale pour les conjoints des militaires et 3) les services proposés. **Discussion :** Pour mettre sur pied une intervention destinée à une population précise, il faut s'assurer de l'optimiser en fonction des besoins, des priorités et des profils de demande d'aide de cette population afin qu'elle soit significative, valide sur le plan écologique et sensible au contexte et à la culture. L'analyse a démontré que la culture des militaires comporte des facteurs de stress psychosociaux, des obstacles, des exigences et des besoins uniques en matière de prestation des services en santé mentale, dont il faut tenir compte pour adapter une intervention en santé mentale fondée sur des données probantes. La nature interpersonnelle de nombreux défis qu'affrontent les conjoints des militaires se prête parfaitement aux problématiques visées par la TIP, ce qui accroît le potentiel de participation des patients et leur impression de compatibilité avec le traitement.

Mot clés : dépression, psychothérapie interpersonnelle, le stress lié au déploiement, les familles militaires, recherche qualitative, marine, conjoint(e)s de militaire/partenaires, vétéran

INTRODUCTION

Operation Enduring Freedom (OEF) in Afghanistan and Operation Iraqi Freedom (OIF) in Iraq have resulted in the deployment of nearly 2 million troops, out of which nearly 60% were married, and nearly half had dependent children.[1] While considerable attention is being paid to the mental health of returning Veterans, the mental health of this substantial population of military family members cannot be neglected.[2,3(p.167)] Military deployment can be delineated into distinct phases – pre-deployment, deployment and post-deployment – with each phase having a different effect on military family members.[4–6] At each stage of deployment, various stressors – such as separation, marital strain, temporary transitioning to single-parent status, and the challenges of maintaining a household – may tax the spouse's resources and can trigger or exacerbate mental health problems, such as depression, anxiety, sleep disorder, acute stress reaction, and adjustment disorder.[7–9] Recent studies[7–9] report elevated rates of psychopathology in deployed service members' spouses compared to community norms.[10,11] Other studies have found that spouses exhibit similar rates of mental health problems as soldiers returning from combat (e.g.,[8,12]). Whereas rates of anxiety have been shown to drop significantly following the service member's return, depression in military spouses appears to persist following deployment.[13] Left untreated, these problems may contribute to an increase in children in the home externalizing and/or internalizing behaviours (including depression)[14–16] and an increase in marital conflict. This, in turn, may adversely affect the Veteran's mental health and adjustment to deployment and return.[17–20] Therefore, addressing the distress of military spouses is a priority for the well-being of military families.

Although a number of psychosocial interventions tailored to military families have been developed (e.g.,[12,21,22]), to the knowledge of the authors, no evidence-based interventions have been adapted to specifically target clinical depression in military spouses. A team of researchers from Columbia University and the Naval Medical Center Portsmouth (NMCP) collaborated on a pilot study to adapt, test, and evaluate Group Interpersonal Therapy (IPT-G),[23] an evidence-based treatment for depression, for depressed military spouses at NMCP. IPT is an evidence-based treatment for depression that focuses on disruptions in significant relationships, changes in social roles, and major life events.[23] In IPT, depression is addressed by four problem areas that guide the treatment focus: grief (deep sorrow following the death of a loved one); interpersonal disputes (overt or covert conflicts with significant others); role transitions (positive or negative changes in life circumstances that may be expected or unexpected); and interpersonal deficits (difficulty in developing or sustaining social relationships).[23] The rationale for selecting IPT as

the evidenced-based treatment of choice for this population was its focus on interpersonal crises that trigger depression, which is highly relevant to the naval spouses' stressors that frequently involve role transitions (such as separations, becoming a temporary single parent, and reunions with a spouse who is coping with post-deployment adjustment); disputes; social isolation; and sometimes grief. IPT has been administered effectively in a group format, making it cost-effective and potentially sustainable in military clinics struggling to meet high treatment demands.[24,25] For these reasons, IPT-G may be particularly relevant for the needs of depressed spouses with varying interpersonal stressors associated with the deployment cycle.

The current study is part of a larger parent study that aimed to adapt and evaluate an evidence-based psychotherapy for depression – IPT-G – to address the unique needs of depressed Navy service member spouses whose husbands or wives are, or have served, in a Global War on Terror (GWOT)-related deployment, by providing feasible, non-stigmatizing, ecologically valid, and effective treatment for their depression. However, in adapting interventions, both content issues (e.g., psychosocial stressors unique to the military context) and logistical considerations (e.g., availability of services) need to be elucidated and factored into the treatment design. A formative qualitative assessment is, therefore, crucial to inform the content and logistics of the IPT-G treatment adaptation to promote the intervention's long-term effectiveness, dissemination and sustainability. This qualitative study aimed to understand spouses' unique mental health needs and their experience with mental health services, with the goal of informing the adaptation of the IPT-G manual to deliver a treatment that is sensitive to context, feasible, sustainable, and experienced by the spouses as relevant and meaningful. The results of this study can help researchers and care providers identify cases of depression and provide qualitative information regarding local community infrastructures to design appropriate and meaningful treatment delivery routes, and thus, optimize the delivery of the treatment and promote its scalability.

METHODS

A case study research design was selected in order to provide an in-depth understanding of the topic and elucidate insights for intervention adaptation.[26] The chosen research technique was focus groups. Focus groups are moderated group discussions that bring together participants to express and exchange their views on a topic, drawing from their personal experiences. The researcher functions as a facilitator that moderates the group discussion to help manage the conversation, rather than lead it.[27] An advantage of focus groups is their efficiency in generating information and reaching data saturation or exhausting the topic of discussion more quickly than other methods.[28] Three focus groups were conducted: two groups of spouses and one group of mental health care providers.

Participants were recruited through professional and patient networks at NMCP. Five service members' spouses were recruited for the study, which is the maximum suggested number of cases for a case study.[29] The spousal sample was segmented by symptom severity: the first group included three women with depression, anxiety and bipolar disorder, and personal tragedies such as miscarriages and substance abuse, while two women in the second group sought counselling for milder cases of depression. Sample segmentation was used to ensure the homogeneity of group characteristics and to allow comparisons to be conducted between groups.[30] To increase the credibility of the findings, a sample of mental health professionals was also recruited to triangulate the information obtained in the spousal focus groups. Triangulation is a validation strategy that explores the convergence and divergence of information from at least two sources in order to increase the trustworthiness of the research findings.[31] The group of mental health professionals consisted of two psychiatrists and a marriage counsellor from the NMCP Mental Health Department, two private practice psychiatrists, and three social workers.

The principal investigator and a graduate student facilitated the focus groups. The discussion of the groups followed a loose conversational format over the course of two hours. For reasons of confidentiality, the discussions were not recorded. Instead, a note-taker transcribed the proceedings to maintain anonymity. Note-taking and note-based analysis, respectively, are generally accepted as modes of gathering and analyzing focus group data.[32] The recommendation that, when a recording device is not used, the recorded notes should be as close to verbatim as possible to avoid summarizing or consolidating peoples' experiences, was followed.[33] To ensure that participants' experiences were captured, two facilitators were present: one to run the group and the other to take notes. The notes were then approved by both facilitators to ensure accuracy.

Qualitative analysis was then performed using an inductive thematic analysis approach[34] during which transcripts were coded for themes that emerged as most salient. Five coders coded all interviews independently using an open coding technique. The transcripts of the two military spousal focus groups were coded first, as they were the target group of the intervention. Initial codes were selected based on their frequency in the discussion and/or their relevance to the research questions. A coders' group meeting was then conducted for line-by-line review of interview transcripts, reconciling differences in codes, and establishing inter-coder reliability.[35,36] Inter-coder agreement was maintained by only selecting codes that were identified by at least four out of the five coders. Following the line-by-line coding, the codes were clustered to form central categories[4] and to establish the initial codebook. The same process was repeated once again with the mental health professionals' focus group to triangulate the perspective of the spouses[37] and to modify the codebook to account for new codes. During this process, preliminary categories generated from the military spouses were supported, while additional important codes and categories were also found. The categories were then reviewed, and a final set of themes were generated that closely fit the data and drew support from both subject groups, ensuring confidence and relevance of the analysis.[38] To facilitate data management, NVivo-11 data analysis software, version 11 (QSR International Pty Ltd., Doncaster, AU) was used. All study procedures were reviewed and approved by the institutional review boards at Teachers College, Columbia University and the NMCP.

RESULTS

The inductive thematic analysis revealed several salient themes. These themes were (1) psychosocial stressors that military spouses experience during the different phases of deployment and reunification, (2) barriers to the utilization of mental health care services by military spouses, and (3) suggestions for services that can help relieve the stressors mentioned earlier and increase service utilization.

Psychosocial stressors for depressed military spouses

Pre-deployment

Spouses discussed a lack of preparation for what to expect once their spouses were deployed.

You're not really prepared. We had a briefing, which was like "you might not be able to reach them on email" and that was it... a more in-depth briefing before they left would be good. (Spouse A)

Deployment

Spouses cited several mental health and interpersonal issues that arose while their active duty spouses were deployed. Spouses experienced anxiety, from mild worries about post-deployment changes to extreme fear that their spouse might get hurt, throughout their spouse's deployment.

I just heard he lost 42 pounds. He'll even look different when he gets back... Or you'll see the news and they send another warship, "Oh, please don't let it be his." (Spouse A)

Depression is the inevitable result of chronic, hyper vigilant waiting. (Clinician M)

Most spouses discussed the stresses related to the changed role they had after joining military life. Some described feeling like they lost their identities, whereas others described the stress of juggling multiple roles in the absence of their deployed spouse.

Because our world seems to revolve around them, and you lose yourself. (Spouse K)

When he's gone, you're everything. You're mom, you're dad; everybody. (Spouse A)

The inconsistency in communication, and the extended periods of time using only audio or video communication, rather than face-to-face communication, created disagreements between the couples. Spouses described feeling frustrated and angry toward their spouse over this.

I resented him when he didn't make our Skype dates. (Spouse K)

Due to their relocation to the Navy base, spouses often had to move away from their families and friends and, thus, lost their support systems. This loss was particularly salient when they needed help taking care of things around the house (i.e., plumbing) or of their children. Spouses often discussed this as a barrier to seeking care, since going to a session would involve finding someone to care for their children while they're gone.

I can't ask people to babysit. (Spouse D)

Post-deployment

The issues related to the spouse's changing role seemed to carry over when the active duty spouse came home.

Spouses must adjust to the military member being back and redefining roles and expectations of what each should be doing.

> Even without kids you start to get used to your life without him, and you're happy that they're back, but it takes a long time to get used to that, too. (Spouse C)
>
> Roles change when the spouse comes back from deployment or face retirement, and they've never talked about it. (Clinician H)

The difficulties of readjustment usually led to conflicts between the couples and between the active duty spouses and their children. Spouses described being conflicted over placating their returning spouse and being resentful, as well as protecting the children from the clashes.

> But then when he came back, we butted heads. Like he wasn't real patient with the kids. He was angry at them all the time ... He doesn't know them, and they don't know him. (Spouse K)

Barriers to mental health care for military spouses

Acceptability

The acceptability of mental health problems and the need for treatment is an important step toward accessing mental health care. However, stigma can be a major barrier to seeking treatment because spouses may fear the judgment of others and the repercussions that seeking treatment may have on their active duty spouse's career. Spouses described the silence that surrounds the topic of mental illnesses in the community and how that can lead to a lack of social support from others and isolation from the community.

> It's a taboo subject. (Spouse K)

Additionally, when spouses internalized society's stigma, they often didn't seek treatment.

> You feel stupid when you have an episode; you start to belittle yourself. (Spouse P)

In many cases, the clinicians reported, spouses perceive their own trauma as less serious, and therefore less deserving of help than the service members', or they may feel pressure not to seek help for something their partners are seemingly able to cope with on their own. This pattern may repeat itself for years.

> Years of untreated issues spill over to the spouse, who holds it in, feels shut out, has traumatic dreams and doesn't know why. It's secondary traumatization. (Clinician Tl)

The spouses also described institutional stigma as a barrier to seeking treatment, which refers to the rules, laws, policies, and procedures put forth by the military that may directly or indirectly discourage active duty members or their spouses from seeking help. One spouse spoke of homesteading, which is when the active duty member is assigned to an area and remains there for an extended duration to allow for stability and access to medical resources for a spouse or child with a chronic medical problem. In this spouse's case, she expressed frustration at the military's restriction on transferring her husband to another billet, even after she felt better (she had a diagnosed mental illness).

> I got into the program, and I thought when I got better, they'll clear him to go to one of the better posts. But no, they said I was better, and we still can't travel. It's called homesteading. (Spouse K)

Furthermore, one Navy psychiatrist claimed he saw few substance use cases, whereas a private practitioner claimed that substance use cases comprised the majority of his military caseload. During the discussion, it became apparent that spouses might be less likely to seek care for substance use from military hospital-based clinicians because they fear their children might be taken from them and they don't want a record of problems regarding substance use.

> I don't see a lot of substance abuse in the spouses. (Clinician TC)
>
> I have seen spouses who have had their children removed due to their drinking. (Clinician Z)
>
> That's why they don't go to you, TC. (Clinician H)

Availability

Spouses agreed that information about care pathways within the Navy that can be utilized by someone experiencing mental health symptoms was not readily available. More tangibly, clinicians confirmed not all services are available for everyone to use. As a result, spouses either didn't seek help or sought help outside the naval base.

> Because of the social level and the special conditions of this group, it's not open to everyone who's active duty. (Clinician TC)
>
> I don't have that person for me, to tell me how to get in. I didn't know. So, I say go outside. (Spouse K)

Accessibility

Spouses discussed the burden of complicated and slow administrative procedures within the Navy medical system that may prevent them from accessing care in time. This is particularly debilitating if the spouse was suffering from an acute episode. Some spouses described the

process taking as long as three months before obtaining an appointment, while others discussed the full capacity of some Navy clinics as additional barriers to access.

> Through TRICARE, you have to call on a particular day to make an appointment. It's like you need an appointment to make an appointment. (Spouse K)

Furthermore, accessing community mental health services also had complications. The limitations of the insurance provided by the Navy, including the spouse having to pay a co-pay or being limited to eight sessions, may cause spouses not to seek help from community services. Of note, since the completion of this study, the eight-session limitation was removed from TRICARE insurance; however, the co-pay remained.

> I was seeing a therapist, which was fine; it was consistent. That was outside the Navy, and I just paid a co-pay. Then they stopped taking my insurance, so I stopped going. (Spouse K)

Interestingly, the clinicians couldn't agree on whether the Navy family had easily accessed services when needed. The Navy clinicians perceived that accessing services within the Navy system and in the network was not difficult, which contradicted both the responses by private practice clinicians and spouses. It is unclear why this discrepancy exists. Network clinicians appeared to imply that Navy clinicians might be "indifferent" to whether spouses are accessing care with ease or not because they have full caseloads. However, both the spouses and the clinicians agreed that once a patient is in the Navy system, either through mental health or medical services, they are able to obtain mental health appointments with ease. Accordingly, the most feasible way to access mental health services within the Navy system was through a referral from medical services, including primary care, emergency care, and tertiary care providers. It appears that this pathway is frequently used both by the spouses and the clinicians to bypass complicated procedures, and due to the lack of knowledge about other means to access the system.

> So, I was seeing a neurologist for migraines, and I told her I needed to see a psychiatrist, and she got me in. Now I'm in. I can make appointments like regular; I don't have to go through the appointment line. (Spouse K)

Clinicians and spouses had conflicting opinions on continuing services after a spouse accesses care. The clinicians indicated that one of the barriers to treatment is that spouses are not penalized for missing their appointments, whereas the spouses advocated for the need to reach out to them when they miss an appointment.

> Unfortunately, one of the barriers to treatment is that there's no consequence to not showing up. I have a policy, if you don't show three times, I don't want to see you. Go private and pay the co-pay. (Clinician Tl)

> If TRICARE took it a step further, maybe to check in on people that missed appointments. (Spouse C)

Proposed services

When asked about suggestions for improving the services provided, both the spouses and the clinicians agreed that services such as child care, home visits, and hotlines are needed. This was based on barriers to treatment, including missed appointments and a lack of familial support.

> There are nine Navy clinics, and none of them have child care except here, and here you have to apply a month ahead of time, and sometimes there's no room. (Clinician Tl)

Additional suggestions included deployment preparation services, increasing awareness about the services available, mandatory mental health screenings, and skills development programs.

> You're not really prepared. We had a briefing, which was like, "You might not be able to reach them on email," and that was it. (Spouse A)

DISCUSSION

Analysis revealed that spouses go through several unique psychosocial stressors before, during, and after an active duty spouse is deployed. In the emotional cycles of deployment, anxiety was a consistent theme throughout all phases. The period during deployment, when the service member is physically absent from the family, is often characterized by emotional disorganization and destabilization.[2,28] Spouses reported multiple stressors related to the shift in family dynamics and roles, including loneliness, role overload (e.g., taking over active duty spouses' role) and role shifts.[3,29] This is compounded by a lack of social support from family and friends who often live off- base or out of the area. Despite their hope for stress and problems to decrease once their active duty family member returns, readjusting to life after deployment is equally stressful. During post-deployment and reunion, spouses experienced anxiety and apprehension about dealing with their active duty spouse's return home and adjustment to living with their family again. Once again, the family undergoes a shift in household dynamics, where roles have inevitably changed and must be re-negotiated and redefined.[2,30]

These psychosocial stressors were exacerbated by the spouse's perception of, at times, a lack of support from the naval system and their community.[1] This lack of support manifested in barriers to accessing mental health care. The analysis revealed there are three main categories of barriers to mental health care for military spouses: (1) acceptability, including mental health stigma, (2) availability, including knowledge of the routes to care, and (3) accessibility, including logistical and bureaucratic barriers. These barriers appear to reduce the likelihood that the military spouse will (1) seek mental health care when faced with stress or mental health issues, and (2) be able to access mental health care if they seek it.

Perhaps the most interesting findings were the discrepancies in the perceptions of the participants about the acceptability, availability, and accessibility of services. Among the clinicians, the two main points of disagreement were related to the prevalence of substance use by spouses, and accessibility of services. Between the spouses and the clinicians, there were opposing opinions about following up after missed appointments. These discrepancies in understanding and, subsequently, meeting the needs of the populations, may prevent the utilization of available mental health services within the Navy system, as well as patient retention. Therefore, there is a need for more open channels of communication between mental health professionals within the Navy and the outside community, as well as between clinicians and military spouses. This collaboration and alliance would ensure more synchronized care is provided for Navy families.

Finally, several suggestions for improving service provision were made by the spouses and the clinicians. The most cited suggestion was the addition of child care services, which they reported was a strong barrier to seeking care, similar to other studies.[1,6] A related suggestion was the creation of home care and hotlines, which would allow spouses to speak to someone who can provide help immediately, without having to leave the house. A second cluster of proposed services was related to spouses' perceived lack of preparation for an active duty member's deployment, as well as a lack of information about available services for families.[26–27] It is likely that all of these suggestions would increase help-seeking behaviour, as well as consistent and highly adherent utilization of services by spouses.

The overarching aim of this research was to adapt and evaluate IPT-G to address the unique needs of depressed Navy service members' spouses, beginning with a formative qualitative phase that will guide this adaptation. When implementing an intervention for a specific population, optimization of its fit to the needs, priorities and help-seeking patterns of the population should take place to ensure that it is meaningful, ecologically valid, and sensitive to context and culture. The versatility of IPT has been demonstrated through its successful adaptations for a wide range of cultures and patient populations, from war-torn adolescents in sub-Saharan Africa to U.S. primary care patients.[24,25,39] This analysis showed that the military culture presents unique barriers, demands, and needs to mental health provision that should be accounted for in the adaptation of evidence-based mental health intervention, such as IPT-G. Furthermore, the spouses and stakeholders revealed very real barriers that can affect service utilization, such as lack of child care, that should be considered when designing an intervention. Therefore, resolving the issue of child care during sessions is just as germane to the successful implementation of this intervention as ensuring that there is protected space and time where group therapy can be conducted.

Limitations

When considering the results of this study, limitations need to be addressed. The study sample was drawn from a few naval bases in one geographic location. Furthermore, participants were presenting for mental health services when recruited, which may limit the transferability of their experiences, with respect to military spouses who have not sought treatment. Therefore, their perceptions, experiences, and opinions may not reflect those of other military spouses and of other professionals who deal with military patients. Alternatively, the participants may have answered questions in a manner that they perceived as desirable, which would further limit transferability.[31] Therefore, interpretations of the study results are suggestive, not conclusive, and should be considered with caution.

Conclusions

During each phase of deployment, military spouses face specific challenges and have particular needs that should be taken into consideration when providing mental health interventions. The interpersonal nature of many of the challenges faced by military spouses (i.e., transitioning to new roles, social isolation during deployment, interpersonal conflict post-deployment, etc.) lend themselves readily to the problem areas that are treatment

targets of IPT, therefore increasing the potential for engagement and sense of compatibility with treatment. The findings of this study provide essential formative and interpretive data for the adaptation of IPT-G for military spouses at NMCP. The next phases of the study will be (1) using the qualitative data to guide the adaptation of IPT-G with depressed spouses of deployed service members (IPT-G with Naval Spouses, IPT-GNS); (2) pilot testing IPT-GNS; and (3) determining the feasibility of assessing the impact of IPT-GNS on participants children and on the service members themselves.

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COMPETING INTERESTS

None declared.

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CONTRIBUTORS

Dalal Alhomaizi analyzed the data, conceptualized the framework of the manuscript, and drafted the original manuscript. Helen Verdeli is the principle investigator of the study who wrote and was awarded the grant, created the interview guide, prepared the IRB, conducted the study, and framed and revised the manuscript. Katherine Keenan co-developed the interview guide for the study, prepared the IRB, and co-conducted the study. Captain J.A. Van Slyke prepared the IRB, co-conducted the study, and edited the manuscript. Cheryl Foo analyzed the data and aided in the framework of the manuscript and draft of the manuscript. Alaa Alhomaizi analyzed the data, aided in the framework of the paper, and edited the manuscript. Arielle Jean-Pierre and Jennifer Chienwen Kao analyzed the data and aided in the framework of the paper. Jennifer Shippy helped in the IRB submission and edited the manuscript. Gail Manos helped in the IRB submission, setting up the focus groups, and edited the manuscript.

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Identifying contextual factors that impact community reintegration in injured female Veterans

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ABSTRACT

Introduction: Women are an ever-growing and integral part of the U.S. military. However, the research on community reintegration (CR) for injured female Veterans is limited. The purpose of this study was to identify the contextual factors influencing CR for injured female Veterans. **Methods:** Female Veterans reporting a physical or psychological injury acquired during military service ($N = 31$) completed the Community Reintegration of Service Members' Extent of Participation (EOP) and Satisfaction with Participation (SWP) subscales, the Craig Hospital Inventory of Environmental Factors, and the New General Self-Efficacy Scale to identify personal and environmental factors affecting CR. Statistical analyses were conducted to determine the clustering of participants on the basis of CR scores and the effect of environmental factors and self-efficacy on CR. **Results:** Levels of CR were organized into low, moderate, and high CR clusters. General self-efficacy was significantly related to CR, and a significant difference was observed between high and low CR clusters. CR was not related to time served in the military, total time deployed, history of suicidal ideation, or having a dependable social support system. **Discussion:** Findings indicate that general self-efficacy had the strongest relationship with CR for injured female Veterans. Results also suggest that participants had varying levels of CR, and those with lower levels of CR were more likely to perceive environmental factors as barriers to CR. Future research should explore the influence of environmental barriers on CR for injured female Veterans with a larger sample.

Keywords: community reintegration, Community Reintegration of Service Members Extent of Participation (EOP), Craig Hospital Inventory of Environmental Factors, injured female Veterans, New General Self-Efficacy Scale, rehabilitation, Satisfaction with Participation (SWP) subscales, U.S. Army

RÉSUMÉ

Introduction : Les femmes sont partie intégrante et croissante des Forces armées américaines. Cependant, peu de recherches portent sur la réinsertion dans la communauté (RC), des vétéranes blessées. La présente étude visait à déterminer les facteurs contextuels qui ont une influence sur la RC des vétéranes blessées. **Méthodologie** : Les vétéranes qui déclaraient avoir subi une blessure physique ou psychologique pendant leur service militaire (n = 31) ont rempli la sous-échelle de l'étendue de la participation des membres des forces armées à la réinsertion sociale (EOP), la sous-échelle de satisfaction à la participation (SWP), l'inventaire des facteurs environnementaux du *Craig Hospital* et la nouvelle échelle générale d'autoefficacité pour établir quels facteurs personnels et environnementaux influent sur la RC. Grâce à des analyses statistiques, les auteurs ont regroupé les participants d'après les données de RC, de même que l'effet des facteurs environnementaux et de l'autoefficacité sur la RC. **Résultats** : Les taux de RC étaient divisés en groupes de RC faible, modérée et élevée. L'autoefficacité générale était reliée de manière significative à la RC, et les chercheurs ont constaté une différence significative entre les groupes de RC élevée et faible. La RC n'était pas liée à la durée du service dans les forces armées, à la durée totale du déploiement, aux antécédents d'idées suicidaires, ni à un système de soutien social fiable. **Discussion** : Selon les observations, l'autoefficacité générale présentait le lien le plus solide avec la RC chez les vétéranes blessées. Les résultats indiquent également que les participantes présentaient divers taux de RC, et celles dont les taux étaient les plus bas étaient plus susceptibles de percevoir les facteurs environnementaux comme des obstacles à la RC. De futures recherches devront explorer l'influence des obstacles environnementaux sur la RC auprès d'un plus vaste échantillon de vétéranes blessées.

Mots-clés : la nouvelle échelle d'autoefficacité générale, réadaptation, réinsertion dans la communauté (RC), Community Reintegration of Service Members Extent of Participation (EOP), vétéranes blessées, armée américaine, la sous-échelle de satisfaction à la participation (SWP), l'inventaire des facteurs environnementaux du Craig Hospital

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INTRODUCTION

After nearly two decades of conflict in the Middle East, there has been an increase in the number of women joining the military, deploying, and engaging in combat. There are more than 2 million U.S. female Veterans across the world, and more than 1,000 women have been wounded serving in the Global War on Terrorism (GWOT).[1,2] The Direct Exclusion Combat Rule preventing women from entering combat-duty assignments, including infantry and special operations, was rescinded in December 2015.[3] Although combat positions have only recently been opened to women, they have been providing direct support to combat units throughout the GWOT.[4,5] An increase in the number of women seeking care for physical or psychological injuries sustained while serving has contributed to female Veterans becoming the fastest growing group seeking health care from Veterans Health Administration (VHA) hospitals and facilities.[6–10]

As a result of the nature of the non-linear battlefield, female service members often find themselves facing direct fire, improvised explosive devices, and other causes of injury.[4,11] Increased combat positions lead to increases in combat-related injuries, such as traumatic brain injuries, spinal cord injuries, limb loss, and posttraumatic stress disorder (PTSD).[4,7] These injuries result in more female Veterans needing health care and reintegration support services. However, much of the research on combat experiences and community reintegration (CR) has focused exclusively on male service members, with female service members often underrepresented.[4,11–13] Researchers have called for the VHA to lead the changes in perceptions and attitudes regarding female Veterans.[6] Additional research is needed to understand how to assist their transition from military service to civilian living by identifying and addressing the factors related to CR. Therefore, the objective of this study was to identify the contextual factors that influence CR for female Veterans who acquired physical or psychological injuries during military service.

LITERATURE REVIEW

Community reintegration

CR after a military deployment or discharge can be a difficult transition for Veterans. If Veterans were also injured during military service, they may face additional CR-related challenges. CR is described as an individual's return to activities of daily living and productive activities while living in their home community. CR is suggested to be influenced by contextual factors, including personal and environmental factors such as self-efficacy, policies, attitudes, social support, and accessibility. Contextual factors can act as barriers or facilitators influencing an individual's CR.[13–15] Services and assistance, attitudes and support in the community and home, and policies are the environmental barriers reported most likely to affect CR.[6,15] General self-efficacy (GSE) has been identified as the strongest personal factor and overall contextual factor affecting injured Veterans' CR.[15] A qualitative study indicated self-efficacy and social support were the primary influencers of CR among a sample of injured Veterans. Also, Veterans with a lower level of GSE were more likely to report environmental factors and their injuries as barriers to CR than those with higher GSE.[9]

Female Veterans

Service members, regardless of gender, are at risk for sustaining injuries during military service.[8,16] However, the risk for certain injuries increases depending on a service member's job and exposure to combat. Men are more likely to be diagnosed with a traumatic brain injury, spinal cord injury, or limb loss because they occupy most of the combat positions.[4,9,16] Whether gender differences exist in psychological injury post-deployment is inconclusive. For example, one study found no significant differences between men and women in mental health or PTSD symptoms post-deployment.[6] However, other studies have found that women are at an increased risk for mental health diagnosis, military sexual trauma, unemployment, and homelessness post-deployment.[9,16,17]

With regard to seeking and receiving supports and services, female Veterans report travel distance, missing work, finding child care for appointments, and navigating the VHA medical system as barriers.[6] The fear of having a mental health diagnosis on one's military record and being perceived as weak have been found to be the greatest barriers preventing male and female Veterans from seeking help.[18] Having quality mental health services was identified by many female Veterans as an important, but lacking, service in their geographical areas. Many women chose not to participate in community Veteran programs because attendees were mostly men.[6,19] Female Veterans more frequently use avoidant coping strategies and are less likely to reach out to friends and family for help.[7] Despite these challenges and times of feeling isolated, many female Veterans are

proud of their service and view their time in the military as an important factor in their self-identity.[6]

These barriers affect many aspects of female Veterans' lives, but less is known about whether or how they affect female Veterans' overall CR.[4,13–15] More specifically, few studies have focused on the personal and environmental factors influencing female Veterans' CR. Personal factors consist of the individual's cognitive and affective background (e.g., self-efficacy, self-regulation), and environmental factors consist of the physical, social, and attitudinal environment in which people live and conduct their lives.[20,21] In one study, injured female Veterans reported that participating in Veteran-focused programs, having a strong social support system, and having personality traits such as motivation, optimism, and self-determination were the strongest facilitators of their CR. These same female Veterans identified insufficient services, accessibility of services, lack of social support, and difficulty trusting others as barriers to CR.[6,13] Further research on injured female Veterans and CR is necessary for service providers to better understand the needs of female Veterans and to provide supportive programs that will increase successful CR and their quality of life.

This study mirrors a previous study that identified contextual factors of CR among injured Veterans, but this study's demographic sample differs in that we focused solely on female Veterans rather than a mixed-gender sample.[14] The objectives of the current study were to determine (1) the contextual factors associated with CR in injured female Veterans and (2) the impact of total time in military service, time deployed, history of suicidal ideation, and a dependable social support system on injured female Veterans' CR.

METHODS

Procedure

This study's methods replicate those of a previous study conducted with a mixed-gender sample[14] to identify and understand the impact of contextual factors specifically related to injured female Veterans' CR. An online survey instrument was administered via Qualtrics survey software (Qualtrics, Provo, UT) to a sample of female Veterans over a six-month period. Eligible participants served in the military during the time frame of the GWOT, were not required to have been deployed to a combat zone, reported a physical or psychological injury during military service, and resided in the community.

Recruitment was completed through flyers and word of mouth with organizations that provide services to Veterans, such as advocacy groups, online support programs, professional Listservs, and adaptive sport programs. The study used maximum variation sampling with these organizations to elicit participants across the spectrum of CR (i.e., differences in years since injury, rehabilitation services received).[22]

Participants provided personal information (name, age, phone number, email address) for potential follow-up studies. They were asked questions regarding their military history, such as years served, branch served, military job titles, number and length of deployments, and injuries sustained with an open-text option to provide specific details about their injuries. Participants were asked to identify their perceived level of disability (i.e., slight, moderate, severe, not disabled). The survey also included questions regarding personal relationships, social support, work, and mental health (i.e., substance abuse and suicidal ideation). The survey settings prevented "ballot box stuffing" and did not allow participants to complete the survey more than once. Institutional review board approval was received before the start of the study.

Measures

An online survey instrument was used to administer measures in the following areas.

Community reintegration

The Community Reintegration of Injured Service Members (CRIS) was developed to measure injured servicemembers' CR using three standalone subscales: Perceived Limitations (PL), Extent of Participation (EOP), and Satisfaction with Participation (SWP).[23,24] The EOP and the SWP subscales were used in this study. The PL subscale was excluded because we instead used a measure of environment-specific barriers, which better corresponded with the study's purpose. The CRIS reported a reliabilities of 0.91 and 0.90, respectively, for EOP and SWP. Individuals can score between 10 and 70 on each subscale, with a higher score indicating a higher level of CR.[23,24]

Environmental factors

The Craig Hospital Inventory of Environmental Factors (CHIEF) measures the frequency and impact of environmental factors on individuals with a disability. The CHIEF Short Form (CHIEF–SF) consists of 12 items that measure environmental factors that can potentially

influence female Veterans' CR (i.e., services and assistance, policies, physical and structural, work and school, and attitudes and support). Scores range from 0 to 8, and the measure has a reliability of 0.93. Higher scores indicate that a factor is a greater barrier to CR.[25]

Self-efficacy

The New General Self-Efficacy scale (NGSE) includes eight items that measure traits that influence an individual's GSE, such as an individual's perception of her or his personal ability to accomplish a task. NGSE scores range from 1 to 5, and a higher score is associated with higher GSE. The NGSE has yielded a high internal consistency reliability (Cronbach's as = 0.86 and 0.90).[26]

Analyses

We used IBM SPSS Software (Version 25.0; IBM Corporation, Armonk, NY) to analyze data. Correlations and scatter plots between EOP and SWP were used to determine participants' overall level of CR. A K-means cluster analysis organized the participants' CR levels into clusters. A multivariate analysis of covariance (MANCOVA) tested the effect that GSE, as measured by the NGSE, and the five environmental factors from the CHIEF–SF had on CR while controlling for perceived level of disability. A least significant difference (LSD) post hoc test analyzed differences between contextual factors and each CR cluster. Pearson χ^2 test was used to analyze the influence of suicidal ideations and having dependable social support on CR.

RESULTS

A total of 31 injured female Veterans, aged 28–59 years (mean = 44 y), participated in the study. The majority of participants had served in the military for more than 10 years (74.3%; mean = 16.52). A large percentage of the sample was injured while on active duty (87.1%) and served in Operation Enduring Freedom (70.9%). A majority of the sample served in the Army (48.4%). PTSD (96.8%) and depression (77.4%) were the most frequently self-reported injuries, followed by brain injury (54.8%; four participants reported mild traumatic brain injury, two reported moderate brain injury, one reported severe brain injury, three did not specify), and generalized anxiety disorder (41.9%). The majority of participants reported more than two injuries (80.6%). More than half of the sample reported a history of suicidal ideation (58.1%) and a dependable social support system (54.8%). Participants reported attending

rehabilitation at private hospitals, Army medical centers, Warrior Transition Battalions, and VHA hospitals across the county. Refer to Table 1 for more participant descriptive information.

Table 1. Participant descriptive statistics (N = 31)

Variables	n (%)
Military branch	
Army	15 (48.4)
Air Force	9 (29.0)
Navy	5 (16.1)
National Guard	2 (6.5)
Marine Corps	3 (9.7)
Other	1 (3.2)
Time served, yr	
<5	3 (9.7)
5–10	5 (16.1)
10–15	6 (19.4)
15–20	7 (22.6)
>20	10 (32.3)
Conflict involvement	
Operation Iraqi Freedom	14 (45.2)
Operation Enduring Freedom	22 (70.9)
Operation New Dawn	1 (3.2)
Other	11 (35.5)
No. of combat deployments	
Not deployed	2 (6.5)
1	9 (29.0)
2	11 (35.5)
3	4 (12.9)
4	5 (16.1)
When injured	
Active duty	27 (87.1)
Reserves	4 (12.9)
Type of injury	
Spinal cord injury	9 (29.0)
Brain injury	17 (54.8)
Burn	2 (6.5)
Sensory impairment	12 (38.7)
Post-traumatic stress disorder	30 (96.8)
Depression	24 (77.4)
Generalized anxiety disorder	13 (41.9)
Other	10 (32.3)
>2 injuries	25 (80.6)

Table 1. (Continued)

Variables	n (%)
Time since injury, yr	
3–5	13 (41.9)
>5	18 (58.1)
Perceived level of disability, handicap, or both	
Not disabled	1 (4.8)
Slight	3 (9.7)
Moderate	6 (28.6)
Somewhat severe	9 (42.9)
Very severe	5 (23.8)
Attended rehabilitation	14 (45.2)
Received CR training during rehabilitation	11 (35.5)
Past problems with alcohol, substances, or both	9 (29.0)
Suicidal ideation	18 (58.1)
Intimate relationship	17 (54.8)
Separated or divorced	4 (12.9)
Children	16 (51.6)
Dependable family or friends in community	17 (54.8)

Note: Not all categories equal 31 participants or 100 percent due to multiple answers (i.e., type of disability). CR = community reintegration.

Correlations

Mean scores were 40.81 (SD = 8.34) on the EOP and 39.52 (SD = 10.34) on the SWP, indicating moderate levels of CR. A significant positive correlation ($r = 0.818$, $p < 0.001$) existed between participants' EOP and SWP scores. GSE had a significant positive correlation with both EOP ($r = 0.688$, $p < 0.001$) and SWP ($r = 0.767$, $p < 0.001$) scores. We found no significant correlations between CHIEF–SF barrier scores, total time in service, or total time deployed and EOP and SWP. Refer to Table 2 for correlations between contextual factor measures (CHIEF–SF and NGSE) and EOP and SWP scores.

A K-means cluster analysis was used to group participants' overall CR scores, based on EOP and SWP scores, into three clusters (i.e., low, moderate, and high CR) to identify the barriers influencing varying levels of CR. Seven cases were assigned to the low CR cluster, 20 to the moderate cluster, and four to the high CR cluster. Figure 1 illustrates the clusters based on EOP and SWP scores.

Five participants did not fully complete the NGSE or the CHIEF–SF, so their data were excluded from this portion of the analysis ($n = 26$). The MANCOVA results showed that GSE was the only contextual factor that had a statistically significant between-subjects effect on CR (partial $\eta^2 = 0.469$, $F_2 = 10.164$, $p < 0.001$). LSD

Table 2. Correlations between contextual factors and CR measures

Variable	EOP	SWP
General Self-Efficacy		
Pearson r	0.688	0.767
p (2-tailed)	0.000*	0.000*
Policy Barriers		
Pearson r	−0.168	−0.174
p (2-tailed)	0.411	0.394
Physical and Structural Barriers		
Pearson r	−0.239	−0.286
p (2-tailed)	0.239	0.216
Work and School Barriers		
Pearson r	−0.341	−0.256
p (2-tailed)	0.088	0.207
Attitudes and Support Barriers		
Pearson r	−0.259	−0.287
p (2-tailed)	0.202	0.155
Services and Assistance Barriers		
Pearson r	−0.346	−0.317
p (2-tailed)	0.083	0.115

Note: CR = community reintegration; EOP = Extent of Participation; SWP = Satisfaction with Participation.

* Indicates significant correlations.

post hoc indicated a statistically significant difference between the high and low CR clusters (mean difference = 1.948, $p < 0.001$) and the moderate and low CR clusters (mean difference = 1.0182, $p < 0.002$) for GSE. This finding suggests that individuals categorized in the high and moderate CR clusters scored higher on GSE than those in the low CR cluster. Veterans in the high and moderate CR clusters most commonly reported physical–structural and attitude–support environmental barriers to CR. Individuals in the low CR cluster reported the five barriers to CR more frequently than did individuals in the high or moderate CR clusters. Table 3 indicates the estimates of contextual factors and the three CR clusters.

Pearson χ^2 tests indicated that suicidal ideation and having a dependable social support system had no significant difference in observed counts between any CR clusters. Pearson χ^2 tests were also conducted between other descriptive variables (i.e., substance abuse, intimate relationship, children, and perceived level of disability) and the low, moderate, and high CR clusters to determine potential significant differences. No significant
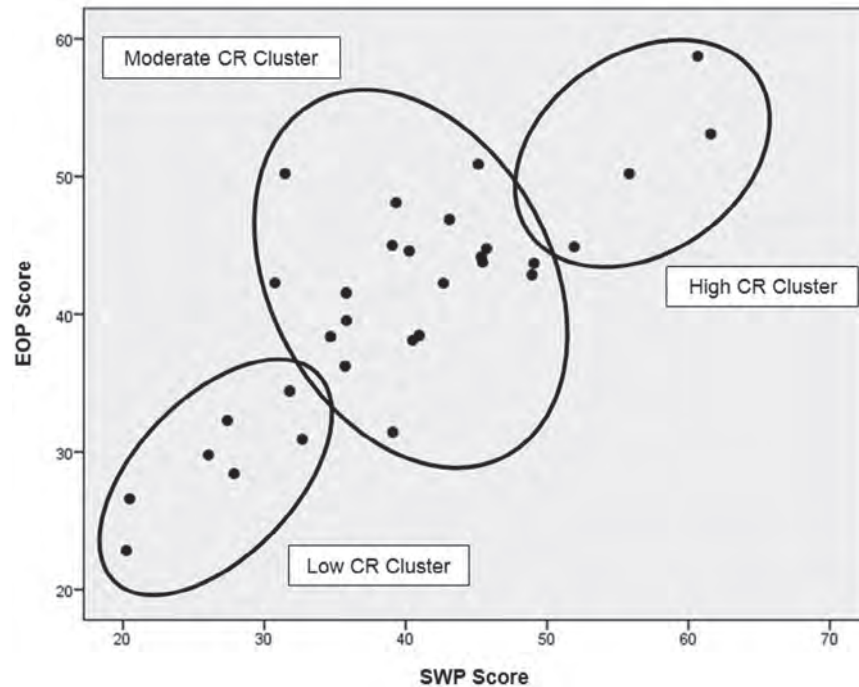
Figure 1. Community Reintegration (CR) Clusters

EOP = Extent of Participation, SWP = Satisfaction with Participation.

Table 3. Estimates for contextual factors on CR clusters

Contextual and descriptive variables	CR clusters, mean (SD)		
	Low	Moderate	High
General self-efficacy	2.05 (0.307)	3.11 (0.179)	3.87 (0.356)
Physical and structural barriers	3.04 (0.734)	2.09 (0.429)	1.96 (0.852)
Service and assistance barriers	4.11 (1.083)	1.71 (0.633)	1.26 (1.257)
Work and school barriers	2.60 (0.921)	1.01 (0.538)	0.805 (1.069)
Attitude and support barriers	2.85 (0.953)	1.98 (0.557)	1.56 (1.106)
Policy barriers	3.96 (0.759)	1.25 (0.443)	0.829 (0.880)

Note: Controlling for Perceived Disability. CR = community reintegration.

difference in observed counts was indicated for any CR clusters and the descriptive variables.

DISCUSSION

The aim of this study was to identify contextual factors influencing injured female Veterans' CR. A positive correlation existed between EOP and SWP scores. Individuals' level of CR was organized into low, moderate, and high CR clusters. Analysis of contextual factors revealed that GSE had a significant effect on CR and significantly accounted for variance in CR scores between individuals in the low and high CR clusters and the moderate and low CR clusters. This finding supports GSE's strong influence on CR for injured female Veterans. No other variables had a statistical association with CR cluster affiliation.

It was found that 87.1% of injured female Veterans scored in a low to moderate CR range, which is considerably higher than the findings from a study with a mixed-gender sample, in which 62% of injured Veterans were classified as having low or moderate CR.[14]

The literature suggests that female and male Veterans face different challenges during CR and that women have unique needs compared with men.[6,16,19] Differences between the women in this study were identified when compared with findings from the study that involved women as part of a larger, mixed-gender sample. Most notable was that environmental factors were not a significant barrier to CR for women in this study (despite a negative correlation), whereas they were a significant barrier for men and women, collectively, in the mixed-gendered study and in other studies of CR.[13–16,18] Although a significant relationship between CR and environmental barriers was not found in the current

study, participants in the high and moderate CR clusters were most likely to report physical–structural and attitude–support as environmental barriers.

The leading result from this study was the association between GSE and CR. The importance of GSE is synonymous with previous research that examined personal and environmental factors influencing injured Veterans' CR.[9,13,14] A possible explanation for why environmental barriers were not significantly related to CR in this study may be that GSE mediates the impact of environmental barriers on CR. The authors did not test this mediating relationship because of sample size limitations. Future research should further explore the influence of environmental barriers on injured female Veterans and the relationship between personal factors such as GSE and environmental factors in the context of CR.

Another possible explanation for why self-efficacy was significantly related to CR but environmental barriers were not related is that the majority of the sample was living at home in their community, more than five years post-injury. At this point in their CR process, the individuals may have been educated or have acquired the skills necessary to navigate environmental barriers, resulting in an increase in barrier negotiation ability and higher self-efficacy. This may also help explain why female Veterans in the moderate and high CR clusters reported fewer environmental barriers than those in the lower CR cluster.

Previous studies suggest that Veterans who served in the GWOT report more than one injury.[12,14] In this sample, 80.6% reported more than two injuries sustained during military service. There are variations in the literature concerning male and female Veterans' susceptibility to certain diagnoses. Some studies have proposed that no differences exist between men and women reporting mental health symptoms post-deployment.[6] Other studies suggest that men are more commonly diagnosed with PTSD than women.[4,7] In this study, 96.8% of women reported PTSD, which was much higher than reports from the previous study, in which 64.7% of the sample reported PTSD,[13] and much higher than a VHA study that ranked PTSD as the most prevalent service-related disability of all female Veterans at 11.8%.[27] This study controlled for perceived level of disability, but it did not attempt to examine the effect of specific injuries on CR. Future research should examine the effect injuries may have on CR – specifically, examining rates of PTSD among female Veterans because PTSD has been suggested to be associated with lower CR.[12]

This study found that 58.1% of the sample reported a history of suicidal ideation, which is higher than previous studies.[14,16] Although the aim of this study was not to understand suicidal ideation among women, individuals who reported a history of suicidal ideation indicated having multiple injuries, had a high prevalence of military sexual trauma, and exhibited low to moderate CR scores. Future research should investigate the possible relationships between these variables and suicidal ideation because findings could be valuable for identifying suicide risk and prevention among female Veterans.

In the current study, it was found that female Veterans reported a lower percentage of dependable social support (54.8%) in their community compared with the previous study, in which 74.5% of Veterans reported having dependable social support.[14] The influence that lack of social support may have on female Veterans' CR should be further examined, taking into consideration increased feelings of isolation during and underrepresentation of women in Veteran programs.[13,16]

Overall, this study supports previous research demonstrating the integral role of GSE in CR.[9,14] Agencies that provide services for Veterans should consider incorporating programs that promote GSE. One avenue for promoting CR is the use of recreation, sport, outdoors, and nature-based programs as well as recreational therapy. These types of programs and services can help promote GSE by providing injured Veterans with opportunities to overcome challenges, increase self-esteem, improve social skills, and acquire new skills.[9,28,29] Many of these community-based programs are designed and implemented by credentialed recreational therapists, who are educated and trained to use recreation as a treatment modality to meet the unique needs and interests of military Veterans.[30] A growing body of literature is emerging that supports the use of recreation and recreational therapy with injured Veterans and their supporters.[28–36]

Limitations

Because of the small sample size, it is challenging to generalize results to other injured female Veterans. A power analysis was not conducted to determine adequate sample size before recruitment, in part because of the study's exploratory nature to identify relationships between contextual factors and CR among female Veterans. Future studies should use this study as a baseline to recruit larger samples to enhance the explanatory ability of the results, as determined by a power analysis.

In addition, having more diversity in participants' age and time in military service could allow for greater generalizability among female Veterans. Participants in this study were more than three years post-injury, so the authors could not adequately measure the implication of time since injury on CR. It is important to note that injuries were self-reported and not verified with medical documentation.

CONCLUSION

This study indicated the significant association between GSE and injured female Veterans' satisfaction with and extent of participation in CR. Findings identified perceived barriers for each CR cluster, whereby those with low levels of CR were most likely to report environmental barriers to CR. The study contributes to the growing body of literature on female Veterans by examining contextual factors influencing CR. Enhancing self-efficacy and training to overcome environmental barriers may have the greatest influence on successful reintegration of female Veterans. As the number of injured female Veterans increases, it is important that additional research be conducted to provide practitioners with the evidence and knowledge to offer the most effective CR services. Understanding the facilitators of and barriers to CR will assist providers in offering services designed to meet the specific needs of injured female Veterans and equip them with the skills necessary for successful CR.

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RESEARCH

Factor structure of posttraumatic stress disorder (PTSD) in Australian Vietnam Veterans: Confirmatory factor analysis of the Clinician-Administered PTSD Scale for DSM–5

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ABSTRACT

Introduction: The *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM–5) brought a change to the symptom clusters of posttraumatic stress disorder (PTSD). In line with the DSM–5 changes, an updated version of the Clinician-Administered PTSD Scale (CAPS–5) was released. The CAPS–5 is considered to be the gold-standard measure of PTSD; however, examinations of the psychometric properties and optimal factor structure of this scale are underrepresented in PTSD studies. **Methods:** This study used confirmatory factor analysis (CFA) to assess the factor structure of the CAPS–5 using a sample of 267 male Australian Vietnam Veterans. Models drawn from the PTSD CFA literature were used to test the underlying dimensions of PTSD: the four-factor DSM–5 model, six-factor externalizing behaviour and anhedonia models, and seven-factor hybrid model. **Results:** The results found that the DSM–5 model showed slightly less than adequate fit (comparative fit index [CFI] = 0.90, Tucker–Lewis index [TLI] = 0.88, root mean square error of approximation [RMSEA] = 0.064), however, other models showed acceptable fit. The anhedonia model provided a significantly better fit than the other models (CFI = 0.92, TLI = 0.90, RMSEA = 0.059). **Discussion:** Overall, the results supported the anhedonia model. This result may indicate that the underlying dimensions of PTSD in Australian Vietnam Veterans may best be represented by six distinct factors.

Keywords: Australian Veterans, clinical interviews, Clinician-Administered PTSD Scale, confirmatory factor analysis, DSM–5, mental health, posttraumatic stress disorder, PTSD, Veteran mental health, Vietnam conflict

RÉSUMÉ

Introduction : La cinquième édition du Manuel diagnostique et statistique des troubles mentaux (DSM–5) a modifié le groupe de symptômes définissant l'état de stress post-traumatique (ÉSPT). Conformément aux modifications contenues dans le DSM–5, une version à jour de l'échelle du TSPT administrée par le clinicien (CAPS–5) a été publiée. La CAPS–5 est considérée comme la mesure de référence du TSPT, mais l'examen de ses propriétés psychométriques et sa structure factorielle optimale sont sous-représentés dans les études du TSPT. **Méthodologie :** La présente étude a fait appel à l'analyse factorielle confirmatoire (AFC) pour évaluer la structure factorielle de la CAPS–5 chez un échantillon de 267 vétérans australiens du Vietnam de sexe masculin. Les auteurs ont utilisé des modèles tirés de publications sur l'AFC de l'ÉSPT pour vérifier les dimensions sous-jacentes au TSPT : le modèle du DSM en quatre facteurs, le modèle de comportement d'externalisation et le modèle d'Anhedonia en six facteurs, ainsi que le modèle hybride en sept facteurs. **Résultats :** D'après les résultats, le modèle DSM–5 présentait une adéquation légèrement moins qu'appropriée (CFI = 0,90, TLI = 0,88, RMSEA = 0,064), mais les autres modèles étaient acceptables. Le modèle d'Anhedonia présentait une adéquation significativement supérieure aux autres (CFI = 0,92, TLI = 0,90, RMSEA = 0,059). **Discussion :** Dans l'ensemble, les résultats appuient le modèle d'Anhedonia. Ainsi, les dimensions sous-jacentes du TSPT chez les vétérans australiens du Vietnam seraient mieux représentées par six facteurs distincts.

Mots-clés : Analyse factorielle confirmatoire, DSM–5, échelle du TSPT administrée par le clinicien, état de stress post-traumatique, santé mentale des vétérans, entrevues cliniques, ÉSPT, guerre du Vietnam, santé mentale, vétérans australiens

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INTRODUCTION

Posttraumatic stress disorder (PTSD) is a trauma- and stressor-related disorder precipitated by exposure to extreme, traumatic life events.[1] Lifetime prevalence rates of PTSD in general populations vary from 1.3% to 12.2%, depending on country and socio-demographic status.[2] Symptoms of PTSD include distress when reminded of the traumatic event, avoidance of situations that may be reminders of the event, alterations in mood and cognitions, poor sleep, and hypervigilance.[1,2]

Diagnostic and Statistical Manual of Mental Disorders and PTSD

Since PTSD was first introduced in the third edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*), its symptomatology has consistently been expanded, including in the most recent fifth edition of the DSM (DSM–5).[3] The previous fourth text revision of the DSM listed 17 symptoms across three factors of PTSD: re-experiencing, avoidance–numbing, and hyperarousal.[4] The DSM–5 expanded this to 20 symptoms across four factors.[1] After establishing that a person has experienced a traumatic event (Criterion A), the 20 symptoms are clustered into the following four factors: intrusion symptoms (Criterion B; five symptoms), avoidance (Criterion C; two symptoms), negative alterations in cognitions and mood (Criterion D; seven symptoms), and alterations in arousal and reactivity (Criterion E; six symptoms).

Clinician-Administered PTSD Scale

The Clinician-Administered PTSD Scale for DSM–5 (CAPS–5) is widely considered to be the most reliable and valid tool for assessing and diagnosing PTSD.[5,6] The CAPS–5 is administered as a structured interview and scored by a mental health professional. The CAPS–5 has been found to more effectively assess PTSD symptoms when compared to self-report measures, likely due to the biases that may be inherent in self-reported methods including under or overreporting, or simply a lack of insight or awareness of one's own symptoms.[7] With the release of the DSM–5, the CAPS–5 has also undergone a revision. These changes have included updating symptomatology to match the DSM–5, combining the two frequency and intensity ratings into a single symptom severity score (ranging from 0 to 4), and including a single severity score cut-off of 2 for diagnostic relevance, rather than two cut-offs of 1 and 2 for frequency and intensity, respectively.[8,9]

Despite generally being considered the gold standard of PTSD measures,[5,6] the CAPS, in both its current form and previous versions, has been underrepresented in investigations into the latent factor structure of PTSD, with most studies being found to use shorter self-report measures, including the PTSD Checklist for DSM–5 (PCL–5).[3] To date, the psychometric properties and factor structure of the CAPS–5 have been examined in two studies, one with a sample of American military Veterans[9] and one with a sample of injured American adults admitted to a trauma center.[10] Both studies combined data from separate studies, collected at different time points, to conduct a confirmatory factor analysis (CFA). It has been noted that examining the underlying dimensions of PTSD using the CAPS–5 in a wider range of samples is needed to assist with future revisions of the DSM.[3] Currently, an examination of the latent factor structure of PTSD as measured by the CAPS–5 in a single, targeted sample has not been conducted.

Posttraumatic stress disorder measures and Australian military Veterans

Certain populations are likely to have an increased exposure to trauma as a result of their occupation, such as service personnel deployed to a combat zone. The prevalence of PTSD is greater among military Veteran populations than civilian populations, with a lifetime prevalence among Veterans ranging from 16.5% to 20.9% compared with 1.3% to 12.2% among general populations.[2,11–13] Australian Vietnam Veterans, in particular, have an estimated lifetime PTSD prevalence of approximately 17%, again higher than that of the general Australian population.[13] Since the release of the DSM–5, no studies have examined the latent construct of PTSD in an Australian military Veteran sample. In addition, no studies have explored the underlying dimensions of PTSD among chronic PTSD sufferers in a focused older Veteran cohort (e.g., those who were exposed to trauma during the Vietnam War and continue to experience symptoms of PTSD). Evaluating the factor structure of PTSD, as measured by the CAPS–5, in such populations ensures that the underlying dimensions of PTSD are being accurately captured in groups of high-risk individuals. Given that the Vietnam Veteran cohort in Australia is currently the largest group of Veterans supported by disability pensions from the Australian Department of Veterans Affairs,[14] continued examination of the progression of mental health

conditions highly prevalent in this group is warranted. Also, examining the underlying dimensions of PTSD among Veterans who were exposed to trauma more than 40 years ago may elicit consideration of how the construct of PTSD and trauma reactions may evolve in the coming decades for contemporary Veterans.

Latent factor structure and models of posttraumatic stress disorder

As described earlier, a four-factor model represents the current diagnostic criteria for PTSD in the DSM–5. However, recent studies have developed alternative models of PTSD that appear to be more statistically robust than the DSM–5 model.[15–17] CFA studies published after the release of the DSM–5 have primarily explored three different models: two six-factor models, the anhedonia and externalizing behaviour models,[15,17] and a seven-factor model, the hybrid model.[16] These models have been tested using the CAPS–5,[9,10] the Secondary Traumatic Stress Scale,[18] the Posttraumatic Diagnostic Scale,[19] and the PCL–5.[15–17]

The six-factor anhedonia model made distinctions in the Criterion D factor of the DSM–5 ((negative alterations in cognition and mood) by separating negative affect (D1–4) and anhedonia (reduced positive affect; D5–7) into two distinct factors. In addition, the six-factor anhedonia model separated the Criterion E factor (alterations in arousal and reactivity) into anxious arousal (E3–4) and dysphoric arousal (E1–2 and E5–6) symptoms.[15] The anhedonia model has been supported in Chinese earthquake survivors,[15] culturally diverse sample of refugees resettled in Australia,[20] and a sample of trauma-exposed Slovakian university students.[21] In comparison, the six-factor externalizing behaviour model made further distinctions between the alterations in arousal and reactivity factor, separating the factors into externalizing behaviour (E1–2), anxious arousal (E3–4), and dysphoric arousal (E5–6) factors.[17] The Externalizing Behaviour model has been supported in a sample of American Veterans.[17]

The most recent model to garner empirical support is the seven-factor hybrid model, described by Armour et al.[16] This model combines the distinctions made in the anhedonia model (negative affect, D1–4, and anhedonia, D5–7) and the externalizing behaviour model (externalizing behaviour, E1–2; anxious arousal, E3–4; and dysphoric arousal, E5–6). The hybrid model has gained significant support in the literature when examined using self-report measures with samples of university students,[16] displaced Filipino persons,[22] Chinese adolescents and adults,[23,24] and Haiyan disaster survivors,[25] as well as in two CAPS–5 studies with samples of American Veterans and injured American adults admitted to a trauma center.[9,10] See Table 1 for factor structures.

Current study

This study aimed to assess the underlying dimensions of PTSD as measured by the CAPS–5, using the current DSM–5 symptom clusters, as well as testing the models drawn from the current literature, including the six-factor anhedonia and externalizing behaviour models and the seven-factor hybrid model. In addition, convergent and discriminant validity of the best-fitting model for the CAPS–5 was examined by determining the relationship between the model factors and other validated measures of depression, anxiety, and stress.

METHOD

Participants and procedure

Participants were recruited as a part of the PTSD Initiative by the Gallipoli Medical Research Institute in Brisbane, Queensland, Australia. Participant consent was obtained before testing, and participants were informed that they could withdraw from the study at any stage. Participant recruitment and study procedures are fully described in McLeay et al.[26] A sample of 311 male Australian Vietnam Veterans was initially recruited for this larger investigation of the physical health implications of chronic PTSD.[26]

From the initial 311 participants, 43 were excluded from this analysis because they had not reported exposure to a traumatic event, as defined by Criterion A on the CAPS–5 (see "Measures" section). One additional participant was excluded because of incomplete CAPS–5 data, leaving a final sample size of 267 participants. Combat-related trauma was targeted during CAPS–5 administration. Of the final sample, 212 participants (79.4%) reported experiencing a traumatic event, 42 reported witnessing a traumatic incident (15.7%), 10 learned of a traumatic incident (3.7%), and 3 were exposed to aversive details of a traumatic event (1.1%). The mean age was 68.72 years ($SD = 4.17$), with an age range of 60 to 88 years. Of the final sample, 27 participants (10.1%) met the criteria for a current diagnosis of PTSD. An additional 127 participants (47.6%) had received a PTSD diagnosis in their lifetime.

Table 1. Item mappings across the DSM–5, externalizing behaviour, anhedonia, and hybrid models

DSM–5 symptoms	DSM–5 (Model 1)	Externalizing behaviour (Model 2)	Anhedonia (Model 3)	Hybrid (Model 4)
B1. Intrusive thoughts	In	In	In	In
B2. Nightmares	In	In	In	In
B3. Flashbacks	In	In	In	In
B4. Emotional cue reactivity	In	In	In	In
B5. Physiological cue reactivity	In	In	In	In
C1. Avoidance of thoughts	Av	Av	Av	Av
C2. Avoidance of reminders	Av	Av	Av	Av
D1. Trauma-related amnesia	NACM	NACM	NA	NA
D2. Negative beliefs	NACM	NACM	NA	NA
D3. Distorted blame	NACM	NACM	NA	NA
D4. Pervasive negative emotional state	NACM	NACM	NA	NA
D5. Lack of interest	NACM	NACM	An	An
D6. Feeling detached	NACM	NACM	An	An
D7. Inability to experience positive emotions	NACM	NACM	An	An
E1. Irritability–aggression	AR	EB	DA	EB
E2. Recklessness	AR	EB	DA	EB
E3. Hypervigilance	AR	AA	AA	AA
E4. Exaggerated startle	AR	AA	AA	AA
E5. Difficulty concentrating	AR	DA	DA	DA
E6. Sleep disturbances	AR	DA	DA	DA

DSM–5 = *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.); In = intrusions, Av = avoidance; NACM = negative alterations in cognitions and mood; NA = negative affect; An = anhedonia; AR = alterations in arousal and reactivity; EB = externalizing behaviour; AA = anxious arousal; DA = dysphoric arousal.

Ethics approval was obtained from the Greenslopes Research and Ethics Committee, the Australian Department of Veteran Affairs Human Research Ethics Committee, the University of Queensland Ethics Committee, and the Queensland University of Technology Human Research Ethics Committee. This study was registered with the Australian New Zealand Clinical Trials Registry (ACTRN12614000429651).

Measures

Clinician-Administered PTSD Scale for DSM–5

The CAPS–5 is a 30-item scale that measures the presence of PTSD symptoms, in accordance with DSM–5 diagnostic criteria.[6] The CAPS–5 is a structured clinical interview and takes 45–60 minutes to administer. When administering the test, the clinician initially determines whether the respondent has experienced a traumatic event according to Criterion A of the DSM–5. If the respondent meets Criterion A, the

clinician continues the interview using the structured questions that assess the severity of symptomatology of the DSM–5 criteria for PTSD (e.g., "In the last month have you been especially alert or watchful even when there was no specific threat or danger?"). The symptomatology for each question is rated by the clinician on 5-point Likert scale ranging from 0 (*absent*) to 4 (*severe*), with a minimum total score of 0 and a maximum score of 80. The CAPS–5 was administered by a registered psychologist trained in its use. The scale demonstrated excellent overall internal consistency in this sample ($\alpha = 0.90$) and moderate to good internal consistency for the Criterion B–E symptom clusters ($\alpha = 0.69–0.79$). The mean score for the CAPS–5 (past month version) in this sample was 11.54 (*SD* = 10.06).

Depression, Anxiety and Stress Scale–21

The Depression, Anxiety and Stress Scale–21 (DASS–21) is a 21-item self-report questionnaire used to measure an individual's levels of depression, anxiety, and stress.[27] The DASS–21 requires test takers to rate how

much each item relates to them in the previous week (e.g., "I felt down-hearted and blue"), using a 4-point Likert scale ranging from 0 (*never*) to 3 (*almost always*). The DASS–21 has shown good psychometric properties and validity in previous studies.[27–30] The scale is divided into three subscales (Depression, Anxiety, and Stress), each with seven items, and has a possible score range of 0–21. Each subscale demonstrated good to excellent internal consistency in this sample ($\alpha = 0.85–0.91$).

Data analysis

The initial data screening was conducted in IBM SPSS Statistics (Version 24; IBM Corporation, Armonk, NY), and the four CFA models were constructed and tested in IBM SPSS AMOS (Version 24). The models included 20 observed variables. The item mappings of the four CFA models are shown in Table 1.

The CAPS–5 scores for the final sample were found to have violations to the assumptions of univariate and multivariate normality. To compensate for this, we used Bollen–Stine bootstrap χ^2 rather than the maximum-likelihood χ^2 significance test.[31] Model fit for each CFA was evaluated using Bollen–Stine bootstrap χ^2, comparative fit index (CFI), Tucker–Lewis index (TLI), and root mean square error of approximation (RMSEA). The Bayesian information criterion (BIC) and Akaike information criterion (AIC) were also reported for model description. Models with CFI and TLI values of 0.90 or more and RMSEA values of 0.06 or more but 0.08 or less would represent an acceptable fit to the data.[32] Models with CFI and TLI values of 0.95 or more and RMSEA values of 0.06 or less would represent an excellent fit to the data.[32]

To determine the model with the best fit to the data, we compared all models. The χ^2 difference test ($\Delta\chi^2$) was used to compare nested models (i.e., models that can be integrated by reducing the number of factors, e.g., the DSM–5 and hybrid models).[32] A significant difference indicates that the more complex model (i.e., the model with more factors) represents a better fit to the data. We used BIC differences (ΔBIC) to compare non-nested models (i.e., models that cannot be integrated by reducing the number of factors, e.g., the externalizing behaviour and anhedonia models).[33] ΔBIC values of 10 or more represent very strong support for model improvement, with the model with the lower BIC value being the stronger model.[33] No missing values were found. All item scores were within appropriate ranges. For the strongest model, we calculated additional bivariate correlations between the PTSD symptom clusters and the DASS–21 subscales (Depression, Anxiety, and Stress) to assess the construct validity of the model factors.

RESULTS

Confirmatory factor analysis

Both the four-factor DSM–5 model and the six-factor externalizing behaviour model were found to have statistically significant Bollen–Stine bootstrap χ^2 values ($p \leq 0.05$), as well as TLI values of less than 0.90, indicating a less than adequate fit to the data. The remaining two models (the six-factor anhedonia model and the seven-factor hybrid model) showed adequate fit to the data across CFI, TLI, RMSEA, and Bollen–Stine bootstrap χ^2 tests. See Table 2 for the relevant goodness-of-fit statistics.

When comparing the models, the six-factor externalizing behaviour ($\Delta\chi^2_9 = 20.26$, $p = 0.016$) and anhedonia ($\Delta\chi^2_9 = 46.98$, $p < 0.001$) and seven-factor hybrid ($\Delta\chi^2_{15} = 52.48$, $p < 0.001$) models showed significantly better fit than the four-factor DSM–5 model. The six-factor anhedonia (ΔBIC = 26.72) and seven-factor hybrid ($\Delta\chi^2_6 = 32.22$, $p < 0.001$) models showed significantly better fit than the six-factor externalizing behaviour model. The seven-factor hybrid model did not show significantly better fit than the six-factor

Table 2. Goodness-of-fit indices for the DSM–5, externalizing behaviour, anhedonia, and hybrid models

Model	X^2	df	CFI	TLI	RMSEA (90% CI)	AIC	BIC
1. DSM–5	341.40*	164	0.90	0.88	0.064 (0.054–0.073)	433.40	598.41
2. EB	321.14*	155	0.90	0.88	0.063 (0.054–0.073)	431.14	628.44
3. An	294.42	155	0.92	0.90	0.058 (0.048–0.068)	404.42	601.72
4. Hy	288.92	149	0.92	0.90	0.059 (0.049–0.070)	410.92	629.74

*$p < 0.05$.

DSM–5 = *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.); df = degree of freedom; CFI = comparative fit index; TLI = Tucker–Lewis Index; RMSEA = root mean square error of approximation; CI = confidence interval; AIC = Akaike information criterion; BIC = Bayesian information criterion; EB = externalizing behaviour, An = anhedonia, Hy = hybrid.

Table 3. Standardized factor loadings and factor correlations for the six-factor Anhedonia model

DSM–5 Symptoms	In	Av	NA	An	DA	AA
B1. Intrusive thoughts	0.73					
B2. Nightmares	0.70					
B3. Flashbacks	0.49					
B4. Emotional cue reactivity	0.69					
B5. Physiological cue reactivity	0.64					
C1. Avoidance of thoughts		0.75				
C2. Avoidance of reminders		0.71				
D1. Trauma-related amnesia			0.31			
D2. Negative beliefs			0.60			
D3. Distorted blame			0.44			
D4. Pervasive negative emotional state			0.67			
D5. Lack of interest				0.55		
D6. Feeling detached				0.76		
D7. Inability to experience positive emotions				0.84		
E1. Irritability–aggression					0.58	
E2. Recklessness					0.26	
E3. Hypervigilance						0.71
E4. Exaggerated startle						0.66
E5. Difficulty concentrating					0.67	
E6. Sleep disturbances					0.55	
In	–					
Av	0.92	–				
NA	0.66	0.72	–			
An	0.82	0.80	0.79	–		
DA	0.85	0.88	0.75	0.89	–	
AA	0.81	0.76	0.59	0.72	0.78	–

Note: All factor loadings and correlations were statistically significant ($p < 0.01$).

DSM–5 = *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.); In = intrusions; Av = avoidance; NA = negative affect; An = anhedonia; DA = dysphoric arousal; AA = anxious arousal.

anhedonia model ($\Delta\chi^2_6 = 5.50$, $p = 0.481$), suggesting that the anhedonia model provides the best fit to the data. Table 3 reports the standardized factor loadings and correlations for the six-factor anhedonia model.

Construct validity of the Anhedonia model

Bivariate correlation coefficients were calculated between the Depression, Anxiety, and Stress scales of the DASS–21 and the factors of the six-factor anhedonia model (Table 4). All correlation coefficients were found to be in the medium to large range, and variations in the strength of correlations were observed. The intrusion, avoidance, and anxious arousal factors showed higher correlations to the Anxiety and Stress subscales of the DASS–21 than the Depression

subscale. Moreover, the anhedonia factor showed a higher correlation with the Depression subscale than either the Anxiety or Stress subscale. In addition, the dysphoric arousal factor demonstrated a higher correlation with the Stress and Anxiety subscales than with the Depression subscale.

DISCUSSION

This study aimed to review the latent factor structure of PTSD as assessed by the CAPS–5 by determining the goodness-of-fit of the four-factor DSM–5 model as well that of as three additional PTSD models drawn from the literature: two six-factor models (anhedonia and externalizing behaviour models) and the seven-factor hybrid model.[15–17]

Table 4 Correlation coefficients between factors of the Six-Factor Anhedonia Model with DASS–21 Subscales

DASS–21 subscale	M	SD	Anhedonia model factors						Total
			In	Av	NA	An	DA	AA	
Depression	4.71	4.67	0.46	0.50	0.54	0.59	0.51	0.38	0.63
Anxiety	4.10	4.31	0.61	0.57	0.50	0.43	0.54	0.49	0.66
Stress	7.93	5.26	0.57	0.58	0.51	0.48	0.63	0.51	0.69

Note: All correlations were statistically significant ($p < 0.05$).

DASS–21 = Depression, Anxiety and Stress Scale–21; In = intrusions; Av = avoidance; NA = negative affect; An = anhedonia; DA = dysphoric arousal; AA = anxious arousal.

The four-factor DSM–5 and six-factor externalizing behaviour models failed to achieve the required goodness-of-fit values to be considered an acceptable fit to the data. This runs counter to the results found by Weathers et al. and Hunt et al.,[9,10] who found excellent model fit for the four-factor DSM–5 model when using the CAPS–5 with American Veterans and with American adults, respectively. However, the results also suggest that, although the CAPS–5 failed to achieve an acceptable goodness-of-fit for the four-factor DSM–5 model of PTSD, it showed adequate construct validity when applied to the more recent models of PTSD symptoms.

The six-factor anhedonia model was shown to be a better fit than the seven-factor hybrid model. All factor loadings were positive and statistically significant, with mostly moderate to strong loadings, although the trauma-related amnesia and recklessness items were found to load weakly. This is not unexpected, and is consistent with the results of Weathers et al. and Armour et al.,[9,16] who also found that trauma-related amnesia loaded poorly in a Veteran sample. The support for the anhedonia model is, however, in contrast to previous studies that supported the seven-factor hybrid model over the six-factor anhedonia when using the CAPS–5 or when drawing on a sample of Veterans.[9,10,16]

A potential explanation for this relates to the age range of the current sample. The major difference between the six-factor anhedonia model and the seven-factor hybrid model is the separation of the four-symptom dysphoric arousal factor into the two-symptom externalizing behaviour and dysphoric arousal factors. One of the symptoms in the externalizing behaviour factor is reckless behaviour, which has been demonstrated in past research to decreases with age,[34] with lower risk-taking behaviours being most notable in adults older than 60 years.[35] The current study was specifically aimed at the experience of Vietnam Veterans rather than a mixed cohort of Veterans who may have served in a variety of conflicts, which is a feature of previous samples.[9] The mean age of this sample was 68.72 years (range = 60–88 y) compared with a mean of 55.80 years and 42.03 years in Weathers et al. and Hunt et al.,[9,10] respectively. Armour et al. also drew on an American Veteran sample and found that reckless behaviour loaded strongly.[16] However, the age range of that sample was 20–94 years,[16] and the study used a self-report measure, which has been found to reflect different factor structures compared with the CAPS.[7]

In the current sample, only 10 participants were found to exhibit reckless behaviour associated with PTSD, and only 4 of those showed clinically elevated levels of reckless behaviour. Because participants generally reported low or nonexistent reckless behaviour symptoms, this may have created difficulty establishing a strong, two-symptom externalizing behaviour factor, resulting in stronger evidence for the simpler anhedonia model over the more complex hybrid model. That said, the general acceptability of these two models, external to comparisons, is consistent with the current literature.

The bivariate correlations demonstrated some evidence of construct validity for the anhedonia model. The intrusion, avoidance, and anxious arousal factors were more strongly related to anxiety and stress than to depression, which clinically and theoretically should be expected.[21] Moreover, dysphoric arousal (sleep disturbance) was also most strongly related to stress, followed by anxiety. In addition, negative affect was similarly related to depression, anxiety, and stress, whereas anhedonia showed a discernible difference, with a stronger relationship to depression than either anxiety or stress. This is consistent with the understanding that anhedonia is a depressive symptom, as well as with previous research that has found anhedonia and negative affect to be distinct constructs.[15] Overall, these results are consistent with those of previous studies that have examined these PTSD symptom clusters and other mental health concerns.[21,36]

This study has a number of implications. Given the results that the current DSM–5 model was a less-than-adequate fit to the data, it highlights the need for additional studies examining the CAPS–5 in more specified populations. Moreover, this result may suggest that there might not be any one optimal factor structure of PTSD but that the presenting underlying dimensions of PTSD may be population dependent.

This study's results have several limitations that need to be considered. First is the specific nature of the sample: Australian ex-servicemen aged more than 60 years deployed to the Vietnam conflict. This limits the generalizability of this study to a wider population; however, inferences could be made from the results of this study about the presentation of PTSD in persons older than age 60 years (e.g., a reduced likelihood of reckless behaviour).

Second, all of the models had at least one factor that contained only two items. When conducting a CFA, it is recommended that each latent variable consist of a minimum of three items.[32] However, it is worth noting that all of the current models of PTSD, including the DSM–5 model, contain at least one factor with only two items.[1,3] Future studies should attempt to replicate the findings of this study, using both the CAPS–5 and other measures of PTSD, across a diverse variety of samples. In addition, group differences in PTSD symptomatology based on age should be explored, because older persons with PTSD may be less likely to exhibit certain externalizing behaviours.

CONCLUSION

This study is the first CFA of the CAPS–5 to use an Australian Veteran sample. When comparing four theoretical and evidence-driven PTSD models, the six-factor anhedonia model, composed of intrusion, avoidance, negative affect, anhedonia, anxious arousal, and dysphoric arousal factors, provided the best representation of the latent structure of the DSM–5 symptoms in this sample. This carries implications for future studies examining the underlying construct of PTSD, as well as future methods of assessment and diagnosis in clinical practice and trauma-related research.

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COMPETING INTERESTS

None declared. This article has been peer reviewed.

APPENDIX 1

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John Gilmour conducted the literature review, developed the analysis methodology, conducted the analysis, wrote the first draft of the manuscript, and assisted with submission preparation. Madeline Romaniuk was an initial investigator with the PTSD Initiative, recruited participants, collected data, conducted CAPS–5 assessments, performed data entry and cleaning, conceived of and supervised this study, provided feedback, and worked on the final manuscript.

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Investigating the characteristics of Canadian Armed Forces help-seekers, non-help seekers, and no mental health need groups: A population-based analysis

Valerie M. Wood[a], Brooke Linden[b], Linna Tam-Seto[b] and Heather Stuart[b]

ABSTRACT

Introduction: This secondary analysis compared three groups of Canadian Armed Forces (CAF) members in their demographics and attitudes toward mental health care: those with a need who have sought help (help-seekers), those with a need who have not sought help (non-help seekers) and those with no current need (no-need). **Methods:** Data from the 2013 Canadian Forces Mental Health Survey, which included responses from 6,996 Regular Force and 1,469 Reserve Force members, was used. Several variables were applied to classify members according to mental health need and help-seeking status. **Results:** The three groups had distinct demographic profiles. In addition, results from a discriminant function analysis indicated group differences in attitudes toward mental health care. Help-seekers reported more negative attitudes toward acquiring mental health care for reasons that relate to stigma and career implications, while non-help seekers reported more negative attitudes toward mental health care that reflect a distrust of professionals and preference for self-management. **Discussion:** These findings suggest more can be done to further support help-seekers who report stigma and to support non-help seekers who may have attitudinal barriers to traditional care but may benefit from innovative care solutions.

Key words: Canadian Armed Forces mental health, Canadian Forces mental health, help-seeking, mental health care, mental health stigma, military mental health

RÉSUMÉ

Introduction : La présente analyse secondaire comparait les caractéristiques démographiques et les attitudes à l'égard de la santé mentale de trois groupes de membres des Forces armées canadiennes : ceux qui avaient des besoins et avaient demandé de l'aide (demandeurs d'aide), ceux qui avaient des besoins et n'avaient pas demandé d'aide (non-demandeurs d'aide) et ceux qui n'avaient pas de besoins pour le moment (pas de besoins). **Méthodologie :** Les données tirées de l'Enquête sur la santé mentale dans les Forces armées canadiennes 2013 ont inclus les réponses de 6,996 membres de la Force régulière et de 1,469 membres de la Réserve. Plusieurs variables ont été appliquées à la classification des membres en fonction de leurs besoins en santé mentale et de leur type de demande d'aide. **Résultats :** Les trois groupes présentaient des caractéristiques démographiques distinctes. De plus, les résultats de l'analyse discriminante indiquaient les différences d'attitude à l'égard de la santé mentale selon les groupes. Les demandeurs d'aide avaient des attitudes plus négatives envers l'acquisition de soins en santé mentale à cause de préjugés et des répercussions sur leur carrière, alors que les non-demandeurs d'aide avaient des attitudes plus négatives à l'égard des soins de santé mentale qui reflétaient une méfiance envers les professionnels et une préférence pour l'autogestion. **Discussion :** Ces résultats laissent supposer qu'on peut en faire plus pour soutenir les demandeurs d'aide qui constatent des préjugés et pour soutenir les non-demandeurs d'aide qui peuvent se créer des barrières psychologiques envers les soins traditionnels, mais qui pourraient profiter de solutions novatrices aux soins.

Mots-clés : demande d'aide, préjugés entourant la santé mentale, santé mentale dans les Forces armées canadiennes, santé mentale dans les Forces canadiennes, santé mentale des militaires, soins en santé mentale

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INTRODUCTION

Difficult deployments in the 1990s, and more recently the mission in Afghanistan, have highlighted the need for research focused on understanding and supporting the mental health of military populations.[1] Exposure to traumatic events during combat and peacekeeping missions is associated with the presence of mental health disorders among military personnel.[2] Among Canadian Armed Forces (CAF) personnel deployed in support of the mission in Afghanistan, it is estimated about 13.5% were diagnosed with mental disorders attributed to their involvement in this mission.[3] Aside from increased exposure to trauma or risk to injury, military life is also characterized by regular family relocations and extended absences as a result of training or deployment.[4] These life experiences can pose challenges for military members and their families to access adequate and timely mental health care. The need for these services is evident. In 2013, for example, Statistics Canada data[5] suggested that 1 in 6 Regular Force members had experienced depression, generalized anxiety disorder, posttraumatic stress disorder (PTSD), panic disorder, or alcohol abuse/dependence in the previous 12 months. This is significantly higher – in some cases double (e.g., depression, generalized anxiety) – than the general Canadian population.[5] Considering the data reflects only 5 mental disorders among the approximately 300 recognized in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5),[6] the overall prevalence of mental health concerns is likely much higher.

Despite the high prevalence of mental disorders among military personnel, only 17% of Regular Force CAF personnel sought care from a mental health professional in 2013.[7] In addition, about 15% of Regular Force CAF personnel reported needing professional help for a mental health issue, but not receiving it.[7] The most commonly cited barriers to accessing care were the desire to self-manage their concerns, fear of the impact on their military career, and the fear of asking for help.[7]

A growing body of research has focused on understanding what differentiates military personnel who seek help for mental health concerns from those who do not seek help. Many researchers have focused on the role of attitudes toward care and anticipated stigma, or the extent to which military members believe they will be perceived or treated negatively if their mental health issue or help-seeking behaviour becomes known by others.[8] Findings indicate a complex relationship between help-seeking intentions, mental health service use and stigma, in particular. For example, a review[9] reported that some studies found no association between perceptions of stigma and help-seeking intentions or service use, while others report a positive relationship between stigma and propensity for help-seeking. More recently, however, one study found greater perceptions of self-stigma (i.e., negative self-judgments for seeking help) were associated with attending fewer mental health care sessions among active military service members over a two-year period, while perceptions of public stigma (i.e., perceptions of public attitudes toward those who seek help) were not associated with future service use.[10] Therefore, while the relationship between stigma and help-seeking among military personnel is complex, inconsistencies across studies may reflect methodological inconsistencies and the potential presence of important moderating variables, such as type of stigma, not previously addressed. Aside from understanding the role of stigma and attitudes toward the mental health care system in military members' help-seeking propensities, other research has focused on understanding demographic differences between military members who report a need for care, relative to those with less reported needs for care.[11] However, there has been an important oversight in the literature, such that researchers have not made direct comparisons in attitudes toward the mental health care system (including barriers to care) among those who have a mental health need (perceived or objective) and have sought help, those with a need who have not sought help, and those with no apparent need.

Using a nationally representative sample of CAF personnel, the goal of this study was to compare potential demographic and attitudinal differences among the following CAF personnel: (1) those who reported a current mental health concern and who have recently sought support for their mental health (*help-seekers*); (2) those who reported a mental health concern but who have not recently sought support (*non-help seekers*); and (3) those who did not report having a mental health concern (*no-need*). In addition to examining differences in socio-demographic variables across these groups, the authors were also interested in examining potential group differences in attitudes toward mental health care, including perceptions of potential stigmatization (both self and public/CAF sources of stigma). A combination of objective and subjective measures of mental health need was used for the following reasons.

First, the literature on military mental health shows military-related stressors are not only associated with more common mental disorders (e.g., generalized anxiety disorder [GAD], and panic disorder), but also more general adjustment disorders. In addition, research using population-based surveys has not found a strong relationship between the presence of a DSM diagnosis and more subjective measures (perceptions) of a need for mental health care.[11] For this reason, there has been an increased need to use multiple methods to assess the presence of mental health issues at the population level.

METHODS

Participants and procedure

Data from the 2013 Canadian Forces Mental Health Survey (CFMHS),[12] a national survey conducted in conjunction with Statistics Canada, were used in this study. The data were collected from a stratified random sample of CAF personnel based on rank, Afghanistan mission deployment status and force employment type (Regular vs. Reserve). The target population included CAF Regular Force personnel ($n = 67,776$, with $n = 30,454$ deployed in support of Afghanistan mission) and CAF Primary Reserve Force personnel who had deployed in support of the mission in Afghanistan ($n = 4,578$). Questionnaires were facilitated through confidential, face-to-face computer-assisted interviews with Statistics Canada personnel on designated bases and wings, between April and August 2013. A total of 6,996 Regular Force and 1,469 Reserve Force personnel participated, yielding response rates of 79.6% and 78.8%, respectively.[12]

Measures

Demographics

Demographic items were captured using items developed by Statistics Canada for household surveys. These items are categorized and reported in Table 1. Participants reported their sex, age, marital status (single, living common-law or married, separated or divorced, or widowed), element (Army, Navy, or Air Force), force (Regular or Reserve), rank category (Junior Non-Commissioned Member [NCM], Senior NCM, or Officer), education level (less than high school, high school, some post-secondary, and post-secondary completion), household income, and base region (Atlantic Canada, Quebec, Ontario, or Western Canada).

Mental health need

Several variables were used to classify participants into those currently experiencing a mental health need, versus those with no current mental health need. First, participants were asked whether they currently had a diagnosed mood disorder, anxiety disorder, or PTSD, that had been diagnosed by a health professional and was expected to last/had already lasted six months or more. Participants who indicated receiving a diagnosis for any of these disorders were defined as having a mental health need. Second, participants were asked to rate their mental health on a Likert scale ranging from 0 (*poor*) to 4 (*excellent*). Those who self-rated their mental health as poor were defined as having a mental health need. Third, participants were asked to complete two mental health screening instruments; the Mental Health Continuum – Short Form (MHC-SF)[13] and the 10-item Kessler Psychological Distress Scale (K-10).[14] The MHC-SF is a 14-item instrument used to classify respondents as having "languishing," "moderate," or "flourishing" mental health. The scale also differentiates between high and low emotional well-being. Participants are asked to respond to each item on a Likert scale from 0 (*never*) to 5 (*every day*). Similarly, the K-10 includes 10 items that capture the respondent's overall level of distress, which is assessed on a scale from 1 (*none of the time*) to 5 (*all of the time*). Participants were classified as having a mental health need, if their scores on the MHC-SF reflected low emotional well-being or languishing mental health, or if their scores on the K-10 were equal to, or above, the cut-off for moderate distress. Finally, participants were asked to complete a number of screeners for major mental health disorders according to the World Health Organization Composite International Diagnostic Interview (WHO–CIDI),[15] which is assessed using DSM-IV criteria.[16] Those who met the criteria for depression, generalized anxiety disorder, PTSD, panic disorder, or alcohol dependency within the past 12 months were defined as having a mental health need. In summary, participants were classified as having a mental health need if they met any of the following conditions: had received a mental health diagnosis from a health professional; had poor self-rated mental health; had MHC-SF scores indicating either languishing mental health or low emotional well-being; had K-10 scores that met the cut-off for moderate distress; or if they met the criteria for a major mental disorder according to the presence of related symptoms in the past 12 months. Participants

Table 1. Demographic characteristics of mental health groups

	Help-seekers	Non-help seekers	No-need
	Weighted % (SE)	Weighted % (SE)	Weighted % (SE)
Age, years (mean)	35.9 (0.3)	35.8 (0.5)	35.3 (0.1)
Sex			
Male	79.7 (1.3)*	89.1 (1.5)†	88.0 (0.5)†
Female	19.7 (1.3)*	10.9 (1.5)†	12.4 (0.5)†
Marital status			
Married/common-law	59.2 (1.4)†	58.7 (2.4)†	68.0 (0.6)*
Single	27.0 (1.3)†	33.5 (2.3)*	28.0 (0.6)†
Separated/divorced/ widowed	13.2 (1.0)*	7.4 (1.2)†	6.0 (0.3)†
Element			
Army	62.0 (1.5)†	60.9 (2.3)†	40.5 (0.7)*
Navy	15.2 (1.1)	13.9 (1.7)	17.0 (0.5)
Air Force	22.2 (1.2)†	24.8 (2.1)	30.0 (0.6)*
CAF force	91.7 (0.4)	91.7 (0.8)*	94.0 (0.1)†
Regular Force	6.3 (0.4)	8.3 (0.8)*	6.4 (0.1)†
Reserve Force			
CAF rank			
Jr NCM	60.0 (1.3)†	60.0 (2.2)†	54.0 (0.4)*
Sr NCM	24.8 (1.1)	26.1 (1.9)	18.0 (0.3)
Officer	14.7 (0.9)†	13.9 (1.3)†	24.0 (0.3)*
Education			
Less than high school	4.2 (0.6)	6.1 (1.1)	3.8 (.3)
High school	26.5 (1.4)	30.4 (2.2)*	26.0 (0.6)†
Some post-secondary	9.7 (0.9)	9.1 (1.4)	8.7 (0.4)
Post-secondary	58.8 (1.5)	54.4 (2.3)†	64.0 (0.7)*
HH income (mean)	$95,400† ($1,171)	$97,000† ($2,234)	$103,800* ($720)
Base region			
Atlantic	21.3 (1.2)	20.9 (1.9)	22.0 (0.)
Quebec	13.7 (1.0)	18.7 (2.0)	15.7 (0.5)
Ontario	36.5 (1.5)	32.2 (2.4)	38.0 (0.7)
Western	28.0 (1.4)	28.3 (2.4)	24.0 (0.6)

Note: These are weighted estimates based on *n* = 12,000 for help-seekers, *n* = 4,600 for non-help seekers, and 50,000 for the no-need groups, and using both sampling and bootstrapping weights.

NCM = non-commissioned member; HH = household

*† indicates that groups are different according to non-overlapping 95% confidence intervals

were classified as having no mental health need if they had an absence of any of the above conditions.

Recent help-seeking status

Two variables were used to evaluate whether participants sought help for a mental health need in the past 12 months. Participants were asked (1) whether they had consulted with a professional or utilized a professional service (e.g., psychologist, psychiatrist, nurse, social worker, counsellor, etc.) in the past 12 months for problems with emotions, mental health, alcohol, or drugs; and/or (2) whether they consulted with a non-professional, or utilized a non-professional service (e.g., family, friends, internet, CFMAP, etc.) in the past 12 months for these problems. If participants answered "yes" to either of these items, they were classified as having

recently sought help for a mental health concern. If they answered "no" to both items, they were classified as not having recently sought help for a mental health concern.

Attitudes toward mental health care

Twelve items captured respondents' beliefs about the mental health care system, as well as perceptions of how receiving care may impact their lives and work. Specifically, these items examined perceptions of the negative impact receiving mental health services may have in CAF. While some of these items were based on the Land Combat Study (LCS) conducted by the Walter Reed Army Institute for Research in the United States, new statements were added.

Statistical analysis

Based on the criteria outlined above, the study categorized participants into the following three groups for analysis, based on the presence of a mental health need, and recent help-seeking status: (1) *help-seekers* (those with a current mental health need and who had recently sought support, weighted *n* = 12,000); (2) *non-help seekers* (those with a current mental health need who had not recently sought support, weighted *n* = 4,600); and (3) *no-need* (those with no current mental health need, weighted *n* = 50,000).

Demographic characteristics between groups were assessed using parameter estimates (weighted proportions) and 95% confidence intervals. Non-overlapping intervals were used to indicate statistically significant differences.[17,18,19] In order to comply with Statistics Canada's confidentiality policies, only the weighted proportions, which are based on counts rounded to the nearest 20, were reported. Both the sampling weight that accounts for the stratified sampling method and non-response, and the 500 bootstrap weights supplied by Statistics Canada for accurate variance estimation, were reported. Therefore, these estimates are reflective of the entire CAF population. In order to assess differences between mental health groups and attitudes toward mental health care, the authors performed a discriminant function analysis. This analysis assessed whether predictor variables – in this case, 12 items that tap into attitudes toward mental health care – can reliably determine group membership, here represented as a mental health group. The sampling weight was applied to these analyses. Initial analysis revealed that the assumption of homogeneity of group variances was violated, with Box's M = 11406.17, $F_{(156,518613745)}$ = 73.07, p < 0.001. However, this test does tend to be overly sensitive to such

violations.[20] Tests of inference tend to be more robust to such violations than classification and, given that inference was more relevant for our purposes, the authors proceeded with the interpretation of the inference tests, but did not interpret the tests of classification.

RESULTS

Demographic variables

There were a number of statistically significant differences in the demographic profiles of the groups (see Table 1). The help-seeking group contained more females and more individuals who were separated, divorced, or widowed, relative to other groups. The non-help seeking group contained more Reserve Force members, those with a high school education and were more likely to be single (e.g., never married), relative to other groups. Finally, the no-need group was comprised of more married individuals, fewer Army and more Air Force personnel, fewer Junior NCMs and more officers, those earning a higher income, and more individuals with a post-secondary education, relative to the other two *need*-based groups.

Attitudes toward mental health care

All 12 of the tests of equality of group means were significant, indicating the user groups were different in their attitudes toward mental health care (Wilks λ ranging from 0.94 to 0.99, and all *p* values < 0.001). Two canonical discriminant functions were produced, one that was driven by the prediction of help-seekers (unstandardized canonical discriminant function loading = –0.71, relative to –0.15 and 0.18), and the other that was driven by the prediction of the non-help-seekers (loading = –0.41, relative to 0.06 and 0.02). The first function had a moderate canonical correlation coefficient (0.32), while the second function had a small correlation coefficient (0.11), which squared is an estimate of effect size, suggesting a small-moderate relationship between attitudes toward care and group membership. Both functions were able to statistically predict group membership (Wilk's Λ = 0.89 and 0.99, and both *p* values < 0.001). The first function differentiated the help-seekers from the non-help-seekers and no-need groups. The structure matrix of correlations shows the strength of the correlations between each item and the discriminant functions and indicates which items are significantly predicted by each function (see Table 2). Accordingly, the best predictors for distinguishing help-seekers from the other groups were perceptions that CAF unit leaders might treat one differently, that one would be seen as weak,

Table 2. Structure matrix of function loadings for attitudes toward mental health care items

	Function	
	1	2
	(Help-seekers vs. other groups)	(Non-help-seekers vs. other groups)
If you needed to seek mental health services …		
CF unit leaders might treat you negatively	.760*	.284
You would be seen as weak	.758*	.409
It would harm your CF career	.651*	.357
Military leaders would discourage it	.605*	.306
It would be difficult to get time off	.585*	.066
Professional will not be able to relate to my situation	.426*	.406
Mental health treatment is a last resort	−.027	.706*
Treatment wouldn't be effective for you	.002	.699*
Prefer to deal with it on your own	−.096	.697*
You would be given medicine that could harm you	.241	.575*
You would have difficulty disclosing personal info	.245	.490*
You wouldn't trust a mental health professional	.341	.490*

Note: This table shows the pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions.

* Largest absolute correlation between each variable and any discriminant function

that seeking mental health services would harm your CAF career, that military leaders would discourage it, that one would have difficulty taking time off work as a result, and that a professional might not be able to relate to one's situation. In other words, help-seekers had more negative attitudes toward seeking mental health care for reasons that relate to anticipated stigma from leaders, perceived weakness, and negative career implications (loadings from 0.43 to 0.76). The predictors that best distinguished the non-help-seekers from the other two groups were the belief that seeking mental health treatment should be a last resort, that it would not be effective, that they would want to personally manage the issue, that they could potentially be given harmful medication, that they had difficulty in disclosing personal information, and that they had a distrust for mental health professionals (loadings from 0.49 to 0.71). The non-help seeking group had more negative attitudes toward seeking mental health care that related to perceived ineffectiveness and a distrust of mental health care and a preference to self-manage issues.

DISCUSSION

Summary of findings

While a growing body of research has focused on understanding the relationships between stigma, attitudes toward the mental health care system, and mental health status in military members, there has been an important oversight in this literature. Previous researchers have examined how attitudes toward mental health are moderated by military members' mental health status and help-seeking propensity or history among those with a mental health need.[21,22] However, they have not considered the interaction of these two factors, or directly compared attitudes toward the mental health care system, including barriers to care, among those who have a mental health need and have sought help, those with a need who have not sought help, and those with no apparent need. For this reason, previous research has not adequately addressed differences between those with a mental health need who have sought help, with those who similarly report a need but have sought help. Using the WHO–CIDI and DSM-IV consistent clinical criteria, and other validated scale clinical thresholds, this study noted significant differences between these three groups of CAF personnel with respect to their demographic profiles and attitudes toward the mental health care system.

Regarding socio-demographics, it was determined the help-seeker group was made up of more females, and members were more likely to be separated, divorced or widowed, relative to the other groups. The non-help

seeker group included more Reserve Force personnel, those with a high school education, and those who were single, relative to the other groups. Finally, the no-need group contained more married individuals, Air Force personnel, officers, those earning a higher average income, and those with a post-secondary education, relative to the other need-based groups.

The help-seekers had more negative attitudes toward seeking mental health care for reasons that relate to anticipated stigma from leaders, perceived weakness, and potential negative career implications, relative to the other groups. Negative attitudes toward care for this group, including perceptions of stigma, might be a consequence of previous care-seeking. They are not only more aware of barriers to care,[22] but the impact of stigma one experiences after receiving help (and a potential diagnosis).[23] These individuals may also be more aware of structural barriers to care and may have lived through stigmatizing experiences, resulting from their help-seeking.[23,22] However, compared to the other groups, the non-help-seekers had more negative attitudes toward seeking mental health care that related to perceived ineffectiveness of the system, a distrust of mental health care professionals, and a preference for self-managing issues. This is a novel finding and may help clarify inconsistencies in the literature and the complex relationship between stigma and help-seeking.[9,22] It is possible that, for non-help seekers, these perceptions might act as a deterrent or attitudinal barrier to accessing required help.[22]

Strengths and limitations

Perhaps the most notable strength of this study is the use of a high-quality Statistics Canada data set based on a large representative sample of CAF members with a relatively high response rate.[24] Further, these variables were produced through validated protocols, including the WHO–CIDI clinical interview protocols and validated scales. In addition, while some mental health measures were more direct (e.g., asking the respondent whether they had a particular mental health disorder), others were indirect, such as assessing whether the respondent met the criteria for a particular mental health condition, regardless of their recognition of symptoms, in addition to completing scales on general psychological distress and well-being.

However, these strengths are qualified by some limitations. First, this data is cross-sectional in nature, so it cannot be ruled out that the potential exists for method invariance due to all variables being assessed in a single session. In addition, in this analysis, particular mediating mechanisms were not explored that might explain why these groups differed in their attitudes toward help-seeking and the mental health care system. Observed group differences may reflect cultural distinctions across elements, ranks, units, or even access to care, particularly for those in the Reserve Forces and remote locations. Future research should continue to assess differences among these need-based groups in order to better understand the factors contributing to help-seeking attitudes. This information will better inform programs and policies appropriate for these groups to most effectively motivate help-seeking behaviours among military personnel.

Conclusion and implications

Demographic and attitudinal differences were found among CAF help-seekers, non-help-seekers and no-need groups. Most notably, while the help-seekers reported more negative attitudes toward seeking mental health care for reasons that relate to anticipated stigma and negative career implications, the non-help-seekers reported more negative attitudes toward seeking mental health care that reflected a pessimism and distrust of mental health care professionals, and a preference to self-manage issues. These findings suggest more can be done to support those who seek help for mental health difficulties, given the anticipated stigma, which may act as a barrier to recovery. In addition, these findings indicate there is a distinct group of individuals requiring mental health supports, yet they are experiencing attitudinal barriers to care and, therefore, may be seeking options outside the traditional mental health care system. Innovative health care options, such as the use of mental health apps[25] may be an appealing alternative to traditional mental health care for non-help-seekers. These options may also address challenges to accessing care in geographically remote areas, or for those who perceive other structural barriers to care.

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COMPETING INTERESTS

None declared.

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IN GRAPHICS

A qualitative analysis of the impact of potentially morally injurious experiences in the Canadian Armed Forces

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Moral injury (MI) refers to the psychological, social, and spiritual consequences of exposure to events that transgress core moral beliefs[1,2]. Such consequences include unresolved moral dissonance, negative self-attributions regarding the morally transgressive event(s), intense guilt and shame, lack of trust in others, spiritual or existential inner conflict, and social withdrawal[1,3-5]. Research shows exposure to potentially morally injurious events (PMIEs) is associated with self-harm and suicidality, substance use and social problems[4,6], and an increased risk of post-traumatic stress disorder (PTSD) and depression[7]. Indeed, features of MI overlap with both disorders, and the determination as to where MI fits within the current nosology of mental illness remains an open question. The purpose of this study was to identify themes of distress associated with PMIE exposure using interview data obtained from Canadian Armed Forces (CAF) members and Veterans.
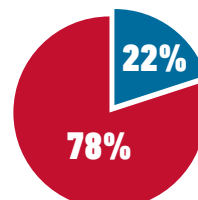
PARTICIPANTS

Participants were 18 treatment-seeking, PMIE-exposed CAF members (n=6) and Veterans (n=12). Participants were mostly male (78%). Number of deployments ranged from 0 to 6 (M=2.8, SD=1.9) All rank categories and military branches were represented in the sample.
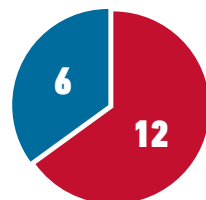
PMIE-exposed
- 6
- 12
- 🔴 Veterans
- 🔵 CAF members

Gender
- 22%
- 78%
- 🔴 Male
- 🔵 Female

METHODS

Participants were recruited from specialized clinics in Ottawa, ON, Canada. They completed semi-structured interviews pertaining to the impact of PMIEs. A thematic analysis[8] was conducted to identify themes describing the distress associated with PMIE exposure.

RESULTS

EIGHT MAJOR FEATURES OF PMIE-RELATED DISTRESS WERE IDENTIFIED (DETAILS IN TABLE 1):

1. Change in moral attitude
2. Increased sensitivity and reactivity to moral situations
3. Loss of trust in self and others
4. Disruptions in identity
5. Disruptions in interpersonal relatedness
6. Disruptions in spirituality
7. Rumination
8. Persistent patterns of internalizing or externalizing emotions and behaviours

SIGNIFICANCE OF FINDINGS

This is the first study to detail patterns of distress related to PMIE exposure in a Canadian sample. The distress associated with exposure to PMIEs displayed in the sample of CAF members and Veterans is consistent with the literature describing the phenomenology of MI. Findings extend existing knowledge of MI by acknowledging several additional features of distress not discussed in other research, most notably, changes in moral attitudes and increased sensitivity and reactivity to moral situations.

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TABLE 1 — THEMATIC ANALYSIS

	Theme	Description	Excerpt
1	**Change in moral attitude**	Marked change in the person's attitude towards morality and moral situations. Three patterns were observed: rigidity, confusion, and pessimism.	"Well I've always known that, known the difference between right and wrong. But I think that the line just got a lot thicker, like between the two."
2	**Increased sensitivity/ reactivity to moral situations**	Increased attention and reactivity towards moral situations, including heightened attention towards such events, and increased sense of personal responsibility.	"Do what is right. That's really the only standard. [...] now it goes to the more subtle things, like "it's your job to show up on time, it's rude to be late for an appointment." [...] I'm majoring in the minor, if you will. Whereas before, meh whatever."
3	**Loss of trust**	Loss of trust in self or others (including institutions and important sources of spirituality or faith) to make moral judgements or carry out moral actions.	"I used to feel good about who I was and the decisions I made and that everything had a purpose, even if I didn't know what it was, it would eventually become clear to me. Now I question every thought I have in my head. [...] I don't feel like I can trust my own thoughts and my own judgements, in a lot of situations."
4	**Disruptions in identity**	Marked change in the person's view of themselves, including dissonance regarding important attributes of one's identity, or a devalued sense of self.	I thought of myself as a bad person, I was always thinking of how, if I ever told that to your average Canadian, would they look at me and think, "this guys' a monster."
5	**Disruptions in interpersonal relatedness**	Disruptions in interpersonal related-ness, including one's perceived ability to relate to others or sense of being connected to others.	"I was totally dead inside, like I didn't know how to talk to him about it or how to tell anybody about it, so I just kind of fully shut down. There was no intimacy, there was no, there was no, nothing... "
6	**Disruptions in spirituality**	Disruptions in spirituality, including changes in the person's spiritual or religious beliefs, perception about the role of spirituality or faith in the person's life, or the person's relationship with some higher being or source of values, meaning or divine order.	"I have no understanding of all of these events. I have no understanding of life and I have no sense of purpose of life..."
7	**Rumination**	Preoccupation with or rumination about the morally transgressive event or other moral situations.	"I visualize it happening over and over again. [...] the things that I wish I had [said] at the time."
8	**Internalizing/exter-nalizing emotions and behaviours**	Persistent pattern of internalizing (e.g. guilt, shame, anxiety) or externalizing (e.g., anger) emotions and behaviours.	"I feel guilty." "I feel angry [...] I have angry outbursts."

FUTURE CONSIDERATION

An examination of patterns of moral distress in those without PMIE exposure, and in those with exposure to other types of trauma is needed. Such findings would help determine if PMIEs increase the risk of psychopathology, or if MI warrants attention as a distinct syndrome.

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COMPETING INTERESTS

None declared.

DISCLAIMER

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Disordered eating and military populations: Understanding the role of adverse childhood experiences

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ABSTRACT

Introduction: Adverse childhood experiences (ACEs) and disordered eating are both common in military populations, yet research on their connection is limited. This systematic review aimed to analyze themes and gaps in the literature and offer recommendations for future research. **Methods:** Four databases were searched using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and Cooper's approach to research synthesis, resulting in nine articles. **Results:** Research on ACEs and disordered eating in military populations tended to focus on participants who were Veterans, women, and white. All studies measured sexual abuse, and few explored relational or health outcomes. **Discussion:** Future research should include diverse samples, a comprehensive assessment of disordered eating, and a wider range of ACEs and other health and relational variables. The inclusion of these variables will contribute to a greater understanding of the far-reaching impact of ACEs on this population.

Key Words: adult trauma, adverse childhood experiences, childhood trauma, Cooper, disordered eating, eating disorders, military, PRISMA, systematic review, Veteran

RÉSUMÉ

Introduction : Autant les expériences indésirables de l'enfance que l'alimentation désordonnée sont courantes dans les populations de militaires, mais les recherches sur les liens entre ces divers éléments sont limitées. La présente analyse systématique visait à déterminer les thèmes et les lacunes des publications, ainsi qu'à établir des recommandations en vue de futures recherches. **Méthodologie :** Les auteurs ont fouillé quatre bases de données au moyen des directives PRISMA et de l'approche de Cooper à l'égard de la synthèse de recherche et en ont extrait neuf articles. **Résultats :** Dans la présente analyse, la recherche sur les expériences indésirables de l'enfance et l'alimentation désordonnée dans les populations de militaires avait tendance à être axée sur les participants qui étaient des vétérans, des femmes et des blancs. Toutes les études mesuraient la violence sexuelle et quelques-unes exploraient les résultats en matière de relations et de santé. **Discussion :** Les futures recherches devraient inclure divers échantillons, une évaluation complète de l'alimentation désordonnée ainsi qu'un plus vaste échantillon d'expériences indésirables de l'enfance et d'autres variables en matière de relations et de santé. L'inclusion de ces variables contribuera à mieux comprendre les répercussions profondes des expériences indésirables de l'enfance au sein de cette population.

Mots-clés : alimentation désordonnée, analyse systématique, expériences indésirables de l'enfance, forces militaires, troubles des conduites alimentaires, vétéran, traumatismes de l'enfance, traumatismes chez l'adulte, troubles de conduite alimentaire, forces armées, approche Cooper, PRISMA

INTRODUCTION

Adverse childhood experiences (ACEs),[1] including physical abuse, sexual abuse, or substance use in the household, are linked to numerous health risk behaviors and conditions in adulthood.[2] Those serving in the military tend to report higher ACE scores than civilians.[3] Military service members and Veterans also exhibit increases in disordered eating,[4] including obesity, with rates in the Army as high as 17%.[5] Yet, the research on the impact of ACEs and disordered eating (ranging from eating disorders to obesity) for this population is limited. This article's purpose is threefold: (1) to provide a theoretical foundation to address how ACEs affect the prevalence of disordered eating, overweight, and obesity among the

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general population, military service members, and Veterans; (2) to identify themes and gaps in the literature to better understand the role of ACEs and disordered eating among service members and Veterans; and (3) to offer research recommendations pertaining to ACEs and disordered eating in military and Veteran populations.

ACEs and health

ACEs are defined as traumatic family events or social environments that occur during childhood. ACEs (alone or in combination) act as toxic stressors,[6] jeopardizing mental, emotional, and physical health outcomes. The National Scientific Council on the Developing Child identified toxic stressors as chronic, uncontrollable, and occurring among those who have limited access to support systems and services.[7] Over time, toxic stressors can alter the body and result in an array of health conditions across the lifespan.[8] This cascade of effects is depicted by the ACE pyramid,[1,2] which describes how ACEs disrupt a child's neurodevelopment, potentially resulting in social, emotional, and cognitive impairment. From there, health risk behaviors are then commonly adopted to cope with these impairments, leading to disease, disability, stress, social or relational concerns, and even early death.[1,9]

The ACEs pyramid is a theoretically informed model demonstrating the progression of ACEs' impact from birth to death.[1,2] It suggests that ACEs are far-reaching, and although toxic stressors do not guarantee poor outcomes, they influence long-term health throughout the lifespan. In relation to the scope of this review, ACEs and other elements of the ACEs pyramid have been linked to three serious health concerns: eating disorders, disordered eating, and obesity.

Adverse childhood experiences, eating disorders, and obesity

When examining the etiology of eating disorders, it is important to also include obesity. In a five-year longitudinal study, Neumark-Sztainer et al. found that dieting and weight control behaviors were predictive of both obesity and eating disorders.[10] More recently, these findings were supported by Stice et al.[11] Moreover, obesity is directly associated with bulimia nervosa (BN) and binge-eating disorder (BED), and patients with anorexia nervosa (AN) have an increased likelihood of developing obesity later in their recovery.[12]

Eating disorders such as AN, BN, BED, and eating disorder not otherwise specified have been linked to ACEs, particularly emotional abuse.[13] Researchers have

shown associations between emotional abuse (an ACE) and symptom severity among women with AN and associations between childhood sexual and physical abuse (both ACEs) and obesity among women.[14–19] Men with a history of sexual abuse have an increased risk of overweight and obesity, whereas women are more likely to exhibit disordered eating.[20] Emotional and sexual abuse are also associated with body dissatisfaction, and severe physical abuse and adverse family background are associated with increased risk for eating disorders among male college students.[21,22] The strength of the relationship between ACEs and disordered eating and obesity in civilian populations and the prevalence of disordered eating and obesity in military populations[4,5] underscore the need to better understand the relationship between ACEs and disordered eating in the military.

Adverse childhood experiences, the adverse childhood experiences pyramid, and disordered eating

ACEs and the ACEs pyramid reveal the layers (i.e., disrupted neurodevelopment; social, emotional, and cognitive impairment; health risks; subsequent disease; early death) that are interwoven with the complexities of disordered eating. Previous researchers have studied the impact of ACEs on the neurodevelopment of people with disordered eating, obesity, or both and have focused on the hypothalamic–pituitary–adrenal axis, specifically the cortisol-awakening response. A sample of 73 women with AN or BN and a history of childhood trauma had a significantly lower cortisol-awakening response than controls without a history of childhood trauma.[23] These findings support the complex levels at which physical and neurological health are exacerbated through the ACEs pyramid and suggest that ACEs have lasting physiological impacts on adult health and eating patterns, which may be most interruptive in the mission readiness of service members.

Many social, emotional, and cognitive factors, including negative affect and impaired psychosocial functioning, further increase the risk for disordered eating and obesity.[10] In a longitudinal study of factors predicting restrictive eating, Haynos et al. associated low self-esteem with the initiation of disordered eating in the short and long term (i.e., 5-y follow-up).[24]

In addition to the factors mentioned earlier, the onset of eating disorders and obesity is associated with past or present behavioral risk factors, including overeating, fasting, dieting, weight control behaviors, excessive

exercise, alcohol abuse, and substance abuse.[11,25,26] These health risk behaviors not only predispose individuals to eating disorders but can also result in other comorbid conditions (e.g., depression, anxiety, Type 2 diabetes) that can worsen a person's physical or mental health, which may be particularly concerning for those entering or enlisted in the military. Because these health behaviors may have begun in childhood as a way to manage adverse experiences, it is essential to consider the role that ACEs play in the lives of today's service members.

Adverse childhood experiences and the military

Although ACEs-informed literature has primarily focused on civilians, military service members, with careers that depend on health fitness and mission readiness, deserve exploration of the role that pre-service traumatic events (i.e., ACEs) play in disordered eating, with the goal of protecting them from lifetime health conditions and early death. The role of ACEs is pertinent to many life-altering health outcomes (e.g., suicide and post-traumatic stress disorder [PTSD]) and must be understood in context within and aside from traumas that occur while enlisted in the military. ACEs have a cumulative effect on suicidal ideation and attempts independent of combat-related trauma.[27] Moreover, recent research has shown that underweight Veterans are more likely to complete suicide.[28] What is less known is how ACEs interact with disordered eating, eating disorders, and obesity and the long-term consequences among service members.

This study poses the research question "How do ACEs affect the prevalence of disordered eating, overweight, and obesity among Veterans and military service members?" Although systematic reviews of eating disorder prevalence among this population exist,[4,29] none have explored the role of ACEs in relation to disordered eating. This systematic review identifies ACEs in tandem with eating disorder and obesity research with military personnel.

METHODS

Cooper's approach to research synthesis and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines grounded this review's methodology.[30,31] After an initial pilot search to refine terms, we searched PsycINFO, CINAHL, PubMed, and the Military Database using the terms *military personnel* or *Veteran* with a disordered eating term: *overweight, obesity, body mass index, weight gain,*

weight loss, body weight, body disorder, anorexia nervosa, bulimia nervosa, binge eating, eating, feeding, eating disorder, or *body image.* The search captured articles dating from 1976 to 2018. After a thorough search and review process, we examined 212 full-text articles for any measure of ACEs, resulting in the inclusion of 5 articles (Figure 1; Table 1). Citation tracking and reverse searching yielded an additional 4 articles, resulting in 9 articles that met all inclusion and exclusion criteria of the systematic review.

RESULTS

Demographics

For a complete breakdown of the demographics of the included studies, see Table 2.

Military status and branch

Seven studies focused on Veterans,[32–38] and two focused on an active duty population.[39,40] Only two studies provided the specific branches of their participants (see Table 2).[39,40] Kimbrel et al. mentioned that 86% of participants were Army Veterans but did not specify a branch for the other 14%.[36]

Gender

The articles tended to focus on women; four included exclusively female Veterans,[32,34,35,37] and one focused exclusively on men.[33] Four studies had mixed-gender samples, with women making up 7%–46% of participants.[36,38–40]

Race/ethnicity

In all nine studies, white or Caucasian participants made up a majority of participants. Racial and ethnic minorities made up as little as 13.4%–35.8%.[32,40]

Education

In four studies,[34,35,37,39] more than 75.4% of participants had completed at least some college. In Warner et al.'s study, 30.2% had completed some college,[40] and Weaver et al. reported the mean number of years of education completed as 13.16 (SD = 1.78).[38]

Marital status

Six studies did not report marital status,[32–34,36,39,40] but Cheney et al. denied its association with outcome variables.[34] McCauley et al. designated participants as partnered (60.9%) or not partnered.[37] A substantial number of participants in Forman-Hoffman et al.'s and Weaver et al.'s studies were married – 43.9% and 38.5%, respectively.[35,38]
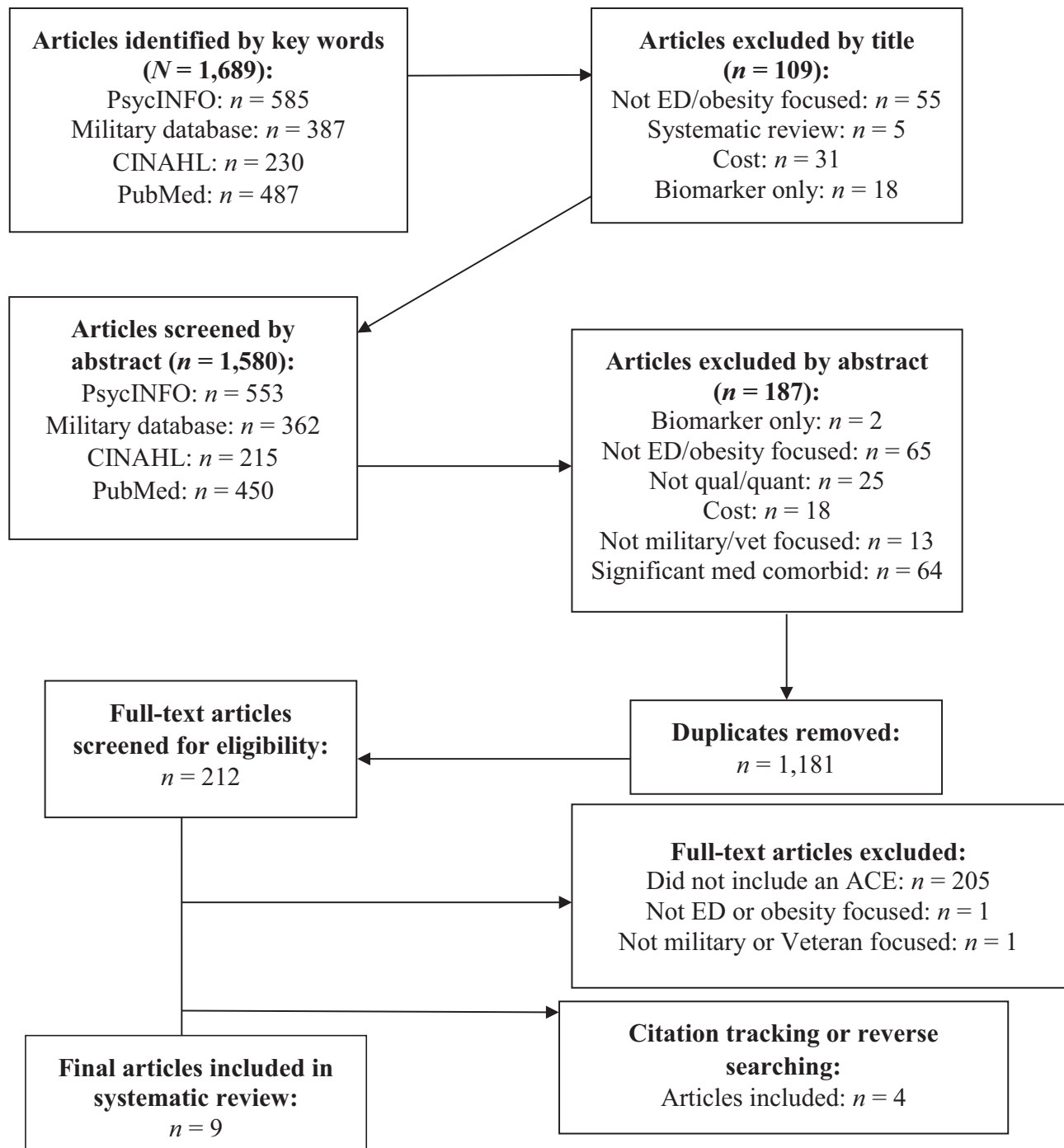
Figure 1. Literature synthesis methodology

ED = eating disorder; ACE = adverse childhood experience.

Measurement of adverse childhood experiences

Several of the included studies measured ACEs using assessments that have been validated for both trauma and military populations. To measure ACEs, both Arditte Hall et al. studies used questions from the Trauma History Screen with Veterans to measure experiences including childhood physical abuse, child sexual abuse, adult sexual assault, adult physical assault, and military-related trauma.[32,33,41] Bakalar et al. used the Life Stressor Checklist–Revised, which measures a variety of stressors (e.g., sexual abuse, emotional abuse) across the lifespan for active duty men and women.[39,42] Weaver et al. had participants identify an index trauma,[38] classified

Table 1. Inclusion and exclusion criteria for selection of articles

Inclusion criteria	Exclusion criteria
Research question and outcome variables were related to eating disorders, overweight, or obesity	Study did not pertain to eating disorders, overweight, or obesity; study was focused on participants with significant medical comorbidities (e.g., cancer, schizophrenia)
Population of interest was military personnel or Veterans	Study was focused on civilians or military dependents
Human participants	Study was focused on animals or biochemistry
Individual was unit of analysis	Study was focused on program evaluation or cost utilization
Study was from an English language journal or database	Study was from a non-English language journal or database
Measures psychosocial variables	Study only included measures of biomarkers (e.g., body mass index)
Was considered quantitative or qualitative research	Study was a literature review, systematic review, theoretical paper, policy brief, or editorial or opinion piece
Study included at least one measure of ACEs, as defined by Felitti et al. and Cronholm et al.[1,48]	Study did not measure ACEs

ACEs = adverse childhood experiences.

as combat, adult sexual assault, child sexual assault, or other trauma, and provided clarity for respondents through an operational definition of these traumas.

Five articles did not provide information about the validity of their measures for military populations but did provide diverse methods to screen for childhood traumas. Kimbrel et al. used the Childhood Trauma Questionnaire with Army Veterans to assess for childhood sexual abuse, emotional abuse, physical abuse, emotional neglect, and physical neglect.[36,43] Forman-Hoffman et al. assessed and defined attempted sexual assault in both childhood and adulthood, using a series of dichotomous questions.[35] In the Warner et al. study,[40] participants checked a box if they had experienced physical, sexual, or verbal abuse, although these were not defined, leaving them open to participant interpretation. McCauley et al. used the ACEs module,[37] informed by Felitti et al.'s conceptualization,[1] to assess the presence and frequency of ACEs. Although only one study used Felitti et al.'s characterization,[1,37] each

study included some measure of childhood adversity for military personnel or Veterans, which served as the basis for their inclusion in this review. A complete list of all health and psychosocial measures that were included in the nine articles in this systematic review can be found in Table 2.

Measurement of eating behaviors, attitudes, and disorders

In addition to assessments of previous traumas, all nine articles attended to eating behaviors, attitudes, or disorders as part of their study. All but two studies used body mass index (BMI) to assess participants' weight.[36,38] Only Warner et al. provided clear information about the validity of their measure (the Eating Attitudes Test–26) both for assessing eating attitudes and behaviors and for use in military populations.[40,44] Four other studies identified their measures as validated for assessing body image and disordered eating concerns;[32,33,38,39] of those, three calculated the reliability of the measure for their sample.[32,33,39] Bakalar et al. used the Eating Disorder Examination–Questionnaire,[39,45] and Arditte Hall et al. used the Eating Disorder Diagnostic Scale to assess bingeing, purging, and fasting.[32,33,46] For unclear reasons, Weaver et al. measured body-focused concerns in only a subsample of participants.[38] Kimbrel et al. used the Psychiatric Diagnostic Screening Questionnaire to assess PTSD, obsessive–compulsive disorder (OCD), somatization, agoraphobia, depression, social phobia, generalized anxiety, hypochondriasis, alcohol use disorder, panic, psychosis, substance use disorder, and bulimia.[36,47]

Forman-Hoffman et al. attempted to differentiate diagnosed eating disorders from experiencing an eating disorder.[35] McCauley et al. asked respondents about mental health and physical health diagnoses.[37] Each outcome or disability was clearly delineated in the survey questions. The measurements from these nine studies informed the results in relation to ACEs and disordered eating, eating disorders, and obesity among military and Veteran populations.

Study findings

Adverse childhood experiences

All nine studies examined childhood sexual abuse with military or Veteran populations. In the Cheney et al. study,[34] 41.6% of respondents reported childhood sexual assault. Forman-Hoffman et al. had similar findings but differentiated between completed rape and

Table 2. Findings

Citation	Sample	Findings	Psychosocial assessments	ACEs
Arditte Hall et al.[32]	Female Veterans (N = 186; mean age = 53.51 y, SD = 14.29; 13.4% racial/ethnic minority; mean BMI = 28.77, SD = 6.93)	Women with a history of childhood physical or sexual abuse were not more likely to report disordered eating; military-related trauma was the only trauma type significantly associated with ED symptom severity	THS; EDDS	Childhood sexual abuse Childhood physical abuse
Arditte Hall et al.[33]	Trauma-exposed male Veterans (N = 642; M age = 64.11 y, SD = 11.20; 14.5% racial/ethnic minority; average BMI = 29.35, SD = 5.57)	Men with a history of childhood physical or sexual abuse were not more likely to report disordered eating; military-related trauma, other than combat, was significantly associated with ED symptom severity	THS; NSES; EDDS	Childhood sexual abuse Childhood physical abuse
Bakalar et al.[39]	Active duty service members (N = 179; mean age = 32.01, SD = 7.34; 46% female; 25.0% racial/ethnic minority, 99.9% some college or higher; 33% enlisted, 40% Army, 32% Navy, 26% Air Force, 3% other; average BMI = 25.03, SD = 3.16)	Childhood, traumatic, and interpersonally perpetrated ALEs, and ALE subjective impact, were positively associated with disordered eating	EDE–Q; LSC–R; CES; PHQ–8; PC–PTSD	Serious disaster or accident Familial incarceration Foster care Parental separation Emotional abuse Emotional neglect Physical neglect Domestic violence Victim of crime Physical abuse Sexual abuse
Cheney et al.[34]	Female enlisted Veterans (N = 948; mean age = 38.2, SD = 8.9; 20.4% racial/ethnic minority; 84.1% some college or higher; 33.4% of the participants had a BMI ³30.0)	BPD and DEP mediated the relationship between LSA and BMI; older age was associated with higher BMI; LSA, CSA, SAIM, and post-military sexual assault were associated with higher BMI; there was not a significant relationship between current depression or PTSD and BMI	CATI; PSS–I; survey of trauma and mental health history; CIDI–SF; SAOM	Childhood sexual assault
Forman-Hoffman et al.[35]	Female Veterans (N = 1,004; 33.3% were 20–34 y old, 34.5% were 35–44 y old, 32.3% were 45–52 y old; 20.1% racial/ethnic minority; 43.9% married; 84.8% some college or higher; 31.2% had a BMI between 25 and 29 and 33.6% had a BMI >30)	Women with a completed rape during childhood were more likely to have been diagnosed with an EDO than women with no childhood sexual trauma; women with lifetime completed rape or attempted sexual assault were more likely to have an EDO; women with higher levels of education and who had been divorced were more likely to have an EDO	CATI (demographics, a series of yes-or-no questions – e.g., "Have you ever suffered from an eating disorder?")	Completed rape Attempted sexual assault
Kimbrel et al.[36]	Iraq/Afghanistan Veterans (N = 155; mean age 40 y, SD = 10; 7% female; 34% racial/ethnic minority)	Veterans who met the criteria for PTSD were significantly more likely than Veterans who did not to have positive screens for DEP, bulimia or binge eating, OCD, panic disorder, agoraphobia, psychosis, social phobia, somatization, and hypochondriasis; childhood trauma was predictive of psychiatric symptoms among Veterans who did not meet the criteria for PTSD, but not among Veterans who did meet the criteria; critical warzone experiences were predictive of bulimia and binge eating, but childhood trauma was not	PDSQ; CWE; CTQ	Sexual abuse Physical abuse Emotional abuse Physical neglect Emotional neglect

(Continued)

Table 2. (Continued)

Citation	Sample	Findings	Psychosocial assessments	ACEs
Mc-Cauley et al.[37]	Female Veterans (*n* = 631; mean age = 50.5 y, SD = 1.14; 15.1% racial/ethnic minority; 60.9% partnered; 75.4% some college or higher; 60.4% were classified as overweight or obese per BMI) and non-Veteran comparison group (*n* = 35,854; mean age = 49.4 y, SD = 0.18; 56.3% were classified as overweight or obese per BMI)	Veterans were significantly more likely than non-Veterans to have experienced household alcohol abuse, exposure to domestic violence, physical abuse, and sexual abuse (touched sexually, made to touch another sexually, forced to have sex); Veterans had a higher mean ACE score than non-Veterans; Veterans were more likely to be current smokers and have a disability; the no. of ACEs was associated with increased odds of all health outcomes	BRFSS ACEs module (demographics, ACEs, health)	Household mental illness Parental separation or divorce Household drug use Household alcohol abuse Incarcerated household member Exposure to domestic violence Physical abuse Emotional abuse Touched sexually Made to touch another sexually Forced to have sex
Warner et al.[40]	Entry-level enlisted US Army soldiers (*N* = 1,090; mean age = 20.9 y, SD = 3.53; 12.4% female; 35.8% racial/ethnic minority; 5% college degree; >33% had a BMI >25, and nearly 5% had a BMI >30)	Participants who were female, overweight, and had a history of verbal abuse or a history of psychiatric treatment had an increased risk of disordered eating; women were more likely than men to report any type of abuse	Demographic and history survey; EAT–26	Verbal abuse Physical abuse Sexual abuse
Weaver et al.[38]	Treatment-seeking Veterans (*N* = 91; mean age = 44.86, SD = 13.27; 16.5% female; 30.8% racial/ethnic minority; 38.5% married)	Body image distress was significantly correlated with DEP symptom severity for those with an appearance-related residual injury; body image distress was not a unique predictor of PTSD; body image distress had a trend relationship with PTSD for Veterans with an appearance-related residual injury	CAPS; PCL–S; BDI–II; DCQ; Health assessment questionnaire developed for study	Childhood sexual assault

Note: BMI = body mass index; ED = eating disorder; THS = Trauma History Screen; EDDS = Eating Disorder Diagnostic Scale; NSES = National Stressful Events Survey; ALE = adverse life event; EDE–Q = Eating Disorder Examination–Questionnaire; LSC–R = Life Stressor Checklist–Revised; CES = Combat Exposure Scale; PHQ–8 = Patient Health Questionnaire–8; PC–PTSD = Primary Care Posttraumatic Stress Screen; BPD = borderline personality disorder; DEP = depression; LSA = lifetime sexual assault; CSA = childhood sexual assault; SAIM = sexual assault in military; PTSD = post-traumatic stress disorder; CATI = Computer-Assisted Telephone Interview; PSS–I = Posttraumatic Symptom Scale; CIDI–SF = Composite International Diagnostic Interview–Short Form; SAOM = Substance Abuse Outcomes Module; EDO = eating disorder; OCD = obsessive–compulsive disorder; PDSQ = Psychiatric Diagnostic Screening Questionnaire; CWE = Critical Warzone Experiences scale; CTQ = Childhood Trauma Questionnaire; ACE = adverse childhood experience; BRFSS = Behavioral Risk Factor Surveillance System; EAT–26 = Eating Attitudes Test; CAPS = Clinician Administered PTSD Scale for DSM–IV; PCL–S = PTSD Checklist–Stressor-Specific Version; BDI–II = Beck Depression Inventory; DCQ = Dysmorphic Concerns Questionnaire.

attempted assault.[35] McCauley et al. distinguished being touched sexually (24.4%) from being made to touch another sexually (14.8%) and being forced to have sex (10.0%).[37] Warner et al. found that 24.4% of women and 3.2% of men reported childhood sexual abuse,[40] whereas Arditte Hall et al., Arditte Hall et al., and Weaver et al. found combined prevalence rates of 26.9%, 5.9%, and 5.2%, respectively.[32,33,38] Kimbrel et al. summed ACEs subscales, precluding availability of prevalence rates for a specific ACE.[36]

Arditte Hall et al., Bakalar et al., McCauley et al., and Warner et al. also examined other types of abuse and adversity during childhood.[32,33,37,39,40] All five examined physical abuse, three examined verbal and emotional abuse,[37,39,40] and one examined all 10 ACEs as defined by Felitti et al.[1,37] Prevalence rates for physical abuse ranged from 15.6% to 27.7%.[33,37] Warner et al. found that 12.6% of men and 33.3% of women reported childhood physical abuse.[40] Warner et al. found that 22.4% of men and 46.7% of women reported verbal

abuse,[40] and McCauley found that 40.0% experienced emotional abuse.[37]

Beyond abuse, in McCauley et al.'s study,[37] 24.1% of Veterans endorsed growing up with household mental illness, 20.9% experienced parental separation or divorce, 12.7% experienced household drug use, 31.5% experienced household alcohol abuse, 4.8% had an incarcerated household member, and 23.4% were exposed to domestic violence. Notably, Veterans were significantly more likely than non-Veterans to report experiencing household alcohol abuse, exposure to domestic violence, physical abuse, emotional abuse during childhood, and all three study definitions of sexual abuse. In addition, Veterans were significantly more likely to have experienced combined household dysfunction and abuse, and they had higher mean ACE scores than non-Veterans.

Only one study explored social, emotional and cognitive impairment in relation to ACEs. McCauley et al. examined mental health risk indicators,[37] which included frequent mental distress, inadequate sleep, low satisfaction with life, and poor social or emotional support. They found that although a higher percentage of Veterans than non-Veterans endorsed all categories, the outcomes were comparable.

Disordered eating, eating disorder, or obesity

A higher, but not significant, percentage of Veterans endorsed being overweight or obese.[37] In Warner et al.'s study,[40] approximately 10% of respondents met the criteria for disordered eating (i.e., 29.6% of women and 7.0% of men). Women who were overweight, men and women who had experienced any type of abuse, and men and women who had a history of previous psychiatric treatment were more likely to report disordered eating. No relationship was found between disordered eating and race, education level, or obesity.

Arditte Hall et al. found that 14.5% of women endorsed disordered eating symptoms severe enough to indicate a possible eating disorder, compared with 4% of men.[32,33] They found that neither childhood sexual abuse nor physical abuse was significantly associated with eating disorder symptoms.[32] However, adult physical assault, adult sexual assault, and military-related trauma were all associated with more severe eating disorder symptoms. Many participants endorsed multiple trauma types, with 4.3% endorsing all five types (i.e., childhood sexual abuse, adult physical assault, childhood sexual abuse, adult sexual assault, and military-related trauma). When these researchers examined trauma

types simultaneously, only military-related trauma was significantly associated with eating disorder symptom severity. This relationship is consistent with Arditte Hall et al.'s findings in their work with male Veterans.[33] They further found that other military-related trauma, but not combat, was associated with eating disorder symptom severity.

Disease, disability, and social concerns

Two studies examined disability,[37,38] and only McCauley et al. explored other physical health diagnoses (with the exception of obesity; see Table 2).[37] Kimbrel et al. and Weaver et al. were the only studies that did not measure obesity;[36,38] all other studies reported BMI as a health indicator. Because they used a similar sample, Cheney et al. and Forman-Hoffman et al. had similar findings for BMI, with approximately two-thirds of participants classified as overweight or obese.[34,35] In Forman-Hoffman et al.'s study,[35] only 2.2% of participants were underweight, whereas 1.1% of participants in Cheney et al.'s study were underweight.[34] Cheney et al. concluded that older women were more likely to meet criteria for obesity and that sexual assault was strongly associated with high BMI.[34] Warner et al. found that less than 1% of men and women were underweight on the basis of BMI, 37.6% of men and 23.0% of women were overweight, and 5% of men and 1.5% of women met criteria for obesity.[40] In Bakalar et al.'s study,[39] based on BMI, none of the participants were underweight. Although these authors did not provide specifics about weight categories, women had a lower average BMI (mean = 24.03, SD = 2.90) than men (mean = 25.97, SD = 3.17), with an overall range between 18.01 and 35.26.

Although many researchers did not attend to physical health beyond weight and eating behaviors, several did attend to mental health diagnoses in addition to weight and eating behaviors (see Table 2). Four studies examined PTSD, depression, and alcohol and substance use disorders,[34–36,38] and Bakalar et al. measured PTSD, depression, and disordered eating.[39] Cheney et al. also explored anxiety, bipolar disorder, borderline personality disorder, panic disorder, and OCD,[34] and Kimbrel et al. explored OCD, somatization, agoraphobia, social phobia, generalized anxiety, hypochondriasis, panic, psychosis, and bulimia.[36] Of the 14 disorders examined by Kimbrel et al.,[36] 10 were associated with childhood trauma, although bulimia was not one of them. McCauley et al. concluded that a higher number of ACEs was associated with increased odds of diabetes, cardiovascular disease symptoms, asthma, disability,

smoking, heavy alcohol use, and overweight or obesity.[37] Forman-Hoffman et al. found that participants with higher levels of education, who had been divorced, who had a lifetime depression diagnosis, or who had drug or alcohol abuse or dependence were more likely to report an eating disorder.[35] Moreover, Forman-Hoffman et al. concluded that female Veterans with a completed rape during childhood were three times as likely to be diagnosed with an eating disorder as those without a trauma history.[35] Cheney et al. concluded that borderline personality disorder and depression mediated the relationship between lifetime sexual assault and BMI and that lifetime sexual assault, childhood sexual assault, sexual assault in the military, and post-military sexual assault were associated with higher BMI.[34] Taken together, these findings highlight the complex relationship between childhood adversity and future relational, mental, and physical health, particularly in military and Veteran populations.

DISCUSSION

This systematic review is the first to review research studies examining ACEs in the context of eating disorders, disordered eating, and obesity in relation to military and Veteran populations. Of 379 unique studies considered for this review, only 9 examined at least one ACE in relation to disordered eating in military or Veteran populations.[1,48] This review emphasizes the chasm that exists in this literature and affords an opportunity to expand ACEs research in the context of disordered eating among military and Veteran populations throughout the lifespan.

Many studies in this review measured abuse, yet this term was not consistently defined across them. It is concerning that sexual abuse was often the only specified type of abuse measured. Although sexual abuse is incredibly important to investigate, other forms of abuse are also adverse experiences in a child's life. In fact, researchers who have previously investigated ACEs with civilians indicate that emotional abuse may have a stronger association with eating disorders than other forms of abuse.[17] When only one type of abuse is measured, it is problematic to attribute observed effects to that one form of abuse, because ACEs tend to co-occur.[1] Moreover, it is imperative to operationalize ACE constructs for participants (as a part of assessments or surveys) to ensure validity of findings.

Although all studies included in this review explored childhood adversity and trauma, many participants also experienced trauma associated with their military service. Past researchers have explored the cumulative effect of trauma, but they have most commonly analyzed it via cross-sectional data with Veterans rather than teasing out the impact of pre-service traumas from those that occurred during duty and as a Veteran. Although there is some value in aggregating trauma across the lifespan, it is also important to report on the unique impact of adversity during childhood.

Future research

This review elucidates numerous possibilities for future research. There are clear gaps in the research, including attention to diversity (i.e., gender, race, sexual orientation), measurement of disordered eating, and use of the ACE pyramid in the conceptualization and execution of research.[1,2] The following recommendations may assist with future research designs. First, researchers should seek out more diverse samples; a majority of participants in this review were Veterans, female, and white and had at least some college education. Attention to diversity is essential because of societal misconceptions about who is at risk for disordered eating and eating disorders. Unfortunately, men and racial/ethnic minorities are less likely than their female and white counterparts to be assessed for these health risk behaviors and health conditions.[49,50] Because the military is composed of a large percentage of men and racial/ethnic minorities,[51] future studies on ACEs should include samples that reflect both the current military population and those at risk for disordered eating.

A second recommendation for future researchers involves adequate and accurate assessments for disordered eating. Because only 10% of men and women with eating disorders receive treatment,[52] it is problematic to limit the assessment of eating disorders through dichotomous questions about previously diagnosed eating disorders or having an eating disorder. People often have difficulty recognizing their eating behaviors as disordered,[53] underscoring the need for practice- and evidence-based assessments and tools to better understand a broad range of disordered eating behaviors.

Summary

In this study, Felitti et al.'s ACEs framework was used to explore the state of eating disorders and obesity research among military personnel and Veterans through a systematic review.[1] Few researchers have explored the connection between experiences during childhood and disordered eating and obesity with a military population,

despite ample evidence of this relationship in civilian populations. When researchers do study this association, they tend to focus only on sexual abuse and samples that do not necessarily reflect the diverse demographics of the military and Veteran populations. Additional research with this population is important because of the high prevalence of disordered eating, high prevalence of ACEs, and physical fitness and body composition requirements particular to military and Veteran populations. It is essential that researchers clearly define constructs, include diverse samples, and collect data on multiple ACEs and an array of demographic variables in the context of disordered eating and military and Veteran populations. Using operationalized levels of the ACEs framework can ensure that future studies capture variables to best measure the complex and far-reaching impact of ACEs.[1,2]

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COMPETING INTERESTS

None declared. This article has been peer reviewed.

CONTRIBUTORS

Erin L. Cobb and Angela L. Lamson conceived and designed the study; Erin L. Cobb acquired and analyzed the data. All authors revised the article for important intellectual content and approved the final version submitted for publication.

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Prevalence of musculoskeletal disorders among Canadian firefighters: A systematic review and meta-analysis

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ABSTRACT

Introduction: Firefighters are set to respond to a number of dynamic demands within their roles that extend well beyond fire suppression. These tasks (i.e., heavy lifting, awkward postures) and their unpredictable nature are likely contributing factors to musculoskeletal disorders (MSDs). Several individual studies have assessed the prevalence of MSDs among Canadian firefighters. Therefore, a systematic review and meta-analysis was conducted to critically appraise the quality of the body of available literature and to provide pooled point- and period-prevalence estimates of anatomical regions of MSDs among Canadian firefighters. **Methods:** The MEDLINE, Embase, PubMed and Web of Science databases were searched from inception to November 2018. Cross-sectional cohort studies with musculoskeletal prevalence estimates (point- and period-) of career/professional firefighters in Canada were identified and critically appraised. MSDs were defined as sprains/strains, fractures/dislocations and self-reported bodily pain (chronic or acute). Period- and point-prevalence estimates were calculated, and study-specific estimates were pooled using a random-effects model. **Results:** Five eligible cohort studies (3 prospective, 2 retrospective) were included, with a total of 4,143 firefighters. The participants had a mean age range of 34 (SD = 8.5) to 42.6 (SD = 9.7) years. The reported types of MSDs included sprain or strain, fractures, head, neck, shoulder, elbow, arm, hand, back, upper thigh, knee, and foot pain. The point-prevalence estimate of shoulder pain was 23.00% (3 studies, 312 of 1,491 firefighters, 95% CI, 15.00–33.00), back pain was 27.0% (3 studies, 367 of 1,491 firefighters, 95% CI, 18.00–38.00), and knee pain was 27.00% (2 studies, 180 of 684 firefighters, 95% CI, 11.00–48.00). The one-year period-prevalence estimate of all sprain/strain injuries (all body parts) was 10.0% (2 studies, 278 of 2,652 firefighters, 95% CI, 7.00–14.00). **Discussion:** High point-prevalence estimates (1 in 4 firefighters) of shoulder-, back-, and knee-related MSDs were identified among Canadian firefighters. This emphasizes the need for early assessment, intervention, and injury prevention strategies that reflect how units work together to maximize ergonomic efficiency and injury prevention.

Key words: acute pain, awkward postures, back pain, Canada, chronic pain, Embase, ergonomic efficiency, firefighters, fractures/dislocations, heavy lifting, injury prevention, knee pain, MEDLINE, multiple injury, musculoskeletal disorders (MSDs), PubMed and Web of Science databases, rehabilitation, self-reported bodily pain, shoulder pain, sprains/strains

RÉSUMÉ

Introduction : Dans le cadre de leur rôle, les pompiers sont appelés à répondre à plusieurs demandes dynamiques qui dépassent nettement l'extinction des incendies. Ces tâches (p. ex., soulèvement de lourdes charges, postures inconfortables) et leur nature imprévisible contribuent vraisemblablement à l'apparition de troubles musculosquelettiques. Plusieurs études distinctes ont évalué la prévalence des troubles musculosquelettiques chez les pompiers canadiens. Les chercheurs ont donc réalisé une analyse systématique et une méta-analyse pour procéder à l'évaluation critique de la qualité des publications scientifiques et ont estimé la prévalence ponctuelle et la prévalence sur une période donnée des régions anatomiques touchées par des troubles musculosquelettiques chez les pompiers canadiens. **Méthodologie :** Les chercheurs ont procédé à une recherche des bases de données MEDLINE, EMBASE, PubMed et Web of Science à compter de leur création jusqu'en novembre 2018. Ils ont extrait les études de cohorte transversales contenant des évaluations de la prévalence de troubles musculosquelettiques (ponctuelle et sur une période donnée) dont sont victimes les pompiers professionnels au Canada et en ont fait l'évaluation critique. Ils ont défini les troubles musculosquelettiques comme des entorses ou des foulures, des fractures ou des dislocations et des douleurs corporelles chroniques ou aiguës autodéclarées. Ils en ont évalué la prévalence ponctuelle et la prévalence sur une période donnée et ont regroupé

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les évaluations propres à chaque étude au moyen d'un modèle à effets aléatoires. **Résultats :** Les chercheurs ont inclus les cinq études de cohorte admissibles (trois études prospectives et deux rétrospectives), pour un total de 4 143 pompiers, d'un âge moyen de 34 ± 8,5 ans à 42,6 ± 9,7 ans. Les types déclarés de troubles musculosquelettiques incluaient les entorses et les foulures, les fractures ainsi que les douleurs à la tête, au cou, à l'épaule, au coude, au bras, à la main, au dos, à la partie supérieure de la cuisse, au genou et au pied. L'évaluation de la prévalence ponctuelle des douleurs à l'épaule s'élevait à 23,00 % (trois études, 312 pompiers sur 1 491, intervalle de confiance à 95 %, 15,00 à 33,00), des douleurs dorsales, à 27,0 % (trois études, 367 pompiers sur 1 491, intervalle de confiance à 95 %, 18,00 à 38,00) et douleur au genou, à 27,00 % (deux études, 180 pompiers sur 684, intervalle de confiance à 95 %, 11,00 à 48,00). La prévalence de l'ensemble des foulures et des entorses (toutes les parties du corps) sur une période d'un an était évaluée à 10,0 % (deux études, 278 des pompiers sur 2 652, intervalle de confiance à 95 %, 7,00 à 14,00). **Discussion :** Les chercheurs ont constaté des évaluations élevées de prévalence ponctuelle (un pompier sur quatre) des troubles musculosquelettiques de l'épaule, du dos et du genou chez les pompiers canadiens. Ces observations font ressortir la nécessité d'adopter des stratégies d'évaluation précoce, d'intervention et de prévention des blessures qui reflètent le travail d'équipe des unités, afin de maximiser l'efficacité ergonomique et la prévention des blessures de cette population.

Mots-clés : blessures multiples, Canada, pompiers, réadaptation, réhabilitation, soulèvement de lourdes charges, postures inconfortables, troubles musculosquelettiques, banques de données MEDLINE, EMBASE, PubMed et Web of Science, entorses ou des foulures, des fractures ou des dislocations et des douleurs corporelles chroniques ou aiguës autodéclarées. des troubles musculosquelettiques de l'épaule, du dos et du genou, l'efficacité ergonomique, prévention

INTRODUCTION

Firefighters are at high risk of sustaining work-related injuries/trauma and this poses major threats to their health.[1–3] Firefighters are required to respond to a vast range of dynamic demands within their roles that extend well beyond fire suppression. Such tasks include ice water rescue, trench rescue, marine rescue, aircraft rescue, motor vehicle accidents, train derailments, automobile extrication, hazardous material, and confined space/high-angle rescue. Firefighting is a dangerous and high-risk profession with tremendous demands on the musculoskeletal system (MSK).[4–6] Such demands are largely due to high on-the-job death rates, unfavourable environment/working conditions, and extreme levels of physical exertion over long periods of time, all while carrying a heavy base load of personal protective equipment (PPE).[4–6] Despite the decline in total number of work-related musculoskeletal disorders (MSDs) injuries among firefighters reported by the National Fire Information Database since 2005, the frequency remains high at 1.5 injuries per firefighter, per reported fire response event in Ontario, Canada.[7]

MSDs (sprains, strains, pain) remain the leading type of injuries sustained during fireground operations (where firefighting operations are performed) among firefighters.[8] The tasks associated with firefighting (i.e., heavy lifting, awkward postures), along with its unpredictable nature and simultaneous exposure to hostile environments, are likely contributing factors.[4] Identifying the prevalence of MSDs among firefighters is crucial to assist the development of injury prevention strategies.

The prevalence of a condition pertains to the proportion of individuals in a population that have a specific condition.[9] Point- and period-prevalence are two distinct measures. Point-prevalence specifies prevalence measured at a particular point in time, whereas period-prevalence denotes prevalence assessed over an interval of time.[9] Such estimates are required for policymakers and health care professionals to enhance the development and delivery of services.[9]

Nearly 80% of Canadian firefighters in small rural communities are volunteers. The 20% of firefighters who perform the job full-time have a more sustained duration and rate of repetitive exposures to the high MSK demands through their role. Several individual studies have assessed the prevalence of MSDs among Canadian firefighters.[4,10–13] While individual studies provide valuable insights, they fail to (1) elucidate both the geographical and anatomical distribution of the condition, (2) compare subgroups, or (3) pool similar studies to provide an estimate from which inferences can be drawn.[9] Therefore, a systematic review and meta-analysis of prevalence studies was conducted in an attempt to:

1. Critically appraise the quality of the body of literature that reports the prevalence of MSDs among Canadian firefighters and;
2. Assess the point- and period-prevalence estimates of geographical and anatomical regions of MSDs among Canadian firefighters.

METHODS

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and the Joanna Briggs Institute [2014] Prevalence Critical Appraisal Checklist

was followed.[9,14] (Protocol registration number: PROS-PERO CRD42018104235)

Eligibility criteria

Studies were included in the systematic review if the following criteria were met:

- **Design:** prospective or retrospective cross-sectional cohort studies
- **Participants:** career/professional Canadian firefighters
- **Outcomes:** point- and period-prevalence estimate of MSDs; and
- **Musculoskeletal disorders:** defined as sprains or strains, fractures, or dislocations and self-reported bodily pain (chronic or acute)

Studies that provided no information on the number of uninjured firefighters (required for prevalence calculation) were excluded from the systematic review. Conference abstracts and posters were also excluded.

Information sources

Systematic electronic searches were conducted to identify relevant prospective or retrospective cross-sectional cohort studies in MEDLINE, Embase, PubMed, and Web of Science, from inception until November 2018. Several different combinations of keywords were used, such as "firefighters", "prevalence", "proportion", "musculoskeletal injuries", "sprains", "strains", "joint injuries" and "head/neck/shoulder/arm/elbow/hand/hip/knee/ankle/back injuries/pain". In addition, a search in the clinical trial registers catalogues was conducted, including the World Health Organization (WHO) clinical trial registry and the National Institutes of Health (NIH) clinical trial registry, and a manual search of the references of all the included studies was performed.

Study selection

Two independent reviewers (GN and JM) performed systematic electronic searches in each database and clinical trial registers catalogue. Duplicate studies were identified and removed. Reviewers GN and JM then independently screened the titles and abstracts and retrieved, in full text, any article marked "include" or "uncertain". In the final stage of study selection, an independent full text review was conducted to determine final eligibility.

Data collection process

Two independent researchers (GN and JM) extracted the data from the eligible studies. Data extraction included the author, year, country, study population/setting/type, sample size, age, gender, point-/period-prevalence, types of MSDs, and ascertainment/case definition.[9] When insufficient data was presented, authors were contacted by email and further data was requested.

Assessment of quality of included studies

Two independent review authors (GN and JM) assessed the quality of included studies using the critical appraisal checklist from the Joanna Briggs Institute [2014] Reviewers' Manual.[9] This checklist used a domain-based approach. The evaluation criteria included (1) whether the sample was representative of the target population; (2) if study participants were recruited in an appropriate way (used a stratified random sampling with eligibility criteria to ensure that the sample was representative of the population that researchers were attempting to generalize to); (3) adequacy of sample size; (4) description of study subjects and setting in detail; (5) whether data analysis was conducted with sufficient coverage of the identified sample (was there a large number of dropouts or refusals among the eligible participants that may diminish a study's validity); (6) whether objective, standard criteria were used for measurement of the condition; (7) if the condition was measured reliably; (8) whether appropriate statistical analyses were performed and precision estimates reported; (9) if all important confounding factors/subgroups/differences were identified and accounted for; and (10) whether sub-populations were identified using objective criteria.[9]

Sub-group analysis and exploring heterogeneity

In the presence of heterogeneity, the authors planned to perform subgroup analyses (a priori) based on the duration of MSDs (chronic vs. acute) and gender (males vs. females). An I^2 estimate of at least 50% was interpreted as evidence of a substantial problem with heterogeneity.[15]

Synthesis of results

A total of 30 meta-analyses of studies reporting the prevalence of MSDs among Canadian firefighters were performed. Both period- and point-prevalence estimates were calculated, and study-specific estimates were pooled using a random-effects model. The proportion (random-effects), their weighted proportions, and 95% confidence intervals were summarized in forest plots. The software programs MedCalc bvba, version 16.2.1 (MedCalc Software Ltd., Ostend, BE) and StatsDirect,

version 3 (StatsDirect Ltd., Merseyside, UK) were used to facilitate all statistical analyses.

RESULTS

Study selection

The initial search yielded 256 publications. After removal of duplicates, 185 articles remained and were screened using their title and abstract, leaving 100 articles selected for full text review. A total of 95 studies were excluded due to ineligible population (35 studies), inappropriate study design (3 studies), or lack of MSK prevalence estimates (57 studies). Five studies were eligible to proceed to data extraction and analysis.[4,10–13] The flow of studies through the selection process is presented in Figure 1.

Study characteristics

The 5 eligible cohort studies (3 prospective, 2 retrospective) were conducted between 2015 and 2018 and included 4,143 firefighters.[4,10–13] Participants had a mean age range of 34 (SD = 8.5) to 42.6 (SD = 9.7) years. The reported types of MSDs included sprain or strain, fractures, head, neck, shoulder, elbow, arm, hand, back, upper thigh, knee, and foot pain. Study size ranged from 294 to 1,363 firefighters. Studies were conducted in various provinces across Canada. A summary description of all the included studies is displayed in Table 1.

Critical appraisal of the quality of individual studies

The authors assessed the quality of the included studies using the Joanna Briggs Institute [2014] Prevalence
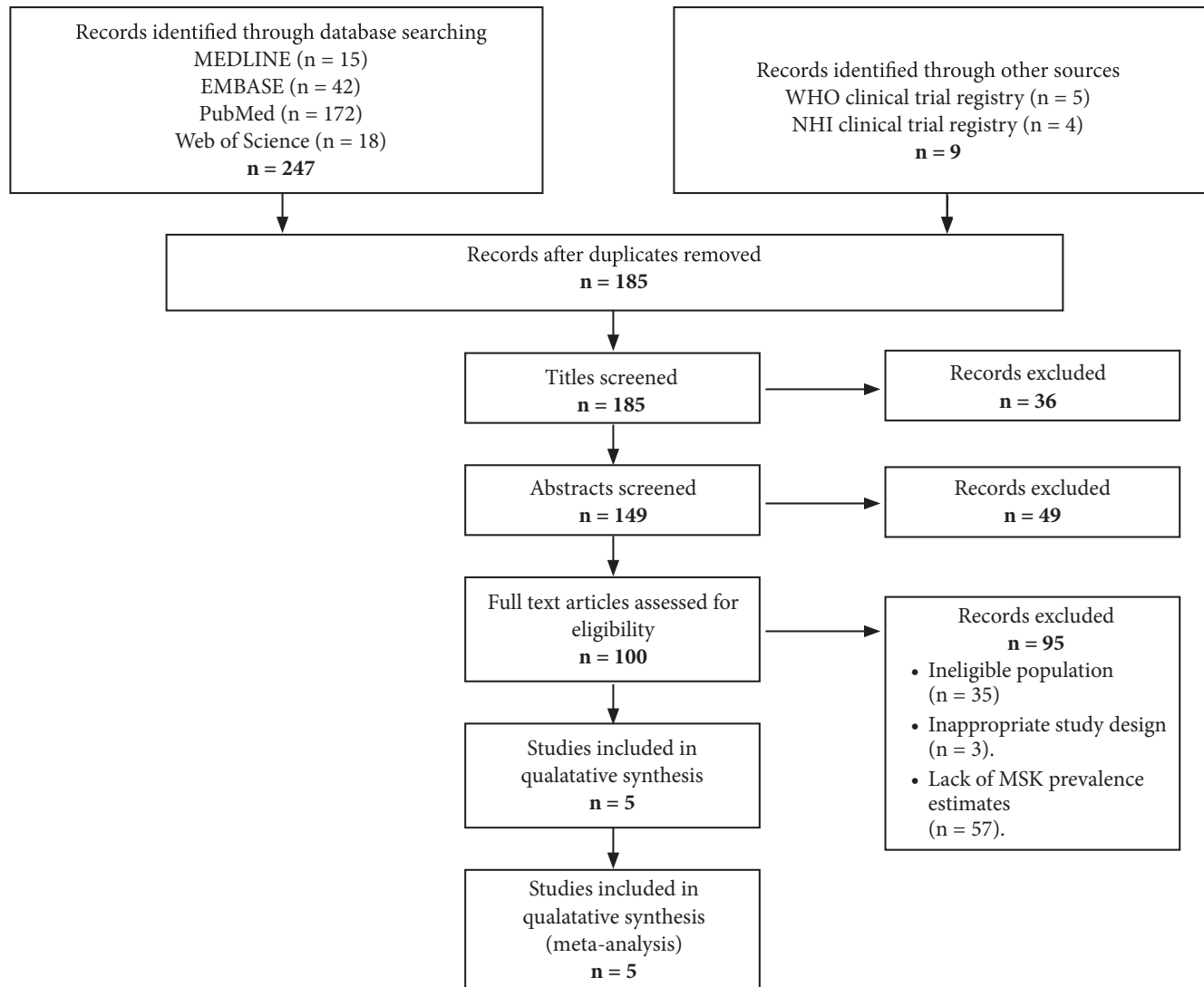

Figure 1. Selection of studies for inclusion in the systematic review

Table 1. Select characteristics of cross-sectional studies reporting on prevalence of musculoskeletal Injuries among firefighters

Study	Population	Prevalence (point- or period-)	Study type	Types of MSDs	Ascertainment / case definition
Frost[11] – Metropolitan Calgary, Alberta	n = 1,289	Period-prevalence, 1-year	Retrospective cohort	Sprain or strain, (shoulder, ankle, back, knee sprains); fractures	Secondary analysis of data collected between January 1, 2012 and December 31, 2012 from the injury reports filed by Calgary Fire Department (CFD)
Frost[10] – Metropolitan Calgary, Alberta	n = 1,363; 1,336 males, 27 females; age 38 (SD = 9) years	Period-prevalence (2007–2011)	Retrospective cohort	Sprain or strain, (shoulder, ankle, back, knee sprains); fractures	Secondary analysis of data from the injury reports filed by Calgary Fire Department (CFD)
Negm[4] – Career; Hamilton, Ontario	n = 294 active-duty firefighters; 283 males, 8 females, 3 not reported; age 42.6 (SD = 9.7) years	Point-prevalence	Prospective cohort	Head, neck, shoulder, elbow, arm, hand, back, upper thigh, knee, and foot pain	Self-reported musculoskeletal disorder questionnaire – pain body diagram on the Iconic Pain Assessment Tool (IPAT); pain felt within the past week
Nazari[13] – Career; across Canada	n = 390 firefighters; 272 males, age 41 (SD = 9.5) years; 118 females, age 34 (SD = 8.5) years	Point-prevalence	Prospective cohort	Head, neck, shoulder, elbow, arm, hand, back, upper thigh, knee, and foot pain	Self-reported musculoskeletal disorder questionnaire; pain felt within the past week
Carleton[12] – Urban & rural; across Canada	807 firefighters	Point-prevalence	Prospective cohort	Neck, shoulder, arm and hand, foot, and back pain	Self-reported questionnaire – developed based on the work done International Association for the Study of Pain; pain lasting longer than 3 months

MSD = musculoskeletal disorder

Table 2. Critical appraisal results for included studies using Joanna Briggs Institute [2014] Prevalence Critical Appraisal Checklist

	Study	Frost[11]	Frost[10]	Nazari[13]	Carleton[12]	Negm[4]
Critical assessment components	Was the sample representative of the target population?	Yes	Yes	Yes	Yes	Yes
	Were study participants recruited in an appropriate way?	Yes	Yes	Yes	Yes	Yes
	Was the sample size adequate?	Yes	Yes	Yes	Yes	Yes
	Were the study subjects and setting described in detail?	Unclear	Yes	Yes	Yes	Yes
	Is the data analysis conducted with sufficient coverage of the identified sample?	No	No	Yes	Yes	Yes
	Was the condition measured reliably?	Unclear	Unclear	Yes	Yes	Yes
	Was there appropriate statistical analysis?	Yes	Yes	Yes	Yes	Yes
	Are all important confounding factors/ subgroups/ differences identified and accounted for?	Yes	Yes	Yes	Yes	Yes

Note. The domain "Were subpopulations identified using objective criteria?" was not applicable

Critical Appraisal Checklist (Table 2). The most common flaws noted were (1) not considering an objective, standard criteria for measurement of the condition; (2) lack of clarity on whether data analysis was conducted with sufficient coverage of the identified sample; and (3) how reliably the condition was measured.

Outcomes: MSDs

Overall, 5 cohort studies (3 prospective, 2 retrospective) were included in the review. Two of the included studies reported on the overall and anatomical regions period-prevalence of sprains/strains and fractures/dislocations.[10–11] In these two studies, MSDs were

examined retrospectively using the data extracted from Workers' Compensation forms and injury reports. The remaining three studies reported on the point-prevalence of anatomical bodily pain (head, neck, shoulder, elbow, arm, hand, back, upper thigh, knee, and foot).[4,12–13] In these studies, bodily pain was assessed prospectively through administering self-reported questionnaires.

Point-prevalence of anatomical regions of MSDs

HEAD

When focused on the pain in the head region, the point-prevalence estimate was 6.00% (3 studies, 100 of 1,491 firefighters, 95% CI, 3.00–10.00; $I^2 = 87.00\%$; Table 3). When stratified by male gender and pain

Table 3. Meta-analyses of the point-prevalence of self-reported MSDs among Canadian firefighters

Study	No. of Injuries	No. of Firefighters	Weight (%)	Proportion (%)	95% CI
Body part: Head					
Nazari[13]	15	390	26.00	4.00	2.00–6.00
Negm[4]	12	294	20.00	4.00	2.00–7.00
Carleton[12]	73	807	54.00	9.00	7.00–11.00
Total	100	1,491	100%		
Random-effects model; heterogeneity $I^2 = 87.0\%$, $p < 0.001$				**6.00**	**3.00–10.00**
Subgroup analysis stratified by gender (male) and duration of self-reported MSD (past 1 week)					
Nazari[13]	8	272	49.00	2.90	1.30–5.70
Negm[4]	11	283	51.00	3.90	2.00–6.80
Total	19	555	100%		
Random-effects model; heterogeneity $I^2 = 0.0\%$, $p = 0.55$				**3.60**	**2.20–5.30**
Subgroup analysis stratified by gender (female) and duration of self-reported MSD (past 1 week)					
Nazari[13]	7	118	93.00	6.00	2.40–11.80
Negm[4]	1	8	7.00	12.50	0.30–52.60
Total	8	126	100%		
Random-effects model; heterogeneity $I^2 = 0.0\%$, $p = 0.34$				**6.80**	**3.20–11.70**
Body part: Neck					
Nazari[13]	74	390	26.00	19.00	15.00–23.00
Negm[4]	58	294	20.00	20.00	15.00–25.00
Carleton[12]	99	807	54.00	12.00	10.00–15.00
Total	231	1,491	100%		
Random-effects model; heterogeneity $I^2 = 86.0\%$, $p < 0.001$				**17.00**	**12.00–22.00**
Subgroup analysis stratified by gender (male) and duration of self-reported MSD (past 1 week)					
Nazari[13]	46	272	49.00	17.00	12.70–21.90
Negm[4]	57	283	51.00	20.00	15.60–25.30
Total	103	555	100%		
Random-effects model; heterogeneity $I^2 = 0.0\%$, $p = 0.33$				**18.60**	**15.50–22.00**
Subgroup analysis stratified by gender (female) and duration of self-reported MSD (past 1 week)					
Nazari[13]	28	118	93.00	24.00	16.40–32.40
Negm[4]	1	8	7.00	12.50	0.30–52.70
Total	29	126	100%		
Random-effects model; heterogeneity $I^2 = 0.0\%$, $p = 0.58$				**23.40**	**16.50–31.00**

MSD = musculoskeletal disorder

duration (past 1 week), the pooled results displayed point estimates of 3.6% (2 studies, 19 of 555 firefighters, 95% CI, 2.20–5.30; I^2 = 0.0%; Table 3). When stratified by female gender and pain duration (past 1 week), the pooled results indicated point estimates of 6.80% (2 studies, 8 of 126 firefighters, 95% CI, 3.20–11.70; I^2 = 0.0%; Table 3).

NECK

In terms of neck pain, the point-prevalence estimate was 17.00% (3 studies, 231 of 1,491 firefighters, 95% CI, 12.00–22.00; I^2 = 86.00%; Table 3). When stratified by male gender and pain duration (past 1 week), the pooled results displayed point estimates of 18.60% (2 studies, 103 of 555 firefighters, 95% CI, 15.50–22.00; I^2 = 0.0%; Table 3). When stratified by female gender and pain duration (past 1 week), the pooled results indicated point estimates of 23.40% (2 studies, 29 of 126 firefighters, 95% CI, 16.50–31.00; I^2 = 0.0%; Table 3).

SHOULDER

For shoulder pain, the point-prevalence estimate was 23.00% (3 studies, 312 of 1,491 firefighters, 95% CI, 15.00–33.00; I^2 = 94.00%; Table 4). When stratified by male gender and pain duration (past 1 week), the pooled results displayed point estimates of 28.60% (2 studies, 159 of 555 firefighters, 95% CI, 22.00–35.80; I^2 = 71.00%; Table 4). When stratified by female gender and pain duration (past 1 week), the pooled results indicated point estimates of 23.70% (2 studies, 27 of 126 firefighters, 95% CI, 12.10–37.70; I^2 = 26.50%; Table 4).

ELBOW, ARM, AND HAND

Regarding elbow, arm, and hand regions, the point-prevalence estimate of pain was 17.00% (3 studies, 235 of 1,491 firefighters, 95% CI, 8.00–27.00; I^2 = 96.00%; Table 4). When stratified by male gender and pain duration (past 1 week), the pooled results displayed point estimates of 18.50% (2 studies, 107 of 555 firefighters, 95% CI, 5.20–37.50; I^2 = 96.0%; Table 4). When stratified by female gender and pain duration (past one week), the pooled results indicated point estimates of 29.20% (2 studies, 14 of 126 firefighters, 95% CI, 0.07–85.00; I^2 = 92.00%; Table 4).

BACK

In terms of back pain, the point-prevalence estimate was 27.0% (3 studies, 367 of 1,491 firefighters, 95% CI, 18.00–38.00; I^2 = 95.00%; Table 5). When stratified by male gender and pain duration (past 1 week), the pooled results displayed point estimates of 31.60% (2 studies, 175 of 555 firefighters, 95% CI, 27.80–35.50; I^2 = 0.0%; Table 5). When stratified by female gender and pain duration (past 1 week), the pooled results indicated point estimates of 42.60% (2 studies, 44 of 126 firefighters, 95% CI, 18.70–68.50; I^2 = 63.00%; Table 5).

UPPER THIGH

When focused on the pain in the upper thigh region, the point-prevalence estimate was 6.0% (2 studies, 41 of 684 firefighters, 95% CI, 3.00–11.00; I^2 = 82.00%; Table 5). When stratified by male gender and pain duration (past 1 week), the pooled results displayed point estimates of 5.80% (2 studies, 33 of 555 firefighters, 95% CI, 2.30–11.00; I^2 = 79.00%; Table 5). When stratified by female gender and pain duration (past 1 week), the pooled results indicated point estimates of 12.00% (2 studies, 8 of 126 firefighters, 95% CI, 0.30–37.10; I^2 = 70.00%; Table 5).

KNEE

For knee pain, the point-prevalence estimate was 27.00% (2 studies, 180 of 684 firefighters, 95% CI, 11.00–48.00; I^2 = 97.00%; Table 6). When stratified by male gender and pain duration (past 1 week), the pooled results displayed point estimates of 29.00% (2 studies, 163 of 555 firefighters, 95% CI, 13.80–46.80; I^2 = 95.00%; Table 6). When stratified by female gender and pain duration (past 1 week), the pooled results indicated point estimates of 21.00% (2 studies, 17 of 126 firefighters, 95% CI, 3.00–48.80; I^2 = 70.00%; Table 6).

FOOT

Regarding the foot region, the point-prevalence estimate of pain was 7.00% (3 studies, 105 of 1,491 firefighters, 95% CI, 6.00–8.00; I^2 = 0.0%; Table 6). When stratified by male gender and pain duration (past 1 week), the pooled results displayed point estimates of 6.80% (2 studies, 37 of 555 firefighters, 95% CI, 4.90–9.10; I^2 = 0.0%; Table 6). When stratified by female gender and pain duration (past 1 week), the pooled results indicated point estimates of 6.30% (2 studies, 7 of 126 firefighters, 95% CI, 2.20–12.50; I^2 = 7.40%; Table 6).

Period-prevalence of sprain/strain injuries

In terms of all sprain/strain injuries (all body parts), the 1-year period-prevalence estimate was 10.0% (2

Table 4. Meta-analyses of the point-prevalence of self-reported MSDs among Canadian firefighters

Study	No. of injuries	No. of firefighters	Weight (%)	Proportion (%)	95% CI
Body part: Shoulder					
Nazari[13]	92	390	26.00	24.00	19.00–28.00
Negm[4]	94	294	20.00	32.00	27.00–38.00
Carleton[12]	126	807	54.00	16.00	13.00–18.00
Total	312	1,491	100%		
Random-effects model; heterogeneity I^2 = 94.0%, $p < 0.001$				**23.00**	**15.00–33.00**
Subgroup analysis stratified by gender (male) and duration of self-reported MSD (past 1 week)					
Nazari[13]	68	272	50.00	25.00	20.00–30.60
Negm[4]	91	283	50.00	32.20	26.70–38.00
Total	159	555	100%		
Random-effects model; heterogeneity I^2 = 71.0%, $p = 0.06$				**28.60**	**22.00–35.80**
Subgroup analysis stratified by gender (female) and duration of self-reported MSD (past 1 week)					
Nazari[13]	24	118	82.00	20.30	13.50–28.70
Negm[4]	3	8	18.00	37.50	8.50–75.50
Total	27	126	100%		
Random-effects model; heterogeneity I^2 = 26.50%, $p = 0.24$				**23.70**	**12.10–37.70**
Body part: Arm, elbow, and hand					
Nazari[13]	38	390	26.00	10.00	7.00–13.00
Negm[4]	85	294	20.00	29.00	24.00–34.00
Carleton[12]	112	807	54.00	14.00	12.00–16.00
Total	235	1,491	100%		
Random-effects model; heterogeneity I^2 = 96.0%, $p < 0.001$				**17.00**	**8.00–27.00**
Subgroup analysis stratified by gender (male) and duration of self-reported MSD (past 1 week)					
Nazari[13]	29	272	50.00	10.70	7.30–15.00
Negm[4]	78	283	50.00	27.50	22.40–33.00
Total	107	555	100%		
Random-effects model; heterogeneity I^2 = 96.0%, $p < 0.001$				**18.50**	**5.20–37.50**
Subgroup analysis stratified by gender (female) and duration of self-reported MSD (past 1 week)					
Nazari[13]	9	118	53.00	7.70	3.50–14.00
Negm[4]	5	8	47.00	62.50	24.50–91.50
Total	14	126	100%		
Random-effects model; heterogeneity I^2 = 92.0%, $p < 0.001$				**29.20**	**0.07–85.00**

MSD = musculoskeletal disorder

studies, 278 of 2,652 firefighters, 95% CI, 7.00–14.00; I^2 = 89.00%; Table 7). Further anatomical region analyses indicated 1-year period-prevalence estimates of 1.30% (shoulder; 2 studies, 35 of 2,652 firefighters, 95% CI, 0.60–2.30; I^2 = 76.00%; Table 7), 2.00% (knee; 2 studies, 51 of 2,652 firefighters, 95% CI, 0.60–4.00; I^2 = 90.00%; Table 7), 3.00% (back; 2 studies, 89 of 2,652 firefighters, 95% CI, 2.00–5.00; I^2 = 64.00%; Table 7), and 2.00% (ankle; 2 studies, 41 of 2,652 firefighters, 95% CI, 1.00–2.00; I^2 = 64.00%; Table 7).

Period-prevalence of fractures/dislocation injuries

When focused on fractures/dislocations (all body parts), the 1-year period-prevalence estimate was 1.00% (2 studies, 26 of 2,652 firefighters, 95% CI, 0.70–1.40; I^2 = 4.50%; Table 8).

DISCUSSION

This systematic review and meta-analysis of MSDs found high point-prevalence estimates of neck, shoulder, arm/elbow/hand, back, and knee pain among both male and female Canadian firefighters. In addition, high period-prevalence (1 year) estimates of sprain/strain injuries (1 in 10 firefighters) were found. These findings represent a unique synthesis of the evidence and put an emphasis on the importance of developing firefighter-specific rehabilitation and injury prevention programs.

The conduct of reliable and valid epidemiologic studies is required to describe and compare the prevalence of MSDs among various populations. Such studies can then be used for identification of risk factors and development of injury prevention and rehabilitation programs. In this review, the point-prevalence estimates of pain in regions of neck (17.00%), shoulder (23.00%), arm/elbow/hand (17.00%), back (27.00%), knee (27.00%), and foot (7.00%) were nearly 1 to 4 times higher than that of the general population in

Table 5. Meta-analyses of the point-prevalence of self-reported MSDs among Canadian firefighters

Study	No. of injuries	No. of firefighters	Weight (%)	Proportion (%)	95% CI
Body part: Back					
Nazari[13]	123	390	26.00	32.00	27.00–36.00
Negm[4]	96	294	20.00	33.00	27.00–38.00
Carleton[12]	148	807	54.00	18.00	16.00–21.00
Total	367	1,491	100%		
Random-effects model; heterogeneity I^2 = 95.0%, $p < 0.001$				**27.00**	**18.00–38.00**
Subgroup analysis stratified by gender (male) and duration of self-reported MSD (past 1 week)					
Nazari[13]	84	272	49.00	31.00	25.40–36.70
Negm[4]	91	283	51.00	32.20	26.70–38.00
Total	175	555	100%		
Random-effects model; heterogeneity I^2 = 0.0%, $p = 0.75$				**31.60**	**27.80–35.50**
Subgroup analysis stratified by gender (female) and duration of self-reported MSD (past 1 week)					
Nazari[13]	39	118	66.00	33.00	24.70–42.30
Negm[4]	5	8	34.00	62.50	24.50–91.50
Total	44	126	100%		
Random-effects model; heterogeneity I^2 = 63.0%, $p = 0.10$				**42.60**	**18.70–68.50**
Body part: Upper thigh					
Nazari[13]	16	390	57.00	4.00	2.00–7.00
Negm[4]	25	294	43.00	9.00	6.00–12.00
Total	41	684	100%		
Random-effects model; heterogeneity I^2 = 82.0%, $p = 0.02$				**6.0**	**3.00–11.00**
Subgroup analysis stratified by gender (male) and duration of self-reported MSD (past 1 week)					
Nazari[13]	10	272	50.00	3.70	1.80–6.65
Negm[4]	23	283	50.00	8.10	5.20–12.00
Total	33	555	100%		
Random-effects model; heterogeneity I^2 = 79.00%, $p = 0.03$				**5.80**	**2.30–11.00**
Subgroup analysis stratified by gender (female) and duration of self-reported MSD (past 1 week)					
Nazari[13]	6	118	63.00	5.10	1.90–10.70
Negm[4]	2	8	37.00	25.00	3.20–65.10
Total	8	126	100%		
Random-effects model; heterogeneity I^2 = 70.0%, $p = 0.07$				**12.00**	**0.30–37.10**

MSD = musculoskeletal disorder

Canada (neck pain 5.40%; shoulder pain 6.10%; arm/elbow/hand pain 7.40%; back pain 22.30%; knee pain 9.50%; foot pain 3.40%).[16] Although these proportions cannot, statistically, be directly compared to the general population estimates in 2007–2008, they do appear higher.[16] Similarly, the 10% period-prevalence (1-year) estimates of sprain/strain injuries among firefighters were much higher than that of the general population estimates of approximately 5.5% in Canada in 2009–2010.[17]

The quality of the included studies was assessed using the Joanna Briggs Institute [2014] Prevalence Critical Appraisal Checklist (Table 2). Use of the Joanna Briggs Institute domain-based tool revealed that the most common limitation was not considering an objective, standard criteria for measurement of the condition, found in two retrospective cohort studies of the five studies included. The Frost 2015 and 2016 studies both involved secondary analyses of data collected from the injury reports filed within the Calgary Fire

Table 6. Meta-analyses of the point-prevalence of self-reported MSDs among Canadian firefighters

Study	No. of injuries	No. of firefighters	Weight (%)	Proportion (%)	95% CI
Body part: Knee					
Nazari[13]	70	390	57.0	18.0	14.0–22.0
Negm[4]	110	294	43.0	37.0	32.0–43.0
Total	180	684	100%		
Random-effects model; heterogeneity I^2 = 97.0%, p < 0.001				**27.0**	**11.00–48.00**
Subgroup analysis stratified by gender (male) and duration of self-reported MSD (past 1 week)					
Nazari[13]	56	272	50.00	20.50	16.00–26.00
Negm[4]	107	283	50.00	38.00	32.10–43.70
Total	163	555	100%		
Random-effects model; heterogeneity I^2 = 95.0%, p < 0.001				**29.00**	**13.80–46.80**
Subgroup analysis stratified by gender (female) and duration of self-reported MSD (past 1 week)					
Nazari[13]	14	118	63.00	12.00	6.60–19.10
Negm[4]	3	8	37.00	37.50	8.50–75.50
Total	17	126	100%		
Random-effects model; heterogeneity I^2 = 70.0%, p = 0.06				**21.00**	**3.00–48.80**
Body part: Foot					
Nazari[13]	23	390	26.0	6.0	4.0–9.0
Negm[4]	21	294	20.0	7.0	4.0–11.0
Carleton[12]	61	807	54.0	8.0	6.0–10.0
Total	105	1,491	100%		
Random-effects model; heterogeneity I^2 = 0.0%, p = 0.58				**7.00**	**6.00–8.00**
Subgroup analysis stratified by gender (male) and duration of self-reported MSD (past 1 week)					
Nazari[13]	17	272	49.00	6.30	3.70–9.80
Negm[4]	20	283	51.00	7.10	4.40–10.70
Total	37	555	100%		
Random-effects model; heterogeneity I^2 = 0.0%, p = 0.70				**6.80**	**4.90–9.10**
Subgroup analysis stratified by gender (female) and duration of self-reported MSD (past 1 week)					
Nazari[13]	6	118	90.00	5.10	1.90–10.70
Negm[4]	1	8	10.00	12.50	0.30–52.70
Total	7	126	100%		
Random-effects model; heterogeneity I^2 = 7.40%, p = 0.30				**6.30**	**2.20–12.50**

MSD = musculoskeletal disorder

Department. However, it was unable to be determined if the measurement tools used were validated instruments, limiting the ability to speak to outcome assessment validity.

Despite the decline in the total number of firefighter injuries reported by the National Fire Protection Association in the United States, firefighter injuries remain high. A total of 62,085 injuries were reported in the United States in 2016.[18] Furthermore, the major types of injuries received during fireground operations were strain, sprain and muscular pain 45.7%.[8] This U.S. data was comparable with the results found by the authors. Similarities exist between individuals in the firefighting profession, the military, and

Table 7. Meta-analyses of the period-prevalence (1 year) sprains/strains among Canadian firefighters

Study	No. of injuries	No. of firefighters	Weight (%)	Proportion (%)	95% CI
All body parts					
Frost[11]	159	1,289	49.00	12.00	11.00–14.00
Frost[10]	119	1,363	51.00	9.00	7.00–10.00
Total	278	2,652	100%		
Random-effects model; heterogeneity I² = 89.00%, p < 0.001				**10.00**	**7.00–14.00**
Body part: Shoulder					
Frost[11]	23	1,289	49.00	2.00	1.10–2.60
Frost[10]	12	1,363	51.00	0.80	0.40–1.50
Total	35	2,652	100%		
Random-effects model; heterogeneity I² = 76.0%, p = 0.04				**1.30**	**0.60–2.30**
Body part: Knee					
Frost[11]	36	1,289	49.00	3.00	2.00–4.00
Frost[10]	15	1,363	51.00	1.00	0.60–2.00
Total	51	2,652	100%		
Random-effects model; heterogeneity I² = 90.00%, p < 0.001				**2.00**	**0.60–4.00**
Body part: Back					
Frost[11]	51	1,289	49.00	4.00	3.00–5.00
Frost[10]	38	1,363	51.00	3.00	2.00–4.00
Total	89	2,652	100%		
Random-effects model; heterogeneity I² = 64.0%, p = 0.10				**3.00**	**2.00–5.00**
Body part: Ankle					
Frost[11]	17	1,289	49.00	1.00	0.80–2.10
Frost[10]	24	1,363	51.00	2.00	1.00–3.00
Total	41	2,652	100%		
Random-effects model; heterogeneity I² = 64.0%, p = 0.10				**2.00**	**1.00–2.00**

MSD = musculoskeletal disorder

Table 8. Meta-analyses of the period-prevalence (1 year) fractures among Canadian firefighters

All body parts					
Study	No. of injuries	No. of firefighters	Weight (%)	Proportion (%)	95% CI
Frost[11]	10	1,289	49.00	0.70	0.40–1.40
Frost[10]	16	1,363	51.00	1.10	0.60–2.00
Total	26	2,652	100%		
Random-effects model; heterogeneity I² = 4.50%, p = 0.30				**1.00**	**0.70–1.40**

professional sports, in that all involve extended periods of training, conduct of heavy and repetitive tasks, and extreme physical exertions; however, athletes are not exposed to occupational loads. Soldiering, or a career in the military, is extremely challenging, considering its high operational tempo and wide spectrum of mission requirements.[19] In addition, members of the armed forces must attain and maintain high levels of physical readiness to be able to carry out their operational tasks.[19]

Likewise, professional athletes train and practice constantly and are expected to be in top physical condition. The results from this review were comparable across both military and athletic populations, when considering different point- and period-prevalence studies. When considering point-prevalence, the bodily pain point estimates (shoulder 23.0%; neck 17.0%) identified in our review were comparable to the 2009 Lew study of 340 U.S. Veterans, with point-prevalence estimates of shoulder 21.0% and neck 19.0%.[20] However, a higher point-prevalence estimate of back pain (58.0%) was reported relative to this study (27.0%).[20] In terms of period-prevalence estimates and comparison with military and athletic populations, estimates of sprain/strain injuries (10.0%) in this review were also similar to the period-prevalence estimates reported in the literature. Jacobsson et al.[21] noted that the period-prevalence (1 year) estimate of sprain/strain injuries among 276 Swedish elite track and field athletes was 8.5%. Lovalekar et al.[22] reported that the period-prevalence (1 year) estimate of sprain/strain injuries among 210 Naval Special Warfare Sea, Air, and Land (SEAL) operators was 9.5% (20 of 210 SEALs)[22] and 10.6% (48 of 451 soldiers) for sprain/strain injuries among the 451 soldiers from the Army 101st Airborne (Air Assault) Division.[23] Abt[24] noted that the period-prevalence (1 year) estimate of sprain/strain injuries among 106 U.S. Army Special Operations Command (USASOC) special forces soldiers was 8.5% (9 of 106 soldiers).[24] It is important to note that the period-prevalence estimate of sprain/strain injuries in this review (10.0%; 278/2,652 firefighters, substantial heterogeneity $I^2 = 89$%), based on two retrospective cohort studies, was consistent with similar high-demand occupational (military) estimates.

Firefighter-related studies tend to exclude women from statistical analyses due to inadequate sample size (underpowered), which ultimately leads to a lack of data concerning female firefighters. Furthermore, it is important to distinguish the prevalence of MSDs by anatomical regions between male and female firefighters. Therefore, in this review, the authors planned a priori to conduct subgroup analysis by sex (male and female) to address these issues. It was identified that the point-prevalence of shoulder- and knee-related MSDs were higher in male firefighters, by 5% and 8%, respectively. Conversely, head-, neck-, arm/elbow/hand-, back- and upper thigh-related MSDs were more prevalent in female firefighters by 3%, 5%, 10.7%, 11% and 6%, respectively. These findings highlight the high prevalence of MSDs among firefighters who are already at an elevated risk of sustaining MSDs, compared to the general Canadian population.

Identifying prevalence estimates and distribution of MSDs is necessary to assist the development of data-driven rehabilitation programs.[25-26] In this review, nearly 1 out of 4 Canadian firefighters reported having suffered from shoulder, back or knee pain in the past three months. Therefore, physical therapists and other health care providers, and personnel with a keen understanding of the occupational knowledge and specific biomechanical requirements of the MSK system, are indicated in the design and implementation of rehabilitation programs that take into account firefighters' demands and occupational requirements. The standard of physical performance to which they need to return after injury must be front of mind in effective service delivery for firefighters.

When interpreting the results of this review, it is important to note that heterogeneity was high in the analyses. High heterogeneity was explained/reduced by sex (male or female) and duration of MSDs (acute or chronic) in the subgroup analyses. However, subgroup analyses are inherently underpowered, and caution must be used when interpreting prevalence estimates.

Firefighting tasks, such as hose dragging or stair climbing with a high-rise pack, have been reported to be physiologically demanding, necessitating firefighters to work at near maximal heart rates.[5-6] Sex is believed to have an impact on fitness levels. Fitness profiles of female firefighters consistently differ in comparison to their male counterparts, in terms of cardiovascular levels, muscle strength and endurance.[27] Furthermore,

there are biomechanical strategies that are distinct among male and female firefighters. For example, in needing to pull up to a window, a male firefighter might use his upper body to achieve the task, whereas a female firefighter might rely on core and leg strength. In addition, female firefighters also employ compensatory strategies, such as bodily momentum, to achieve task completion.[27] This review highlights the need for early assessment and intervention; assessing how firefighters carry out tasks; injury prevention strategies that reflect gender differences in biomechanics; and re-evaluating how units work together to maximize ergonomic efficiency and injury prevention. Furthermore, "women firefighters are not just 'size small' men"[28] and PPE needs to be both functional, as well as safe, in order to ensure firefighter health. The implications are very real in the potential for non-gender-sensitive PPE to enhance risk.

CONCLUSION

This systematic review provides evidence of the prevalence of MSDs among Canadian firefighters. Overall, high point-prevalence estimates (one in four firefighters) of shoulder-, back- and knee-related MSDs were found among Canadian firefighters. The point-prevalence of shoulder- and knee-related MSDs were higher in male firefighters, whereas head-, neck-, arm/elbow/hand-, back-, and upper thigh-related MSDs were more prevalent in female firefighters. Furthermore, the period-prevalence of sprain/strain injuries were also noticeably high (1 in 10 firefighters).

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COMPETING INTERESTS

None declared.

This article has been peer reviewed.

CONTRIBUTORS

Goris Nazari conceived and designed the study and acquired and analyzed data. Joy MacDermid was

partially involved in study design, data analysis and revised the article for important intellectual content and approved the final version submitted for publication. Heidi Cramm was heavily involved in interpretation of the data; she also provided important intellectual content and approved the final version submitted for publication.

REVIEW

Toward an improved hearing safety standard for impulse noise exposure in the Canadian Armed Forces

Ann Nakashima[a] and Christian Giguère[b]

ABSTRACT

Introduction: Current hearing safety standards for the Canadian Armed Forces (CAF) do not adequately address exposure limits for mitigation of noise-induced hearing loss (NIHL) from weapon noise. Recommendations for updating the hearing safety standard are being formulated by the recently initiated Noise Health Hazard Working Group (NHHWG). In this article, we aim to provide a way forward for the NHHWG. **Methods:** On the basis of experience with auditory research, noise measurement, acoustic standards development, interactions with CAF members, and a review of the literature, we present an overview of the current state of knowledge regarding impulse noise. The topics include impulse noise measurement, engineering and administrative controls for noise exposure, and use of personal hearing protection devices (HPDs). **Results:** Although technology for impulse noise measurements and ways to account for HPDs have improved substantially in recent years, not much has changed in hearing damage risk criteria. Energy-based metrics can account for the impulse duration and frequency-dependent characteristics of the HPD, which are important considerations in calculating allowed exposures. **Discussion:** The NHHWG is recommended to focus on measurements of current weapons systems in various configurations and training environments and to evaluate the use of energy-based metrics, together with frequency-dependent HPD insertion loss.

Key Words: Canadian Armed Forces (CAF), energy-based metrics, hearing damage risk criteria, hearing loss, hearing protection devices (HPD), hearing safety standard, impulse noise, Noise Health Hazard Working Group (NHHWG), noise-induced hearing loss (NIHL)

RÉSUMÉ

Introduction : Les normes en santé et sécurité auditive dans les Forces armées canadiennes (FAC) ne tiennent pas suffisamment compte des limites d'exposition pour prévenir la perte auditive due au bruit (PADB) des armes. Le récent groupe de travail sur les dangers du bruit sur la santé (GTDBS) a comme objectif de formuler des recommandations pour mettre à jour les normes de sécurité auditive. Le présent article vise à donner des moyens d'action au GTDBS. **Méthodologie :** Les auteurs ont puisé dans leur expérience de recherche en audition, en mesures du bruit et d'élaboration des normes acoustiques, leurs interactions avec les membres des FAC et une analyse documentaire pour présenter un aperçu de l'état actuel des connaissances sur les bruits impulsifs. Les sujets couverts comprennent la mesure du bruit impulsif, les méthodes de réduction du bruit, les contrôles administratifs de l'exposition au bruit ainsi que l'utilisation de protecteurs auditifs individuels. **Résultats :** Les techniques instrumentales pour la mesure des bruits impulsifs et la manière de tenir compte des protecteurs auditifs se sont beaucoup améliorées ces dernières années, mais il n'y a pas eu tellement de changements quant aux critères de risque de lésions auditives. Les indicateurs de risques mesures fondés sur l'énergie peuvent tenir compte de la durée des impulsions et des caractéristiques fréquentielles des protecteurs auditifs, lesquelles sont des éléments importants à considérer pour calculer l'exposition permise. **Discussion :** Il est recommandé que le GTDBS se concentre sur les mesures acoustiques des systèmes d'armes actuels dans diverses configurations d'utilisation et différents milieux de formation et qu'il évalue le recours aux indicateurs fondés sur l'énergie en conjonction avec l'affaiblissement acoustique des protecteurs auditifs selon la fréquence.

Mots-clés : bruit impulsif, critères de risque de lésions auditives, Force armées canadiennes, groupe de travail sur les dangers du bruit sur la santé (GTDBS), indicateurs fondés sur l'énergie, norme de sécurité auditive, perte auditive, perte auditive due au bruit (PADB), protecteurs auditifs.

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INTRODUCTION

Noise-induced hearing loss (NIHL) continues to be a major problem for the Canadian Armed Forces (CAF). Medical conditions of the ear have been reported as the second highest cost in terms of Veteran compensation.[1] Previous publications have documented the presence of NIHL in the CAF,[2] its prevention,[3] barriers to use of hearing protection,[4] and special considerations for a hearing loss prevention program (HLPP) in military environments.[5] Despite these efforts, there have been no documented changes in hearing standards for the CAF.[6] For noise exposure, the Canadian federal daily noise limit of 87 A-weighted decibels for eight hours applies. Impulse noise is not part of the federal limit but is limited to 140 decibel peak in the Territories, British Columbia, Quebec, and New Brunswick.[7] Given that noise from shooting and blasts exceeds 140 decibels peak,[8–11] special consideration must be given to impulse noise for CAF members.

From the perspective of military trainers and operators, it is important to determine limits to the number of rounds able to be fired and the type of hearing protection device (HPD) to be worn to prevent NIHL. Providing this information for all in-service weapons, based on recent damage-risk criteria (DRC) and modern HPDs, is not an easy task. Impulse noise DRC are under constant scrutiny as researchers and policymakers search for better solutions to prevent NIHL. In addition, although knowledge of HPD effectiveness for impulse noise has improved, thanks to acoustic test fixtures (ATFs) and an American National Standards Institute/Acoustical Society of America standard (ANSI/ASA S12.42:2010),[12] HPDs are not currently labeled for impulse noise protection. This makes it difficult for users to select an appropriate device.

In recent years, a Noise Health Hazard Working Group (NHHWG) was initiated by the Department of National Defence with the goal of producing a framework for acoustic safety specifically for weapon noise. The aim of this article is to provide a way forward in defining an impulse noise safety standard for the CAF. It focuses on the following topics: weapon and blast noise measurement, management of impulse noise exposure, and personal hearing protection.

WEAPON AND BLAST NOISE MEASUREMENT

Dosimetry

There is currently no Canadian standard for measuring impulse noise from weapons. The Canadian Standards Association (CSA) Standard Z107.56 for measurement of noise exposure excludes high-energy impulse noise from its scope.[13] Therefore, measurement of weapon noise cannot be achieved through conventional noise exposure surveys in which noise dosimeters or basic sound-level meters are used. A previous study of live-fire noise at an indoor range showed that, compared with recordings from high-amplitude microphones, the noise dosimeters clipped impulses that were above the instrument ranges (146 or 151 dB) and even showed erroneous results for impulses that were within the range.[14] Generally, dosimeter microphones and circuitry are not designed to handle the rise time and amplitude of weapon noise.[15] With advances in technology, significant progress has been made toward producing noise dosimeters that can handle impulse and complex noises.[16,17] However, there are no widely accepted dose–response relationships for impulse noise.

Weapon noise

Methods for measuring an impulse noise source are given in ANSI/ASA S12.7,[18] which, although reaffirmed in 2015, has not changed since 1986. The minimum requirements for instrumentation are defined, but guidance for positioning microphones for specific noise sources, such as firearms, is not provided. International Test Operations Procedure (ITOP) 4-2-822 is much more comprehensive, providing specific requirements for measuring the overpressure from firearms and explosive blasts.[19] An International Organization for Standardization (ISO) standard (ISO 17201-1:2018) provides methods for measuring the muzzle blast, but only at a distance for which the peak pressure is less than 154 decibels and for calibres of less than 20 millimetres and TNT equivalent of less than 50 grams.[20] These limitations exclude many classes of military weapons.

None of these standards address the measurement of noise exposure at the ear of the operator, let alone in realistic training environments. This is where interaction with subject matter experts, such as military shooting instructors, is particularly important. Aside from the noise signature of a weapon, many factors can affect personal noise exposure (Table 1). Training environments range from open fields with few reflective surfaces, to indoor shooting ranges, and to mobile platforms such as armoured vehicles, aircraft, and sea vessels. Extreme weather and temperatures, either cold or hot, affect noise propagation. Personal noise exposure is increased in the presence of vehicles, other shooters, and radio communications fed directly to the ear. Although not exhaustive, the factors listed in Table 1 are crucial pieces of

Table 1. Information required to assess noise exposure from a weapon.

Weapon-specific training requirements	Environment	Head-worn PPE	Other noise sources
No. of rounds	Outdoor or indoor range	Ballistic eyewear	Adjacent shooters
Type of ammunition and charge weight	Terrain	Helmet	Land vehicle interior and exterior noise
Use of suppressors	Enclosure (partial or full)	Communication headset or tactical radio	Aircraft interior and exterior noise
Use of muzzle brakes	Climate and temperature	Night vision eyewear	Ship noise
Single round or bursts	Daytime or nighttime	Earmuff or earplug	Communication headset or tactical radio
Position of shooter (standing or prone)	Mounted on vehicle, aircraft, or ship	Mask (respiratory, balaclava)	
Head orientation of shooter (grazing vs. normal noise incidence)			
Position of other operators (spotter, loader, etc.)			

information for ensuring that operationally appropriate advice is provided for realistic noise assessments.

Explosive blast

Although it is feasible to set up impulse noise measurements on a shooting range when the positions and movements of the operators are predictable, it is much more difficult to conduct such measurements during other types of training. During tactical breaching, operators use different methods to gain entry to closed structures, including through the use of controlled explosive charges and ballistics. Breaching is conducted on external structures and inside buildings – conditions that cause varying blast wave propagation patterns and exposures at operator positions. Body-worn sensors have been developed to record blast overpressure time signals and provide visual feedback when a user-defined peak overpressure is exceeded. These devices have been used to track blast exposure among military operators, largely to gain insight into blast-induced traumatic brain injury.[8,10,11] However, blast gauges are not dosimeters, and with respect to impulse noise, there are no widely accepted dose–response relationships between blast exposure and hearing or brain injury. Blast peak overpressure limits are typically 3 to 4 pounds per square inch, based on a risk threshold for eardrum rupture.[8,10]

MANAGEMENT OF IMPULSE NOISE EXPOSURE

Engineering controls

Following the principles of hearing conservation, the first preference is to use engineering controls to reduce noise at the source. Weapons are primarily designed for effectiveness and accuracy, which often come at the cost of high noise levels and recoil. Muzzle brakes used to reduce recoil impact on the shooter sometimes increase the noise level.[21] The North Atlantic Treaty Organization (NATO) standard for measuring the reduction of noise from suppressors is focused on the performance of the suppressor and does not address the noise exposure of the shooter.[22] Previous measurements of CAF rifles showed reductions of 22–32 decibels near the shooter's ear.[9] Figure 1 shows a sample time signal of a single shot from a 7.62-millimetre rifle measured about 50 centimetres from the ear, with and without a suppressor. A comprehensive trial using nine different suppressors, muzzle brakes, different barrel lengths, and different ammunition on AR-15 rifles found reductions of 7–32 decibels near the ear.[23] Although the suppressors were deemed to be effective, the authors cautioned against the use of short-barrelled rifles with muzzle brakes because this configuration produced the highest peak noise levels at the ear. Another study found the suppressors reduced the peak pressure levels by 17–26 decibels at the ear, although the authors emphasized that reduction of the equivalent energy is more relevant to hearing hazard.[24]

It is important to note that although suppressors can reduce the amplitude of the muzzle blast, there is no way to reduce the shockwave, or N-wave, that occurs in the case of supersonic ammunition (Figure 2). In certain training scenarios, military operators could be exposed to the N-wave from passing bullet trajectories, which would increase their auditory risk.[25] Because different
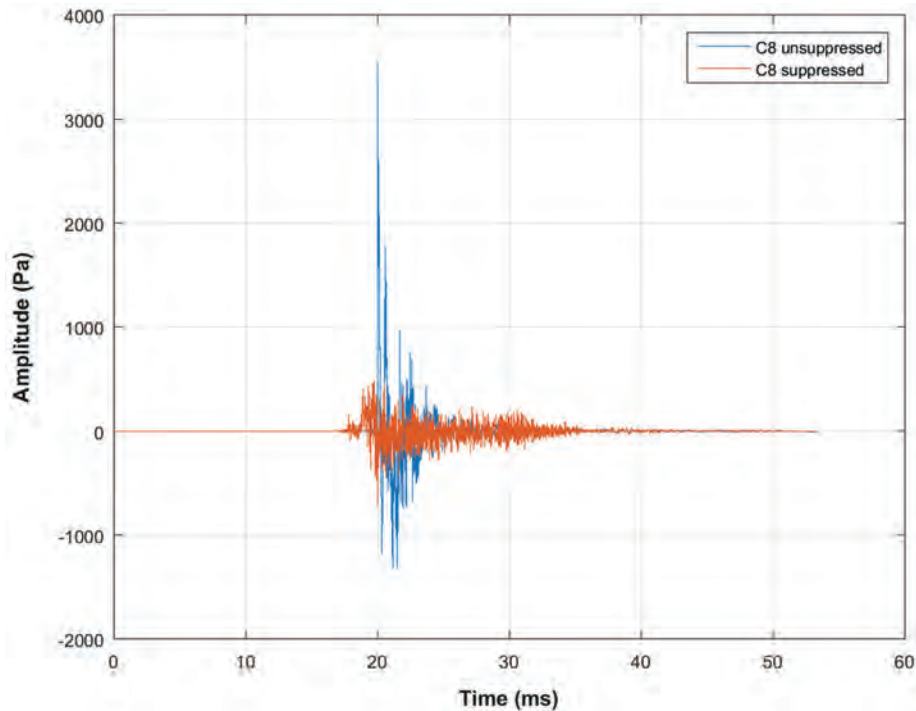
Figure 1. Sample unsuppressed (blue) and suppressed (orange) muzzle blast signal from a 7.62-mm rifle, measured about 50 cm from the ear
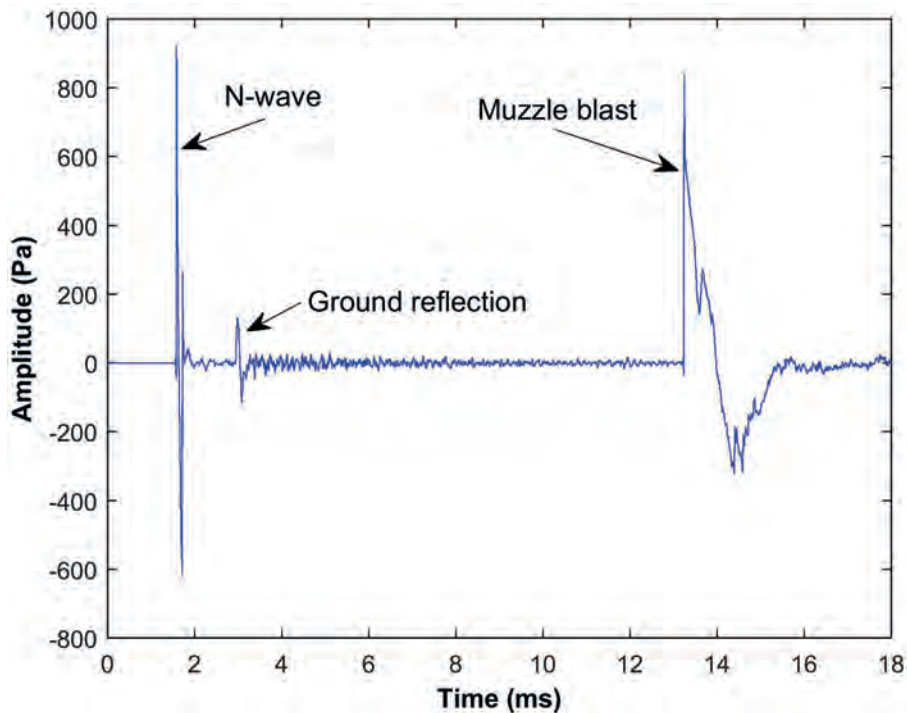

Figure 2. Sample pressure–time signal (left) of a rifle noise source at a distance of 10 m measured in front of the barrel[26]

weapon configurations and ammunition change the noise signature of a weapon, it is important to consider all configurations that the CAF are using in training and in theatre.

Administrative controls

Administrative controls are measures taken by the employer to limit the duration and level of hazards to personnel. Shooters cannot gain distance from their

weapons, and for explosive breaching, moving farther away from the breaching site comes at the tactical cost of increasing the time to advance to the target. Considering these constraints, administrative controls in the military are often in the form of limits on the number of exposures per day. In the CAF, these limits are integrated into training protocols for weapons training and tactical breaching. However, a previous analysis of an internal training safety document found that the maximum daily exposure for weapons firing was calculated using an older metric based on the peak level and duration of the impulse.[9,27,28] HPDs were generically accounted for with 20- and 30-decibel reductions in the peak level for earmuffs and earplugs, respectively, and the list of weapons is incomplete. An update of the training safety document requires knowledge of current impulse noise DRC, hearing protection technologies, and noise data from current in-service weapons, as discussed in the previous section.

The history of impulse noise DRC have been thoroughly reviewed elsewhere.[9,29–31] Past DRCs were largely based on acceptable levels of hearing temporary threshold shift (TTS) and their recovery after exposure to an impulsive sound. The first known DRC proposed by the Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) was based on impulse duration (A- or B-duration) and peak level.[27,28] The A-duration is based on the ideal Friedlander wave for free-field explosions and corresponds to the time interval between the onset of the impulse and its first and only crossing with the baseline. The B-duration is the time interval in which the envelope of the impulse exceeds a level of 20 decibels below the peak level.[29]

An energy-based metric using sound exposure level (SEL) was recommended in 2003.[29] The SEL is the level of constant sound lasting for 1 second that would equate to the same amount of energy as the impulse. The recommended critical exposure levels are as follows:

- 116 A-weighted decibel SEL per impulse for rifles and small-calibre weapons with A-durations in the range of 0.2–0.3 milliseconds, for the unprotected ear, measured in the free-field near the ear, for up to 50 impulses at a rate of one impulse per 5–10 seconds
- 135 A-weighted decibel SEL per impulse for blast and large-calibre weapons with A-durations in the range of 0.9–2.0 milliseconds, measured in-ear under the HPD, for up to 100 impulses at a rate of about one per minute.

The NATO metric is different from the CHABA approach because it is based on energy (SEL) rather than peak level. The use of two categories, rifles and blast, maintains the concept from CHABA that different criteria should be used for short and long impulses.

Another energy-based metric, the LAeq8hr, uses an 8-hour integration time (typical of a civilian working day) to calculate the exposure. The LAeq8hr is used in France,[32] and it was recommended by the American Institute of Biological Sciences as an interim metric for impulse noise.[30] In 2015, U.S. Military Standard MIL-STD 1474E presented two methods determining the damage risk for impulse noise: the auditory hazard assessment algorithm for humans (AHAAH) and a variation of the LAeq8hr, the LIAeq100ms.[33] Some experts have questioned the validity of the AHAAH model.[29,30,35] A special feature of the AHAAH is the inclusion of the acoustic reflex as a protective mechanism. It has been shown that the acoustic reflex is not pervasive enough in the general population to justify its use in a model.[35] Moreover, use of the AHAAH software requires an appropriate level of expertise.[9,31] The LIAeq100ms is the equal energy equivalent measured over 100-millisecond intervals, with a correction for long-duration impulses. However, MIL-STD 1474E states that, although it is based on the LAeq8hr, it has not yet been systematically evaluated or peer reviewed.[33]

Several other DRC models have been proposed, for example, the AHAAH with an integrated cochlear energy model,[36] an empirical model using chinchilla TTS data,[37] and numerical models that have been well summarized by De Paolis et al.[38] Recently, a comparison of six different DRCs using impulses recorded from 49 different civilian firearms indicated a reasonably high correlation between DRCs and good predictability of the outcomes of one DRC based on another DRC; however, the different DRCs yield vastly different limits in terms of allowed number of exposures.[39] In other words, the values from one DRC can be transformed to another set of DRC values, but the criterion limits are not compatible.

It is worth mentioning kurtosis, which is a statistical parameter that relates to tails of a probability distribution. In the context of noise measurement, the kurtosis statistic would be sensitive to infrequent but high-level impulses. Kurtosis has been successfully applied in the calculation of cumulative noise exposure for impact noise in factories.[40] Although kurtosis is likely less useful for the evaluation of individual blasts and gunfire, it

should be considered for complex noise, such as intermittent weapons fire superimposed on helicopter noise.

PERSONAL HEARING PROTECTION

Measuring the insertion loss

HPDs are considered to be the last resort for hearing conservation after engineering and administrative controls have been exhausted. Although HPDs are used as the primary method of noise reduction in the military, their proper selection and use is not obvious, especially because they are not typically labelled for impulse noise protection. Impulse noise insertion loss (IL) has long been measured at the French-German Research Institute of Saint-Louis, where an ATF was specifically developed for this purpose.[41,42] It is the decibel subtraction of the sound pressure level measured at the ear microphone of the ATF before and after the HPD is installed. In 2010, a standard was published for measuring the impulse peak insertion loss (IPIL) of HPDs and specifications for the ATF.[12] Since then, several authors have used this method not only to measure the IPIL of various types of HPDs but also to compare differences between ATFs.[43–47]

If the effective IL (in A-weighted decibels) is known for a given HPD, it can be used in the calculation of the allowed number of exposures (ANE) or number of rounds fired from a given weapon, as

$$ANE = 10^{\frac{LAeq8hrMAX - (LAeq8hr - IL)}{10}} \qquad (1)$$

where $LAeq8hrMAX$ is usually 85 or 87 A-weighted decibels, depending on the country or jurisdiction, and the $LAeq8hr$ is calculated from a single shot of the weapon.[48] Giguere and Laroche previously recommended a similar approach,[5]

$$ANE = 10^{\frac{LAeq8hrMAX - (SEL - 10log10(T_{8hr}) - IL)}{10}} \qquad (2)$$

where T_{8hr} is the conversion factor between SEL (T = 1 s) and 8-hour exposure (28,800 s). The advantage of this formulation is that the two NATO SEL limits for rifles and blasts can be considered.[29] Note that Equations 1 and 2 strictly apply to energy-based IL metrics, and it would be incorrect to use the IPIL directly because it is a peak, unweighted IL rather than an energy-based, A-weighted IL. A previous report used the IPIL as the IL term in Equation 1, but only after it had been de-rated to account for overestimation by the ATF

and the A-weighting.[9] Another difficulty with Equations 1 and 2 is how to account for the bone conduction pathway. Previous measurements have confirmed that using an ATF leads to overestimation of the IL because ATFs cannot compensate for bone conduction.[43–47]

Zagadou et al.[34] introduced the LAeq8hr equivalent unprotected free field (EUFF) noise exposure, adapted here for a single impulse as

$$LAeq8hr_{EUFF} = 10log\left(\sum_{k=1}^{n}10^{\frac{L_{FF}(k)-IL(k)+F(k)}{10}}\right) - 10log_{10}(T_{8hr}), \qquad (3)$$

where the summation is over the one-third octave band intervals k, $L_{FF}(k)$ is the band sound pressure level in the free field measured over time T, $IL(k)$ is the spectral IL of the HPD, $F(k)$ is the A-weighting correction, and T_{8hr} is the conversion factor from the measurement duration T to an 8-hour exposure. A previous study demonstrated that $IL(k)$ can be calculated by decibel subtraction of the occluded ear one-third octave band spectrum from the estimated open-ear spectrum measured with an ATF.[49] The next version of ANSI/ASA S12.42 (currently under revision) is expected to provide an expanded set of methods to support the application of the complex IL to impulse noise hearing protection. Equation 3 can be further modified to account for the sound pressure level of the weapon with a muzzle brake or suppressor,[23,24] $L'_{FF}(k)$, and the bone-conduction-limited[12] IL of the HPD measured with an ATF, $IL'(k)$,[12] such as

$$LAeq8hr'_{EUFF} = 10log\left(\sum_{k=1}^{n}10^{\frac{L'_{FF}(k)-IL'(k)+F(k)}{10}}\right) - 10log_{10}(T_{8hr}). \qquad (4)$$

Then the ANE can be calculated from Equation 1, using the $LAeq8hr'_{EUFF}$ as

$$ANE' = 10^{\frac{LAeq8hrMAX - LAeq8hr'_{EUFF}}{10}}. \qquad (5)$$

Similar to Equation 1, Equation 5 can be reformulated to incorporate the SEL or other metrics, if critical limits to single exposures are also considered, such as the NATO SEL limits for short and longer A-duration impulses mentioned earlier.[29] However, there is a general lack of data on integrating single-impulse critical limits (based on SEL, peak levels, or other metrics) for

a wide range of A-durations within the DRC or computation of ANE. It is recommended that the NHHWG evaluate the DRC represented by Equation 5, including the use of different critical levels for a wide range of A-durations, for noise from CAF weapon systems.

Special considerations for use of HPDs

The most challenging aspect of successful HPD use is that success is highly dependent on the individual. The reader can refer to CSA Z94.2-14 for information on the selection, care, and use of HPDs.[50] The use of field attenuation estimation systems (FAES; ANSI/ASA S12.71) for estimating an individual's personal attenuation rating or verifying fit is recommended.[51] Although FAES measure personal attenuation rating for continuous noise, it can still be used as an educational tool for CAF operators in choosing and installing their personal hearing protection.

All sources of noise, whether impulsive or continuous, must be accounted for in the assessment of total daily noise exposure. For example, when a communication headset is used as an HPD, the sound exposure from radio traffic must be accounted for and added to that from the external noise entering the headset.[52] Preferred methods to measure the exposure from the radio signals are the Microphone In a Real Ear technique and the Manikin technique (refer to Section 7 of CSA Z107.56[13])

SUMMARY AND DISCUSSION: WAY FORWARD FOR THE IMPULSE NOISE WORKING GROUP

With regard to an HLPP, it has been stated that "valid decisions and actions regarding HLP are only possible on the basis of an accurate and up-to-date picture of noise risks in the workplace."[53(p.7)] This is difficult to achieve in a military organization, in which tactical objectives vary highly depending on training. Rather than trying to define an HLPP for the CAF, the NHHWG should focus on

- Understanding the training requirements for weapons, for example, training environments, the number of rounds needed for qualification, and requirements for stand-off distances;
- Measuring the $LAeq8hr'_{EUFF}$ (Equation 4) using CAF in-service HPDs and communication headsets for as many weapons and environments as possible, then using the data to provide general guidance for selection of HPDs by weapon and environment;
- Evaluating the preceding recommendation to use Equation 5 to calculate the allowed number of

exposures and the use of different critical levels for a range of A-durations; and

- FAES to improve operator awareness of proper HPD selection and use.

Today, TTS studies are more limited by human research ethics than in the past. A possible approach is to start with a DRC that produces the most conservative ANE, provided that the number of rounds is within routine training exposures and measuring TTS on the trainees. If no TTS is found, the DRC result could be eliminated as being too restrictive. Until such results are available, energy-based metrics are currently the most practical approach, possibly with an added restriction on the maximum single-event exposure. The calculation of the ANE using the recommended metrics, with the inclusion of current HPDs and practical knowledge of training requirements and environments, will provide the CAF with the best available knowledge for hearing conservation during weapons training.

These recommendations do not address auditory fitness for duty for service personnel, and the NHHWG should maintain awareness of new testing protocols and approaches in this field.[54] As for breaching and repeated low-level blast exposure, the literature has focused on traumatic brain injury, rather than hearing, and this issue should be addressed as a separate safety standard outside the scope of the NHHWG.

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PERSPECTIVES

Youth offending in military-connected children

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Early youth offending, including violent behaviour and delinquency, are risk factors for serious criminal behaviour and social, educational, and health problems in youth and later adulthood.[1,2] On average, a serious and persistent youth offender costs society between US$1,000,000 and US$5,000,000.[1] Thus, youth offending presents a serious problem for not only the child themselves, but also for parents, peers, victims, and the wider community.[3]

Several risks and protective factors for youth offending have been identified in civilian children, yet little is known about the factors associated with offending in military-connected youth. Though most military-connected children appear to be functioning well, these youths are exposed to a unique constellation of stressors, such as extended separation from their parent(s), frequent relocations, and parental physical or psychological injuries.[4] Military families also tend to possess particular strengths that may protect against the risk of offending, including relatively stable income and access to quality schools. As there is evidence supporting both increased risk factors and increased protective factors, the actual risk of offending among military-connected children is currently unknown. This article will explore these risk and protective factors to illustrate the need for further research into this topic.

Using an ecological framework, we explore individual, familial, and community factors associated with offending in civilian children; we will also discuss how these factors may relate to military-connected children.[5,6] Further, risk and protective factors may vary by region, and the degree to which research in one context applies more broadly is unclear. Therefore, similarities and differences in risk profiles between the United States and the United Kingdom will be highlighted, as the majority of large-scale research investigating youth offending, as well as research with military families, has been conducted in these contexts.[2,7] It is important to stress that individual, familial, and community factors do not occur in isolation, and many of the risk and protective factors described are interrelated.[5,6] Moreover, the risk/protective factors described in the present article are not an exhaustive list, which would be beyond the scope of this review. The present examination of youth offending in military-connected children is especially timely, as recent reviews of Youth Justice Services in England and Wales,[8] Australia,[9] and the U.S.[10] have not directly considered youth offending of children in military families, and the potential support needs of this population.

INDIVIDUAL FACTORS

Many children who become serious offenders have a history of aggressive and disruptive behaviours in childhood.[1] Military-connected children, particularly those with a deployed parent, report significantly more school-based physical fighting, gang membership and weapons carrying than civilian children.[11,12] Access to weapons is also a risk factor for delinquency in civilians, and military-connected youth may have increased access to weapons, as military personnel are more likely to have a firearm at home.[13] Furthermore, longitudinal studies highlight the link between bullying in childhood and adult criminality.[1,14] This may add to military-connected youth's risk of juvenile offending, as these children report experiencing higher levels of peer victimization when compared to their civilian counterparts.[11,12]

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An increased rate of mental health difficulties in youth offenders have been found, with prospective studies pointing to childhood psychopathology (e.g., substance use, conduct disorders) as a predictor of youth offending.[1] Though the evidence is not conclusive, this may apply to military-connected children as, especially in cases of parental deployment, some studies report higher rates of suicidal ideation, substance abuse, and depressive symptoms, as compared to civilian children.[11,15,16] The prevalence of other mental health disorders that are particularly strongly linked with offending, such as conduct disorder,[1] remain underexplored in military-connected youth.

FAMILY FACTORS

Although most families cope well, the deployment of a parent can cause parent-child attachment difficulties and increase the risk of child maltreatment in some military families.[17] For example, Rentz et al.[18] found that the rate of child maltreatment in military families rose substantially as the number of active duty personnel departing to, and returning from, operation-related deployments increased. Multiple and prolonged deployments have also been linked to increased anxiety and depression in the spouses of service personnel[19] and deployment may reduce the non-deployed parent's availability to monitor children due to increased household responsibilities.[20]

In civilian families, poor parent-child relationships, lack of parental monitoring, maternal depression and child maltreatment are risk factors for youth psychopathology and criminal behaviour.[1] These risk factors may possible apply to youth in military families.[21] Moreover, U.S. military-connected parents often have children at a younger age as compared to civilians. There are large numbers of single parents in the U.S. Armed Forces,[17] both of which may impact parenting behaviour and are risk factors for youth offending in civilian samples.[1] It is unclear whether this risk factor may be applicable to youth in the United Kingdom, as the demographics of UK military families have received limited research attention.

COMMUNITY FACTORS

Community risk factors that have been identified for youth offending among civilians include neighbourhood and familial poverty and higher crime rates.[1] Such community factors are related to the environment in which children are raised. While not all military families will reside on a military base, particularly in the UK, communities on and around military bases generally have low rates of unemployment and, arguably, more disposable income than many civilian neighbourhoods, which may be protective. Furthermore, military-connected families are often able to access quality services, including schools, child care and health care, which may also be protective.[22] However, military-connected youth may lack a support network in their schools or wider civilian communities that understands their military experience.[23] This may contribute to social isolation in military-connected youth and increases their vulnerability to youth offending. Moreover, when a service member leaves the military, their children may experience several transitional stressors, including changes to peer support networks due to moving schools and/or home, unstable family income, and the renegotiation of family roles.[20,24] Although many Veteran-connected families cope well with this transition from military to civilian life, the impact of such factors on children in relation to youth offending has yet to be explored.

DIRECTIONS FOR FUTURE RESEARCH

The evidence reviewed suggests that the association between military connectedness and youth offending may not be clear-cut. Given the known adverse impact of youth offending in civilian populations, epidemiological research is needed to determine rates of offending in military-connected children, compared to their civilian counterparts, and the factors associated with youth offending. As differences in the nature of military service and its impact on personnel and their families' well-being vary by context (e.g., U.S., UK, Canada), an investigation of nation-specific risk factors for youth offending in military families may be required. Longitudinal studies would help determine how risk and protective factors influence offending behaviour over time.

CLINICAL IMPLICATIONS

The importance of delinquency prevention efforts early in child development has been highlighted in previous studies;[1,3] however, in military families, the period prior to parental deployment could be a critical window for formal support, given the possible adverse effects of deployment on family dynamics and child coping found in previous studies.[12] Interventions for positive adjustment in military families following parental deployment could be supplemented by pre-deployment

support targeting the risk factors for youth offending (e.g., poor parental supervision). Similarly, there is a dearth of evidence for the impact of transitioning out of the military for Veteran-connected families on youth offending, and additional guidance focused on supporting child adjustment and addressing potentially salient risk factors for youth offending (e.g., loss of peer support) may be beneficial. Currently, the efficacy of many programs and interventions to address youth offending in the general population has yet to be established.[3]

Youth offending continues to be a pressing societal concern. Many factors associated with offending in civilian children may also apply to military-connected youth; however, specific investigation into whether military-connected youth are particularly at risk of offending is needed.

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