Health, Well-being, and Readiness Across the Services: A Review of the Current Literature

Prepared by:
Health Promotion and Wellness Directorate,
Health Promotion Metrics and Evaluation Division

December 2025

Authors, Defense Centers for Public Health–Aberdeen (DCPH-A)
(Contributors are listed by team in alphabetical order.)

Health Promotion Metrics and Evaluation (HPME) Division, Health Promotion and Wellness (HPW) Directorate

Writing Team:
Meghan Haffey, DrPH, MPH
Nicole Mayo, PhD
Michelle Paggi, PhD
Genevieve Smith, PhD, MS
Christina Via, MPH
Tiara Wilson, PhD

Literature Extraction and Database Development Team:
Richard Barton, DSW
Abimbola Daferiogho, MPH
Meghan Haffey, DrPH, MPH
LTC Julianna Jayne, PhD, RDN, LD, CHES
Nicole Mayo, PhD
Ijeoma Mordi, MPH
Ivy Mushimiri, PhD
Michelle Paggi, PhD
Genevieve Smith, PhD, MS
Christina Via, MPH
Deanna Williams, PhD
Tiara Wilson, PhD

ACKNOWLEDGMENTS

The authors would like to extend their thanks to our colleagues from the Defense Health Agency (DHA) Defense Centers for Public Health (DCPH); DHA Medical Affairs; the U.S. Air Force, U.S. Army, and U.S. Navy; and the Uniformed Services University Consortium for Health and Military Performance, including Dr. Jennifer Bell (DHA Medical Affairs), LTC Melissa Boyd (DCPH), Dr. Caitlin Cornelius (OUSD(P&R)), Capt Leigh Durden (DCPH-D), Mr. Drew Hammond (U.S. Army-H2F), Ms. Loraine Heckenberg (Military Community and Family Policy), Col. Scott Irwin (USAF, Dental Research and Consultation Service), Ms. Karen Jones (DCPH-P), Ms. Jennifer Meeks (DCPH-A), Dr. Gloria Park and team (USU-CHAMP), Dr. Anthony Scroggins (Office of the Chief of Chaplains), and Dr. Megan Springate (OUSD(P&R)) for their careful and insightful review of this document. Additionally, the authors wish to extend thanks to the DCPH-A Health Promotion and Wellness (HPW) Directorate, Health Promotion Metrics and Evaluation (HPME) Internal Scientific Review team, of which two members, Ms. Claudia Geary and Dr. Stephanie Meier, provided review of and input to this document. Finally, the authors would like to give special thanks to Ms. Lauren Shirey (HPME Chief, DCPH-A) Dr. Stephanie Gomez (Acting HPME Chief (former), DCPH-A), Ms. Carrie Kilby (Health Promotion and Competency Development (CONCOMDEV) Chief (former), DCPH-A), LTC Julianna Jayne (HPW Director, DCPH-A), Ms. Laura Mitvalsky (HPW Director (former), DCPH-A), and Dr. Theresa Santo (OCCWI, OUSD(P&R)) for their thoughtful leadership and support of this project.

DISCLAIMER

The views expressed in this presentation are those of the authors and do not necessarily reflect the official policy of the Department of Defense, Defense Health Agency, or the U.S. Government. The mention of any non-federal entity and/or its products is for informational purposes only, and is not to be construed, implied, or interpreted, in any manner, as federal endorsement of that non-federal entity or its products.

Contents

Executive Summary

Narrative Review Purpose and Scope

Given the complexity of Service member and military community readiness, health, and well-being, achieving holistic health and well-being requires that leaders, health promotion and integrated primary prevention advocates, and policymakers develop strategies to address modifiable fitness, health, and well-being behaviors, practices, and beliefs that have been demonstrated to support Force protection. There is a need for a multifaceted and holistic approach to military readiness that addresses physical, environmental, financial, medical and dental, nutritional, psychological, social, and spiritual health needs of both the Force at large as well as individual Service members and the communities that support them. This literature review was developed through the lens of health and fitness as an eight-domain framework, as described in the Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3405.01, *Chairman's Total Force Fitness Framework,* and highlights the interrelatedness of these eight domains, wherein health, fitness, and well-being specific to an individual domain can impact these attributes within the other domains. Moreover, while military branches may differ in culture as well as occupational demands and risks, most of the factors aligned with with these domains are universal, with evidence to support their vital nature in both military and civilian populations.

Thus, this narrative review was developed with the following primary objectives:

1. Provide a comprehensive synthesis of the available scientific, peer-reviewed literature demonstrating relationships of health and fitness-related behaviors, practices, and beliefs with military-relevant outcomes, including readiness, health, and well-being, at both the individual Service member and military community levels.

2. Demonstrate relationships among the eight domains of holistic health and fitness and discuss how these intersections influence military-relevant outcomes, including readiness, health, and well-being, at both the individual Service member and military community levels.

3. Provide a foundational document that may serve as a resource for the identification of future public health program, policy, and research priorities.

Gaps Filled by this Narrative Review

This narrative review was developed to serve as a foundational resource in response to the need for a better understanding of current literature regarding military-relevant outcomes addressed by the eight health and fitness domains. Although these eight domains have been identified as important contributors to a fit and ready fighting military force, previous reviews and summaries of evidence supporting the application of such multi-dimensional frameworks of health have focused predominantly on the contribution of one or two domains to outcomes

of interest. To date, there has not been a comprehensive synthesis of the current scientific, peer-reviewed evidence demonstrating association of *eight* dimensions of health and fitness-related with both military-relevant outcomes and each other. Thus, this narrative review aims to summarize and synthesize the empirical evidence examining associations of various health and fitness-aligned behaviors, practices, and beliefs, and interactions among them, with military-relevant outcomes.

Limitations to the Narrative Review

This is not a systematic review; therefore, no meta-analysis or evaluation of the strength of the evidence was performed. The synthesis of the available literature may include potentially conflicting evidence, as well as instances where evidence suggests pro-health behaviors, practices, and beliefs may have no influence on or be detrimental to military-relevant outcomes. Evidence presented in this literature review is the result of studies that may vary in terms of rigor (e.g., volunteer sampling approach, study design, analytical approach), which may impact generalizability. According to the *2022 Demographics Profile of the Military Community*, 19.1% of the total DoD Military Force and 17.5% of the active-duty Military Force were female, and the distribution of male and female Service members may vary by Service (DoD 2022c). Given the demographic make-up of the U.S. Military, volunteer enrollment of study samples that mirror the demographics of the Force in original research studies is often challenging. Therefore, the findings of some studies may have limited generalizability to military populations. This narrative review, while developed and intended to be as comprehensive as possible, may have unintentionally excluded some currently available peer-reviewed literature. This document is intended to serve only as a synthesis of the current evidence, and no recommendations based on the evidence presented have been developed. Therefore, no recommendations aside from the identification of research gaps will be provided as part of this review.

How to Read this Narrative Review

The synthesized research was organized around six categories of military-relevant outcomes. These categories, included as primary sub-sections within the section titled, “The Domains of Health and Fitness and Service Member Outcomes,” are as follows:

1. Cognitive Performance
2. Behavioral Health
3. Physical Performance
4. Physical Health
5. Recruitment and Retention
6. Community and Family Readiness

These six categories are further divided into secondary sub-sections representing the domains of health and fitness for which empirical evidence was identified. It is at this level that relationships between domain-specific factors and individual outcomes of interest are summarized and synthesized. Each primary sub-section ends with a table or brief narrative demonstrating interactions of the domains and how these interactions contribute to the category of military-relevant outcomes. A summary of identified evidence gaps, which may be helpful for determining topic areas for future investigation, is also included. This narrative review was designed to be read either in its entirety or by section or sub-section of interest (e.g., impact of psychological health and fitness on physical performance).

Who May Find this Narrative Review Useful

The audience for this narrative review consists primarily of public health, health promotion, and integrated primary prevention personnel, researchers, and policymakers/proponents. The findings synthesized in this narrative review may serve as a useful tool for these audiences to better understand how health and fitness-related behaviors, practices, and beliefs may influence Service member outcomes. The information contained here may be employed as a reference for the development of public health policies and health promotion activities and programs; the development of logic models to explain the connections between health and fitness-related behaviors, beliefs, and military relevant outcomes; the assessment or evaluation of health promotion activities and programs; the development of research proposals aiming to address knowledge gaps to further military readiness; the identification of appropriate metrics and development of measurement frameworks across the domains of health and fitness; and the development of content designed to communicate the importance of readiness, health, and well-being-related behaviors, practices, and beliefs to a wider military audience. This narrative review may also serve as a resource for follow-on projects designed to carefully and systematically analyze and evaluate the strength of evidence pertaining to relationships between specific health and fitness-related behaviors, practices, and beliefs and individual outcomes of military relevance.

What this Narrative Review Captures, and Key Takeaways

The evidence synthesized in this narrative review represents more than 900 original studies and systematic reviews that detail more than 50 individual outcomes across the eight domains of health and fitness. The amount of empirical evidence synthesized within each domain reflects the available science and may indicate potential research biases toward some domains over others rather than inclusion preference by the authors of the review.

A substantial body of evidence, some of which is listed below, suggests that various health and fitness-related behaviors, practices, and beliefs influence military-relevant outcomes.

- Multiple studies provide evidence that, despite the universal availability of both dental and medical preventive care in the U.S. Military, barriers to Service member medical and dental preventive health remain, including Service member access to care;

knowledge and accurate understanding of risks and benefits of some medical preventive procedures, such as screenings and immunization; social and personal stigmas; misinformation; healthcare provider training and knowledge; and continuity of care.

- Healthy nutrition behaviors appear to cluster, e.g., regular breakfast eating practiced in conjunction with healthier dietary patterns.

- Multiple studies suggest that, to improve and even optimize all aspects of physical fitness, Service members should participate in physical activities and training that span a variety of modalities, to include aerobic, strength, power, and agility training. Evidence also suggests that training specific to occupational tasks may support or improve occupational task performance.

- Evidence suggests that social support, including unit cohesion and morale, may mitigate the relationship among exposures such as traumatic experiences, injuries, or moral injury and adverse outcomes, including posttraumatic stress disorder (PTSD), experience of adverse somatic symptoms, and sleep disturbances.

In many instances, the behaviors, practices, and beliefs within one domain may have meaningful impacts on those within another domain. Some examples of these interrelationships follow.

- In addition to clustering with one another, healthy nutrition behaviors may also influence the practice of other healthy behaviors across the domains of health and fitness, including increased physical activity, following sleep duration recommendations, and practicing healthy dental hygiene behaviors such as toothbrushing and yearly dental check-ups.

- Psychological constructs such as resilience and mental toughness may be important for successful completion of physical tasks such as rigorous military training and occupational tasks.

- Evidence suggests that spiritual health may be a key factor for psychological resilience, acting as a protective factor for the prevention of both physical and psychological burnout and emotional exhaustion among Service members, and this effect may be further supported by higher degrees of social health.

- Financial health may serve as one important leverage point in suicide prevention for both Service members and veterans.

- There is considerable evidence that exposure to environmental factors such as extreme heat, humidity, and cold may adversely influence a wide variety of Service member outcomes, including cognition and cognitive performance; behavioral health,

particularly sleep, mood, and risk for depression symptoms; physical and occupational performance; and physical health and well-being.

Table 1 provides additional examples of the linkages among health and fitness-aligned behaviors, practices, and beliefs and military-relevant outcomes that will be discussed in this review.

These relationships support the concept of health and fitness as a series of interconnected factors that work synergystically to influence Service member readiness, health, and well-being. While considerable and growing evidence already suggests that Service members' practice of healthy behaviors across all eight domains of health and fitness is vital to ensuring an ever-ready Force, gaps specific to the military research literature will need to be addressed through future studies. These gaps include understanding how health and fitness-related behaviors, practices, and beliefs across multiple domains may synergistically influence military-relevant outcomes; how wearable technologies aligned with one or more health and/or fitness-related metrics may be developed and leveraged to improve Service member health, performance, and readiness; and a more robust, scientifically supported (i.e., less anecdotally-based) understanding of how the unique military culture and environment may influence the practice of healthy behaviors, practices, and beliefs. As these gaps are addressed, it will be important for military science professionals and health promotion, integrated primary prevention, and public health personnel to maintain a finger on the pulse of this growing evidence base so new findings and conclusions may be applied across programs and policies designed to support and improve the readiness, health, and well-being of Service members across all U.S. Military Services.

Table 1. Health and Fitness Domain Relationships with Military-relevant Outcomes		
Domain	**Factor**	**Relationship**
Environmental Health	Extreme climates	● Adverse influences on cognitive performance. ● Adverse impacts on sleep, mood, and mental health. ● Adverse impacts on physical and occupational performance. ● Adverse impacts on physical health. ● Proper acclimation may mitigate some impacts on performance, mood, and physical health.
	High altitude and hypoxia	● Similar adverse impacts as extreme climate exposure, but via different mechanisms. ● Proper acclimatization, when possible, may mitigate some adverse impacts of high altitude exposure.
	Air quality, continuous noise, toxic exposures, dangerous flora and fauna, disease vectors	● May have detrimental impacts on readiness, physical and mental health, and well-being. ● Generally, cannot be overcome by acclimatization and require different mitigation strategies.
	Domain interaction	● Environmental health interacts with multiple domains, including Psychological, Nutritional, and Physical health; environmental impacts on Service member readiness may be exacerbated by concurrent exposures (e.g., sleep deprivation, inadequate nutrition, low physical fitness).
Financial Health	Financial stability	● Important leverage point for suicide prevention. ● Financial stability and security support Service member retention and military family satisfaction.

	Financial health prior to transition out of military	• Key indicator of military-to-civilian transition success.
	Domain interaction	• Financial health may influence nutritional health by addressing food insecurity and increasing access to high-quality, nutrient-dense foods. • Better Financial health may positively impact Psychological, Social, and Medical and Dental Preventive health (e.g., mental health, substance use risk, family strain, and interaction with healthcare system).
Medical and Dental Preventive Health	Non-ready classification; issuance of medical/dental waivers for deployment	• Increases risk for in-theater medical evacuation, adverse personnel safety and mission impacts, and costs.
	Medical provider and Service member knowledge and training	• Better medical training of providers removes barriers that may improve healthcare access. • Education of Service members can eliminate healthcare-related stigmas and misinformation about medical procedures such as immunization and screenings, improving medical and dental outcomes. • Better training can improve the availability and level of care provided to Servicewomen, who have unique healthcare needs.
	Access to care	• Improves Service member readiness and deployability. • Access to timely care can improve recovery prognosis. • Access to even basic medical treatment, such as treatment for severe acne, can have beneficial psychological impacts.
	Tobacco use	• Significantly degrades fitness across all eight health and fitness domains. • Increases risk of musculoskeletal injury, failure to recover from injuries and/or surgical procedures, and attrition.

		● Evidence supports effectiveness of intensive campaigns and efforts to support tobacco cessation and uptake prevention, but there are still challenges to preventing tobacco use specific to military populations.
	Immunizations	● Decreases Service member morbidity, reducing lost training and work time and adverse mission impacts. ● Protects both military Service members and the civilian communities in which they live, work, and are deployed.
	Primary and secondary preventive screening	● Increases Service member health and readiness and may improve military retention.
	Domain interaction	● Medical and Dental Preventive health influence spans the remaining seven domains; reciprocity in many of these relationships is evident in the literature (e.g., components of social health may influence uptake of medical preventive services such as preventive screenings or immunizations).
Nutritional health	Dietary patterns	● Healthy dietary patterns (e.g., consuming adequate amounts and quality of protein, carbohydrates, and fats; recommended intakes of fruits and vegetables) support not only physical health and well-being but also cognitive, physical, and occupational performance. ● Consumption of foods rich in micronutrients (i.e., vitamins and minerals) is a protective factor against musculoskeletal injury. ● Unhealthy dietary patterns degrade Service member readiness by adversely impacting body composition, chronic disease risk, and injury risk.
	Eating behaviors	● Influence physical performance. ● Cluster together; cluster with other healthy behaviors across domains of health and fitness (e.g., sleep, physical activity, and dental preventive health).
	Food availability and access	● High nutrition standards at military dining facilities can positively influence Service member diet quality.

		● Poor dietary patterns may be associated with perceptions of limited access to high quality foods; improving access to high quality foods can encourage adoption of healthier dietary patterns. ● Making the "healthy choice the easy choice" by reducing access to low-quality foods (e.g., fast food restaurants) and increasing healthy dining options can encourage healthy eating.
	Domain Interaction	● Nutritional health can influence Physical health, as unhealthy behaviors such as skipping breakfast may decrease physical activity levels and be associated with lower cardiorespiratory fitness, while better overall diet quality may improve physical and occupational performance. ● Nutritional health may improve Psychological health by decreasing symptoms associated with poor mental health. ● Nutritional health can influence Medical and Dental Preventive health through the effects that dietary quality may have on oral, acute, and chronic disease risks.
Physical Fitness	Cardiorespiratory fitness Muscular endurance Strength Power Agility	● Support better physical and occupational performance. ● Support healthier body composition and ability to meet military body composition standards. ● Support better ability to acclimatize to extreme environments.
	Training modalities	● Training that incorporates multiple modalities better supports occupational task performance. ● Multi-modal training supports better physical fitness outcomes. ● Training specific to occupational tasks can support or even improve task performance.

	Domain interaction	● Physical fitness can influence environmental health, as poor physical fitness can degrade the ability to acclimatize to extreme environments, increasing injury risk. ● Physical fitness may influence Psychological health through participation in physical activity and training, which can positively impact mental health; however, symptoms of mental illnesses such as depression may include decreased motivation to participate in physical activity.
Psychological Health	Positive Psychological characteristics	● Support successful completion of rigorous military training and occupational task performance.
	Mental health	● Evidence supports reciprocal relationships between mental health and health behaviors such as physical activity and building social support networks. ● Psychological health was the only domain for which there was published evidence from studies of military populations for associations with each of the outcomes examined in this literature review.
	Coping styles and behaviors	● Coping behaviors such as active problem-focused coping and positive emotion-focused coping in response to various stressors may be associated with better outcomes, including less anxiety, lower perceived stress, and fewer symptoms of depression or post-traumatic stress disorder. ● Mindfulness practice has consistently been demonstrated to positively influence cognitive performance, emotion regulation, and stress management.
	Resilience	● Service members who have greater trait resilience may perform better in stressful conditions. ● Higher levels of resilience may act as a driver for the practice of health-related behaviors.
	Substance use/misuse	● Evidence suggests strong bi-directional relationships between alcohol misuse and mental illness in Service members. ● Stress in response to a high OPTEMPO, deployment, and/or combat exposure may exacerbate prescription drug misuse, substance abuse, or heavy alcohol use in U.S. Military personnel.
	Domain interaction	● Evidence supports linkages of psychological health with all other domains of health and fitness, suggesting that psychological health is likely paramount for ensuring holistic Service member readiness, health, and well-being.

Social Health	Social connectedness and unit cohesion	● Large social networks support both the physical and mental well-being of Service members and their families. ● Social support, including unit cohesion, can buffer the negative impact of traumatic exposures and injuries with adverse outcomes, including posttraumatic stress disorder, adverse somatic symptoms, and sleep disturbances. ● Interpersonal support in the workplace can positively influence occupational performance, well-being, and motivation. ● Perceptions of military community connectedness may positively influence civilian spouses' satisfaction with military life. ● Social connectedness can mitigate the stresses of military life on military families and decrease spouse and child psychosocial symptoms.
	Leadership	● Supportive leadership styles can facilitate unit cohesion, better occupational performance, and motivation and can positively influence military retention. ● Negative leadership styles (i.e., abusive or laissez-faire styles) can degrade motivation, well-being, and occupational performance.
	Hazing and bullying behavior	● Increase risk for suicidality. ● Can degrade unit cohesion and performance.
	Domain interaction	● Social health may influence multiple domains of health and fitness, as participation in social groups (e.g., units, teams, or family units) can influence behavior in many of the other domains and may serve as significant facilitators or barriers to the practice of healthy behaviors. ● Social health may directly influence Spiritual health, as a higher degree of social health can support greater spiritual health.
Spiritual Health	Spirituality	● Has been a protective factor against harmful behaviors as spirituality and belief in a higher power can be associated with a sense of purpose and meaning in life.

		● Protective factor for prevention of physical and psychological burnout and emotional exhaustion.
	Feelings of purpose and meaning	● Serves as a protective factor for suicide prevention.
	Chaplain services	● Mental health interventions that integrate Chaplain or Unit Ministry leader services may improve mental health outcomes. ● Chaplain- or Unit Ministry leader-provided resources for spiritual health may improve Service member spirituality, resilience, family coping, marital satisfaction, and military satisfaction.
	Domain interaction	● Spiritual health may positively impact psychological health through increased resilience, which may lower symptoms associated with mental illnesses such as posttraumatic stress disorder.

Abbreviations

(listed alphabetically)

ADA	American Dental Association
ADHD	Attention-deficit/hyperactivity disorder
ADM	Admiral
AMA	American Medical Association
AMS	Acute mountain sickness
BMI	Body mass index
BMT	Basic military training
CDC	Centers for Disease Control and Prevention
CHAMP	Consortium for Health and Military Performance
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
CMI	Chronic multisymptomatic illness
CRF	Cardiorespiratory fitness
DCPH-A	Defense Centers for Public Health–Aberdeen
DHA	Defense Health Agency
DHA	Docosahexaenoic acid
DHHS	Department of Health and Human Services
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
EHI	Exertional heat illness
EHS	Exertional heat stroke

EPA	Eicosapentaenoic acid
EPA	Environmental Protection Agency
GAO	Government Accountability Office
HPD	Hearing protection device
HPV	Human papilloma virus
HQ DANAF	Headquarters, Departments of the Army, Navy, and Air Force
HRV	Heart rate variability
MCRMC	Military Compensation and Retirement Modernization Commission
MDD	Major depressive disorder
MMR	Measles, mumps, and rubella
MOS	Military occupational specialty
MSKi	Musculoskeletal injury
NCHS	National Center for Health Statistics
NFCI	Non-freezing cold injury
NHANES	National Health and Nutrition Examination Survey
PFAS	Per- and polyfluoroalkyl substances
PPE	Personal protective equipment
PTSD	Posttraumatic stress disorder
SERE	Survival, Evasion, Resistance, and Escape
STI	Sexually transmitted infection
T2DM	Type 2 diabetes mellitus
TBI	Traumatic brain injury
USPSTF	U.S. Preventive Services Task Force
USU	Uniformed Services University

VO_2 max	Maximum volume of oxygen consumption during exercise
WHO	World Health Organization
WTST	Warrior task simulation test

List of Tables

Introduction: What are the Eight Domains of Health and Fitness?

The Need for and Establishment of the Multi-Dimensional Approach to Health

Force protection to ensure Service member readiness is a key component of maintaining a ready and lethal Force and may be best accomplished through 1) expeditious remediation of illness and/or injuries when they occur; 2) early identification and treatment of sub-clinical issues before they reach clinical levels; 3) proactive approaches that prevent mental or physical health conditions before they can begin; and 4) the proactive building of competencies that contribute to optimized Service member health and performance. Historically, military health has demonstrated a more reactive approach, with interventions aimed at alleviating health, well-being, and readiness issues already present (Messina and Park 2023). This approach may not be optimal for ensuring that the Force is continually ready and able to meet mission demands. Department of Defense Directive (DoDD) 6200.04, *Force Health Protection,* mandates that all Service members should be physically and mentally fit to carry out their missions (DoDD 2004). The need to meet this requirement furnished the impetus to develop a framework designed to holistically provide a preventive, or "left of bang," approach to multiple aspects of readiness that include medical, nutritional, and physical fitness considerations, as well as the psychological, social, spiritual, and other needs of Service members (Messina and Park 2023). By implementing an approach to Force protection that is comprehensive and proactive, issues associated with non-readiness (e.g., injury, illness, and other potentially disqualifying conditions) may be prevented before they have an opportunity to develop. To this end, The *Chairman's Total Force Fitness Framework* serves as an integrative framework by which Service member readiness may be addressed through eight domains of fitness: environmental, financial, medical and dental preventive, nutritional, physical, psychological, social, and spiritual. The identification of and guidance for application of this framework are provided in the Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3405.01, *Chairman's Total Force Fitness Framework*, published in 2011. This instruction establishes the Total Force Fitness framework as a key component of the Department of Defense's (DoD) Force Health Protection Program, specifies the framework be applied across the DoD wherever Service members are assigned, and directs that it include both active and reserve components of the U.S. Army, Navy, Air Force, Marine Corps, Space Force, and the National Guard, Air Guard, and Coast Guard (CJCSI 2011).

The Total Force Fitness Framework

Department of Defense Instruction (DoDI) 1010.10, *Health Promotion and Disease Prevention,* (DoD 2014) states that Total Force Fitness is the DoD methodology for understanding, assessing, and optimizing Service members' ability to meet mission requirements in accordance with CJCSI 3405.01, *Chairman's Total Force Fitness Framework* CJCSI 3405.01 (CJCSI 2011). According to

CJCSI 3405.01, this framework "is a methodology for understanding, assessing, and maintaining the fitness of the Armed Forces" (CJCSI 2011). Thus, the Total Force Fitness framework aims to sustain Force protection and lethality by maintaining Service member health, well-being, and readiness through a holistic approach that recognizes the integral and *interrelated* contributions of the eight domains to Service member fitness. According to the Military Health System website, an important aspect of this framework of health and fitness is the recognition that addressing a single domain, or even just one or two domains, is unlikely to be sufficient to adequately address *holistic* health, readiness, and wellness (DHA 2024). Just as the various support beams of a scaffold serve to buttress one another at their points of intersection, so, too, do the individual domains of a holistic health framework serve to reinforce and even augment each other.

In addition to identifying a holistic framework for health and fitness, CJCSI 3405.01 describes five tenets that inform the interrelated functionality of the eight domains (CJCS 2011):

1. Total fitness extends beyond the Service member; total fitness should strengthen resilience in families, communities, and organizations.

2. A Service member's family's health plays a key role in sustained success and must be incorporated into any definition of total fitness.

3. Total fitness metrics must measure positive and negative outcomes and must show movement towards total fitness.

4. Total fitness is linked to the fitness of the society from which the Service members are drawn and to which they will return.

5. Leadership is essential in achieving total fitness.

These tenets provide additional context pertaining to the intention of the Total Force Fitness framework: to address fitness in a holistic fashion, which means not only addressing the domains of health and fitness for an *individual* Service member but also addressing these domains on a larger scale as a means by which to promote *Force* protection since "… a total force that has achieved total fitness is healthy, ready, and resilient, capable of meeting challenges and surviving threats" (ADM Mullen 2010).

An Introduction to The Domains of Health and Fitness

Table 2 provides an overview of the individual factors of health considered within each domain and which informed the literature review.

Table 2. Factors Commonly Used to Operationalize the Domains of Health and Fitness

Domain	Factors
Environmental Health	Air quality Built environment Elevation/Altitude Noise Thermal stress Whole-body vibration
Financial Health	Financial capability Financial literacy Financial planning Financial saving Financial stability Income variability Money and debt management skills
Medical and Dental Preventive Health	Cardiometabolic health Dental hygiene Dental preventive care Hearing loss prevention Immunization Health screening Men's health and screening

	Sexual health Tobacco use Vision loss prevention Women's health and screening
Nutritional Health	Dietary patterns Diet quality Dietary supplement use Food access Macronutrients Micronutrients
Physical Fitness	Aerobic capacity Agility Body composition Endurance Flexibility Mobility Muscular endurance Physical training modalities Strength
Psychological Health	Alcohol abuse Behavioral health practices Coping strategies Emotional regulation Mental wellness

	Mental toughness Perseverance Resilience Sleep Substance use or misuse
Social Health	Community engagement Family relationships Interpersonal relationships Leadership style and skills Social connectedness and engagement Unit cohesion
Spiritual Health	Ethics Ideology Meaning in life Moral injury Purpose Religiosity Spirituality

Environmental Health

CJCSI 3501.01 defines environmental fitness as “the ability to perform mission-specific duties in any environment” (CJCSI 2011). Other publications provide ancillary context, adding that environmental health ensures Service members can “withstand the stressors of deployment and war,” although in many cases metrics for this domain remain incompletely defined for most environments (O'Connor et al. 2010). The literature identifies numerous environmental factors reported to influence Service member performance or readiness, particularly those associated with extreme environments, including thermal stress-inducing climates and extreme altitudes. However, in addition to challenges presented by climate or the natural environment, environmental stressors may also include manmade environmental factors such as noise, air quality, and whole-body vibration (USU 2022). Furthermore, the built environment, which may include office buildings, housing, or dining facilities, may also contribute to environment-related

stress of Service members and should therefore be included in considerations of Service member health, well-being, and performance. Exposure to any of these environmental variables, whether natural or manmade, has the potential to manifest as adverse physical and psychological outcomes in unprepared Service members. Thus, environmental health may be considered as preparedness of Service members to maintain their health, well-being, performance, and, ultimately, lethality despite potentially challenging or adverse environmental conditions.

Financial Health

The inclusion of a recommendation to "promote Service members' financial literacy" in the *Report of the Military Compensation and Retirement Modernization Commission* demonstrates the DoD's recognition of the role that financial literacy and associated fitness play in Service member readiness and well-being (MCRMC 2015). Resources, such as the Human Performance Resources on the CHAMP website, define financial fitness as "the combination of attitude, knowledge, and skills to make and exercise money management decisions that best support [an individual's] life circumstances" (USU 2022). Specific examples include an individual's money and debt-management skills, ability to plan for potential emergencies and unforeseen circumstances, ability to set and meet financial goals, and recognition of the value of investment-wealth strategies (DHA 2024). Gaps in any of these areas potentially impact Service member financial readiness, which is defined in Department of Defense Instruction (DoDI) 1322.34, *Financial Readiness of Service Members,* as "The state in which successful management of personal financial responsibilities supports a Service member's ability to perform their duties" (DoD 2021). DoD's adoption of a multi-faceted, holistic approach to assessing a Service member's financial health and its impact on readiness is also informed by work of the Consumer Financial Protection Bureau, which defines financial well-being as a state of being wherein a person can fully meet current and ongoing financial obligations, can feel secure in their financial future, and is able to make choices that allow enjoyment of life (CFBP 2024).

Medical and Dental Preventive Health

According to the *Chairman's Total Force Fitness Framework*, medical and dental preventive fitness is "the ability to meet established standards for medical readiness" (CJCSI 2011). For U.S. Military Service members, these standards include being free from conditions or physical defects that would require excessive lost duty time or adversely affect performance of duties (CJCSI 2011). *United States Medical Standards for Military Service* lists these conditions or defects, to include factors such as chronic diseases and musculoskeletal or other injuries (DoD 2022a, 2022b). Military medical standards also require that Service members are up to date on dental and medical wellness exams; attend required vision, hearing, and health screenings; adhere to immunization requirements; and are free of communicable diseases (DoD 2022a, 2022b). However, medical and dental preventive health may also include Service member health *behaviors* such as tobacco-free living, daily dental hygiene practices, regular use of vision and hearing protection devices, and safe sex knowledge and practices, as well as

sociodemographic considerations such as healthcare access, social stigmas, and other barriers. Notably, many of these factors align with the U.S. Department of Health and Human Services' *Healthy People Goals, Objectives, and Evidence-based Resources* (DHHS 2024) and are specifically cited in DoDI 1010.10, *Health Promotion and Disease Prevention* (DoD 2014). This suggests these factors are important indicators for Service member health, well-being, and readiness, as well as general population health.

Nutritional Health

Nutritional fitness is defined in CJCSI 3501.01 as "the ability to recognize and select the requisite nutrition to sustain and optimize physical and cognitive performance and health" (CJCSI 2011), and as "the provision and consumption of foodstuffs in quantities quality, and proportions sufficient to preserve mission performance and to protect against disease and/or injury" in *Total Force Fitness for the 21st Century: A New Paradigm* (Montain, Carvey, and Stephens 2010). Additional resources further note that nutritional health refers to "…finding the right 'fuel' so [individuals] perform at [their] best" and add that a good diet is not only healthy but also habitual (DHA 2024). Furthermore, nutrition, along with physical activity and obesity, is cited as a leading health indicator in both *Healthy People Goals, Objectives, and Evidence-based Resources* (DHHS 2024) and *Health Promotion and Disease Prevention* (DoD 2014), suggesting that nutrition is a vital aspect of both general population and Service member health, well-being, and performance. To this end, nutritional health has been operationalized using a variety of metrics, including the consumption of macro- and micronutrients based on mission requirements, selection of nutrient-dense foods, the type and quantity of dietary supplement use, and access to high-quality foods (USU 2022). Thus, nutritional health can be thought of as *the quality of foods* Service members consume, *how much* of those foods they consume, and *how accessible, affordable, and acceptable* those foods are.

Physical Fitness

Much like nutritional health, physical fitness has been consistently included and defined in various forums and is also included as one of the leading health indicators cited in both *Healthy People Goals, Objectives, and Evidence-based Resources* (DHHS 2024) and *Health Promotion and Disease Prevention* (DoD 2014). As defined in CJCSI 3405.01, *Chairman's Total Force Fitness Framework*, physical fitness is, "the ability to physically accomplish all aspects of the mission while remaining healthy and uninjured" (CJCSI 2011), a definition echoed verbatim in *Defining Total Force Fitness for the 21st Century: A New Paradigm* (Roy et al. 2010), which also adds that physical fitness can be divided into four components: endurance, mobility, strength, and flexibility. This domain is further operationalized through metrics of strength and agility, aerobic capacity or $VO2_{max}$, muscular endurance, functional mobility, physical training modalities, indices such as the body mass index (BMI), and body composition metrics such as lean mass and percent body fat (USU 2022).

Psychological Health

As defined in CJCSI 3405.01 *Chairman's Total Force Fitness Framework*, psychological fitness refers to "the ability to effectively cope with the unique mental stressors and challenges needed to ensure mission readiness" (CJCSI 2011). While this is a precise and succinct definition of psychological fitness, it does not address the wide range of factors and spectrum of characteristics that contribute to psychological health or the health, well-being, and mission readiness of Service members. To this end, *Human Performance Resources by CHAMP,* developed by the Consortium for Health and Military Performance (CHAMP), provides additional detail, adding that "mental fitness—including toughness and resilience—contributes to the overall goal of optimum performance" (USU 2022). *Total Force Fitness for the 21st Century: A New Paradigm* further states that psychological fitness is "the integration and optimization of mental, emotional, and behavioral capacities to optimize performance and strengthen the resilience of [Service members]" (Bates et al. 2010). This underlines the concept of identifying and employing strategies for improving psychological health to address a variety of factors, including mental toughness and resilience, cognitive performance, coping skills, emotional regulation, sleep, mental health behavioral practices, and alcohol and substance use or misuse.

Social Health

Social fitness is defined by CJCSI 3405.01 *Chairman's Total Force Fitness Framework* as "the ability to engage in healthy social networks that promote overall well-being and optimal performance" and is often presented in the context of social cohesion for Service members (CJCSI 2011; USU 2022). *Total Force Fitness for the 21st Century: A New Paradigm* stresses the scientific support for the importance of social cohesion and morale in military populations. The authors note that in the context of military sociology, social cohesion is a Force strength multiplier and "the strengthening and psychologically protective effect of stable, socially cohesive units is not scientifically speculative, ambiguous, or uncertain" (Coulter, Lester, and Yarvis 2010). Thus, social health reflects both an individual's ability to form healthy social bonds and the intertwined nature of the individual with the larger structure of family and community relationships, all of which are "crucial to [Service member] health and performance" (USU 2022). Thus, assessment of a Service member's social health should consider not only the fitness of an individual, but also the fitness of family and social groups with which an individual may interact, recognizing that there are likely reciprocal relationships between the fitness of an individual and that of the social networks (familial or otherwise) and environments with which an individual interacts (McCarthy et al. 2023). However, assessment of social health can be challenging, as the construct is complex and multifactorial, often involving complicated factors such as the nature of individual social engagement, interpersonal relationships, family relationships, community engagement, the nature and quality of professional relationships, culture, peer-to-peer networks, social development, and leadership (McCarthy et al. 2023). These various constructs demonstrate the influential nature of social health at essentially all levels of the socioecological model and may be considered as the *cumulative* effect of both

positive and negative relationships among family and community members, professional colleagues, and leadership.

Spiritual Health

Although spiritual health as a field of study is relatively new, the understanding of its importance in health and well-being has been growing steadily. Defined in *Chairman's Total Force Fitness Framework* as "the ability to adhere to beliefs, principles, or values needed to persevere and prevail in accomplishing missions" (CJCSI 2011), the spiritual health of Service members includes their beliefs about the meaning of life or a non-physical dimension of life, often within the framework of religious belief (Huffard, Fritts, and Rhodes 2010). However, the definition of spiritual health also extends beyond theological aspects and the practice of religious beliefs to encompass *ideology*, or "a systematic body of concepts especially about human life or culture" (Merriam-Webster 2024). In this sense, spiritual health in the military context can be conceptualized as encompassing identity and belonging, awareness of meaning and purpose, embracing Service core values, and the ability to cope, as defined by *Human Performance Resources by CHAMP* (USU 2022). It is important to recognize that spirituality and spiritual health may look very different to different people and that the favoring of one spiritual tradition over another would be inappropriate for the U.S. Military; instead, spiritual fitness in the military context should focus on the personal intersection of spirituality, ideology, and ethics, which provides room for the development of guidelines, recommendations, and policy without favoring one spiritual tradition over another (Huffard, Fritts, and Rhodes 2010). Importantly, spirituality may also include access to spiritual, ideological, and philosophical support services to further develop and support health in this domain.

The Narrative Literature Review

Background

Despite general population evidence suggesting associations of various behaviors, beliefs, and practices with outcomes likely relevant to military populations, understanding whether and how these associations translate to military Service members is an important aspect of developing health promotion and integrated primary prevention campaigns, programs, interventions, and policies. Knowledge of gaps in the available body of evidence can assist research and analytic partners in identifying potential areas for future study, facilitating effective and efficient use of funding and the development of partnerships to answer remaining questions. This literature review was undertaken as an important first step to addressing the need for better awareness of the available literature as well as to identify where gaps remain, with the objective of providing a clear picture of the current body of evidence as it pertains to factors and metrics in alignment with the domains of health and fitness as well as the potential relationships between those factors and metrics and military-relevant outcomes. Thus, this review aims to serve as a foundational document for the development of future health promotion-related assessments, programs, and evaluations, the institution of new policies, and the identification of health promotion research needs.

Approach

This literature review was purposefully developed to be broad in scope to capture a comprehensive depiction of the available military-specific research regarding health and fitness-related behaviors, practices, and beliefs, and their associated military-relevant outcomes. Therefore, inclusion criteria for this narrative literature review were as follows:

1) Literature addressed one or both of two guiding questions:
    a. What does scientific evidence suggest regarding associations of Service member behaviors, beliefs, and/or practices that align with one or more of the domains of health and fitness with outcomes of military relevance, including but not limited to Service member health, well-being, and readiness?
    b. What does scientific evidence suggest regarding the interrelatedness of the domains of health and fitness and how relationships between the domains and/or aligned behaviors, beliefs, and practices influence outcomes of military relevance, including but not limited to Service member health, well-being, and readiness?
2) Literature underwent the peer-review process and was published in research journals (i.e., gray literature was out of scope for this review).
3) Literature was specific to research studies conducted with military populations. While primary focus was placed on U.S. Military populations, studies conducted with foreign militaries were also included, with primary consideration given to North Atlantic Treaty Organization countries.
4) Literature was published in or after January 2000.

Literature considered within scope included both qualitative and quantitative original research studies, systematic reviews, meta-analyses, and, in some cases, narrative literature reviews. Search terms for the literature review included each health and fitness domain and how it relates to an *a priori* determined list of military-relevant outcomes. These outcomes were identified based on discussions with subject matter experts. PubMed and PsychInfo databases were searched between March and July 2023, with additional iterative searches extending to November 2023. After exclusion of literature that did not meet all inclusion criteria, a total of 1,227 articles were extracted into the literature database for inclusion in the literature review.

Table 3 provides counts for the total number of published, peer-reviewed studies identified for each of the eight domains of health and fitness, as well as the overall number of published, peer-reviewed studies identified.

Table 3. Identified Literature Counts by Health and Fitness Domain	
Domain	**Total Count**
Environmental	230
Financial	45
Medical/Dental Preventive	308
Nutritional	171
Physical	199
Psychological	146
Social	57
Spiritual	71
Overall	1,227

The Domains of Health and Fitness and Service Member Outcomes

Cognitive Performance

Health and Fitness Domains with Evidence Pertaining to Cognitive Performance

Environmental	Financial	Medical/ Dental	Nutritional	Physical	Psychological	Social	Spiritual
★		★	★	★	★		

Introduction

Cognitive performance generally refers to multiple mental abilities including learning, thinking, reasoning, remembering, problem solving, decision making, and attention (Harvey 2019). Preservation and improvement of cognitive performance, both higher order processes such as executive function as well as more basic functions, such as vigilance, have been topics of interest in the general population (Falck et al. 2017; Petersson and Philippou 2016; Sabia et al. 2009; Solfrizzi et al. 2017) and military populations alike, especially given the high cognitive demands placed on Service members and the high-stakes nature of many military occupations. For example, the inability to simultaneously employ sustained vigilance and effectively process and reason through received stimuli during guard duty tasks could have life or death consequences for Service members. A recent systematic review of 60 studies noted that among health-related behaviors, practices, and beliefs, factors associated with improved Service member cognition included aerobic fitness and dietary and nutritional supplementation, while factors such as fatigue, dehydration, and undernutrition were associated with poorer cognitive function (Martin et al. 2020). Thus, the extent to which factors within each of the eight dimensions of health might serve to preserve or augment Service member cognitive performance is likely to be of interest to both Service members and military leaders.

Environmental Health and Cognitive Performance

Environmental factors such as thermal stress and high altitude can impact cognitive performance.

Environmental heat exposure and cognition

Research with the general population and military Service members suggests environmental exposures, particularly severe environments such as those with extreme hot or cold climates, or those at high elevation, may have significant and often adverse effects on cognitive performance (Buoite Stella and Morrison 2022; de Aquino Lemos et al. 2012; Falla et al. 2021;

Hancock et al. 2007; Martin et al. 2019; Muller et al. 2012). For example, exposure to a hot, humid climate during sustained field training was reported to result in severe decrements in the reaction time, vigilance, short-term spatial memory, motor learning, attention, short-term memory, and grammatical reasoning of U.S. Army officers (Lieberman et al. 2005). However, some studies have reported no impact of heat-induced thermal stress on cognitive functions (Ashworth et al. 2021; Caldwell et al. 2011; Tikuisis and Keefe 2005), while others have noted a variety of potentially confounding factors, including sustained and intense physical activity, inadequate nutrition, sleep deprivation, and dehydration, all of which may also impact Service member cognition. For instance, field training exercises that include severe sleep restriction coupled with high energy expenditure have been reported to degrade cognitive alertness (Ponce et al. 2023). Thus, when investigating the association of heat exposure with cognitive performance in the context of field training or other sustained operations, it is important to also consider potential mediating or moderating effects these factors may have on this relationship, as they may have implications for results interpretation. This was demonstrated in controlled-environment laboratory studies in which no change was observed in cognitive performance or performance on military-relevant functional tasks when adequately fed and hydrated male and female Service members were exposed to heat strain (Ashworth et al. 2021; Caldwell et al. 2011; Tikuisis et al. 2002).

Environmental heat exposure duration and cognition

Heat exposure *duration* may also be an important variable in studies of thermal stress effects on cognition (Martin et al. 2019). In a meta-analysis of 49 studies, there was a systematic effect of increasing heat exposure duration on declining performance of cognition-related functional tasks intended to assess perception and psychomotor response (Hancock et al. 2007). However, there remains disagreement regarding the nature of this relationship, as at least one meta-analysis suggested that shorter exposure at higher temperatures may result in larger decrements of cognitive function (Pilcher et al. 2002). In support of the latter, laboratory-controlled studies that achieved only relatively mild elevation of the core temperature found little or no association between the heat-induced thermal stress and cognitive performance (Ashworth et al. 2021; Caldwell et al. 2011). However, a systematic review of 124 studies suggests the complexity of the cognitive task may play a mediating role in determining the magnitude of cognitive deficit resulting from thermal stress (Martin et al. 2019). Together, these studies suggest thermal stress resulting from heat exposure may adversely affect Service member cognitive performance, but exposure duration, temperature, and complexity of the cognitive task or function in question may be important factors when considering the magnitude of cognitive decrement.

Environmental cold exposure and cognition

Perhaps more so than heat exposure, there is compelling evidence to suggest that exposure to extreme cold may elicit decrements in cognitive performance relevant to military tasks, including time to detect targets, reaction time, sustained attention, and visual vigilance (Adam et al. 2008; Kallinen and Ojanen 2023; Lieberman et al. 2009). In a systematic review of studies

conducted with participants exposed to either cold air or cold water, a significant decrease in cognitive function was observed for both cold conditions, even after accounting for other confounding factors. Notably, in 15 of the 18 studies included in this systematic review, cold exposure significantly impaired performance in cognitive domains, including attention, executive function, and memory, even prior to the onset of accidental hypothermia (Falla et al. 2021). Evidence also suggests that, such as thermal strain resulting from heat exposure, the duration of cold exposure may play an important role in the degree of cognitive function decrement resulting from cold-associated thermal strain (Hancock et al. 2007), although exposure to cold, even temperatures at or below 64°F, may have more profound effects on cognition as compared with heat exposure, as suggested in one systematic review and meta-analysis of 23 studies (Pilcher et al. 2002). However, on this point, there is disagreement among systematic reviews (Hancock et al. 2007).

Similar to studies conducted with Service members in hot climates, there may be other factors that influence the association between cold exposure and cognitive outcomes. For example, a study of male Finnish military personnel exposed to extreme cold during field training reported that study subjects exhibited impaired cognitive function but also underwent sustained physical exertion, sleep deprivation, and energy deficit, all of which may have also contributed to the observed decline in cognitive function (Kallinen and Ojanen 2023). Likewise, a study examining the effects of laboratory-induced cold stress on male trainees during recovery following intensive U.S. Army Ranger training found that visual vigilance decreased over the course of recovery while other cognitive factors, such as reaction time, pattern recognition, learning, and reasoning, improved. Based on this finding, the authors concluded that, in this scenario, it was the rigors of field training that had the more profound influence on cognition (Lieberman et al. 2009). Two earlier studies of reserve and active- duty male and female Canadian Service members also found that in a controlled laboratory environment designed to isolate the effects of thermal strain, moderate cold stress did not negatively impact performance on cognitively demanding marksmanship tasks; in some cases, precision and accuracy were improved (Tikuisis and Keefe 2005; Tikuisis and Keefe 2007).

High-altitude flight and cognitive function

Exposure to high-altitude flight resulting in hypoxia, particularly exposure to lower partial pressure of oxygen (McMorris et al. 2017), has been reported in both the general population (Pun et al. 2018) and military populations to adversely influence both executive function and more basic aspects of cognitive function such as working memory, attention, perception, and concentration (Aebi et al. 2020; Bliemsrieder et al. 2022; Malle et al. 2013; McMorris et al. 2017). While the underpinnings of this process are not well-characterized, it is likely that arterial desaturation and associated compensatory biological mechanisms affecting cerebral metabolism are responsible for altitude-associated impairments in cognitive performance (Ando et al. 2020).

The effects of high-altitude exposure experienced by military pilots on cognition and functional capacity for cognitively demanding tasks during flight may be considerable, as suggested in a

study of male military helicopter pilots exposed to mild hypoxia during flight simulations at 14,000 feet versus 8,000 feet (Bouak et al. 2018). A study of male and female U.S. Marine Corps and Navy aircrews found that acute exposure to an altitude of 20,000 feet in a pressure-controlled chamber rapidly induced significant impairment of cognitive functions, particularly among learning and memory domains, such that participants failed to encode new memories when administered a standardized learning task (Nation et al. 2017). This finding is supported by a preceding study of male French military personnel showing adverse effects of high-altitude hypoxia on working memory (Malle et al. 2013). Similarly, a small study of male and female U.S. Navy pilots found the ability to complete simple timed math problems and auditory monitoring tasks declined significantly at 18,000 feet and at 25,000 feet, although sessions typically were not sustainable for longer than 5 minutes because of low oxygen saturation, pilot-requested descent, or pilots becoming unresponsive (Beer et al. 2017). Acute exposure to hypoxia may adversely influence executive aspects of functional cognitive performance, as demonstrated in a study of pilots who were asked to perform flight tasks under particularly challenging simulated flight conditions, including hypoxia (Temme et al. 2010). During the hypoxic condition, pilot control of the aircraft was significantly more variable than during the normoxic condition, and there was a large effect size of the hypoxic condition on pilot ability to maintain both speed and altitude. Results of this study demonstrate that tests designed to assess individual domains of Service member cognition, such as vigilance, attention, or memory, may be inadequate to capture the decrements in performance that can occur with high altitude exposure. Thus, studies designed to assess performance on flight-related functional tasks that require combinations of cognitive functions may be more effective for demonstrating how altitude can meaningfully and negatively influence pilot cognition (Temme et al. 2010). Recommendations to help mitigate the adverse effects of altitude on cognitive performance of pilots and other flight personnel flying unpressurized aircraft include oxygen supplementation for the first 30 minutes at altitudes above 10,000 feet (Fabries et al. 2022).

High elevation environments, acute mountain sickness, and cognitive function

High elevation environments such as those in high mountain regions can also present challenges to Service members, as exposure to high altitudes and the low partial pressure of oxygen, especially in cases of rapid ascent (e.g., elevation increases of approximately 2000 feet or more, or abrupt ascent to more than 9,800 feet), can result in altitude sickness and alterations in cognitive function for the unacclimatized (Fabries et al. 2022). Research suggests that these decrements in cognitive performance induced by exposure to high elevations can be exacerbated or even facilitated by sleep deprivation, highlighting the importance of sleep for Service members, especially those traveling to high elevation environments (de Aquino Lemos et al. 2012; Fabries et al. 2022; Figueiredo et al. 2022).

Evidence suggesting the importance of proper acclimatization for the prevention of altitude sickness and associated effects on cognition has been provided by studies of the general population (Bliemsrieder et al. 2022; Pun et al. 2018; Zhang et al. 2013). In addition to gradual acclimatization, studies of the general population suggest that moderate exercise may improve cognitive performance at high altitude (Ando et al. 2020). However, some effects of hypoxia

exposure on cognition may persist beyond initial acclimatization and may take up to 24 hours to resolve (Phillips et al. 2015). At least one general population study suggests there may be important differences in the physiologic responses to hypoxia in normobaric versus hypobaric altitude exposure, as hypoxia in a simulated normobaric environment induced different cardiovascular and sympathetic nervous system responses as compared with hypoxia in a hypobaric environment (Hohenauer et al. 2022), a finding that may have implications for the interpretation of hypoxia research conducted in the two different environments.

While understanding the influence of environmental heat, cold, and altitude exposure on Service member cognitive function and performance is important for determining how to best prevent the adverse effects these factors may have on Service members' ability to think and react, these variables represent only a small sample of the various environmental exposures that could potentially affect Service members. For instance, associations of toxic environmental exposures common during deployment, including burn pits, pesticides, and exhaust fumes, with chronic multi-symptom illness, which includes symptoms related to cognitive changes, have been reported in veterans of the wars in Iran and Iraq (DeBeer et al. 2017). Additional research into how other environmental exposures, including natural exposures (e.g., hypobaric pressure) man made exposures (e.g., carbon monoxide or carbon dioxide gases, or particulate matter suspended in the air), and occupational exposures (e.g., whole-body vibration, hazardous noise, and exposure to chemicals via inhalation or dermal contact) may either augment or degrade Service member cognitive function and performance will likely be an important aspect of ensuring that Service members are ready and able to perform at their best, regardless of environmental conditions.

Medical and Dental Preventive Health and Cognitive Performance

Evidence suggests that medical and dental preventive health may support aspects of Service member cognitive function. There is evidence demonstrating the importance of both abstaining from tobacco use and preserving adequate hearing ability for cognitive function and performance in military populations (Giannakoulas et al. 2003; Job et al. 2018).

Tobacco withdrawal and cognitive performance

Evidence suggests that tobacco use may have adverse effects on cognition as a result of withdrawal symptoms associated with mandated abstinence. A study of male Hellenic Air Force pilots reported adverse effects on pilot concentration, alertness, and reaction time following mandatory 12-hour abstinence from smoking prior to flight duties (Giannakoulas et al. 2003).

Hearing conservation for preservation of cognitive performance

Hearing is vital for Service member lethality and survivability (Abel 2008; Keller et al. 2017; Sheffield et al. 2017). For example, impaired hearing may impact the ability to effectively hear vital communications and commands (Keller et al. 2017) which could have dire consequences in combat scenarios. In one study of U.S. Sailors, impaired speech intelligibility interfered with their ability to interpret and respond to auditory information and commands and their ability to

pay attention to visual information (Keller et al. 2017). Furthermore, blast exposure or consistent exposure to factors such as continual loud or moderately loud noise may be sufficient to impair cognitive function even without obvious hearing loss (Grant et al. 2021; Irgens-Hansen et al. 2015). Exposure to factors that may threaten auditory function are often unavoidable in many military occupational specialties (MOS). For example, personnel aboard naval ships may be exposed to 77 dB of continual average background noise, which approaches the 84 dB noise threshold for hazardous continuous noise set by the DoD and individual Service branches (DoD 2019). In one study of Royal Norwegian Navy personnel, cognitive testing revealed that continual loud noise exposure may have impaired reaction time on visual attention tests even after accounting for alertness, workload, the amount of sleep on the night preceding cognitive testing, and hearing protection device (HPD) use (Irgens-Hansen et al. 2015). Moreover, in this study, self-reported HPD use by military personnel with the highest levels of noise exposure may have *attenuated* the magnitude of association between increasing noise exposure and delayed reaction time, suggesting the effects of continuous noise exposure may have been worse had participants not worn hearing protection (Irgens-Hansen et al. 2015). Even low-frequency noise exposure may adversely impact higher cognitive functions such as logical reasoning and mathematical calculations, as suggested in a systematic review of eight studies (Liang et al. 2024).

Hearing conservation aims to ensure Service members are protected from and educated about exposure to various occupational hazards that may adversely affect their auditory function, including noise, blasts, and ototoxic substances (Fuente et al. 2019; Kaufman et al. 2005). Although HPD use is encouraged and demonstrated to be effective in preserving Service member hearing (Batchelor et al. 2020; Cleveland 2009; Paakkonen and Lehtomaki 2005), consistent use of HPDs by military Service members is mixed (Abel 2008; Acchiardo et al. 1991; Jones and Pearson, 2016). When asked about facilitators and barriers to HPD use, Service member responses vary, but common themes include inability to hear commands or other vital communications, reduced situational awareness, poor fit, and discomfort (Abel 2008; Acchiardo et al. 1991). In some cases, HPD educational programs may be ineffective as they do not address these concerns (Jones and Pearson, 2016). Studies suggest training Service members to correctly and effectively fit and self-test HPDs may improve the attenuation rating achieved when Service members use HPDs (Federman and Duhon 2016; Federman et al. 2021). Devices specially designed to meet the unique needs of Service members, such as active earmuffs, use advanced digital technology to enhance certain sounds such as speech while suppressing or attenuating loud noises and can facilitate communication and help to ameliorate communication-related concerns (Clasing and Casali 2014; Federman et al. 2022; Giguere et al. 2015; Manning et al. 2017).

Among the potential long-term auditory-related consequences of noise, blast, and/or ototoxic exposures is the development of tinnitus. This condition causes intermittent or persistent ringing in the ears, which may be detrimental to cognitive function (Lewis et al. 2023). In a study examining the relationship between tinnitus and cognitive function, male and female Service members and veterans affected by tinnitus exhibited significantly impaired inhibitory control as compared to those without, although in this case the authors determined that tinnitus

appeared to influence cognitive *efficiency* more than performance (Sherlock and Brungart 2021). Earlier studies of tinnitus provide additional support for these findings, noting that tinnitus was associated with impaired attention, concentration, reading, speech, hearing, and understanding, as well as sleep disorders (Henry et al. 2019; Job et al. 2018). Together, these findings suggest that medical and dental preventive health, namely hearing conservation, may be a way to help ensure continued Service member cognitive function and performance.

Nutritional Health and Cognitive Performance

There is mixed evidence on the benefits of dietary supplements to improve cognitive performance.

Dietary supplements

Evidence supporting the use of dietary supplements for the sustainment or improvement of cognition is relatively small for military populations, likely due to strict standards and restrictions for Service members, coupled with a relative lack of robust evidence (Crawford et al. 2021). Nevertheless, studies suggest there may be benefits associated with some dietary supplements in terms of improving or sustaining Service member cognition (Austin et al. 2014; Dretsch et al. 2014; Oliver et al. 2021; Stephens et al. 2014; Zwilling et al. 2020; Samadi et al. 2022). A recent randomized, controlled trial suggested that co-supplementation of beta-alanine and creatine for 28 days improved mathematical processing performance of male Soldiers over time as compared with beta-alanine supplementation alone (Samadi et al. 2022). Caffeine is often touted as having beneficial effects on cognition, as suggested in a recent meta-analysis in which caffeine in the form of energy drinks elicited small improvements in cognitive reaction time but not accuracy (Oliver et al. 2021). However, while consumption of energy drinks and shots for the purposes of improving mental alertness and endurance is common among U.S. Service members, these supplements may also be associated with adverse physiological reactions, including heart palpitations and difficulty sleeping (Stephens et al. 2014), highlighting the fact that Service members must be cautious in the use of dietary supplements. In addition to caffeine, dietary supplements in the form of vitamin, mineral, and/or herbal ingredient blends that may not be accurately represented on product labels are often targeted to Service members with claims of increasing cognitive performance, despite a lack of robust research to support such claims (Crawford et al. 2020; Crawford, Boyd, and Deuster 2021). A recent study evaluated scientific-sounding claims and employed an educational tool designed to flag potentially unsafe and/or banned substances coupled with laboratory testing to investigate 12 popular dietary supplements claiming to enhance cognition (Crawford et al. 2020). The majority (67%) of products examined had at least one ingredient listed on the label that could not be identified through laboratory testing, while 83% of the tested products contained one or more ingredients not listed on the label (Crawford et al. 2020). Furthermore, the study identified multiple scientific-sounding claims made by the supplement manufacturers that were not scientifically supported (Crawford et al. 2020).

Dietary supplementation may augment the effects of other interventions designed to improve Service member cognitive performance. For example, in a novel physical training program, a dietary supplement consisting of β-hydroxy β-methylbutyrate, lutein, phospholipids, docosahexaenoic acid (DHA), and various micronutrients was provided to male and female U.S. Air Force study participants. This combination led to improvements in various cognitive domains, including working memory, reaction time, and processing efficiency by almost 10% over the novel physical activity intervention alone (Zwilling et al. 2020). However, while some studies have suggested associations of dietary supplement use with cognitive outcomes ranging from mood states to coordination, there is currently little biological mechanistic evidence or studies on causality to explain or support these relationships (Austin et al. 2014). Furthermore, some studies have failed to identify relationships between dietary supplementation and cognitive performance, including a study of primarily male (93.0%) active-duty U.S. Soldiers which found that an omega-3 fatty acid supplement consisting of DHA, eicosapentaenoic acid (EPA), and docosapentaenoic acid had no significant effect on measures of neurocognitive functioning (Dretsch et al. 2014). Likewise, a double-blind randomized controlled trial conducted with primarily male (98.6%) U.S. Army officers suggested no association of fatty acid supplementation with attention, cognitive processing speed, or executive control (Marriott et al. 2021). However, compliance in these studies was generally poor, which may have contributed to the outcomes (Dretsch et al. 2014; Mariott et al. 2021). Finally, a randomized controlled trial of vitamin D supplementation among male and female active-duty Service members had similar results, reporting no significant improvement of cognitive test scores despite significant improvement in vitamin D status (McCarthy et al. 2019). Together, the findings of these studies suggest that more robust study designs and adequately powered studies may be needed to substantiate previous findings (Marriott et al. 2021).

Carbohydrate supplementation during calorie deprivation and cognitive performance

Supplementation with carbohydrate in the context of inadequate calorie consumption (e.g., two meals, each consisting of approximately 765 kilocalories (kcal) over the course of 10 hours) may help to enhance measures of both mood and cognitive vigilance in Service members during sustained aerobic activity, as suggested in at least one double-blind, placebo-controlled study of male U.S. Soldiers (Lieberman, Falco, and Slade 2002). However, the relatively small number of studies to support this association suggest that additional studies are warranted (Lieberman, Falco, and Slade 2002). There is mixed evidence regarding the effects of sustained caloric deprivation (as low as 266 kcal per day) on cognitive performance and ambulatory vigilance measured repeatedly over the course of the deprivation period, even when coupled with high levels of physical exertion, with some studies noting significant decrement in cognitive function while others report no effect (Lieberman et al. 2008; Lieberman et al. 2017; Giles et al. 2019; Beckner et al. 2023). Disagreement among studies and a lack of study populations representative of the U.S. Military provide further evidence of a need for additional research.

Physical Fitness and Cognitive Performance

Evidence suggests physical activity can preserve and even improve cognitive function.

Physical fitness metrics and cognitive performance

Among the factors recognized as playing an important role in supporting cognitive function, physical fitness and activity are perhaps two of the most well-studied. Physical fitness is often operationalized with metrics including cardiorespiratory fitness (CRF), measures of physical and occupational function and performance, and exercise frequency. Studies of the general population support robust associations between physical fitness and various aspects of cognitive performance across the lifespan, including studies seeking to understand the biological mechanisms behind these associations (Alvarez-Bueno et al. 2020; Angevaren et al. 2008; Clouston et al. 2013; Moore et al. 2022; Suarez-Manzano et al. 2018; Zou et al. 2023). Likewise, there is evidence for positive associations of physical fitness and activity with cognitive function and performance in Service members. For example, in a study of female military recruits, reaction times to correct responses on tests of grammatical reasoning, psychomotor vigilance, and working memory were found to have improved at the completion of basic military training (BMT) as compared with baseline scores obtained at the start of BMT (Lieberman et al. 2014). At the opposite end of the military lifecycle spectrum, research with older male and female military veterans suggests that consistent physical activity after leaving military service may be protective against cognitive decline (Pitts et al. 2020).

Physical training modalities and cognitive performance

In addition to improved physical fitness, the physical training modality, that is, the type of physical training a Service member undertakes, may also play a role in improving Service member cognitive performance. A study conducted with male and female U.S. Air Force technical training students in which a standard military training protocol consisting of calisthenics and running was compared to a novel agility training program found that participants in the agility training group improved performance on continuous memory and visual vigilance tasks and performed the test tasks significantly more quickly than the standard military training group (Lennemann et al. 2013). Similarly, a randomized, controlled trial compared a unimodal program consisting of aerobic training only versus a multi-modal program consisting of both aerobic and strength training in active-duty male and female U.S. Air Force personnel. The authors reported that the multi-modal training group improved memory, processing efficiency, executive function reaction time, and fluid intelligence accuracy, while the unimodal training group did not (Zwilling et al. 2020).

Physical fitness to preserve cognition

Physical fitness may also act as a protective factor for cognitive performance during times of high operational tempo or other physically and/or mentally stressful events (Beckner et al. 2021; Sekel et al. 2023). In fact, adaptive tactical decision-making ability during times of intense operationally induced stress has been reported to be greater for male Service members with high aerobic capacity as compared to those with lower aerobic fitness (Sekel et al. 2023). In a small study of male U.S. Army active-duty and reserve Service members and ROTC cadets performing tests of executive function after 48 hours of energy deficiency and sleep restriction, participants with the greatest CRF demonstrated more stable measures of vigilance and working

memory as compared with participants with lower aerobic fitness (Beckner et al. 2021). Moreover, participants with lower CRF also had a greater propensity for risk-taking behaviors associated with occupational stress exposure (Beckner et al. 2021). In addition to aerobic training, strength training has been suggested as a means by which to mitigate the adverse influence of stress-related hormonal factors on working memory during physical fatigue, although the currently available evidence supporting this is limited (Shia et al. 2015). However, there remains some disagreement regarding the association between physical training and cognition, as at least one mixed-population study (i.e., Service members, veterans, ROTC cadets, and civilians) reported no association between physical fitness and cognition as assessed via performance on mental math problems, suggesting more research, including studies conducted with representative sample populations, is needed to understand whether and how cognition may be influenced by physical fitness (Stein et al. 2022).

Psychological Health and Cognitive Performance

In many ways, psychology and cognition are interrelated concepts, since many cognitive processes such as learning, attention, perception, and thinking directly influence and may even have reciprocal relationships with constructs and comorbidities that define the human psychological experience, while psychological principles such as emotion and mood may also influence cognition (Storbeck and Clore 2007).

Sleep and cognitive performance

Sleep and meditation practices play important roles in cognitive performance. There is evidence that sleep may influence Service member cognitive performance, particularly response time and decision-making capabilities (Rice and Schroeder, 2019; Smith et al. 2019), though conclusions from systematic reviews of general population studies are mixed (Cardenas-Egusquiza and Berntsen 2022; Pearson et al. 2023). In a cross-sectional study of male and female U.S. Military active-duty and veteran personnel, self-reported sleep disturbances and poor sleep quality were associated with slower response times and poor response accuracy on cognitive tests of reaction time (Rice and Schroeder, 2019). However, poor sleep may have increased feelings of anxiety in this study, suggesting the association between sleep and cognitive test scores might have been mediated to some extent by anxiety, making interpretation of these findings challenging (Rice and Schroeder, 2019). In a study on sleep deprivation and shooting accuracy conducted with male active-duty U.S. Soldiers in which participants were restricted to 2 hours of sleep every 24 hours over the course of 72 hours, Service members' ability to successfully strike targets did not change, while their ability to correctly distinguish between friend and foe targets was significantly degraded (Smith et al. 2019). Importantly, in this study, study participants believed that their performance on the friend-foe discrimination task did not change over time, suggesting that Service members may not recognize when sleep deprivation has adversely influenced cognitive performance (Smith et al. 2019). Thus, given the importance of sleep for optimal cognitive function, strategies to address the adverse effects of sleep deprivation on cognition may be important for ensuring Service member readiness and performance, since periods of little to no sleep are common for Service members during field training, combat, and

other high operational tempo conditions. The strategy of "sleep banking" or "sleep extension", by which Service members extend their nightly sleep duration in the days or even weeks leading up to periods of anticipated inadequate sleep or sleep deprivation, has been suggested as an approach to proactively mitigate declines in cognitive performance that may accompany sleep deprivation (Ritland et al. 2019; Rupp et al. 2009). Though the body of evidence supporting the utility of this approach in the Service member population is relatively small, at least one randomized controlled trial, conducted with male and female U.S. ROTC cadets, supports sleep banking as a potentially effective means by which to preserve cognitive performance during times of high operational demands (Ritland et al. 2019); however, given the small sample size (n = 50) and lack of additional supporting studies, further research on this topic is warranted.

Psychological resilience and cognitive performance

Military operational stress, often marked by sleep deprivation, undernutrition, and sustained activity, may adversely impact cognitive performance, hindering military tactical decision-making capability (Sekel et al. 2023). In a study of male active-duty and reserve component Service members and ROTC cadets, participants who self-reported greater psychological resilience were found to respond better to simulated military operational stress exposures; in fact, adaptive decision-making capabilities of these individuals were observed to improve, rather than decline, throughout the 96-hour simulated military operational stress protocol (Sekel et al. 2023). Additional research has provided further support for this association, with Service members scoring higher on objective measures of trait resilience (i.e., Conner-Davidson Resilience Score) experiencing less severe declines in vigilance during a 48-hour simulated military operational stress protocol (Beckner et al. 2021). However, additional research on this topic, including studies incorporating participant groups representative of the U.S. Military population, is warranted.

Mindfulness meditation and cognitive performance

Mindfulness, which has origins in Eastern traditions, involves the self-regulation of attention to present-moment experiences and the development of non-judgmental awareness of moment-by-moment experience, including thoughts, emotions, or sensations that arise, even if unpleasant or unwanted (Brintz et al. 2020). Mindfulness meditation is a specific form of meditation practice that involves paying attention, on purpose, to the present moment without judgment (Kabat-Zinn, 2012). Mindfulness meditation has been shown to improve attention and executive function in the general population (Ai Holzel et al. 2011), although a meta-analysis on mindfulness found that, while such programs improved participants' working memory, they appear to have limited effect on attention, declarative memory, and cognitive aging (Whitfield et al. 2022). Nevertheless, a systematic review suggests there may be specific cognitive benefits of mindfulness meditation for Service members, including improved attention, emotion regulation, and impulsivity control (Hepner et al. 2022). Mindfulness may also benefit decision-making, morale, productivity, and readiness in military populations, although the number of studies supporting these associations is relatively low (Hepner et al. 2022).

Mobile applications and wearable devices for cognitive performance

Technology-based approaches to improving Service member cognitive performance through psychological intervention have also been explored, including the use of mobile device applications. While research in the general population (Bruehlman-Senecal et al. 2020; Economides et al. 2018; Huberty et al. 2019; Sasaki et al. 2021) is promising, evidence for effectiveness among Service members is mixed (Adler et al. 2017; Ben-Avraham et al. 2022). While at least one study of ActiGraph use for tracking and improving sleep reported encouraging results of improved self-reported sleep quality and quantity in a sample of predominantly male (92.4%) active-duty U.S. Soldiers (Adler et al. 2017), a second study conducted with male and female Israeli Army personnel assessing the use of a mobile device application for cognitive control training reported low feasibility and effectiveness, primarily due to difficulty of consistent, daily use (Ben-Avraham et al. 2022). Commonly reported barriers to consistent device use include lack of consistent internet connection in remote locations, time constraints due to the high operational tempo of military training or occupational demands, and inconsistent access to personal mobile devices during field training and missions (Ben-Avraham et al. 2022). Development of future mobile devices and other technology applications for Service member use will need to consider the unique demands and needs of military Service members to ensure practicality, utility, and effectiveness.

Interaction of the Health and Fitness Domains and Cognitive Performance

An important aspect of this multi-dimensional framework is the interaction of the eight domains and how such interactions contribute to Service member health, well-being, and readiness (Table 4). While literature pertaining specifically to the influence of domain intersections on Service member cognitive performance is sparse, there is some evidence demonstrating how factors in multiple health dimensions may work together to preserve or even augment cognition.

Table 4. Interaction of Health and Fitness Domains and Their Influence on Cognitive Performance

Outcome	Interacting Domains	Findings	Reference
Memory, Processing efficiency, Reaction time, accuracy	Physical Fitness Nutritional Health	Combined intervention of aerobic and strength training and nutritional beverage improved cognitive function	Zwilling et al. 2020
Vigilance, memory, risk propensity	Physical Fitness Psychological Health	High trait resilience combined with high CRF buffered effect of occupational stress on cognitive function	Beckner et al. 2021
Cognitive function during high altitude	Environmental Health Psychological Health	Adequate sleep mitigated effects of high altitude	Figueiredo et al. 2022

Cognitive function during cold weather training	Physical fitness Environmental Health Nutritional Health	Strenuous physical exertion coupled with inadequate nutrition during extended cold weather field training degraded cognitive function	Kallinen and Ojanen 2023

Gaps and Calls to Action in Cognitive Performance

Despite the importance of high-level cognitive function for Service members, there remain relatively few studies that provide empirical evidence across the eight domains of health and fitness pertaining to how health-related behaviors, practices, and beliefs influence Service members' cognitive functioning. Identified gaps in the evidence and potential areas for additional study include:

1. *Factors associated with improved Service member cognitive performance*. Many of the studies pertaining to health and fitness domain factors and cognitive function or performance discussed in this review focused on those associated with *degraded* cognitive function. There is a need for research investigating means by which to *improve* Service member cognitive performance. Based on studies conducted with the general population, factors anticipated to positively impact Service member cognition span all eight domains, and may include nutrition, physical activity, sleep, stress management, social connectedness, and spirituality. Moreover, there are likely interactions among some or all health and fitness domains that may further support and even augment Service member cognitive performance, but little research with Service members to this effect is currently available. Additional areas for future research include investigation of the aspects of cognitive performance most beneficial for human performance and how to define optimized cognitive performance.

2. *The influence of thermal stress on Service member cognitive function*. Given the mixed findings regarding the effect of thermal stress, particularly in hot climates, on Service member cognition, clarification of the impact that exposure to hot environmental conditions has on various domains of cognition, including attention, reaction time, and executive performance, may have important implications in terms of policies and procedures mandated for managing Service members' acclimatization, training, and fighting in such environments. Additionally, understanding the potential mediating or moderating influence of short-term versus prolonged thermal stress and the impact of other environmental factors such as humidity, high levels of physical activity, nutritional status, and physical fitness on these relationships would serve to identify areas that may be addressed to limit declines in cognitive performance that might accompany military occupational tasks performed in hot environments.

3. *Multi-exposure interactions*. There is a need for improved understanding of the potential interaction of multiple exposures, either with the same domain (e.g., the interaction of

cold climate and high altitude) or among domains (e.g., the influence of aerobic fitness on cognitive performance at high altitudes) on Service member cognitive performance. There is little information on the combined influence of multiple domain factors on Service member cognitive performance, even though Service members are likely to encounter such combinations in real-life training and combat situations. Even for studies in which the likely contribution of other factors, often those from other domains of health and fitness, was acknowledged, minimal attempts were made to further explore the nature and magnitude of potential interaction effects on cognitive performance, such as the effects of cross-tolerance (e.g., training in heat to improve performance at higher altitudes). Practically, however, studies encompassing multiple exposures are challenging to undertake; nevertheless, exploration of these relationships and their interactions as they pertain to Service member cognitive function and performance would provide important information to individuals tasked with developing means by which to mitigate adverse impacts and take advantage of potential augmenting effects on cognition.

4. *The influence of chronic illnesses on cognition*. Despite evidence from systematic reviews of primarily general population research suggesting associations of chronic conditions such as type 2 diabetes mellitus (T2DM), hypertension, dyslipidemia, and even chronic pain disorders with cognition (Geijselaers et al. 2015; Malfliet et al. 2017; van den Berg et al. 2009), there is a relative absence of such literature investigating these associations in military Service members. Although the Service member population may be expected to be less prone to developing these conditions, some of which may even be disqualifying in nature, studies assessing the prevalence of chronic illnesses in the U.S. Military suggest that they may be more common than generally expected (Hruby et al. 2017; Shrestha et al. 2019; Walker et al. 2019). Thus, there is a need for improved understanding of how chronic illnesses may affect various domains of Service member function and performance, including cognition.

5. *Technology to bolster overarching cognition and/or specific domains of cognitive performance*. Development of mobile device-based or wearable technologies designed to improve various aspects of cognition may benefit Service members by improving cognition-related occupational skills and decision-making capabilities. However, thoughtful consideration must be given to the unique needs of and demands placed on military personnel to ensure that such devices and digital applications retain their utility and therefore effectiveness. Moreover, there is a need for careful, robust study and testing of currently available cognitive performance wearables, as claims regarding their efficacy have not generally been examined via high-quality research studies. Future research into effective ways to accomplish these requirements is needed to drive development and implementation of such products.

6. *Studies incorporating female Service members*. Many of the studies discussed in this section utilized all-male Service member samples, resulting in a gap regarding understanding of how female Service member cognitive performance may or may not be

influenced by environmental exposures. Given the increasing proportion of female Service members in the U.S. Military, as well as the opening of combat roles to these individuals, additional research into how to capitalize on and optimize their strengths and mitigate their weaknesses, as has been examined for their male counterparts, will be crucial for ensuring cognitive performance and effectiveness, both of which influence lethality, survival, and well-being of the Force as a whole.

Behavioral Health

Health and Fitness Domains with Evidence Pertaining to Behavioral Health

Environmental	Financial	Medical/ Dental	Nutritional	Physical	Psychological	Social	Spiritual
							

Introduction

According to the American Medical Association, behavioral health refers to, “mental health and substance use disorders, life stressors and crises, and stress-related physical symptoms” (AMA 2022). For the purpose of this narrative literature review, mental health and illness, including depression, anxiety, adjustment disorders, and PTSD, will also be discussed in the context of behavioral health. This approach aligns with how behavioral health is defined within the Defense Centers for Public Health, a component of Defense Health Agency Public Health (DHAPH 2024). Behavioral health has been one of the foremost interests of military researchers, public health personnel, and leaders over the last decade or more, largely owing to the substantial risks for degraded mental health and substance use disorders associated with combat-related and other traumatic experiences that may be associated with military service (Goldstein et al. 2017; Geuzinge et al. 2020; Trousselard et al. 2021). Thus, there has been an appreciable amount of research conducted to examine means by which the effects of these exposures may be mitigated or buffered against, many of which have focused on factors aligned with one or more of the eight domains of health and fitness. Taken together, the cumulative evidence suggests that a multi-dimensional framework of health may be an effective model by which Service member behavioral health outcomes may be improved.

Environmental Health and Behavioral Health

Evidence suggests environmental health factors such as altitude, temperature, light, and noise may influence behavioral health. Mental health can also be associated with changes to environment, such as during field exercises or deployments.

Environmental exposures and mental health

Research has investigated relationships of mental well-being, wellness, and mood with environmental factors such as altitude, built environment, thermal stress, and field training (Bardwell et al. 2005; Bouak et al. 2018; de Aquino Lemos et al. 2012; Fabries et al. 2022; Lieberman et al. 2005; Lieberman et al. 2009; Wang et al. 2022), and suggest that such exposures may contribute to significant decrement in multiple behavioral health outcomes. Studies suggest that high altitude exposures may be associated with negative mood (Bouak et al. 2018; de Aquino Lemos et al. 2012; Fabries et al. 2022) and increased depression in Service members (Wang et al. 2022). Field training exercises, which may include sustained physical exertion, inadequate nutrition, and little or poor sleep, have been reported to elicit negative mood and higher anger levels post-training in studies of male U.S. Marines and Soldiers (Bardwell et al. 2005; Lieberman et al. 2005). Similarly, environmental conditions such as noise, vibration, ship motion for Service members onboard ocean-going vessels, ambient temperature, and poor sleeping or living conditions, as often reported for those on-board ships, may all adversely impact Service member sleep, mood, depression or anxiety symptoms, and overall job-related well-being (Brooks and Greenberg 2022).

Military housing and behavioral health

Within an environment, social determinants of health (SDOH), such as housing, transportation, and neighborhoods, may impact Service members' health, well-being, and quality of life (Blosnich et al. 2020).

General Population Research: The Built Environment

Research suggests that the built environment has significant effects on physical health (Keralis et al. 2020; Nguyen et al. 2021; Renalds, Smith, and Hale 2010; Tarlov et al. 2020; Nguyen et al. 2019). Neighborhoods characterized as more walkable and those where crosswalks are present are associated with increased physical activity rates and lower obesity rates (Renalds, Smith, and Hale 2010), as well as a lower prevalence of all negative health outcomes (Nguyen et al. 2019). Neighborhood walkability is also associated with reduced BMI, specifically among U.S. veterans (Tarlov et al. 2020). Rural areas are associated with less access to healthy foods and dental care, as well as higher obesity, diabetes, physical inactivity, physical distress, mental distress, and premature mortality (Nguyen et al. 2019).

Mental illness and the deployment environment

Deployment to austere environments and challenging conditions is considered a normal expectation of Service members and often cannot be controlled. However, awareness of the potential impacts of hazards that may be encountered during such deployments can help ensure that military leaders recognize and act to mitigate these impacts to the extent possible. Environmental health research has examined relationships between mental illness and the unique environmental exposures and stressors associated with deployment, which may include oil fire smoke, sand and dust, and burn pit smoke (Armed Forces Health Surveillance Center 2012; Bøg et al. 2018; LaRocca et al. 2020). At least one study of male and female U.S. veterans reported an association between these types of environmental exposures, adverse mental health outcomes, and PTSD symptom severity (LaRocca et al. 2020), and a systematic review found that deployment was associated with increased likelihood for mental health disorders, including PTSD, depression, and substance use (Bøg et al. 2018). Because of the adverse effect that mental illness may have on Service member readiness, the identification of means by which to mitigate the incidence of these behavioral health concerns following deployment is of considerable importance. For example, one study suggested that limiting deployments to less than nine months may reduce the occurrence of mental illness, especially PTSD (Armed Forces Health Surveillance Center 2012).

Financial Health and Behavioral Health

Financial health is an important factor in behavioral health, specifically regarding mental illness, suicidality, anger and frustration, and substance use and misuse.

Financial health and mental illness

Financial health is closely related to financial security, which has been shown in general population studies to be associated with mental health outcomes (Yenerall and Jensen 2021; Simpson et al. 2021). In military population studies, there is evidence suggesting associations of mental health concerns such as PTSD, depression, and even suicidal ideation with financial strain or hardship, job loss, and food insecurity, and these associations may be bidirectional (Allen et al. 2011; Bell et al. 2014; Beymer et al. 2021; Gibbons et al. 2012; Gomez et al. 2023; Gorman et al. 2011; Gorman et al. 2016; Rabbitt et al. 2022; Riviere et al. 2011; Russell et al. 2017; Schure et al. 2016; Sullivan et al. 2023; Yan et al. 2013; Riviere, Sinclair, and Graham 2024. 2024). For example, a study of U.S. Army families found that financial strain due to COVID-19 was related to clinical depression and generalized anxiety (Gomez et al. 2023). Moreover, other factors may also act to influence the relationship between financial health and mental health. For example, in small study of National Guardsmen following injury, lack of timely behavioral health treatment and financial support were linked with decreased mental health and financial stability (Gorman et al. 2016). Similarly, a study of male and female Washington State National Guard personnel demonstrated that socioeconomic difficulty magnified negative mental health outcomes for Service members on Domestic Civil Support (Russell et al. 2017). At least one study conducted with U.S. Army personnel suggests financial strain may also adversely impact

sleep and anxiety (Bell et al. 2014). Finally, the influence of financial strain on mental health is not limited to Service members; it increases stress for military families as well (Allen et al. 2011).

Financial health and suicidality

Considerable evidence supports relationships between financial strain, food insecurity, and suicidality in U.S. Service members (Beymer et al. 2021; Bryan and Bryan 2019; Edwards et al. 2023; Goodin et al. 2019; Hoffmire et al. 2023; Langhinrichsen-Rohling et al. 2011; Skopp et al. 2019). A qualitative content analysis of case records from 135 predominantly male (96.3%) U.S. soldiers who died by suicide found that 17.8% of examined cases had financial problems (Skopp et al. 2019), and a study of nearly 53,000 U.S. Air Force members suggests that financial stress is an independent predictor of suicidal ideation in both male and female Service members (Langhinrichsen-Rohling et al. 2011). Furthermore, sources of financial strain may impact suicide risk differently. In a study of male and female U.S. National Guard personnel, financial strain was associated with increased risk for suicidal ideation, while credit problems had the strongest relationship with suicide *attempts,* even after controlling for mental health diagnoses (Bryan and Bryan 2019). Food insecurity was also related to suicidal ideation in a survey of more than 5,000 male and female U.S. soldiers (Beymer et al. 2021). Finally, a case-control study of U.S. Army, Navy, Air Force, and Marine Corps personnel demonstrated that both death by suicide cases (predominantly male, 92.9%) and suicide attempt (male and female) cases had higher prevalence of financial difficulties than a control group of U.S. Army personnel with no history of recent suicide behavior (Goodin et al. 2019). Research conducted with U.S. Military veterans also suggests that financial security may serve as a protective factor against suicide risk (Hoffmire et al. 2023).

Financial health and well-being

Supporting Service members by encouraging and developing their financial literacy could have important implications for their well-being. In a study of U.S. Army Soldiers, those who reported higher credit card debt and lower perceived net worth were found to have impaired subjective well-being, conceptualized in the study as self-reported feelings of worry and anxiety and difficulty sleeping attributed to financial stress (Bell et al. 2014). Conversely, Soldiers in the study who reported greater perceived financial knowledge and having at least $500 in emergency funds in savings reported more positive subjective well-being and lower levels of financial stress (Bell et al. 2014). In this study, increasing sums of money in savings and decreasing amounts of debt were associated with increasing magnitude of positive subjective well-being (Bell et al. 2014).

Financial health and anger and frustration

In addition to mental health disorders and suicide risk, the financial health literature supports associations of financial health, specifically financial strain, financial stress, and difficulty meeting basic needs, with Service member anger and frustration (Adler et al. 2020; Adler et al. 2022; Newby et al. 2003; Russell et al. 2017; Slep et al. 2010). Some of these relationships may

be reciprocal in nature, as at least one study of both male and female Army, Navy, Air Force, Marine Corps, and Coast Guard personnel reported that problematic anger during the military-to-civilian transition was associated with increased likelihood of substantial financial insecurity approximately 5 years later (Adler et al. 2022). Financial insecurity may also be associated with increased risk for intimate partner violence, as suggested by a study of 135 male and female U.S. Air Force personnel in which financial stress was an independent predictor of violence against intimate partners for both male and female participants (Slep et al. 2010). Similarly, a study of female U.S. soldiers found that they showed more aggression toward unemployed than employed spouses (Newby et al. 2003). Given these associations and the importance of the family unit for Service member readiness, a better understanding of factors that may ameliorate financial insecurity is needed.

Financial health and substance use and misuse

Substance use, particularly hazardous drinking, has been reported to be relatively prevalent in both U.S. and foreign militaries and may be further instigated by factors such as financial strain and job loss, although evidence regarding this association is conflicting (Riviere, Sinclair, and Graham 2024; Campbell-Sills et al. 2018; Foran et al. 2011a; Foran et al. 2011b; Pyle et al. 2007). Moreover, financial strain may exacerbate risk for substance use following experiences such as deployment (Campbell-Sills et al. 2018; Foran et al. 2011a). However, literature also suggests reciprocal relationships may exist between financial strain and substance or tobacco use, such that financial strain may influence increased substance and tobacco use as a coping mechanism, while the use of such products may put strain on Service members' finances, further exacerbating the need to cope with negative feelings (Pyle et al. 2007).

Medical and Dental Preventive Health and Behavioral Health

Literature supports linkages between Service members' medical and dental preventive health and a variety of behavioral health outcomes, including mental illnesses, acute anxiety, and stress reactions.

Medical and dental preventive health and mental health

Research suggests improved access to medical care, or even the perception of better access, can have profound implications for Service member mental health (Moore et al. 2013). Even access to basic dermatological medical treatment may support behavioral health and readiness through improvements in Service member self-image, which can have positive effects on mental health and well-being, and healthy dental behaviors such as regular oral exams may be associated with reduced acute anxiety or stress (Albright et al. 2020; Brahe 2022). Military personnel who endorse medical and/or dental prevention-related behaviors may also be more likely to report healthy behaviors across multiple domains, which could further contribute to lower stress and anxiety (Albright et al. 2020).

Access to behavioral healthcare outside of a Service member's command chain may help to overcome barriers to help-seeking for those struggling with their mental health by eliminating

stigma and fear of reprisal (Waitzkin et al. 2018). However, behavioral health providers within the Military Health System are obligated to report any thoughts of harm to self or others, as well as any behavioral health symptoms that could adversely impact deployment readiness (e.g., major depression, psychosis), requirements that are disclosed to Service members upon self-referral for behavioral healthcare.

Heart rate variability as an indicator of mental health

Evidence suggests that cardiovascular factors such as low heart rate variability (HRV) may be longitudinally associated with risk for PTSD in Service members following deployment (Minassian et al. 2015; Pyne et al. 2016), as greater HRV is considered an indicator of better self-regulation capacity (Pyne et al. 2016; Tomes et al. 2020). In a longitudinal study of male U.S. Marines, lower HRV measured approximately one month before deployment was associated with higher likelihood of PTSD 6 months after returning from deployment (Minassian et al. 2015). Improvements in CRF through aerobic training may improve HRV, suggesting important linkages between the physical, medical preventive, and psychological domains (Tomes et al. 2020). For this reason, HRV monitoring has been proposed as a means to assess psychophysiological responses of military personnel experiencing acute stress, especially during and immediately following exposures to highly stressful situations such as tactical training (Tomes et al. 2020). However, a better understanding of the underpinnings of relationships between HRV, physical fitness, and psychological stress responses, in addition to studies of more representative military populations, is needed before targeted approaches are implemented.

Hearing loss and mental health

Hearing loss, hearing-related deficits, and afflictions such as chronic tinnitus are often associated with increased risk for social isolation and emotional distress, which may lead to the development of other mental health disorders (Parker et al. 2022). In military populations, hearing problems and tinnitus have been implicated in worsening sleep, insomnia, and depression symptoms and may even increase risk for adverse coping mechanisms such as alcohol misuse (Henry et al. 2019; Job et al. 2018; Luha et al. 2020; MacGregor et al. 2021; Parker et al. 2022), and evidence suggests this relationship may be bidirectional, as poorer mental health and hearing loss were shown to predict incident tinnitus or progression of tinnitus symptoms (Clifford et al. 2019). Furthermore, these associations demonstrate the importance of measures to prevent hearing loss, such as HPD use (Ahroon et al. 2011; Fuente et al. 2019; Hammill et al. 2019; Henry et al. 2019; Kaufman et al. 2005; Moon et al. 2011; Orru et al. 2020; Paakkonen and Lehtomaki, 2005; Parker et al. 2022; Schaal et al. 2019).

Tobacco use and mental health

Tobacco use prevention and cessation programs are an important aspect of medical and dental preventive health, as tobacco use has been identified as a predictor of symptoms associated with mental disorders such as PTSD, depression, and anxiety in military personnel (Haddock et al. 2007; Smith et al. 2014). Conversely, stress is often cited as a predicating factor for tobacco use initiation, although studies of both male and female Service members report those who use

tobacco products as a stress-coping mechanism report significantly higher stress and/or anxiety levels as compared with those who do not (Pyle et al. 2007; Smith et al. 2014; Stein et al. 2008; Vander Weg et al. 2015; Morgan et al., 2017; Godby et al. 2023). Higher levels of stress may also be associated with higher levels of cigarette smoking (i.e., more packs per day) or even poly-product use (e.g., concurrent use of cigarettes and smokeless tobacco products), as observed in a tri-Service study of more than 12,000 male and female Army, Navy, Air Force, and Marine Corps personnel (Stein et al. 2008). Moreover, new uptake of tobacco use by former non-users may indicate mental health distress, with potential for bi-directional associations between tobacco use and adverse mental health symptoms (Booth-Kewley and Larson 2005; Hermes et al. 2012; Lin et al. 2018; Smith et al. 2014). As an addictive substance, tobacco use restriction may elicit withdrawal symptoms in chronic tobacco users that can include anger, irritability, and tension or anxiety, which could in turn adversely influence occupational effectiveness, as suggested in a study of male Hellenic Air Force pilots (Giannakoulas et al. 2003). Other barriers to tobacco cessation include perceptions of cessation program ineffectiveness and infringement of rights (Poston et al. 2017; Smith and Malone, 2012). Service members may use smokeless tobacco products instead of quitting tobacco all together, believing they are a safe alternative (Lin et al. 2020), with cigarette smoking reported to be a leading predictor of both smokeless tobacco and/or e-cigarette initiation in military Service members (Ebbert et al. 2006; Klesges et al. 2010; Lin et al. 2020). A 2023 study of 2014 Health Related Behaviors Survey data showed that approximately 8% of the 45,986 male and female survey respondents reported using e-cigarettes at least once in the past year, and of those reporting any e-cigarette use, almost half (49%) reported using e-cigarettes exclusively (Godby et al. 2023). Among survey respondents, the prevalence of exclusive e-cigarette use was highest for White, male, Navy-affiliated Service members whose self-reported yearly income was less than $45,000 (Godby et al. 2023).

Despite these considerations, studies suggest that tobacco cessation interventions may have some effectiveness, particularly those designed to educate Service members on the various harms associated with all types of tobacco products (Klesges et al. 2006; Little et al. 2016; Little et al. 2021; Severson et al. 2009; Sobell et al. 2017). Additionally, some research suggests that medical provider messaging regarding the risks of e-cigarette use may be an effective deterrent of these products (Godby et al. 2023). Other studies suggest that interventions, including complete tobacco use restriction, are ineffective in preventing tobacco use initiation, suggesting that different approaches for targeting non-users may be warranted (Hermes et al. 2012; Klesges et al. 2006; Little et al. 2020; Little et al. 2016; Patten et al. 2019; Vander Weg et al. 2015).

Medical visit screening and alcohol misuse intervention

Research examining post-deployment screening records of U.S. Army personnel suggests that alcohol misuse and alcohol use disorder may be prevalent in military populations, particularly for Service members returning from deployment (Adams et al. 2019). Studies conducted within U.S. Military treatment facilities suggests that routine screening of Service members in the medical treatment facility setting, conducted during annual exams, post-deployment exams, or in the emergency room setting, may be a viable way to ensure that Service members with

alcohol use disorder are identified and receive timely intervention and access to treatment services (Reed et al. 2021; Adams et al. 2019).

Nutritional Health and Behavioral Health

Evidence suggests nutritional health, in particular dietary patterns, may be associated with mental health.

Dietary patterns and mental health

Optimal Service member behavioral health involves the knowledge of and decision to make healthy lifestyle choices, including those related to food and beverages. Unhealthy dietary behaviors such as skipping breakfast and underconsuming fruits, vegetables, and whole grains are common among Service members (Fagnant et al. 2022; Smith et al. 2013), and evidence suggests that these types of health behaviors tend to cluster (Fagnant et al. 2022). In a study of 492 male and female U.S. Soldiers, study participants had a mean HEI-2015 score of 59.9 out of 100, suggesting relatively poor dietary intakes (Rittenhouse, Scott, and Deuster 2021). In this study, dietary components with the highest scores were refined grains, greens and beans, total protein food, and whole fruit, whereas components with the lowest scores included whole grains, sodium, and fatty acids (Rittenhouse, Scott, and Deuster 2021). Aside from affecting physical health, dietary choices have the potential to impact psychological health. For example, in a cross-sectional study of male and female Army and Air Force recruits, those with higher self-reported diet quality, particularly the consumption of fruit and dark green vegetables, were more likely to score highly on tests of resilience (Lutz et al. 2017). However, there may be differences in such associations depending on the nutrient or study population being examined, as a study of predominantly male (98.6%) U.S. Army officers suggested approximately 20 weeks of omega-3 fatty acid supplementation did not influence measures of resilience (Marriott et al. 2021). That said, dietary omega-3, as provided through a Mediterranean-style diet, may be associated with reduced clinical depression or ADHD symptoms among Service members (Hibbeln and Gow 2014). Omega-3 fatty acid status of U.S. Soldiers has shown to be well below the recommended level of greater than 8% and likely reflective of low dietary intake (Rittenhouse, Scott, and Deuster 2021). At least one study of male and female U.S. Soldiers suggests diets low in fruits or vegetables or high in sweetened beverages may increase odds for screening positive for depression or anxiety (Forys-Donahue et al. 2020). Healthy dietary patterns have also been reported to associate with reduced symptoms of generalized anxiety disorder and major depressive disorder (MDD) among male and female U.S. Soldiers, particularly when paired with regular physical activity (Oakey-Frost et al. 2022), supporting the benefit of concurrent practice of positive health behaviors. Factors such as food insecurity may also contribute to stress and negatively impact mental health among male and female U.S. Soldiers (Beymer et al. 2021), as self-reported stress has been associated with symptoms of mental health disorders, including psychological distress, PTSD, and depression among male and female U.S. Service members across all DoD components (Smith et al. 2014). Thus, increasing access to healthy foods may be a way to help improve Service member mental health outcomes (Brooks and Greenberg 2022).

Finally, diet quality also impacts the consumption of micronutrients, including vitamin D, with insufficiency common among Service members, likely due to poor diet quality and unhealthy dietary behaviors (Fagnant et al. 2022; Rittenhouse, Scott, and Deuster 2021; Lutz et al. 2017). Importantly, associations between vitamin D deficiency and depression diagnosis have been reported among male and female active component U.S. Soldiers (Schaad et al. 2019).

Healthy Dietary Patterns and Behaviors in the General Population

Maintaining a balanced and nutrient-dense diet, as suggested by the *Dietary Guidelines for Americans*, outlined in the chart that follows, is crucial for reducing risk of chronic illnesses and promoting overall well-being. Research has extensively demonstrated links between dietary habits and health outcomes, and it is widely acknowledged that healthy lifestyle behaviors significantly reduce the risk of chronic diseases at every stage of life. However, the general population in the United States struggles with maintaining healthy eating patterns and behaviors. Many do not consume enough fruits and vegetables, and exceed recommended intake levels of sodium, saturated fat, caffeine, alcohol, and sugar. If left unchanged, these unhealthy diet behaviors ultimately increase susceptibility to chronic diseases and other health problems.

A considerable number of general population studies have explored the association between healthy dietary patterns and various health-related outcomes, many of which have been further examined via systematic reviews and meta-analyses, providing substantial support for the beneficial relationships between healthy dietary patterns and better health-related outcomes. These outcomes include lower risk for obesity (Rezagholizadeh et al. 2017); metabolic syndrome (Fabiani, Naldini, and Chiavarini 2019); cardiovascular disease, coronary heart disease, and stroke (Kontogianni and Panagiotakos 2014; Jayedi et al. 2020; Morze et al. 2020; T. Wang et al. 2023; Rodriguez-Monforte, Flores-Mateo, and Sanchez 2015); breast and colorectal cancers (Brennan et al. 2010; Grosso et al. 2017; Hou et al. 2019; Morze et al. 2020; Bu et al. 2022; Steck et al. 2015); type 2 diabetes mellitus (Alhazmi et al. 2014; Jayedi et al. 2020; Morze et al. 2020; Maghsoudi, Ghiasvand, and Salehi-Abargouei 2016); renal disease (Soltani and Jayedi 2022); hypertension (Ndanuko et al. 2016; Wang, Shen, and Liu 2016); and both cardiovascular and all-cause mortality (English et al. 2021; Morze et al. 2020). Moreover, systematic review and meta-analysis of existing general population studies suggest that healthy dietary patterns may be associated with better health-related quality of life (Vajdi and Farhangi 2020) and healthy aging (Milte and McNaughton 2016; Nguyen et al. 2021; Denova-Gutierrez et al. 2018). The results of at least one systematic review suggest that healthier dietary patterns at midlife may confer lower risk for age-related cognitive decline (Gauci et al. 2022). Many of these studies also suggest that unhealthy dietary patterns may contribute to worse health-related and aging outcomes.

T

Guidelines for Healthy Eating Patterns*		
Guideline	**Behaviors**	
Follow a healthy dietary pattern consisting of nutrient-dense forms of foods and beverages across all food groups, in recommended amounts, and within calorie limits.	Vegetables	Consume 2 to 4 cup-equivalents per day†‡
	Fruits	Consume 1.5 to 2.5 cup-equivalents per day†
	Grains	Consume 5 to 10 ounce-equivalents per day†
	Dairy	Consume 3 cup-equivalents per day
	Protein foods	Consume 5 to 7 ounce-equivalents per day†
	Oils	Consume 22 to 44 grams per day†
	Beverages	Consume primarily calorie-free beverages, especially water, or those that contribute beneficial nutrients (e.g., fat-free or low-fat milk).
Consume nutrient dense foods and beverages.	Prepare healthy meals at home as often as possible.	
	Use the USDA MyPlate Plan as a guide at each meal.¥	
	Avoid skipping meals.	
	Customize nutrients dense foods and beverages to reflect personal preferences, cultural traditions, and budgetary considerations.	
Limit added sugars, saturated fat, sodium, alcoholic beverages, and caffeine.	Consume less than 10% of daily calories as added sugars.	
	Consume less than 10% of daily calories as saturated fat.	
	Consume less than 2,300 mg per day of sodium.	
	Do not drink alcohol at all, or limit alcohol intake by drinking in moderation: 2 drinks or less per day for men and 1 drink or less per day for women.	
	Limit caffeine intake to 400 mg per day or less.	

* U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2020–2025*. 9th Edition, December 2020.

† Depending on caloric needs. Lower calorie needs may be met by consuming quantities at the lower end of the range for these items.

‡ AR 40-25 recommends a higher minimum of 2.5 and 2 cups per day of vegetables and fruits, respectively, regardless of differences in calorie intake.

¥ From AR 40-25, *Nutrition and Menu Standards for Human Performance Optimization*

Physical Fitness and Behavioral Health

Physical activity may be an important factor for the prevention and treatment of mental illness. Evidence also suggests that there may be important reciprocal relationships between physical activity and mental health.

Physical fitness, activity, and mental illness

More physically fit Service members have been shown to report fewer depression symptoms or lower perceived stress at the end of rigorous training, such as that encountered during BMT or highly stressful Survival, Evasion, Resistance, and Escape training, a relationship that may be mediated in some part by greater resilience in such individuals (Sekel et al. 2023; Proessl et al. 2022; Tuch et al. 2017; Barringer et al. 2016; Crowley et al. 2015; Taylor et al. 2008). For example, a longitudinal study of predominantly male (95.5%) U.S. Army personnel found that participants who endorsed exercising and playing sports as mechanisms for coping with depression and anxiety had fewer symptoms of anxiety, stress, or depression (Morgan et al. 2017). Similar associations between regular, consistent physical activity and depression or post-traumatic stress symptoms have also been reported in older military veteran populations, even among veterans with a genetic propensity for increased depression risk (Adams et al. 2020; Pitts et al. 2020; Pitts et al. 2019). Furthermore, evidence suggests male and female Service members of all DoD components who meet or exceed the current *Physical Activity Guidelines for Americans* (DHHS 2018), may have a lower likelihood of self-reported symptoms of anxiety disorder, depression, or PTSD (Hruby et al. 2021). There is also evidence that behavioral health therapies designed to incorporate physical activity may be effective mental illness treatment approaches (Meerwijk et al. 2022; Walter et al. 2023; Young-McCaughan et al. 2022). For example, in a longitudinal study of almost 100,000 predominantly male (92.2%) active-duty U.S. Solders with chronic pain, prescriptive exercise therapy had a protective effect in terms of number of prescribed opioids, incident alcohol or substance use, and suicidal ideation, particularly among those who participated consistently (Meerwijk et al. 2022). However, there is some evidence to suggest that *leisure time* physical activity specifically may have the strongest association with improved mental health outcomes, and encouragement of such activities may be important for supporting better mental health of U.S. Service members (Brooks and Greenberg 2018; Walter et al. 2023). This is an area of research that remains relatively unexplored within the military community.

Research also suggests that there may be bi-directional relationships between physical activity and mental health. For example, a cross-sectional study found that male and female Service members who reported symptoms of depression or generalized anxiety were significantly more likely to also report lower levels of physical activity and higher levels of obesity (Hruby et al. 2021), while other studies have suggested inverse associations between depression symptoms or psychological stress and sports participation, CRF, and even military fitness test performance, such that individuals who reported symptoms of depression or psychological stress were less likely to report participation in or desire to participate in physical activity (Lin et al. 2020; Morgan et al. 2017; Russell et al. 2019). Together these studies suggest that, while physical

activity may be beneficial for Service member mental health, those who are experiencing mental distress may find it challenging to consistently participate in physical activities, underscoring the importance of timely recognition of mental distress indicators so that timely intervention can be achieved.

Body composition and mental distress or illness

Body composition may influence mental and behavioral health. Studies conducted with large, representative samples of male and female Service members across all U.S. Military branches suggest that individuals with obese BMI may be more likely to report symptoms of depression, anxiety disorder, or PTSD (Hruby et al. 2021; Knapik et al. 2023). It is possible these relationships may be mediated by the stress and negative perceptions about body image that can accompany higher BMI, which may be common for military Service members who must adhere to military body composition standards (Stukenborg et al. 2021). Given the importance of identifying sources of mental distress to Service member behavioral health, this is an area for which additional research may be warranted. It is important to note, however, that BMI is not an indicator of body composition but rather a ratio of height to weight-squared that does not provide information regarding an individual's lean or fat mass. Military studies suggest that body mass or equations utilizing total body mass may be poor predictors of Service member performance (Pierce et al. 2017; Pletcher et al. 2023). Rather, *lean mass*, reflective of an individual's non-fat mass, to include bone and skeletal muscle and often measured via dual-energy x-ray absorptiometry, has been observed to be predictive of military task performance, as demonstrated in a study of predominantly male (93.9%) U.S. Soldiers (Spiering et al. 2021). While dual-energy x-ray absorptiometry is considered the gold standard for evaluation of body composition, its use is limited by the availability of costly, immobile equipment, making it impractical for use in the field or for regular assessment of Service member body composition (Achamrah et al. 2018). Therefore, multiple field-expedient methods for the assessment of body composition may be necessary. This may include waist-to-height ratio, which can provide important insight into an individual's abdominal adiposity versus their height and is a widely accepted method for the assessment of cardiometabolic disease risk (Ashwell, Gunn, and Gibson 2012; Bernstein, Lo, and Davis 2017).

Psychological Health and Behavioral Health

Aspects of psychological health such as sleep quality, stress management, and healthy coping behaviors are important factors in behavioral health.

Sleep problems and behavioral health

Sleep disturbance and insomnia have been salient concerns among active-duty Service members and veterans due to comorbidities with various mental illnesses (Chou et al. 2016; Farhadian et al. 2022; Luxton et al. 2011; Rice and Schroeder 2019; Seelig et al. 2016). Studies investigating the relationships between sleep problems, depression, and anxiety among military personnel found that poor sleep quality or short sleep were associated with worse mental health (Chou et al. 2016; Rice and Schroeder 2019; Hruby et al. 2021), and, moreover, that poor

sleep quality may lead Service members to engage in less effective coping strategies (Chou et al. 2016). Short sleep duration, common during deployment, may also mediate relationships between deployment and a variety of negative mental and physical health outcomes, such as PTSD, panic disorder, and other comorbidities (Luxton et al. 2011). There may also be interrelationships between sleep and body composition in terms of behavioral health, as sleep apnea, often co-morbid with obesity, may further increase risk for poor mental health; one study reported that more than one-third of male and female active-duty Service members and veterans with obstructive sleep apnea also reported depression or anxiety symptoms (Rice and Schroeder, 2019).

Prevalence of Mental Illness among Military Personnel

Evidence suggests military personnel are at greater risk than civilians for common psychological disorders due to the rigors of military life (Bogaers et al. 2023; Britton et al. 2012; Chou et al. 2016; Farhadian et al. 2022; Hruby et al. 2021; Lapierre et al. 2007; Levin-Rector et al. 2018; Mayo et al. 2013; McCabe et al. 2021; McLean et al. 2022; Paxton Willing et al. 2022; Rice and Schroeder, 2019; Schuler et al. 2022; Trousselard et al. 2021), and research suggests approximately 19% and 17% of DoD survey respondents report depression or anxiety symptoms, respectively (Jones et al. 2008). Moreover, approximately 30% of Vietnam-era veterans may manifest psychological symptoms related to combat over their lifetime, while veterans of other conflicts may experience PTSD at rates ranging from 8% to 17% (Lapierre et al. 2007).

Stress, behavioral health, and risk for suicidal ideation, attempt, and suicide

The connection between the stress of military missions, as well as the unique occupational hazards associated with military life and the emotional health of male and female military personnel has been well documented (Chou et al. 2016; Corrigan et al. 2021; Day and Livingstone 2001; Myers and Bechtel 2004; Pflanz 2001; Pflanz and Ogle, 2006; Stein et al. 2008; Turner et al. 2020). Research suggests unique job-related stressors (e.g, frequent relocation, high operational tempo and overload, promotion requirements) are common in the military and may place personnel at increased risk for depression, PTSD, and other mental disorders (Wang et al. 2015), which can increase suicide risk (Conner et al. 2012).

Evidence from the DoD Suicide Event Report, a surveillance tool used by all Services within the DoD to collect data on demographics, Service characteristics, and psychosocial factors associated with a suicide event, supports a relationship between major psychiatric diagnoses such a MDD and suicide attempt among both male and female U.S. Army personnel (Maguen et al. 2015). Findings of this study concluded that among Soldiers included in the study, male and female Soldiers shared more similarities than differences in terms of risk factors for suicide attempt and suicide (Maguen et al. 2015). In a study of almost 310,000 male and female U.S. Air

Force personnel, clinically diagnosed (as indicated via ICD-10 codes) mood disorders such as MDD, bipolar 1 disorder, or adjustment disorder; mental disorders such as anxiety disorder; and substance use disorder were associated with increased risk for suicide, with mood disorders having greater magnitude of association as compared with anxiety disorder (Conner et al 2012). Male Service members in these analyses were found to have more than two-fold greaterlikelihood for suicide as compared with their female counterparts (Conner et al. 2012). In a later study assessing mental health predictors of suicide attempt within the first 30 days of documented suicide ideation for 11,178 male and female active-duty U.S. Army personnel, of the 7.4% who attempted suicide, Soldiers with an anxiety disorder diagnosis prior to suicide ideation or sleep disorder diagnosis on the same day as suicide ideation were more likely to attempt suicide within 30 days (Mash et al. 2021). Unlike the study of Conner et al. (2012), results indicated that female Soldiers had approximately 50% increased likelihood for suicide attempt following documented suicide ideation as compared with their male counterparts (Mash et al. 2021), while findings of both a study of U.S. Army personnel and a large systematic review of 47 military samples from 42 studies note little or no difference in risk factors for or lifetime prevalence of suicide or self-harm between male and female Service members (Shelef et al., 2019; Gromatsky et al. 2023). This noncongruence between studies suggests the topic may warrant further investigation. Understanding factors that may be associated with increased suicide risk is important not only for identifying Service members who may have increased risk but also for the timely provision of intervention, which may help to mitigate the prevalence of suicide among military-connected individuals.

Allostatic load and post-traumatic stress disorder

Recently, research has begun to focus on awareness of the potential adverse effects cumulative stress and acute fatigue may have on occupational performance and chronic health outcomes in military personnel (Corrigan et al. 2021; Hourani et al. 2020). Allostatic load is the collective psychophysiological wear and tear resulting from stress exposure (Carbone et al. 2022). In particular, stressors associated with combat exposure have repeatedly been identified as influencers of military Service member allostatic load and have been shown to influence psychological health among U.S. Military veterans (Piazza et al. 2022). Regardless of combat exposure, military service may predispose Service members to substantial allostatic load, although combat exposure may lower the age at which high levels of allostatic load are experienced in this population (Piazza et al. 2022). Importantly, evidence suggests a likely association between allostatic load and PTSD diagnosis in military Service members, but findings have been mixed (Carbone et al. 2022).

General Population Research: Allostatic Load, Wearable Devices, and Intervention

Evidence from general population research suggests that allostatic load, defined as the accumulation of wear and tear on the body due to chronic stress (Guidi et al. 2021), may have substantial impact on both mental and physical health. A recent systematic review suggests healthcare providers and medical researchers take an integrated healthcare approach to address the combined effects of allostatic load and PTSD on physical health (Carbone et al. 2022). To better understand the relationship between stress, allostatic load, and health outcomes, there is need for the expansion of medical research to include both biomarkers to measure allostatic load and clinical tools to capture the potential underlying causes of increased physical stress (Guidi et al. 2021). General population research highlights the importance of measuring allostatic load as it relates to psychological factors, as poor health behaviors including smoking, alcohol use, sedentary lifestyle, unhealthful diet may be more likely to be exhibited by stressed individuals, and may in turn contribute to higher allostatic load, thus negatively impacting future health outcomes (Suvarna et al. 2020).

In recent years there has been considerable interest in the use of wearable devices for measuring and tracking a variety of health-related variables, including physical and mental health-related metrics. While a systematic review regarding use of these devices to monitor for depression, anxiety, and stress concluded that measuring HRV or electrodermal activity may be useful for detecting stress and/or anxiety, the authors noted that use of these devices to detect depression continues to be challenging. Nevertheless, evidence from the review suggests that wearable electroencephalograms and accelerometers may prove useful for screening for depression (Hickey et al. 2021).

Job-related stress and substance use

Stress from deployment and/or combat exposure has been reported to exacerbate prevalent prescription drug misuse, substance abuse, heavy alcohol use, stress, PTSD, and suicide attempts in male and female U.S military personnel (Bray et al. 2010; Shen et al. 2012), even when considering that rates of substance use and mental health conditions may vary across military Services and missions (Schuler et al. 2022). Strong direct, bidirectional associations between alcohol misuse and mental disorders have been observed in U.S. Army and Marine Corps personnel, as among Service members and veterans with lifetime alcohol or substance misuse, adverse outcomes such as suicidal ideation, PTSD, MDD, and panic disorder have been reported to be more prevalent (Levin-Rector et al. 2018; Stein et al. 2017). Job-related stressors (e.g. work responsibilities, work hours, difficulties with supervisors, work overload, threat of military discipline) have been shown to be significantly and positively correlated with symptoms of depression in a U.S Air Force active-duty population consisting of both men and women (Pflanz et al., 2006).

Trauma-related stress and behavioral health

Evidence suggests past trauma, whether occurring in childhood or adulthood, can influence current mental health. For example, in a study of Canadian Armed Forces personnel, self-reported adverse childhood experiences were associated with probable mental health conditions during military service, associations that were stronger for male Service members as compared with their female counterparts (Gottschall et al. 2022). Likewise, in this study childhood sexual abuse was associated with increased likelihood of probable PTSD, an association that was stronger for men (Gottschall et al. 2022). Sexual trauma experienced in adulthood, particularly military sexual trauma, has been associated with increased risk for adverse mental health outcomes such as PTSD and depression in U.S. veterans (McLean et al. 2022). Moreover, Service women may have a greater risk for military sexual trauma, and previous research examining the deleterious effects of traumatic military experiences on female veterans reported that sexual assault was strongly associated with both PTSD and depressive symptoms, even when accounting for several aspects of combat exposure (Goldstein et al. 2017). Nevertheless, a qualitative study of male and female U.S. Military veterans concluded that the outcomes of military sexual trauma exposure, including more severe PTSD, anxiety, and psychotic disorders as compared with combat-related trauma, were similar between male and female veterans, suggesting that this type of trauma has significant impact on Service member mental and behavioral health (Sexton et al. 2017).

While military personnel may experience repeated trauma and non-trauma-related stressors that increase their risk for adverse mental health outcomes, there is evidence that such outcomes may be mitigated through factors such as positive relationships with family, social support from individuals such as other military personnel who understand military culture, and personal identity (Easterbrook et al. 2022; Schubert et al. 2016). However, this is not always sufficient to protect Service members from the high-risk of traumatization, which may even occur in individuals who were well-adapted to the demands of a military occupation prior to deployment (Geuzinge et al. 2020; Trousselard et al. 2021).

Deployment-related trauma and behavioral health

Evidence from an epidemiological surveillance study of male and female U.S. Army personnel shows that during deployment, the most common mental health disorders identified for Soldiers included stress reactions, adjustment disorders, depression, anxiety, and sleep disorders (Paxton Willing et al. 2022). However, characteristics such as grit, mental toughness, hardiness, and resilience, as well as social support and unit cohesion may mitigate PTSD severity in deployed military personnel by reducing negative post-traumatic cognitions (Bartone and Bowles 2020; Campbell-Sills et al. 2018; Donald et al. 1987; Doody et al. 2021; Hourani et al. 2020; Ligeza et al. 2022; Maguen et al. 2008; Naifeh et al. 2019; Orak et al. 2022; Schok et al. 2010; Seelig et al. 2016; Ungar and Theron 2020; Zang et al. 2017). However, injuries such as extremity trauma or traumatic brain injuries (TBI) sustained during combat may further increase the risk for decreased mental and physical health and functioning as well as decline in long-term health related quality of life (McCabe et al. 2021).

Coping and other psychological strategies to improve behavioral health

U.S. Army research has focused on the important link between Soldier coping behaviors and mental health outcomes (Britt et al. 2017; Morgan et al. 2017). Specifically, studies conducted with primarily male and female U.S. Soldiers suggest coping style may serve to moderate associations between work stressors and mental health symptoms, and healthy coping behaviors (e.g., active problem-focused coping, positive emotion-focused coping, looking to social support, self-reflection, exercising, playing sports, or participating in a hobby) may be associated with less anxiety, perceived stress, depression symptoms, and PTSD symptoms, whereas negative coping behaviors (e.g., preference for handling problems oneself; venting of negative emotions; denying or disengaging from problems; cigarette smoking; or marijuana use) may increase these symptoms (Bartone and Bowles 2020; Britt et al. 2017; Day and Livingstone 2001; Morgan et al. 2017). Studies conducted with male and female Service members across the DoD indicate that when Service members struggle to tolerate the stressful military environment, they may become more impulsive, and may engage in negative coping strategies such as nicotine use (Stein et al. 2008).

Positive coping techniques may include mindfulness and self-compassion, which may be beneficial for military personnel who are exposed to highly stressful environments (Bravo et al. 2018; Hepner et al. 2022; Ihme and Sundstrom 2021; Jones et al. 2022; Mantzios 2014; Schuler et al. 2022). Furthermore, mindfulness practice may improve some aspects of Service member emotional regulation, work-related morale, social support, and impulsivity, and may even benefit military families through reduction of parental stress (Hepner et al. 2022). Evidence suggests that other strategies and intervention efforts (e.g., peer support programs, crisis-focused psychological interventions, self-reflection training) may beneficially impact Service member well-being and may even support the adaptive process of resilience (Anderson et al. 2020; Bravo et al. 2018; Britton et al. 2012; Crane et al. 2019; Hepner et al. 2022; Naifeh et al. 2019; Orak et al. 2022; Schok et al. 2010; Ungar and Theron, 2020).

Nevertheless, there remains a substantial gap in peer-reviewed literature on the effectiveness of departmental interventions, services, and programs across the DoD for reducing mental health symptoms and promoting psychological health and subsequent mission readiness (Anderson et al. 2020), and there is a need for additional understanding regarding mechanisms underpinning the contribution of psychological stress reactivity to mental health and chronic disease outcomes (Turner et al. 2020).

Social Health and Behavioral Health

Social health dimension factors such as unit cohesion and social connectedness can impact mental health outcomes, including mental resilience, suicidality, self-harm, substance use or misuse, and family behavioral health.

Social factors influencing behavioral health outcomes

The mental health of Service members may be influenced by a variety of social factors, which include trauma exposure, feelings of loneliness, and hazing or bullying. Exposure to wartime events such as severe violence or traumatic injury have been associated with higher rates of PTSD and depression, and evidence from studies conducted with male and female U.S. Air Force personnel suggest these exposures may additionally serve to degrade perceptions of unit cohesion and self-efficacy, which may further adversely impact mental health outcomes (Welsh et al. 2015; Welsh et al. 2019). While social connectedness, which may include being married or in an intimate partner relationship, has been identified as a protective factor for Service member mental health, literature suggests that feelings of low social support or marital dissatisfaction may act as a significant source of stress and depressive feelings for these individuals (Brooks and Greenberg 2018; Bartone and Bowles 2020). Similarly, studies conducted with male and female U.S. Soldiers indicate feelings of loneliness, which may occur with smaller social networks or following relationship disruptions, may compound the impact of combat experiences on mental health, although evidence suggests that this relationship may be moderated by strong unit cohesion (Reed-Fitzke and Lucier-Greer 2020; Taylor et al. 2023). A study of predominantly male (90.4%) U.S. Soldiers suggests harmful social behaviors such as favoritism, hazing, or bullying may substantially degrade unit cohesion, potentially eliminating the positive effect robust unit cohesiveness can have on Service member mental health (Campbell-Sills et al. 2023). Moreover, a study conducted with predominantly male (94.8%) German military personnel provides evidence that stigma associated with disclosing such abuse may further compound the degrading effect of these adverse behaviors, resulting in increased likelihood of depression or even anger disorders such as intermittent explosive disorder (Thomas et al. 2023).

Unit cohesion and psychological resilience

Unit cohesion, an important aspect of social health for Service members, may impact their psychological resilience. For example, a study of more than 700 male and female National Guardsmen found that greater unit cohesion may mitigate avoidant coping style, in turn enhancing Service members' resilience in the face of traumatic deployment experiences (McAndrew et al. 2017). This study further indicated unit cohesion may be more amenable to modification in deployment environments than other psychosocial interventions, suggesting unit cohesion may be a vital leverage point by which leaders may improve psychological resilience and coping behaviors (McAndrew et al. 2017). Importantly, evidence from a study of predominantly male U.S. Soldiers points to strong unit cohesion as a means by which to mitigate the adverse effects of combat exposure on mental health and improve PTSD, depression, and suicide ideation outcomes (Campbell-Sills 2022).

Social health, suicidality, and self-harm

Evidence suggests that suicidality and self-harm may be substantially influenced by social health-related factors that may be important targets for prevention efforts (Maguen et al.

2015; McLean et al. 2017; Taylor et al. 2023). Among these factors, evidence from the DoD Suicide Event Report suggests that failed intimate relationships, especially within the first three months of the relationship's end, may be a common risk factor for suicide among both male and female U.S. Soldiers (Maguen et al. 2015). Social connectedness and the size of social networks also appear to play key roles in Service member suicidality and/or self-harm risk, as demonstrated in a longitudinal study of predominantly male (94.0%) U.S. Soldiers, which reported that small social networks predicted suicidal behavior five years after Army enlistment (Taylor et al. 2023). This association has been reported to be related to the amount of interpersonal support provided by social networks in a study of male and female U.S. Army and Air Force personnel, as greater amounts of interpersonal support moderated associations between depression and suicidal ideation following combat deployment (McLean et al. 2017). Similarly, studies of U.S. Army personnel suggest strong unit cohesion and feelings of closeness may also decrease risk for suicidal behavior and may even offset the effects of combat exposure on suicidal ideation (Anderson et al. 2019; Campbell-Sills et al. 2022; Dempsey et al. 2021). Finally, while social health factors such as individual social connectedness and unit cohesion may lower suicidal ideation and behavior risks, behaviors such as bullying and harassment may significantly degrade social connectedness, increasing these risks (Campbell-Sills et al. 2023; Thomas et al. 2023). This factor may be a stronger predictor for female Soldiers, as analysis of DoD Suicide Event Report data suggests that workplace difficulties, which may include bullying and/or harassment, were more strongly associated with suicide risk for female as compared with male U.S. Army personnel (Maguen et al. 2015). Moreover, stigma associated with reporting bullying and hazing may exacerbate suicide risk, highlighting the importance of leadership in fostering a supportive culture for suicide prevention (Thomas et al. 2023).

Social health and substance use or misuse

Social health may have implications for the risk of substance use or misuse by Service members. Unit cohesion appears to have a substantial impact on substance use risk, as suggested in a study of male U.S. Reserve and National Guard Service members, in which personnel who deployed attached to a unit other than their own were more likely to endorse higher levels of binge drinking (Ursano et al. 2018). Likewise, perceptions of unit cohesion pre-deployment may have important impacts on behaviors following return from deployment, as higher perceived unit cohesion prior to deployment has been reported to be a protective factor against alcohol misuse in a study of predominantly male (94.7%) U.S. Soldiers, as it was associated with lower alcohol or substance use disorder risk post-deployment (Anderson et al. 2019).

Social health and family behavioral health

Social health may have important consequences on behavioral health outcomes for both individual Service members and their families. Challenges unique to the military, such as Service-related relocations, may be significant sources of psychological stress for military spouses (Ribeiro et al. 2023), and older spouses of enlisted Service members may be more likely to experience psychological stress or perceive less social support (Corry et al. 2021). Given the unique demands of military life for both Service members and their partners, social

connectedness with the military community, members of which likely better understand these unique demands, may help Service members and their spouses to better cope with military life and improve the well-being of military families (O'Neal et al. 2020). In a study of female spouses of male active-duty Service members, a sense of community for military spouses was reported to be further fostered by perceived social support from friends and was correlated with better psychological well-being for these individuals (Wang et al. 2015). These social resources may be particularly important for military spouses during deployment, which evidence suggests may be a time when military families are at greatest risk for adverse mental wellness-related outcomes (Meadows et al. 2017). Moreover, active-duty Service members's spouses, both male and female, who have fewer protective factors, including social connections, family cohesion, and positive coping behaviors, have been shown to be at greater risk for mental health diagnoses, highlighting the importance of social connectedness and support for these individuals (Sullivan et al. 2021).

Spiritual Health and Behavioral Health

Spiritual health is an important factor in both mental wellbeing and resilience, and may be a protective factor for mental illness, suicidality, acute stress, and substance abuse.

Spiritual health, mental well-being, and resilience

Spiritual health may improve overall mental well-being and life satisfaction, as shown in general population studies (Green, Noor, and Ahmed 2020), which may be particularly important for military personnel (Bufford et al 2023). The practice of mindfulness and self-compassion has also been reported to predict better mental health-related quality of life among male and female U.S. Military veterans (Ramon et al. 2020), while transcendental meditation, mindfulness, and progressive muscle relaxation may be suitable options for improving Soldier resilience (Rees 2011). A study of male U.S. Air Force personnel suggests that the integration of chaplain services into behavioral health interventions may improve their success (Cafferky et al. 2017) and that such interventions should address religious or spiritual struggles, loss of meaning and purpose, guilt and shame, interpersonal alienation, anxiety, and depression (Bufford et al. 2023).

General Population Research: Spirituality

Spirituality and religion have a connection to wellness in the general population. Individuals who are highly spiritual and/or religious often have greater longevity compared to those who are not, with evidence for associations of spirituality with lower risks of all-cause, cardiovascular, and cancer mortality (Dominguez, Veronese, and Barbagallo 2024). Spirituality and religion are often captured through attendance of religious services, indicating potential mechanisms of social support and connectiveness that may explain the relationship between spirituality and health. Additional outcomes associated with spirituality include positive coping, having a high sense of purpose in life (Cohen, Bavishi, and Rozanski 2016), and greater well-being (Martin-Maria et al. 2017; Dominguez, Veronese, and Barbagallo 2024), which together may translate to higher quality of life (Borges et al. 2021). Additionally, spirituality is associated with resilience (Schwalm et al. 2022) and may be protective from depression symptoms (Rosmarin et al. 2022; Aggarwal et al. 2023). Building optimism and self-confidence through spiritual coping can aid in recovery from serious mental disorders (Sawab et al. 2024). Religiosity has also been shown to protect against suicidal ideation, plans, and attempts (Poorolajal et al. 2022), which may partly be due to prohibitions of suicide or violence and the support system that accompanies many religions. Health-related interventions that take place in faith-based settings have also demonstrated effectiveness on several health outcomes, such as cardiovascular disease (Maroney et al. 2023).

Spiritual health and mental illness

Spiritual health may have an important impact on mental illness among both active-duty Service members and veterans. In the National Health and Resilience in Veterans study, religion and spirituality had protective, dose-response associations with several mental health outcomes, including decreased risk for lifetime PTSD, MDD, and alcohol use disorder (Sharma et al. 2017). Similarly, an integrative review found that the presence of a strong sense of meaning and purpose within a supportive environment appears to help moderate the impact of life-threatening situations among deployed military healthcare professions (Gibbons et al. 2012) an association also reported in other studies, including a systematic review and meta-analysis of 25 studies (Fischer et al. 2020). Studies of both U.S. veteran and U.S. and foreign Service members suggest that spiritual health may be particularly important for moderating risk and severity of PTSD for which negative perceptions on the meaning of life (Fischer et al. 2020) and greater lifetime trauma burden (Nichter et al. 2020) have been associated with increased probability and severity of PTSD and co-morbidities, while values of tradition and universalism may lower this risk (Zimmermann et al. 2014).

In the literature, there are several protective factors that have been suggested to influence PTSD risk and intensity. Greater spirituality, existential well-being, and religious involvement have been found to be protective against both lifetime PTSD and symptom severity in both male and female U.S. Service members across all DoD branches and components (Ganocy et al. 2016; Hourani et al. 2012; Koenig et al. 2019; Rubenstein et al. 2021; Wood et al. 2018). However, there is some disagreement in the literature on the association between religiosity and PTSD (Ames et al. 2019; Britt et al. 2017; Koenig et al. 2020), as some studies report that this association may be mediated by demographic factors (Koenig et al. 2018; Mota et al. 2013).

Finally, spiritual health may also impact hazardous drinking. A study of U.S. veterans reports that intrinsic religiosity lowered the risk of hazardous drinking (Rubenstein et al. 2021), while exposure to potentially morally injurious experiences, understood to be any experiences that, “elicit a strong emotional and/or cognitive response following events that violate a person’s moral or ethical code,” have been reported to increase this risk in combat veterans (Litz et al. 2009; Battles et al. 2019). Taken together, these studies suggest that spiritual health may have important, advantageous effects for mental health, but additional research examining associations between spirituality and mental illness is needed for the development of effective interventions incorporating tenets of the spiritual domain. Studies conducted with veterans and in the general population on Mantram intervention, meditation, and chaplain intervention suggest these approaches may be effective in treating PTSD and its symptoms (Ames et al. 2021; Bormann et al. 2012; Freeman et al. 2020).

Spiritual health and suicidality

While more research is warranted, there are a few studies examining spiritual health and its association with suicidality. For example, spiritual struggles in areas of morality, ultimate meaning, interpersonal relationships, and doubting have been associated with increased risk for suicidal behavior in U.S. Military veterans (Currier et al. 2018). Moreover, research among

military veteran populations suggests that perceived lack of control and problems with self-forgiveness may be associated with suicidal ideation, while lack of meaning and purpose have been associated with suicide attempt history (Smigelsky et al. 2020), and the presence of moral injury may complicate these associations (Ames et al. 2019). However, at least one study found that purpose and meaning among veterans experiencing moral injury may moderate this relationship (Trachik et al. 2021).

Moral injury and behavioral health

Moral injury, defined as, "perpetrating, failing to prevent, bearing witness to, or learning about acts that transgress deeply held moral beliefs and expectations" is an important factor in spiritual health (Richardson et al. 2020). Several themes have been associated with moral injury in male and female Canadian Armed Forces personnel, including changes in moral attitudes, increased sensitivity and reactivity to moral situations, loss of trust, disruptions in identity, spirituality, and interpersonal relatedness, rumination, and internalizing and externalizing emotions and behaviors (Houle et al. 2021). Moral injury may also have a reciprocal relationship with spiritual health among military personnel, as spirituality may both mitigate and exacerbate moral injury, as well as be influenced by it (Bremault-Phillips et al. 2019), which is important given the demonstrated associations between moral injury and PTSD, depression, anxiety, and risk of suicide among U.S. Service members and veterans (Ames et al. 2019; Hall et al. 2022; Koenig and Al Zaben 2021; Koenig et al. 2019). However, the presence of meaning in life may serve as a protective factor for male and female U.S. Military veterans experiencing moral injury and concurrent suicidal ideation (Kelley et al. 2021). Moreover, the literature suggests routinely screening for moral injury (Koenig and Al-Zaben 2020; Mensink et al. 2022), and that addressing spiritual wounds may help in recovery (Smith-MacDonald et al. 2018). Other interventions may include repairing feelings of guilt, shame, betrayal, and isolation, and may include the involvement of chaplains (Ames et al. 2021; Griffin et al. 2019).

During combat, military Service members may be required to engage in activities, witness acts, or make decisions that may violate their moral codes, all of which may result in moral injury and adversely affect their physical, psychological, social, and spiritual health (Richardson et al. 2020). Exposure to morally injurious experiences may also contribute to mental health problems among Service members returning from combat, an association that may be moderated by the extent to which a Service member can make meaning of their identified stressors or traumas (Currier et al. 2015), while distress caused by morally injurious experiences may promote harmful health behaviors such as excessive alcohol use (Battles et al. 2019). This phenomenon remains relatively under-studied despite its importance to the military community; further research is needed to understand moral injury and its potential risk and protective factors.

Interaction of the Health and Fitness Domains and Behavioral Health

The available evidence exploring relationships between health-related behaviors, practices, and beliefs is substantial, as are examples of health and fitness domain interactions that contribute

to behavioral health outcomes. In particular, evidence suggests that psychological health is a key contributor to behavioral health; however, given the high degree of interrelatedness between psychological health exposures and behavioral health outcomes, these relationships will not be represented in the health and fitness domain interactions presented in Table 5.

Table 5. Interaction of Health and Fitness Domains and Their Influence on Behavioral Health

Outcome	Interacting Domains	Findings	Reference
Post-training negative mood and anger	Environmental health Physical fitness Nutritional health	Field training exercises, which may include sustained physical exertion, inadequate nutrition, and little or poor sleep, have been reported to elicit negative mood and higher anger levels post-training.	Bardwell et al. 2005; Lieberman et al. 2005
Suicidal behavior	Financial health Nutritional health	Food insecurity was also related to suicidal ideation	Beymer et al. 2021
	Spiritual health Social health	Spiritual struggles in areas of morality, ultimate meaning, interpersonal relationships, and doubting have been associated with increased risk for suicidal behavior in military veterans	Currier et al. 2018
	Physical fitness Medical/dental health	For Service members with chronic pain, prescriptive exercise therapy had a protective effect in terms of number of prescribed opioids, incident alcohol or substance use, and suicidal ideation	Meerwijk et al. 2022
General anxiety and major depressive disorder	Nutritional health Physical fitness	Healthy dietary patterns may be related to reduced symptoms of generalized anxiety disorder and major depressive disorder among Service members, particularly when paired with regular physical activity.	Frost et al. 2022
Mental health overall	Medical/dental health Physical health Environmental health	Hearing loss, due to occupational exposure, can degrade mental health;hence, HPD use is recommended.	Ahroon et al. 2011; Fuente et al. 2019; Hammill et al. 2019; Henry et al. 2019; Kaufman et al. 2005; Moon et al. 2011; Orru et al. 2020; Paakkonen and Lehtomaki, 2005; Parker et al. 2022; Schaal et al. 2019

Gaps and Calls to Action in Behavioral Health

1. *Environmental exposures during deployment and behavioral health*. There is a need for more comprehensive understanding of how environmental exposures related to deployment, including exposures to unique climate or altitude-related conditions or toxic exposures, may influence Service member mental health, both during and after deployments. Furthermore, studies designed to investigate the mechanistic underpinnings of these relationships, where they exist, may further assist with the development of mitigation, intervention, or treatment strategies for Service members who may suffer adverse mental health outcomes related to environmental exposures experienced during deployment.

2. *Military housing considerations and behavioral health.* Despite concerns regarding the quality of military barracks and other military housing, particularly for junior enlisted Service members, few studies have examined the influence of this environmental factor on Service member behavioral health. There is also a dearth of research examining how the built work environment (e.g., office buildings, including windowless sensitive compartmented information facilities, and other indoor work facilities) may impact Service member behavioral health outcomes. These concerns represent important gaps in the understanding of how the built environment may affect Service members and how improvements in housing might positively impact behavioral health outcomes.

3. *Allostatic load and heart rate variability*. While heart rate variability (HRV) may hold promise for better understanding of linkages between psychophysiological stress responses and Service member behavioral health outcomes, there remain considerable questions regarding the mechanisms underlying these associations as well as the best HRV variables to employ in assessing them. Additional research specific to military populations is needed to better understand this variable and how it may be used to monitor Service member stress and psychological well-being. Moreover, there is little, if any, research available examining this variable in study samples that more closely mirror the demographic make-up of the U.S. Military. To ensure comprehensive understanding of how HRV may be leveraged to track and even improve psychophysiological stress outcomes for Service members, studies utilizing representative Service member samples are warranted.

4. *The link between allostatic load and mental health.* The recognition of allostatic load as an important contributing factor to mental health has been increasing. However, additional research is needed, as studies examining relationships between allostatic load and Service member mental health do not consistently agree.

5. *Relationships of nutrition, dietary patterns, and nutrition behaviors with behavioral health outcomes.* Given the small number of studies assessing associations of dietary patterns and nutrition behaviors with Service member behavioral health, additional research more closely examining this relationship, including identification of any

potential causal linkages, is needed. Evidence of this nature could be used as an important leverage point for encouraging Service member uptake of healthier eating habits, which in turn influence various military relevant outcomes and improvement in the remaining seven domains.

6. *The influence of spiritual health on behavioral health.* There is a need to better understand the complex relationship between spirituality and behavioral health outcomes in Service members. In particular, better understanding of the interactions of religiosity, moral injury, and adverse mental health outcomes may benefit Service members and professionals involved in treating Service members experiencing moral injury and/or poor mental health.

7. *Leadership as a means to influence behavioral health outcomes.* Better understanding of how leadership engagement impacts alcohol use culture in the military setting may inform important leverage points for decreasing the prevalence of alcohol misuse and alcohol use disorder among Service members, as well as the behavioral health-related consequences associated with alcohol misuse and alcohol use disorder. Research examining these relationships, as well as the interaction of social connectedness with these factors, could help military health promotion personnel to further develop impactful education and intervention products.

8. *The need for participant samples that mirror the demographic make-up of the U.S. Military in studies examining the influence of cohesion on Service member behavioral and mental health.* Although social domain constructs such as unit cohesion have frequently been identified as important factors for Service member behavioral health, most studies examining relationships between unit/military group dynamics (including cohesion) and behavioral health outcomes have been conducted with male Army personnel. There is a need for the expansion of this type of research into populations that are representative of Service members across all military branches.

Physical Performance

Health and Fitness Domains with Evidence Pertaining to Physical Performance

Environmental	Financial	Medical/ Dental	Nutritional	Physical	Psychological	Social	Spiritual
★		★	★	★	★		★

Introduction

Physical performance, a key metric used for determining Service member readiness, can be assessed using a variety of factors, from ability to pass required fitness tests to performance on

occupational tasks. Although numerous studies exist examining training strategies for physical performance improvement, it is essential to also consider, through a multi-dimensional health lense, how each of the domains of health and fitness may intersect with physical performance and, ultimately, readiness among Service members.

Environmental Health and Physical Performance

Physical performance can be affected by several environmental factors, including high-altitude, thermal stress, and complex environments.

Physical performance in high-altitude environments

The external environment can substantially impact physical performance, particularly in hot or cold climates and at high altitude. In a study of predominantly male (93.0%) military personnel examining rifle marksmanship at simulated altitudes, speed to target on marksmanship tasks was impaired at 14,000 feet while the simpler psychomotor task of weapons disassembly and reassembly was not affected by any simulated altitude. The authors speculated that marksmanship speed was sacrificed to maintain accuracy in this instance; moreover, the decrements to rifle marksmanship were still observed 30 hours after the exposure to 14,000 feet ceased (Kryskow et al. 2013). This lingering effect of high-altitude exposure on performance, likely due to the low concentration of atmospheric oxygen at high altitudes (sometimes referred to as a "hypoxia hangover") have been examined by other researchers, including a recent systematic review which reported that the lingering effects of acute hypoxia exposure are particularly dangerous to pilots, as flight performance may be impaired even after descent to lower altitudes (Shaw et al. 2021). This is an important consideration, and hypoxia-related decrements to flight performance are especially common in unpressurized aircraft such as helicopters, even at altitudes as low as 6,500 feet (Balldin et al. 2007). For example, in studies of Dutch and Australian helicopter pilots, the aircrew reported symptoms of hypoxia at altitudes as low as 6,500 feet and degraded performance among their colleagues at less than 10,000 feet (Steinman et al. 2017; Smith 2005). Even the milder hypoxia symptoms observed at altitudes lower than 6,500 feet can result in serious operational consequences, including decrements in target identification and accuracy, alertness, and mood; and increased feelings of fatigue, in both flight and tactical situations requiring optimal performance (Bouak et al. 2018; Beer et al. 2017; Temme et al. 2010). Another important consideration for Service members at high altitude is that higher altitudes will require longer acclimatization periods. For example, evidence suggests that as many as four days of exposure to 10,000 feet may be needed to acclimatize breathing, while acclimatization to 16,000 feet may require as much as four to six weeks (Ainslie et al. 2013). For this reason, experts recommend gradual ascent of no more than 980 feet to 1,600 feet per day at altitudes of 9,800 feet or above, with a rest day every three to four days to further acclimatize (Bartsch and Swenson, 2013; Luks et al. 2010) and to avoid symptoms of acute mountain sickness (AMS) (Fabries et al. 2022).

Physical performance in hot climates

Training and operating in hot climates may continue to become increasingly common with ongoing climate change. This is an important consideration for both Service members and their leaders because research suggests physical performance is blunted in the heat, particularly among those not yet acclimatized, and may be exacerbated by factors such as body armor and load carriage (Ashworth et al. 2020; Hunt et al. 2022). A systematic review estimated performance decrements of approximately 11% under thermal strain, with greater decrement during exposures of longer duration and higher temperatures, particularly for marksmanship accuracy (Hancock et al. 2007). In addition to decreasing performance, exposure to thermal stress in hot climates also increases Service members' risk of heat illness during common activities such as foot marches (Moran et al. 2023).

General Population Research: The Impacts of Climate Change on Human Health and Performance

Environmental hazards and climate change go hand in hand, with climate change having the potential to impact nearly every aspect of human health. Weather conditions are growing more volatile and extreme, and natural disasters will continue to occur and may grow more intense. The World Health Organization estimates that between 2030 and 2050, an additional 250,000 preventable deaths will occur due to climate change-related factors such as undernutrition, malaria, diarrhea, and heat stress (WHO 2023). Further, a recent review on the health impacts of climate change noted that over half of infectious diseases worldwide have been aggravated by climate change at some point (Mora et al. 2022). This includes warming and precipitation changes leading to increased range of vectors such as mosquitos and ticks, warmer winters allowing for viruses and vectors to survive, wastewater overflow from flooding leading to waterborne disease outbreaks, melting ice exposing previously frozen pathogens, wildlife moving closer to humans due to deforestation and wildfires, and even adaptations to pathogens and viruses due to warming that increases transmission and virulence (Mora et al. 2022). Additionally, increased wildfire occurrence due to rising temperatures contributes to greater levels of air pollution. This, coupled with the rise in ambient air temperatures, increases the risk for cardiovascular disease incidence and mortality (De Vita et al. 2024).

While it is recommended to acclimatize for at least five days prior to arrival in a hot climate (Daanen et al. 2018; Tyler et al. 2016), Service members typically undergo heat acclimatization on site rather than prior to deployment (Ashworth et al. 2020). A recent systematic review found that the physiologic adaptations that occur with heat acclimatization include increased sweat rate and reduced resting core temperature and heart rate (Brown et al. 2024). Importantly, male and female Service members who have a higher degree of physical fitness may experience lower physiologic strain when exercising in the heat, therefore acclimatizing to the heat more easily and with lower risk for heat illness (Alele et al. 2021b; Bedno et al. 2014; Hosokawa et al. 2019; Parsons et al. 2019). Some research suggests that female Service members may require additional time to acclimatize to heat and experience greater cardiovascular strain in hot environments compared to males, but these differences may be due to differences in anthropometry (e.g., surface area, muscle mass) or fitness (e.g., VO_2 max, a measurement of cardiovascular fitness) not adequately accounted for in these studies (Corbett et al. 2023; Kazman et al. 2015; Wickham et al. 2021). Notably, in a systematic review of 24 military studies examining heat illness and heat tolerance in male and female Service members, while the incidence of EHI was higher for female as compared with male Service members, Servicewomen were found to have a lower incidence of heat stroke (Alele et al. 2020a). Moreover, despite physiological factors known to increase risk for thermal cardiovascular strain and heat illness (e.g., lower cardiovascular fitness, smaller surface area, lower mass and higher body fat percentage, lower sweat rates), studies report lower incidence of heat illness in women (Corbett, Wright, and Tipton 2023). Given that few robust studies with adequate ecological validity have been conducted to examine sex-related differences in heat tolerance and susceptibility among Service members, additional research in this area is warranted (Alele et al. 2020a; Corbett, Wright, and Tipton 2023; Dyches et al 2023).

Active participation in physical training in hot conditions may provide better acclimatization than passive heat acclimatization (Malgoyre et al. 2018), which may be further impacted by training modality. For example, a study of interval training and isothermic conditioning which involved exercising up to and maintaining a target core temperature of 101.3°F to induce heat adaptations resulted in greater cardiovascular and sweat rate adaptations compared to typical military training activities or interval training (Tan et al. 2022).

Physical performance in the cold

Evidence suggests that cold exposure may degrade CRF and thus aerobic performance, as well as strength, power, balance, and manual dexterity (Castellani and Tipton 2015) and may share some of the same consequences as training at high altitude or at high temperatures. For example, similar to high-altitude exposure, the volume of oxygen required to perform the same workload is greater in a cold environment compared to one that is thermoneutral, while, similar to heat exposure, those with greater baseline fitness levels are likely to experience lower physiologic strain (Hancock et al. 2007; Young and Castellani 2001, 2007). Furthermore, decrements to occupational performance may also be dependent on the duration and intensity of exposure to cold. Cold exposure may also result in decrements of marksmanship response time, but not accuracy, at temperatures below 52°F (Hancock et al. 2007).

Cold acclimatization can vary considerably, as thermoregulatory tolerance in the cold is partly determined by body size and composition (Young and Castellani 2001, 2007). The most common form of cold acclimatization is habituation, resulting in reduced shivering and/or reduced cutaneous vasoconstrictor response (Castellani and Young 2016). The degree of habituation is dependent on the severity and duration of the cold exposure and can occur even with repeated localized cold exposure, such as the hands, rather than whole body cold exposure (Castellani and Young 2016). Cold exposure can also induce metabolic acclimatization, including increased basal metabolic rate and non-shivering thermogenesis, and insulative acclimatization, which enhances heat conservation (Castellani and Young 2016). Finally, although exercising in the cold can aid in warming the body and prevent shivering, it also facilitates increased heat loss due to the increase in blood flow to the skin and working muscles (Castellani et al. 2010; Young and Castellani 2001, 2007). Taken together, exposure to sustained cold weather military operations, which typically involve prolonged physical activity often resulting in weight loss and fatigue, may present unique challenges for Service members, the consequences of which may be a reduced capacity to maintain body temperature.

Physical performance in complex environments

There may be situations where a Service member is exposed to not one, but two, environmental stressors, such as altitude combined with heat or cold. For example, in a small study of male and female military personnel, work rate was found to be lowest in simulated high-altitude conditions, while heat combined with altitude produced greater work-rate decrements than heat alone (Bradbury et al. 2019). These results also suggest that elevation may have a greater impact on performance than heat (Bradbury et al. 2019). Furthermore, although it appears that the physiological mechanisms by which heat and altitude affect physical performance do not overlap, evidence suggests the favorable cardiovascular adaptations that occur while training in a hot environment, such as improved CRF, can improve exercise performance in high-altitude environments, where greater baseline VO_2 max may be advantageous (Gibson et al. 2017; Park et al. 2022; Waldron et al. 2021; White et al. 2014).

General Population Research: Cross-Tolerance	
Evidence suggests that adaptation to one environmental stressor may improve tolerance to another. This has been referred to as cross-acclimatization, cross-adaptation, or cross-tolerance, and typically involves altitude acclimatization with either heat or cold acclimatization.	
Cold and Altitude	**Heat and Altitude**
A small study by Launay and colleagues observed an improvement in cold tolerance, including increased metabolic heat production and decreased heat debt, following 5 days of progressive simulated altitude acclimation (Launay et al. 2006). Recent studies sought to examine whether acute hypoxia exposure could augment response to cold, including a study of two sessions of repeated cold-water immersions at either sea level or at simulated hypoxia (~14,000 feet for 10 hours at 20°; Keramidas, Kolegard, and Eiken 2020). While this study found that the cold-induced drop in core temperature was augmented in the hypoxia condition, and metabolic heat production had a greater sensitivity to change (Keramidas, Kolegard, and Eiken 2020), a second, similar study did not observe any thermoregulatory changes to cold following simulated hypoxia (Shin et al. 2020). However, studies differed in the duration of cold exposure and simulated hypoxia levels, which suggests that these factors may also play a role in eliciting cross-adaptation.	At least one study has reported that acclimation to exercise under high-temperature thermal strain could improve physical performance in simulated high-altitude conditions (Salgado et al. 2020). In this study, the incidence of acute mountain sickness during a 30-hour hypoxia simulation challenge was lower after exercise heat acclimation compared to the incidence of acute mountain sickness prior to heat acclimation, suggesting that acclimatization to exercise in heat may reduce risk for acute mountain sickness (Salgado et al. 2020). Heat acclimatization may improve altitude tolerance through cardiovascular adaptations (White et al. 2014; Gibson et al. 2017) and may be a more practical alternative for Service members expecting to deploy to high-altitude environments but may be unable to acclimatize via altitude chamber. However, if heat adaptations are utilized to better prepare for time at altitude, it is important to keep in mind that there is a decay in heat acclimation effects on heart rate and core temperature of about 2.5% each day after an individual leaves a hot environment (Daanen, Racinais, and Periard 2018).

Medical and Dental Preventive Health and Physical Performance

Medical and dental preventive health may influence physical performance in several ways, such as through personal health behaviors and tobacco use, medical conditions, and use of protective equipment.

Health behaviors and physical performance

Service members' physical health and health behavior practices can impact physical performance in a variety of ways. For example, factors such as obesity, hypertension, anemia, smoking or vaping, temporomandibular dysfunction, or recently giving birth can all result in reduced physical performance (Armitage and Smart, 2012; Dinkeloo et al. 2020; Feinberg et al. 2015; Macera et al. 2011; Miller et al. 2017; Schulze et al. 2017; Teyhen et al. 2016; Tsai et al. 2019; Miettinen et al. 2021). Although striving to increase physical activity, including leisure time activity, will naturally benefit physical performance (Schulze et al. 2017), evidence suggests potential benefits for the practice of additional multiple, concurrent positive health behaviors such as maintaining a healthy diet and sleep patterns. Conversely, multiple adverse health behaviors may have an additive negative effect on performance, as demonstrated in a cross-sectional study of predominantly male (94.1%) active-duty military personnel in which increasing number of adverse medical and/or dental-related factors, including smoking, overweight BMI, inactivity, and injury history, appeared to linearly increase Service members' performance decrements (Teyhen et al. 2016).

Tobacco use and physical performance

There is considerable evidence for the adverse effects of smoking on Service members' physical performance. Compared to nonsmokers, self-reported smoking among Service members is associated with lower fitness levels, a decline of CRF over time, and decreased muscular strength and endurance (Feinberg et al. 2015; Macera et al. 2011) whereas smoking cessation has been reported to aid in improving physical performance of male U.S. Marines (Feinberg et al. 2015). Furthermore, the adverse sequalae associated with acute tobacco cessation, which can include anger, irritability, and even slowed reaction times, may initially reduce occupational performance (Giannakoulas et al. 2003), indicating the importance of preventing tobacco uptake and use by Service members.

Medical conditions and occupational performance

Studies have shown that there are certain acute or chronic medical conditions that may degrade occupational task performance among Service members, including—

- Chronic pain (male and female U.S. Navy personnel, Ransom et al. 2022).
- Barodontalgia (i.e., tooth pain caused by a decrease in ambient pressure) during flight (male personnel of the Spanish Armed Forces; Gonzalez Santiago Mdel et al. 2004).
- Tinnitus (male and female active-duty and veteran U.S. Military personnel; Henry et al. 2019).
- Musculoskeletal injury (MSKi)(predominantly male (97.4%) French Armed Forces personnel; Sauvet et al. 2009)

- Traveler's diarrhea, particularly relevant during deployment (predominantly male (93.2%) French Armed Forces personnel; Aoun et al. 2014).

Protective equipment and physical performance

Multiple measures are available to ensure safety and optimal readiness among Service members, including the use of personal protective equipment (PPE) such as body armor, protective eyewear, mouthguards, and HPDs. However, compliance with use of PPE is often suboptimal, at least in part because the devices themselves may sacrifice tactical and occupational performance in favor of safety. In one critical review, the use of body armor was reported to reduce physical performance by impairing strength, power, and balance as compared to not wearing body armor (Larsen et al. 2011). Studies of Israeli Defense Force and U.S. Navy personnel suggest wearing protective eye coverings in combat may have adverse effects on performance and situational awareness as a result of reduced visual function, lens fogging, and significantly reduced measured peripheral vision as reasons for eyewear disuse (Gunther and Riddle 2008; Weinstein et al. 2019, respectively), and male Israeli Defense Force personnel reported the use of mouthguards to be uncomfortable and/or inhibit their ability to speak clearly and be verbally understood (Zadik, Jeffet, and Levin 2010). Use of HPDs has been reported to lead to perceived loss of situational awareness and decreased operational performance in Canadian Army combat personnel, as HPD use may affect the ability to hear orders or radio communications (Abel 2008). However, the injuries that PPE is intended to prevent may themselves be associated with reduced Force lethality, as in the case of hearing loss, so maximizing PPE use in non-life-threatening situations, such as the use of HPDs during training exercises, should be prioritized (Giguere et al. 2015; Sheffield et al. 2017). Newer technology may be able to mitigate the operational performance decrements commonly cited with PPE use. In a recent study examining new HPDs designed to facilitate situational awareness of U.S. Marine Corps Weapons Instructors, use of an active communications earmuff device over one year of follow-up was effective in preventing a decline in high-frequency hearing sensitivity while maintaining user situational awareness (Federman et al. 2022), suggesting that the development of new protective technology may preserve tactical effectiveness without sacrificing safety.

Nutritional Health and Physical Performance

Nutritional health can affect physical performance through healthy dietary behaviors as well as macronutrient, micronutrient, and water intake.

Healthy dietary behaviors and physical performance

Following a dietary pattern that meets energy and protein recommendations and avoids eating behaviors such as skipping meals or overconsuming sweets is advantageous to Service member physical performance (Ghodsi et al. 2023). In particular, eating behaviors such as skipping breakfast have been associated with reduced physical activity and lower CRF (Clayton and James 2016; Jayne et al. 2021), whereas a study of male U.S. Soldiers undergoing Special Forces selection found that healthier overall diet quality was associated with better performance on

military physical fitness tests (Farina et al. 2020). The practice of healthy eating behaviors may also increase the likelihood of practicing other health behaviors that may further benefit physical performance, such as meeting physical activity recommendations, suggesting that these behaviors may cluster (Farina et al. 2020). A systematic review of studies examining free-living dietary intake of tactical personnel suggests that military and other tactical personnel may meet some nutritional requirements, such as protein intake, while overconsuming fats and/or underconsuming carbohydrates (MacKenzie-Shalders et al. 2021), which could have adverse consequences for physical performance.

Protein and carbohydrate intake and physical performance

Optimal protein intake equaling 10% to 35% of total daily caloric intake (HQ DANAF 2017) is both recommended to optimize skeletal muscle training adaptations and Service member physical performance and supported by findings of at least one study conducted with male U.S. Marines (Cermak et al. 2012) and a meta-analysis of 22 randomized, controlled trials representing 680 subjects (Ross et al. 2020). Adequate protein consumption is particularly important during times of sustained physical activity such as field training, deployments, and sustained operations that often result in severe negative energy balances and losses in lean muscle mass (Gan et al. 2022; Henning et al. 2011; Margolis et al. 2016).

Evidence from at least one systamtic review suggests carbohydrates play an important role in supporting optimal Service member physical performance, with particular importance during longer duration exercise (Stellingwerff and Cox 2014). Low carbohydrate intake may even impair the muscle hypertrophy associated with strength training, and a study of male Norwegian Soldiers suggests long-term restriction of carbohydrate intake (i.e., 8 to 12 weeks) may impair anaerobic output during high-intensity aerobic physical exertion (e.g., sprinting, timed fitness tests) (Margolis and Pasiakos 2023). However, literature exploring associations of carbohydrate supplementation in military populations has provided mixed findings, with some reporting no performance improvement linked to carbohydrate intake, even in comparison with high-fat ketogenic diets, although differing study subject sample and designs and varying levels of study robustenss make comparisons challenging (Tvaryanas et al. 2018; McGinnis et al. 2018; Murphy et al. 2021; McAdam et al. 2022). Nevertheless, carbohydrate intake may be important for optimal recovery from strenuous expercise, as suggested by a meta-analysis of 20 original studies showing that co-ingestion of protein *and* carbohydrate was important for optimzing muscle gycogen sythesis rates for recovery following exercise, and that ingestion of additional energy from protein in the absence of carbohydrate did not support optimal muscle glycogen synthesis (Margolis et al. 2021).

Hydration and physical performance

The importance of adequate hydration for physical performance has been generally well documented, particularly for the deleterious effects of hypohydration on performance of low-intensity endurance exercise (Cheuvront, Carter, and Sawka 2003). More recently, systematic reviews have compiled evidence supporting adverse effects of hypohydration on other physical performance metrics, including strength, power, and high-intensity endurance, reporting

significant decrements in performance for these metrics (Judelson et al. 2007; Savoie et al. 2015). Proper and adequate hydration are particualrly important for Service members when training and working in the heat, especially in hot, humid environments, as a means to prevent dehydration and EHI or exertional heat stroke (EHS) (Knapik and Epstein 2019; Periard, DeGroot, and Jay 2022). Inadequate fluid intake while training in the heat may not only increase risk for dehydration but may also decrease Service member tolerance to even mild central hypovolemia, or reduced blood volume as a result of dehydration, highlighting the importance of adequate hydration during periods of concurrent exertion and thermal strain (Schlader et al. 2015). However, there are also risks associated with overconsumption of water, even during exercise in hot conditions, as this may result in hyponatremia, or low serum and cellular sodium concentrations, a dangerous condition that can be fatal (Kolka et al. 2003; Poon et al. 2022). Encouraging Service members to adhere to fluid replacement guidelines may help to mitigate this risk (Kolka et al. 2003). At least one randomized controlled trial of 57 male South African Soldiers reported approximately 300 mL of fluid intake per hour during a 16-km march in hot conditions could be considered as a safe minimum, although only under similar experimental conditions (Nolte, Noakes, and Nolte 2013).

Micronutrient supplementation and physical performance

Supplementation of micronutrients in the form of additional vitamins and minerals may support physical performance. For instance, evidence from at least one general population study suggests that muscle soreness may be reduced through omega-3 supplementation (Kyriakidou et al. 2021), while studies of male and female military personnel, ROTC cadets, and recruits suggest that both supplemental vitamin D and DHA/EPA may be favorably associated with military fitness test performance, specifically plank performance for EPA and performance on deadlift, push-up, 2-mile run time, endurance, and overall fitness test score for vitamin D (Carswell et al. 2018; Heileson et al. 2022.) Creatine (either as creatine monohydrate or creatine nitrate), a nutritional ergogenic aid and perhaps one of the most widely studied dietary supplements, is considered a safe dietary supplement and may have beneficial effects on Service member physical performance, with studies suggesting improvements on bench press (volume and peak power), vertical jump performance, and pull-up performance (Bennett et al. 2001; Warber et al. 2002; Galvan et al. 2016; Samadi et al. 2022). Conversely, at least one systematic review of 21 military studies concluded no performance-enhancing benefits of creatine supplementation in military personnel, although dosing, types of military fitness testing, and sample groups and sizes in the included studies may have precluded the ability to detect performance differences (Havenetidis 2016). These discordant results suggest there may remain a need for more robust research with military populations to further investigate and quantify the effects of creatine supplementation. Nevertheless, systematic review findings also suggests benefits other than improved physical performace, to include enhanced cognitive-psychomotor performance, bone health, protection from musculoskeletal damage, and neuromuscular function (Havenetidis 2016).

Physical Fitness and Physical Performance

Physical fitness is an important factor for both current and new military personnel and can be addressed and assessed through training interventions and fitness testing, respectively.

Physical activity and physical performance

Maintenance of physical fitness through regular and consistent physical activity benefits physical performance by improving multiple aspects of fitness, including CRF, strength, agility, and functional training, and may directly impact occupational performance. During routine operations in the garrisoned environment, Service members should strive to meet or exceed physical activity recommendations, to include both aerobic and strength training, and decrease time spent sitting, which may become increasingly important for Service members as they age and/or take on more sedentary roles in the workplace (Kennedy-Armbruster et al. 2013).

Table 6 presents recommendations, definitions, and examples for the various types of exercise that are listed in *Health and Human Services Physical Activity Guidelines for Americans* (DHHS 2018).

Table 6. Physical Activity Guidelines

	Aerobic Activity: Moderate	**Aerobic Activity: Vigorous**	**Strength Training**
Definition	Any activity that raises heart rate between approximately 50% and 60% of an individual's age-estimated maximum heart rate and can be performed while still holding a conversation with minimal difficulty.	Any activity that raises an individual's heart rate to age-estimated maximum or near maximum and cannot be performed while holding a conversation without difficulty.	Exercises that work all major muscle groups against some form of resistance.
Examples	Brisk walking, playing tennis with a partner, household chores such as mopping floors or raking leaves	Running faster than 5 mph or swimming laps	Weightlifting, or exercises that use body weight as resistance such as push-ups and sit-ups
Recommendation	150 minutes/week	75 minutes/week	At least 2 sessions/week

During deployment, however, Service members may find it more difficult to participate in regular physical activity outside of that achieved during routine operations due to the competing demands placed on Service members during this time. Nevertheless, evidence from at least one study of male and female U.S. Army personnel supports the importance of achieving aerobic and strength training three or more days per week throughout deployment as a strategy to support CRF, endurance, and strength (Warr et al. 2013), especially given evidence that aerobic endurance may decrease during deployments concomitant to reduced participation in aerobic training (Pihlainen et al. 2023).

Military recruit fitness and physical performance

Trends in fitness of the general U.S. population indicate that fewer than 1 in 3 young adults are fit for military service, and that recruits may enter military service at lower fitness levels than previous generations, thus requiring more conditioning to achieve the standard (Cawley and Maclean 2012; Webber et al. 2023). A 2017 systematic review examining 38 years of data on U.S. Army recruits reported a trend of decreasing 2-mile and 1-mile run times with little to no change in push-up and sit-up performance during the years that data were collected (Knapik et al. 2017), supporting the need for increased cardiorespiratory endurance training among new recruits.

General Population Recommendations and Research: Physical Activity

Engaging in regular physical activity is effective for improving overall health and fitness, as well as reducing the risk of chronic disease. Scientific research extensively demonstrates the many health benefits of physical activity among the general population and emphasizes that any additional activity beyond recommended levels yields further benefits. A minimum of 150 minutes of weekly, consistent, moderate-intensity aerobic activity is recommended and shown to reduce the risk of chronic diseases and adverse health outcomes. However, the general population in the United States struggles with meeting the recommended guidelines for physical activity. Many individuals live sedentary lifestyles and do not engage in as little as 60 minutes per week of physical activity. According to the CDC, the prevalence of physical inactivity among U.S. adults was 25.3% (CDC 2025); less than half (46.9%) of U.S. adults aged 18 and older met the Physical Activity Guidelines for aerobic physical activity; and only 24.2% of U.S. adults age 18 and older met the Physical Activity Guidelines for both aerobic and muscle-strengthening activity (CDC NCHS 2022). If these unhealthy physical activity behaviors continue, the general population will experience increased risk of many adverse health outcomes.

Many studies involving the general population have investigated the health benefits of physical activity, highlighting the beneficial relationships between physical activity and better health-related outcomes, including improved brain health and cognitive functioning (Deslandes et al. 2009; Phillips 2017; Erickson et al. 2019); weight management (Rippe and Hess 1998; Oppert, Bellicha, and Ciangura 2021; Petridou, Siopi, and Mougios 2019; Paixao et al. 2020; Swift et al. 2014); reduced risk of cardiovascular disease (Elagizi et al. 2020; Garcia et al. 2023; Kaminsky et al. 2022; Myers, Kokkinos, and Nyelin 2019); reduced risk of type 2 diabetes (Carbone et al. 2019; Wahid et al. 2016); reduced risk of serious outcomes from infectious diseases (Chastin et al. 2021; Nieman and Sakaguchi 2022; Jimeno-Almazan et al. 2021; Morrow et al. 2022; You 2023); reduced cancer risk (Garcia et al. 2023; Brown et al. 2012; Wang and Zhou 2021; McTiernan et al. 2019); management of existing chronic conditions and disabilities (West et al. 2019; Barkley and Reams 2021; Sharif et al. 2018; Ko et al. 2021); and improved quality of life (Wu et al. 2017; Pucci et al. 2012; Marker, Steele, and Noser 2018; Reid et al. 2010).

Fitness testing and physical performance

Evidence, including at least one systematic review, suggests balanced training programs that include both aerobic and full-body strength training are optimal for improving fitness test performance (Kyrolainen et al. 2018; Vaara et al. 2022), with those who meet or exceed physical

activity guidelines being more likely to score higher on and pass fitness tests (Anderson et al. 2017; Grier et al. 2015; Heinrich et al. 2022; Kraemer et al. 2004; Santtila et al. 2022). Studies of predominantly male (90% or greater) U.S. Military personnel suggest that healthier body composition, including greater lean mass and lower body fat percentage and fat mass, may be associated with better performance on fitness tests (Anderson et al. 2017; Farina et al. 2022) and tests of strength and power (Aandstad 2020; Hydren et al. 2017; Poser et al. 2019). Just as better physical fitness and healthier fitness behaviors may improve military fitness test performance, practice of unhealthy behaviors, including tobacco consumption and failure to meet physical activity guidelines, may degrade fitness test performance for both male and female Service members (Heinrich et al. 2022; Russell et al. 2019).

The physical demands of Service members can vary widely, making it difficult to determine the optimal way to assess performance and physical readiness, particularly due to the constraints of testing a large population on a regular basis. Researchers have compared various fitness assessments to identify comprehensive indicators of Service member physical fitness and performance. While there are key physical occupational tasks Service members are likely to perform, including load carriage, manual material handling, and casualty evacuations (Vaara et al. 2022), historically U.S. Military physical assessments have measured basic fitness through exercises such as timed runs, push-ups, sit-ups, and planks. However, evidence suggests these tests may only assess muscular and aerobic endurance without providing accurate measures of functional performance (Huang et al. 2018). A systematic review and meta-analysis assessing relationships between fitness test performance and military-related occupational tasks found correlations between cardiorespiratory endurance and the lift and carry test, and between upper body strength and the single-repetition lift and lower task, while lower body strength tests were correlated with performance on the stretcher carry task (Hauschild et al. 2017). However, many of the other tests assessed, such as those assessing trunk strength or endurance, only weakly correlated, or were not correlated, with occupational task performance (Hauschild et al. 2017). Conversely, occupational task tests such as the warrior task simulation test (WTST), which consists of various occupationally relevant tasks such as high crawl, casualty drag, point-aim and move drills, 91-meter shuttle sprint with ammo can, and agility sprint, have been developed with the aim to better understand the true physical requirements of Service members. Studies of the WTST conducted with male civilians suggest that muscular endurance, aerobic fitness, lower levels of body fat, and higher agility are independent predictors of performance on the WTST, and that historic military fitness tests may not be adequately comprehensive to assess occupational task performance (Huang et al. 2018). Whilte there may be no perfect solution for assessing military performance, studies of other occupational task tests such as box lifts, the casualty evacuation drill, and the Ranger Physical Assessment test, or occupation-specific movement tests such as the countermovement jump, conducted with military Service members support previous reports highlighting the importance of training approaches designed to support the development of aerobic fitness, lean muscle mass, strength, and power for both male and female Service members (Szivak et al. 2014; Barringer et al. 2019; Pihlainen et al. 2018; Poser et al. 2019).

Training modality and physical performance

Given the importance of physical training for improving and optimizing Service member performance, the development of military physical training programs has been an important research focus. Training programs designed to increase Service members' practice of interval and functional type training in addition to, or even in lieu of, traditional military training consisting of long-distance running and bodybuilding-type resistance training have shown success in improving Service members' body composition, CRF, power, and performance on military occupation-relevant tasks such as casualty recovery drills (Helen et al. 2023; Lester et al. 2014; Walker et al. 2011), although many of these studies have included predominantly or all-male participants. Highlighting the value of training programs that address multiple aspects of Service member fitness for both male and female Service members, a 12-week study of male and female active-duty U.S. Air Force personnel assessing the effects of a program consisting of a total body resistance circuit, moderate recovery-oriented cardiovascular exercise, and high intensity cardiovascular endurance training reported significant improvements in participant strength and endurance, power, mobility, and lean muscle mass versus a traditional military training program (Zwilling et al. 2020). Further support for similarly novel, multimodal military training programs is provided in a systematic review and meta-analysis reporting significantly greater improvements to muscular endurance, power, strength, and occupational physical performance measures with such programs as compared with traditional training regimens (Smith et al. 2022). Similarly, studies have also examined ways to prevent the decrements in fitness commonly reported for Service members during deployment. These studies noted that combined endurance and strength training, regardless of strength-to-endurance training emphasis, undertaken an average of three days per week throughout deployment was sufficient to help male Soldiers maintain body mass and fitness (Pihlainen et al. 2022).

Although most available studies on the topic of training modalities for Service member performance have enrolled predominantly male participants, research with female Service members suggests that these individuals may benefit from tailored physical training programs, with greater emphasis on the development of upper body strength and power, especially for those with a combat-arms MOS (Nindl 2015). In fact, training programs tailored specifically for improvement of occupational lifting tasks for female Service members have demonstrated success in qualifying female Soldiers for "heavy: and "very heavy" MOSs after six months of training (Nindl et al. 2017).

Together, the literature suggests that identifying a single best training program for Service members may be challenging due to substantial differences in tested programs, including program length, training frequency, and modality. Moreover, performance optimization is likely not a one-size-fits-all approach; rather, Service members should focus on meaningful training progression, with emphasis on functional movement and balanced programs with sufficient recovery and nutritional support to prevent injury (Kyrolainen et al. 2018). The available evidence suggests that incorporating agility and high intensity functional training in lieu of long-distance aerobic training may maximize training adaptations with lower training time commitments (Haddock et al. 2016; Helen et al. 2023; Lennemann et al. 2013).

Psychological Health and Physical Performance

Psychological health may have important linkages with physical performance through reciprocal relationships with allostatic load and physical activity.

Mental health, allostatic load, and physical performance

Psychological health may contribute to physical performance through the association of allostatic load with physical fitness (Corrigan et al. 2021). Evidence from a systematic review of 26 studies suggests that lack of physical activity may contribute to increasing allostatic load (Suvarna et al. 2020), which is an indicator of the cumulative burden of chronic stress and associated with overall poorer health outcomes (Guidi et al. 2021). As lower HRV may indicate increased allostatic load, HRV may be a means by which to capture allostatic load. In a systematic review, HRV was reported to be reduced following stress exposure, with greater magnitude of stress resulting in more persistent reduction of HRV, and reduced HRV was associated with occupational performance decrements among tactical operators and first responders (Corrigan et al. 2021). Taken together, this evidence suggests that cumulative "wear and tear" measures such as allostatic load may be indicative of linkages between psychological health and physical health and performance-related outcomes, and that the relationship between allostatic load and these measures may be mediated to some extent by physical activity or fitness.

Psychological health and occupational performance

Beneficial psychological characteristics such as resilience, mental toughness, and hardiness, may improve occupational performance (Beckner et al. 2021; Giles et al. 2018; Lin et al. 2017; Wong et al. 2022; Bartone and Bowles, 2020) and studies with male and female U.S. Air Force personnel suggest that these attributes may help Service members push through the rigors and challenges that often accompany military life and high stress occupational environments (Pflanz 2001; Pflanz and Ogle 2006). A previous synthesis of more than 270 research studies defined resilience as "the process of negotiating, managing, and adapting to significant sources of stress or trauma" (Windle, Bennett, and Noyes 2011), while mental toughness has been defined as "a state-such as psychological resource that is purposeful, flexible, and efficient in nature for the enactment and maintenance of goal-directed pursuits" (Gucciardi 2017). Hardiness, which has both state- and trait-like qualities, is marked by a strong sense of commitment; a belief that the world is interesting and meaningful; belief in the ability to control or influence outcomes; and a willingness to accept challenge in terms of having an adventurous approach to living (Bartone and Bowles 2020). Service members with greater trait resilience, coupled with a high level of fitness, may perform better in stressful operational environments, which can include exposure to multiple external stressors for a sustained period (Beckner et al. 2021), and mental toughness may improve the ability to handle stressful situations and increase commitment to tasks (Lin et al. 2017). Mental toughness has also been associated with behavioral perseverance in male and female U.S. Army personnel (Giles et al. 2018), which may enhance occupational task

performance and improve the likelihood of selection to certain military assignments such as Special Forces (Gucciardi et al. 2021).

Conversely, psychological factors such as mental health conditions can negatively impact Service member occupational performance. Specifically, associations of work-related stress, anxiety, depression, and PTSD with impaired work performance and absenteeism have been reported among both male and female active-duty U.S. Military personnel (Dunbar et al. 2022; Pflanz and Ogle 2006). Importantly, occupational specialty may play a mediating role in this relationship, as two large studies have associated Service member MOS with new-onset PTSD and/or suicide risk, particularly for Service members in combat roles (Mayo et al. 2013; Straud et al. 2020).

Spiritual Health and Physical Performance

Spiritual well-being, which may include existential and/or spiritual well-being, may influence physical performance by increasing physical resilience and other measures of occupational well-being.

Spiritual well-being and physical performance

General population studies, as well as studies of U.S. Air Force personnel and military veterans, suggest that spiritual well-being, existential well-being, and workplace spirituality can improve physical resilience and protect against professional burnout, work or family conflict, and emotional exhaustion, and increase self-efficacy (Bormann et al. 2012; Dal Corso et al. 2020; Oglesby et al. 2021; Wood et al. 2018). Spiritual well-being, defined by the National Interfaith Coalition on Aging as "the affirmation of life in a relationship with God, self, community, and environment that nurtures and celebrates wholeness," consists of multiple dimensions, including the "horizontal dimension" of existential well-being, or "one's sense of purpose and satisfaction in life," and the "vertical dimension" of religious well-being, or "an individual's relationship with God or some higher power" (National Interfaith Coalition on Aging 1975; Ellison 1983). Spiritual well-being includes practices and behaviors such as mindfulness and self-compassion, fostering a sense of gratitude, feelings of well-being and joy, a positive spiritual connection to something larger than self, and a cognitive sense of being authentic and engaged in meaningful occupations, all of which have been found to contribute to active coping and improved quality of life (Ramon, Guthrie, and Rochester 2020); life satisfaction (Green, Noor, and Ahmed 2020); and higher positive affectivity and work engagement (Dal Corso et al. 2020). Research with U.S. Air Force personnel suggests that individuals with a greater sense of well-being tend to have greater levels of social support, and it is likely that this relationship is bi-directional, while work conflict and overload, relationship stress, low job satisfaction, and low unit cohesion are associated with lower levels of well-being (Bufford et al. 2023).

Interaction of the Health and Fitness Domains and Physical Performance

Table 7. Interaction of Health and Fitness Domains and Their Influence on Physical Performance

Outcome	Interacting Domains	Findings	Reference
Physical performance (overall)	Medical Preventive Health Physical Fitness	Endorsement of multiple adverse health behaviors (such as inactivity, obesity, smoking) have an additive negative effect on physical performance.	Teyhen et al. 2016
	Nutritional Health Medical Preventive Health Physical Fitness Psychological Health Environmental Health	Field training and sustained operations, which combine sustained physical activity with sleep restriction, low caloric intake, stressful scenarios, and often environmental extremes, is associated with physical performance decrements.	Heilbronn et al. 2023; Margolis et al. 2014; O'Hara et al. 2014; Ojanen et al. 2023; Pihlainen et al. 2023; Ponce et al. 2023; Vaara et al. 2015
Occupational performance	Medical and Preventive Health Psychological Health	Acute tobacco cessation can result in anger, irritability, and slowed reaction times, reducing occupational performance.	Giannakoulas et al. 2003
CRF	Nutritional Health Psychological Health	Health behaviors such as skipping breakfast and consuming low-quality diets reduce physical performance.	Clayton and James 2016; Farina et al. 2020; Ghodsi et al. 2023; Jayne et al. 2021

Gaps and Calls to Action in Physical Performance

Physical performance is a key component of Service member readiness that allows Service members to meet the rigorous physical demands of military service. Service member physical performance is often assessed through military fitness tests or individual component measures such as CRF, muscular and cardiovascular endurance, and muscular strength or power, and research findings highlight the importance of concurrent positive health behaviors across multiple domains to maximize physical performance. However, gaps remain in the understanding of how many factors spanning multiple domains of health and fitness influence Service member physical performance, and future studies addressing these gaps will be an important part of continued efforts to optimize U.S. Military personnel readiness.

1. *The influence of financial, social, and spiritual health on Service member physical performance*. There is limited available information in military populations on how social, spiritual, or financial health may impact physical performance or performance on fitness tests. For example, better understanding of how unit cohesion, a social domain component, contributes to physical performance may provide additional support for programs designed to optimize unit leadership and cohesion among unit members.

2. *The influence of other environmental factors (e.g., climate change, the built environment) on physical performance.* There is a need to better understand how environmental factors such as climate change and the built environment, to include both the design of military installations and communities as well as the buildings in which Service members live and work, may be associated with both physical performance and cross-domain factors such as physical training- which may also influence physical performance. Moreover, there is a need for study populations that better reflect the demographic makeup of military populations when these research questions are investigated. Specifically, an evidence gap exists pertaining to the exploration of potential differences between male and female Service members (e.g., performance of female Service members in cold climates and at high altitudes; training modalities for the optimization of performance of female Service members), as most currently available studies were conducted with all-male military personnel samples.

3. *Wearable devices and Service member physical performance*. Continued research regarding the impact of wearable devices designed to track metrics associated with improving Service member physical and occupational performance, as well as compliance with the use of such devices, is warranted as a means to maximize Service member physical performance without unnecessary safety risks.

4. *Service member acclimatization to adverse environmental and climatic conditions.* There is a need for research that can further elucidate the physiological mechanisms associated with environmental acclimatization and adaptation and how these processes may influence Service member performance, especially in harsh and unforgiving climates. There is also a need for additional robust research examining whether and to what extent male and female Service members may differ in terms of performance in and acclimatization to training and operational performance in adverse environments.

Physical Health

Health and Fitness Domains with Evidence Pertaining to Physical Health

Environmental	Financial	Medical/ Dental	Nutritional	Physical	Psychological	Social	Spiritual
★		★	★	★	★	★	

Introduction

Maintaining optimal physical health is essential for ensuring the operational readiness and effectiveness of Service members and overall mission success. Physical health directly impacts Service members' ability to endure arduous conditions, execute missions effectively, and recover quickly from injuries, as well as contributes to stress resilience, enhances mental well-being, and reduces risk of injuries and illnesses, all of which may promote longevity and even military retention. Given the critical role of physical health for Service member readiness, it is important to explore how domain components and factors contribute to physical health; in turn, this understanding may inform comprehensive strategies for maintaining and even improving Force physical health and readiness.

Environmental Health and Physical Health

Environmental factors, such as extreme environments, flora and fauna, and vector-borne disease can affect physical health, particularly injury, communicable and chronic disease, sleep, and mortality.

Body composition, obesity, and extreme environments

The external environment can impact a Service members' body composition, due primarily to a combination of factors involving both energy consumption and expenditure. Studies conducted with predominantly male Service members suggest it is common for military personnel to experience declines in both muscle and fat mass during strenuous field training operations or deployments due to the concurrent sustained physical activity and low caloric intake (Gan et al. 2022; Henning et al. 2011; O'Hara et al. 2014; Ojanen et al. 2023; Pihlainen et al. 2023). When combined with certain environmental conditions, such as thermal stress during cold exposure, there is an increased energy demand resulting from the need to complete strenuous physical tasks while also maintaining body temperature, which may further exacerbate body weight decline if sufficient energy intake is not maintained (Ahmed et al. 2020; Ojanen et al. 2023). For example, a small study of male and female Canadian Armed Forces personnel found that during a 5-day cold weather field exercise, participants consumed a significantly lower energy intake as compared to daily expenditure, resulting in a 4% decrease in body fat percentage (Ahmed et al. 2020). Similarly, there is evidence that exposure to high elevation may impact Service member body composition by increasing basal metabolic rate by as much as 30%, and, subsequently, increasing the total energy required for physical activity (Hill et al. 2011). This, coupled with the loss of appetite that has been shown to occur with rapid ascent to high elevation, may make it difficult for military personnel to consume enough energy to avoid body mass loss (Hill et al. 2011); however, Service member performance may be protected through consumption of a high-carbohydrate diet (Hill et al. 2011). In contrast, hot thermal stress due to hot climatic conditions may interact with body composition in a different way, where those with higher levels of body fat are more prone to experiencing heat intolerance and exertional heat illness (EHI), important given the association of hospitalization for EHI with both all-cause and cardiovascular long-term mortality as shown in at least one cohort study of U.S. Army personnel

(Wallace et al. 2007; Bedno et al. 2014; Alele et al. 2021b). Taken together, literature supports the importance of adequate or even supplemental energy intake for the preservation of body composition in situations of exposure to cold or high-elevation environments, although measures to reduce the risk of heat illness may need to be taken when Service members who exceed body composition requirements are operating in hot environments.

Environmental health and musculoskeletal injury

Physical strain and exertion involved in military missions significantly increases the risk of MSKi, which can adversely impact overall physical health (Ang et al. 2009; Armed Forces Health Surveillance 2012; Henning et al. 2011; Kollock et al. 2016; Lyons et al. 2021; O'Hara et al. 2014; Posch et al. 2019; Shiri et al. 2015; Yoganandan et al. 2015). Skeletal muscle and bone are susceptible to loss, weakening, and damage during prolonged military missions, primarily due to repetitive motions, carrying of heavy loads, and vibrations associated with military vehicles, making soldiers highly vulnerable to stress fractures (Henning et al. 2011) and spinal injuries (Kollock et al. 2016). Military subgroups who may be at increased risk for MSKi due to operational stress include U.S. Special Operators (O'Hara et al. 2014) and Service women in the U.S. Military who completed at least one deployment (Armed Forces Health Surveillance 2012). Thus, evidence suggests that limiting deployment frequency may promote physical health benefits and reduce risk for MSKi (Armed Forces Health Surveillance 2012; Henning et al. 2011).

Military pilots may have particularly increased risk for occupational-related injuries to the cervical and lumbar spine as a result of flight-specific environmental factors, including high-volume flight schedules, in-flight posture required to perform certain tasks, helmet mass, number of flight hours logged, helicopter vibrations, and crewmember height and overall fitness (Ang et al. 2009; Harrison et al. 2015; Posch et al. 2019; Shiri et al. 2015; Wallace et al. 2021; Yang et al. 2021). These factors highlight the growing concern of MSKi for this subpopulation and the need for preventive approaches, as a study of male Chinese male military pilots suggests that pain and injury to the spine in these personnel may lead to worsening neck pain, weak core muscle activation, and reduced hip strength (Yang et al. 2021). Effective approaches to reducing neck and/or back pain prevalence in this population may include incorporation of neck and shoulder exercise regimens (Ang et al. 2009) or vibration exercises, shown in at least one general population study to reduce low back pain by improving core strength (Lyons et al. 2021).

High altitude and non-musculoskeletal injury

Along with increased risk for MSKi, military Service members may also have increased risk for other injuries and illnesses due to environmental exposures. Exposure to hypoxic conditions due to high elevation can lead to AMS, generally occurring for most unacclimatized individuals at altitudes greater than 14,700 ft (Bartsch and Swenson 2013; de Aquino Lemos et al. 2012; Fabries et al. 2022; Issa et al. 2016; Luks et al. 2010; McMorris et al. 2017; Shaw et al. 2023; Shaw et al. 2021). Common AMS symptoms include headache, dizziness, and nausea, and are more common among those who ascend quickly and are not acclimatized to high elevation (Burtscher, Hefti, and Hefti 2021; Bartsch and Swenson 2013; Norris et al. 2012). General

population research suggests increased severity of AMS is associated with increasing altitude (Irarrazaval et al. 2017) and higher rate of perceived exertion (Bakker-Dyos et al. 2016), which may have important consequences for Service members. More severe forms of AMS can include cerebral and pulmonary edema and can be life-threatening if untreated (Bartsch and Swenson, 2013). However, it is important to note that side effects of hypoxia may vary on an individual basis, as does the time to high-altitude acclimatization, and at least one systematic review and meta-analysis suggests certain there may be sex- and age-based differences in AMS risk (Hou et al. 2019). A history of migraines or previous AMS may also increase Service members' risk for AMS (Richalet et al. 2012), and a study of U.S. Marines has identified dehydration and recent arrival at the designated elevation identified as additional risk factors (Norris et al. 2012). High altitude exposure may also increase the risk for development of inflammatory or autoimmune disease, particularly when combined with other pro-inflammatory risk factors such as smoking (Hussain and Tripathi, 2018). Importantly, tolerance of and recovery from high altitude exposure may be supported by hypoxia training (Cable 2003), dietary nitrate supplementation (Marshall et al. 2021), and medications such as zolpidem and zaleplon, administered before sleep to promote sleep recovery and reduce high altitude induced fatigue (Jouanin et al. 2009).

Cold exposure and non-musculoskeletal injury

Depending on the severity of cold exposure, military Service members exposed to cold environments may also be at an increased risk for frostbite or non-freezing cold injuries (NFCI), which covers a range of clinical syndromes often referred to colloquially as trench foot, immersion foot, and paddy foot, all of which are associated with sustained exposure to cold, wet environments (Imray et al. 2011). While NFCI typically does not occur at temperatures below freezing owing to the need for moisture, variables influencing frostbite, which can only occur in below-freezing temperatures, may overlap with those influencing NFCI (Zafren, 2021), and evidence suggests military personnel may be more likely to have such injuries during routine training exercises rather than combat operations (Imray et al. 2011). Avoiding prolonged exposure to cold, wet environments is an effective approach to preventing NFCI, along with other prevention behaviors such as increasing blood flow to the feet, remaining active, keeping feet dry, and maintaining core body temperature (Imray et al. 2011).

Hot climates and non-musculoskeletal injury

A substantial amount of research strongly suggests prolonged exposure to hot climates may significantly impact Service member physical health, and that military personnel may be at an increased risk for EHI including heat exhaustion, heat injury, exertional heat stroke (EHS), or other related illnesses such as exertional rhabdomyolysis, exercise-associated hyponatremia, and exercise collapse associated with sickle cell trait (Alele et al. 2021a; Alele et al. 2020b; Goforth and Kazman 2015; Hosokawa et al. 2019; Kazman et al. 2020; Kazman et al. 2015; Lee et al. 2022; Lewandowski and Shaman 2022; Li et al. 2021; Nelson et al. 2018; Oh et al. 2022; Periard et al. 2022; Williams and Oh 2022). In addition to thermal stress, other factors may mediate risk for EHI in military populations, including low physical fitness levels, obesity, prior day thermal exposure or history of EHI, sleep deprivation, dehydration, and MOS (Alele et al.

2021b; Alele et al. 2020b; Goforth and Kazman 2015; Hosokawa et al. 2019; Lewandowski and Shaman 2022; Williams and Oh 2022). Despite some studies suggesting that female sex may play such a role in EHI risk, evidence is conflicting (Alele et al. 2020a; Kazman et al. 2015; Periard et al. 2022; Williams and Oh 2022). Other mediating factors may also include dietary choices such as caffeine consumption, which may increase exercise-induced physiological strain (Kazman et al. 2020), insufficient energy/nutrient intake, and improper fluid and electrolyte intake (Lee et al. 2022). Body armor and load-carrying may also contribute to risk for overheating among military personnel, as suggested by an *in silico* study reporting an inverse relationship between body armor coverage and the work duration needed to reach dangerous core temperatures (Hunt et al. 2022). Finally, high motivation may also place military personnel at increased risk for EHI, as highly motivated individuals will likely push themselves in an attempt to work through early symptoms (Alele et al. 2020b; Goforth and Kazman 2015; Hosokawa et al. 2019; Periard et al. 2022). The EHS literature has also explored the possible role of rhabdomyolysis in EHS, especially in hot environments (Li et al. 2021), and among both male and female Service members, there is evidence that a significant relationship exists between exertional rhabdomyolysis (Oh et al. 2022) and EHI (Nelson et al. 2018).

Dangerous flora and fauna and non-musculoskeletal injury

Certain deployment or training environments may increase Service member risk for dangerous wildlife encounters and injuries associated with bites or stings. Temporary structures commonly used for field sanitation and living quarters in austere environments may increase exposure to biting and stinging arthropods, and use of such structures may even serve as a surrogate marker of that exposure risk (Shiau et al. 2007). Service members should ensure they are aware of venomous snakes and arthropods and use of protective clothing, when possible, to help to mitigate risk of injury (Shiau et al. 2007).

Communicable and vector-borne diseases

A considerable amount of military-focused research strongly suggests that vector-borne and communicable disease infection has significant effects on Service member physical health. Research has found this population is at an increased risk for vector-borne diseases, including arthropod-borne diseases such as Lyme disease, malaria, dengue, leishmaniasis, chikungunya, Rift Valley fever, West Nile virus, Rocky Mountain spotted fever, Mediterranean spotted fever, African tick bite fever, ehrlichiosis, Congo hemorrhagic fever, sleeping sickness, Q fever, brucellosis, and chagas disease (Aronson et al. 2006; Frickmann and Herchenroder 2019; Hurt and Dorsey 2014; Kitchen et al. 2009; Pages et al. 2010; Schubert and Melanson 2020; Webber et al. 2017; Weina et al. 2004; Willard et al. 2005; Yanik et al. 2004). Vector hosts include mosquitos, sand flies, ticks, mites, fleas, louse, tsetse flies, and kissing bugs; Service members may also be exposed to infected rodents carrying tick-borne diseases (Chae et al. 2003). Vector-borne diseases specific to a particular locale or environment may pose significant challenges to deployed military personnel. For example, malaria incidence was once as high as 52 cases per 1000 Soldiers deployed in the Middle East (Beiter et al. 2019), with few cases observed in other geographic locations. This rate has decreased in recent years, largely due to withdrawal of

Service members from the Middle East (Beiter et al. 2019). However, climate change poses unique challenges to the prevention of vector-borne diseases, as it alters the geographic distribution and prevalence of vector species carrying human pathogenic diseases (Mora et al. 2022). Health hazards in areas of military operations vary with climatic and sanitary conditions, including overcrowding of barracks and training spaces, poor hygiene, and lack of clean water in field or deployment operations (Aronson et al. 2006; Ho et al. 2014; Korzeniewski, 2011), prompting the need for transformative approaches in military medicine and defense medical support (Robinson et al. 2023). Surveillance and control measures for specific diseases, such as West Nile virus near naval stations, have been implemented (e.g., miniature light traps baited with dry ice, baited gravid traps, New Jersey light traps, Fay-Prince traps, encephalitis vector surveillance traps, the Mosquito Magnet) (Stein and Claborn, 2005). Satellite vegetation index data for forecasting mosquito population dynamics is another effective tool implemented by military stations (Britch et al. 2008). Additionally, the use of personal protective measures (Vickery et al. 2008) such as permethrin treated uniforms and bed nets and the use of DEET to prevent insect bites are common approaches for preventing or limiting vector-borne disease exposures (Kitchen et al. 2009).

Environmental health and chronic health conditions

Environmental exposures such as toxins, extreme temperatures, and characteristics of the built environment may increase Service members' risk for developing chronic conditions and increased somatic symptom burden, which may be mediated by concern about environmental exposures (McAndrew et al. 2012). For example, environmental exposures in the workplace, such as to noise and solvents (e.g., jet fuel) may have a combined adverse impact on the central auditory nervous system (Warner et al. 2015). Additionally, exposure to per- and polyfluoroalkyl substances (PFAS), used in many military munitions and fire retardants and released into the environment where they can be directly inhaled or absorbed into water and soil, may increase risk for diabetes mellitus and cardiovascular disease (Koban and Pfluger 2023).

Other chronic conditions associated with environmental exposures include an increased risk for chronic respiratory symptoms, airway diseases, and lung injury during or following deployment, due to airborne particulate matter, dust, lead, silica dust, and firearm-related chemical exposures (Berman et al. 2021; Falvo et al. 2015; Garshick and Blanc, 2023) associated with burn pits (Olsen et al. 2022; Wang et al. 2023), dust storms, improvised explosive device blasts, exhaust from small arms fire, and combustible fuel exhaust from vehicles (Wauters et al. 2019). While evidence from Service members returning from deployment to Iraq and Afghanistan consistently supports the development of chronic airway obstructions, airway hyperreactivity, and other respiratory tract diseases associated with these exposures there (Falvo et al. 2015; Korzeniewski et al. 2013), there is mixed evidence regarding the development of asthma (DelVecchio et al. 2015; Morris et al. 2014; Rivera et al.), suggesting a need for additional studies of Service member deployment-related risk for this condition.

Pesticide exposures and risk for chronic illness

Pesticide exposure associated with environmental pesticides, pesticides applied to uniforms and in flea collars, and government issued DEET-containing insect repellant is a significant predictor of chronic multisymptomatic illness (CMI) in veterans, with one study of male and female U.S. Military veterans from the post-9/11 era suggesting that almost three-quarters of veterans may have at least one symptom of CMI and that more than one-third likely meet criteria for a CMI diagnosis (DeBeer et al. 2017). In particular, the vector-control insecticide permethrin (Macedo et al. 2007), often used to treat military uniforms to prevent bites from arthropods such as mosquitoes and ticks, may present risk for CMI, as evidence suggests that permethrin exposure via military uniforms may result in higher permethrin exposure among military personnel compared to other occupational groups (Maule et al. 2019). Moreover, permethrin-treated uniforms worn in high-heat conditions may result in significant permethrin absorption, as indicated by substantially increased urinary permethrin biomarker concentrations compared to ambient conditions (Maule et al. 2020; Proctor et al. 2020), which may be further exacerbated by wear-time duration (Proctor et al. 2014). Recommendations to reduce permethrin exposure include limiting wear-time duration (Proctor et al. 2014) and wearing uniforms that are treated using a new permethrin formulation (Proctor et al. 2023). Frequent washing of uniforms may also reduce permethrin exposure, likely due to removal of some of the permethrin during washing (Scarpaci et al. 2020). Notably, permethrin-treatment of military uniforms has been shown in studies to play a valuable role in the prevention of tick bites to Service members (Nadolny et al. 2024; Faulde et al. 2015), which may prevent infection with and spread of tick-borne diseases, underlining the need to examine risk-benefit ratios specific to the topic of permethrin and other pesticide use in Service member uniforms.

The built environment, climate, and sleep

There are many factors that may adversely impact physical health through their influence on sleep health among Service members. Good sleep hygiene, which includes environmental factors such as light, temperature, and noise conditions, is one of the basic tenets of ensuring sound, quality sleep (WRAIR 2025). However, military barracks are often not conducive to a good night's rest, as they are usually located near installation operations but not soundproofed against the associated noise, which can include moving troops, vehicles, and airfield noises, depending on the installation (Mantua et al. 2019). Further, sleeping near others, particularly during the day, may feel intrusive, especially to those new to the military environment (Mantua et al. 2019). Air pollution near military bases and lack of adequate climate control in high temperatures may also be barriers to adequate sleep for military personnel (Mantua et al. 2019). In addition to barracks conditions, requirements of operational missions and sustained field training may also prohibit Service members from obtaining the recommended 8 hours of sleep per 24-hour period (Bernhardt et al. 2019; Bulmer et al. 2022; Henning et al. 2011; Lieberman et al. 2005; Ponce et al. 2023). The conduct of such missions in extreme cold environments may worsen the adverse influence on sleep quality, increasing risk for sleep disorders, sleep latency, daytime impairment, and poor subjective sleep quality, as suggested in a study of predominantly male (97.8%) Chinese military personnel (Wang et al. 2020).

High elevation and sleep problems

Evidence suggests maintaining proper sleep health is especially important when exposed to high-elevation environments. Sleep parameters may become significantly altered and sleep disturbances more common at elevations greater than 13,000 ft, and may worsen sleep disorders, mood state, and depression (Ainslie et al. 2013; H. Wang et al. 2022). Sleep disturbances at high elevation may also include alterations in breathing patterns while sleeping, referred to as periodic breathing, that produce apneas and hypopneas and may affect male more than female Service members, as suggested in studies of the general population (Lombardi et al. 2013). While the hyperventilation response triggered by periodic breathing has been suggested to increase the overall oxygen saturation in the blood and aid in altitude acclimatization, periodic breathing during sleep in high-altitude environments is more likely to be characteristic of poor sleep (Nespoulet et al. 2012). Thus, Service members are advised to take measures to avoid sleep deprivation, which may include "sleep banking," the extension of normal nightly sleep duration, in the time leading up to high-altitude ascent (Fabries et al. 2022). Studies with Marine Corps personnel and the general population suggest Service members with pre-existing sleep difficulties such as insomnia may have greater risk for developing high-altitude headache (Norris et al. 2012) or AMS (Tang et al. 2014), which may also be associated with increased sleepiness, anger, depression, and fatigue (Figueiredo et al. 2022). Additional research on the use of sleep banking and the impact of sleep disorders such as obstructive sleep apnea and insomnia in high-altitude environments is needed to better understand the physiological implications of these overlapping stressors on both Service member health and performance.

Heat, exertional heat illness, and mortality

Research suggests that heat illness, occupational factors, and the built environment may influence Service member mortality risk. Heat related morbidity and mortality are becoming greater concerns due to climate change, although the incidence of morbidity and mortality from EHI is relatively low among Service members (Donham et al. 2020). Nevertheless, EHI incidence has been steadily rising over the past several decades alongside increasing temperatures and heat indices (Lewandowski et al. 2022; Williams and Oh 2022), with the incidence of EHI ranging from 1.4 to 2.6 cases per 1000 Soldiers (DCPH-A 2022; Williams and Oh 2022). Importantly, EHI incidence tends to be greater among new enlistees and Service members less than 25 years of age (DeGroot et al. 2022; Ogden et al. 2023; Williams and Oh 2022), as well as those in the Army or Marine Corps (Williams and Oh 2022). In addition to climate change, prior EHI hospitalization has also been shown to influence heat-related mortality, potentially resulting in standardized mortality rates as high as 50% in some circumstances (Wallace et al. 2007).

Occupational specialty-related exposures and mortality risk

In addition to EHI-related morbidity, cancer incidence and mortality are significant threats to Service member and veteran longevity and may be MOS-specific (Sharifian et al. 2023; Webber et al. 2022). A retrospective cohort study reported that male U.S. Air Force fighter aviators were more likely than their fellow officers to be diagnosed with melanoma and prostate cancers, with

greater standardized incidence and mortality ratios as compared with the general U.S. population (Webber et al. 2022). However, some studies suggest there may be a 'healthy deployer' effect, in which Service members with deployment experience appear to experience lower rates of certain adverse health outcomes, including cancers, compared with Service members who did not deploy; however, this is likely due to better baseline health of Service members who were deemed fit to deploy as compared with those unable to deploy (Rivera et al. 2018; Sharifian et al. 2023).

Occupational accidents also account for Service member mortality risk and may be mitigated by training and experiential learning, particularly for Service members in highly technical, high-risk MOS, such as military helicopter pilots. For example, a study of helicopter pilots in the general population suggests that those with fewer than six years of experience have as much as nine-fold higher risk for fatal crash during nighttime flights compared with those having at least six years of experience (Aherne et al. 2018). When generalized to military Service members, these findings suggest that prevention of operational accidents and reduction of the likelihood of fatal outcomes associated with such accidents may be dependent on ensuring that Service members have adequate instruction and experience both in simulations and under the tutelage of more experienced personnel, especially for operations in challenging environmental conditions, such as nighttime flight (Aherne et al. 2018).

Medical and Dental Preventive Health and Physical Health

Medical and dental preventive health includes a variety of concepts targeting physical health, including access to medical care and knowledgeable providers, cardiovascular health, immunizations, preventive health screens, dental health, hearing and vision protection, and tobacco-free living.

Medical and Dental Preventive Healthcare in the General Population: Alignment with Healthy People 2030

Ensuring medical and dental preventive health is an important aspect of reducing risk for both acute and chronic diseases and improving long-term quality of life. The U.S. Office of Disease Prevention and Health Promotion's *Healthy People 2030* outlines 34 preventive health objectives and more than 20 leading health indicators for the U.S. general population guided by evidence-based behavior recommendations that include regular dental and medical screenings. Examples of these recommendations are provided in the table that follows. Recommendations from the U.S. Preventive Services Task Force (USPSTF), the Centers for Disease Control and Prevention (CDC), the American Medical Association (AMA), and the American Dental Association (ADA) provide further support for these recommendations and more specific guidance on the types of screenings and preventive healthcare services demonstrated in the scientific literature to be effective for the prevention of acute and chronic diseases. Moreover, health indicators identified in the *Healthy People 2030* publication focus on upstream measures as opposed to disease outcomes; that is, identified health indicators are generally behaviors that are modifiable in the short term and address high priority public health issues that have major impacts on public health outcomes (Healthy People 2030).

In addition to the medical and dental preventive strategies shown below, other preventive strategies include assessment of and counseling for cardiovascular disease prevention, (USPSTF et al. 2022; USPSTF et al. 2020) and meeting recommended guidelines for vaccination against vaccine-preventable diseases, including influenza and human papilloma virus (Arbyn et al. 2018; Drolet et al. 2019). The most current data cited by *Healthy People 2030* suggests that the proportion of adults in the general population who received the recommended evidenced-based preventive healthcare in 2020 was relatively low at 5.3%, a number that represents a decrease from 2015, when 8.5% of adults aged 35 years or older received all recommended clinical preventive services (DHHS 2024). *Healthy People 2023* cites various barriers to preventive healthcare in the general population, including racial and other socioeconomic barriers, lack of access to quality healthcare, and even stigma (Healthy People 2030). Thus, ensuring the future health of the U.S. general population will mean not only promoting healthy behaviors and preventive healthcare practices but also addressing the barriers to these practices faced by many Americans.

Selected Healthy People 2030 Leading Health Indicators and/or Objectives*	Supporting Preventive Care Recommendations
Use of the oral care system. **	Regular dental cleanings by a dental clinician are recommended (CDC 2024). ‡ Daily practices for the prevention of caries and gingivitis, including daily flossing, twice daily teeth brushing with fluoride toothpaste, and limiting sugary snacks and beverages. †
Yearly vaccination against influenza.	Obtain 1 dose annually of influenza inactivated, recombinant, or live, attenuated vaccine. ‡
Women who receive breast cancer screening. §	Biennial screening mammography for women aged 50 to 74 years and those aged 40 to 49 years who place higher value on the potential benefits versus potential harms (Siu 2016). ¥
Women who receive cervical cancer screening. §	Screening for cervical cancer every 3 years with cervical cytology in women aged 21 to 65 years, or every 5 years with human papilloma virus screening for women aged 30 to 65 years (USPSTF 2018). ¥
Adults who receive colorectal cancer screenings based on guidelines. §	Screening for colorectal cancer is recommended for adults aged 50 to 75 years (frequency depends on the test used), and there may be moderate benefit for screening of adults aged 45 to 50 years of age (USPSTF 2021b). ¥
Adults whose high blood pressure is controlled.	Regular screening for hypertension in adults 18 years or older (yearly for those age 40 and older or at increased risk for hypertension; every 3 to 5 years for those under age 40) with office blood pressure measurement, with blood pressure measurements obtained outside of the clinical setting for diagnostic confirmation before starting treatment (USPSTF 2021b). ¥
Adults newly diagnosed with pre-diabetes or diabetes. £	Screening for diabetes should be part of a cardiovascular risk assessment in adults aged 35 to 70 years of age, or those younger than age 35 who are overweight or obese (O'Brien et al. 2023).
Adults who have been screened for and/or know their sexually transmitted disease status (HIV, chlamydia, gonorrhea, syphilis). €	Chlamydia and gonorrhea screening are recommended for all sexually active women aged 24 years or younger and 25 years or older who are at increased risk for infection (USPSTF 2021a). ¥ Screening for HIV is recommended in adolescents and adults aged 15 to 65, with screening in younger and older adults who are at increased risk for infection (USPSTF 2019).¥
Adults who endorse cigarette smoking.	Clinicians should ask all adults about tobacco use, advise them to stop using tobacco, and provide behavioral interventions and FDA-approved pharmacotherapy for cessation to nonpregnant adults who use tobacco (USPSTF 2021a). ¥

Notes:

*_Healthy People 2023_; Not all indicators or objectives are listed here.

**USPSTF currently states there is insufficient evidence to assess the balance of benefits and harms of screening for oral health conditions performed by primary care physicians in asymptomatic adults (Moyer 2014; USPSTF 2023).

‡ Centers for Disease Control and Prevention

† American Dental Association (ADA 2024)

§ Added based on inclusion in *Healthy People 2030*

¥ Evidence-based recommendations from USPSTF; insufficient evidence to recommend specific screening intervals, but repeat screening is reasonable for persons at increased risk for infection.

€ Amended to include syphilis and chlamydia, both noted as important sexually transmitted diseases for screening in *Healthy People 2023 Objectives*.

£ American Diabetes Association; Persons with pre-diabetes should be tested yearly; persons with diagnosed gestational diabetes should have lifelong testing at least every 3 years; persons with normal diabetes test results should have repeat testing at a minimum of 3-year intervals (ElSayed et al. 2023)

Medical and dental preventive health and self-reported or perceived health

Medical and dental health factors such as obesity, poor dental health, MSKi, hearing and vision loss prevention, and lack of access to health-promoting personal hygiene may play an important role in Service members' perceptions of their own health and may also predict whether and how they seek to improve their health and/or engage with healthcare (Abiero et al. 2022; Golenbock et al. 2017; Hatzfeld et al. 2016; Henry et al. 2019; Job et al. 2018; Kostas-Polston et al. 2022; Leiendecker et al. 2011; Lewis et al. 2023; MacGregor et al. 2020; McLaughlin et al. 2017). Meeting standards for medical and dental health may result in improved personal perceptions of health for Service members. However, perceptions of superior health when not genuinely reflective of a Service member's true medical or dental health may prevent military personnel from obtaining the healthcare they need or engaging in prevention practices (e.g., HPD use, compliance with immunization or cancer screening recommendations) intended to support their medical and dental health (Abhar et al. 2022; Halista et al. 2020; Moon et al. 2011; Mrena et al. 2009; Polak et al. 2011; Porter et al. 2008; Theis et al. 2022). Misconceptions that some behaviors, such as smokeless tobacco or e-cigarette use, may have few risks may result in the uptake of such behaviors, which may then degrade health (Klesges et al. 2010; J. Lin et al. 2020; Little et al. 2020). Even when Service members recognize a deficit in their medical or dental health, they may fail to recognize the extent of the deficit or the extent to which the deficit may be adversely impacting their fitness or associated occupational capacity. For example, Service members may recognize they have hearing loss but fail to accurately perceive the extent to which the loss has adversely affected functional capacities such as situational awareness (Abel, 2008; Kirk et al. 2012). Together, this evidence suggests that, while Service members' medical and dental preventive health likely contribute to personal perceptions of their health, the inverse of this relationship may also be true. Specifically, the perceptions military personnel hold regarding their own health and health-related risk may influence whether and how they endorse behaviors aligned with medical and dental preventive health.

Medical and dental preventive health and body composition

Body composition is an important component of Service member health and readiness that may be impacted by components of medical and dental preventive health, including lifestyle interventions designed to reduce obesity and chronic disease risk, tobacco use and cessation, women's health considerations such as pregnancy and postpartum weight gain, and oral health behaviors (Armitage and Smart, 2012; Fahey et al. 2021; Johnson et al. 2023; Kramer et al. 2023; Peterson and Helton, 2000; Stiegmann et al. 2023; Vander Weg et al. 2005). Health policies and programs may have differing impacts on the body composition of Service members. For example, increases in sedentary behavior associated with public health-related quarantines in response to the COVID-19 pandemic may have resulted in significantly increased prevalence of overweight and obesity among active-duty U.S. Service members (Stiegmann et al. 2023). Conversely, evidence suggests that lifestyle prevention programs including the Diabetes Prevention Program, when modified to address the specific needs of Service members, may be effective in helping male and female active-duty Service members, retirees, and their family members improve BMI and waist circumference (Kramer et al. 2023). Other healthy behaviors,

including those that cluster across domains, may also be associated with healthy body composition and/or BMI. For example, results of one study examining the impact of oral health behaviors among military veterans suggest individuals who endorsed attending dental appointments within the last 12 months were more likely to also endorse eating more fruits and vegetables and have a healthy BMI (Albright et al. 2020), suggesting that practicing healthy dental behaviors may translate to the practice of other healthy behaviors such as the consumption or more nutritious foods, in turn promoting healthier BMI.

While maintaining healthy weight and body composition is important for both men and women, the unique experience of pregnancy may present potential challenges for some Servicewomen. Management of weight and/or body composition during and following pregnancy can be difficult, and retained pregnancy weight in the postpartum period may be an important factor associated with fitness test failure following pregnancy (Armitage and Smart 2012; Miller et al. 2017; Johnson et al. 2023). Evidence also suggests that pre-pregnancy BMI is a significant predictor of postpartum BMI, providing an important leverage point for medical providers and other professionals caring for Servicewomen before and early in pregnancy to prevent excess postpartum weight retention (Johnson et al. 2023). Furthermore, studies suggest extending return-to-duty physical fitness and body composition standards from 6 months to 12 months can help ensure post-partum Servicewomen achieve military body composition goals and do so in a healthy way (Miller et al. 2017; Iobst et al. 2021; Herrick and Chai 2024).

Tobacco use and body composition

Tobacco use may influence body composition and is generally prevalent in military populations, with some studies showing use prevalence as high as almost 20% for e-cigarette users and as much as 12% for Service members using three or more types of tobacco products (e.g., cigarettes, e-cigarettes, and smokeless tobacco products) (Fahey et al. 2021). Moreover, some Service members may perceive that tobacco use may aid in weight management, which may serve as a driver for both tobacco use initiation as well as a hesitance to stop using tobacco; the motivation to use tobacco as a tool for weight management has been reported among young men and women in the U.S. Air Force to be associated with more frequent tobacco use and beliefs that such products carried low health risks, particularly in the case of e-cigarette use (Fahey et al. 2021). However, smokeless tobacco use has not been shown to support successful weight management, as suggested by a study of male U.S. Air Force recruits in which occasional, current, and experimental smokeless tobacco users were 13% to 50% *more* likely to be classified as overweight as compared to those who had never used smokeless tobacco (Vander Weg, 2005). Studies suggest that tobacco *cessation*, particularly smoking cessation, may be associated with weight gain, primarily as a result of removing the effects of nicotine on the central nervous system, and as former smokers seek a replacement for smoking behavior, which is often increased caloric intake (Bush et al. 2016; Peterson and Helton 2000). However, given the known harms associated with tobacco use, including significantly increased risk for cardiovascular disease, cardiovascular mortality, cancer, cancer mortality, and reduced physical fitness, encouraging Service members to stop the use of tobacco products, including e-cigarettes, is imperative (Akter et al. 2023; Al-Bashaireh et al. 2018; Dai et al. 2022; Bush et al.

2016). Given these adverse health outcomes, it may be prudent for military tobacco cessation programs to incentivize cessation through, for example, use of one-time waivers for body composition standards to offset the potential temporary weight gain that may accompany ending tobacco product use (Peterson and Helton 2000).

Medical preventive health and musculoskeletal injury

Tobacco use may come with additional risks for Service members. Studies from the general population suggest that tobacco use may come with significant risks for MSKi, which is particularly concerning for Service members given the arduous physical nature of many MOS (Al-Bashaireh et al. 2018). Research conducted with male United States Military Academy cadets suggests cigarette smoking may be associated with significantly lower bone mineral density, particularly in the hip and spine, which may increase risk for future MSKi (Ruffing et al. 2006). In fact, tobacco use is a widely accepted risk factor for MSKi and time-loss injuries in military Service members (Anderson et al. 2021; Bedno et al. 2017; Bedno et al. 2019; Brooks et al. 2019; Bulzacchelli et al. 2014; Clifton et al. 2023; Kardouni et al. 2016; Knapik and Bedno, 2018; Knapik et al. 2001; Lappe et al. 2001; Mullinax et al. 2023; Reynolds et al. 2000; Yepson et al. 2020). This association persists even after adjusting for other potentially confounding variables such as age, and tobacco use may compound the influence of other risk factors, such as high body weight or mass, on injury risk, which may increase with intensifying tobacco use in a dose-dependent manner (Bedno et al. 2017; Bedno et al. 2019; Bulzacchelli et al. 2014; Grier et al. 2011; Knapik et al. 2001; Mullinax et al. 2023; Reynolds et al. 2000; Schram et al. 2022; Teyhen et al. 2015). In studies conducted among U.S. Soldiers, Sailors, and Marines, and more than one systematic review, use of cigarettes and smokeless tobacco products has been demonstrated to increase the risk for MSKi, as well as modify the protective effect of high physical fitness on MSKi risk such that any benefit that may have been conferred is negated through smoking (Bedno et al. 2017; Bedno et al. 2019; Bulzacchelli et al. 2014; Grier et al. 2011; Knapik et al. 2001; Mullinax et al. 2023; Reynolds et al. 2000; Schram et al. 2022; Teyhen et al. 2015; Brooks et al. 2019; Reynolds et al. 2000). Tobacco use may also increase Service member risk for hospitalization for both MSKi and non-MSKi causes, and evidence strongly suggests that tobacco use may increase Service members' risk for poorer outcomes after sustaining MSKi, including the need for surgical intervention and worse surgical recovery outcomes following medical intervention procedures (Anderson et al. 2021; Antosh et al. 2020; Chin et al. 2015; Clifton et al. 2023; Kardouni et al. 2016; Robbins et al. 2000; Yepson et al. 2020). Encouragingly, evidence suggests that risk of MSKi and poor outcomes following MSKi decrease following cessation of tobacco use, providing a strong impetus for military leaders to support health promotion campaigns and healthcare interventions endorsing tobacco use cessation (Knapik and Bedno, 2018).

Despite considerable evidence to the contrary, at least one original research study and one meta-analysis suggest a lack of association between tobacco use and MSKi risk (Dos Santos Bunn et al. 2021; Henderson et al. 2000). Although it is unclear why smoking was not found to be a risk factor in these two publications, the authors of the one original study suggest their findings may be a result of timing in the military lifecycle, as study participants were assessed

throughout advanced individual training and immediately following initial military training, both times when new Service members are prohibited from smoking. The authors suggest the observed lack of association between tobacco use and MSKi may indicate the beneficial effects of tobacco use cessation, even over the shorter periods of time, in terms of reduced MSKi risk (Henderson et al. 2000). Finally, although no explanation for the findings of the one meta-analysis among these two publications is noted, it is possible that higher levels of study heterogeneity may have contributed to the inability to observe any association between smoking and MSKi risk; additionally, the meta-analysis dichotomized study participants as smokers or non-smokers, which may have either excluded smokeless or dual-product tobacco users, or not accounted for the potential effects of smoking currency, including former smoking and time since last tobacco use (Dos Santos Bunn et al. 2021).

Medical preventive health and the musculoskeletal injury risk of female Service members

Compared with male Service members, female Service members may have different levels of risk and different risk factors for MSKi. Some studies suggest the latter may be at higher risk for MSKi, although evidence to this effect is conflicting (Anderson, Grier, Dada, et al. 2017; Henderson et al. 2000). While apparent increased risk for MSKi among female Service members may actually stem from their being more likely to seek medical care for their injuries than their male counterparts, a difference likely to skew epidemiological data, research suggests that female Service members may be at increased risk for bone stress injuries, especially during initial military training, due in part to biological differences in bone geometry as a result of differential effects of androgen and estrogen during development (Dyches et al. 2023). However, studies have demonstrated that targeted approaches to MSKi prevention, including minor modification of training programs and micronutrient supplementation, can reduce female Service members' MSKi risk (Dyches et al. 2023). Studies assessing female Service member-specific MSKi risk factors have also shown that use of specific types of birth control, specifically depo-medroxyprogesterone acetate, may increase MSKi risk, though the evidence is inconsistent (Henderson et al. 2000; Lappe et al. 2001). Additionally, relative energy deficiency resulting from inadequate nutrition coupled with high energy expenditure and leading to disturbances of the hypothalamic-pituitary-ovarian axis and chronic amenorrhea (known as the female athlete triad) may adversely impact bone mineral density and increase risk for MSKi in female Service members (O'Leary, Wardle, and Greeves 2020). However, the effects of relative energy deficiency on endocrine function and skeletal health have also been described in men; there is less literature on this topic as it pertains to male Service members (O'Leary, Wardle, and Greeves 2020). Importantly, multiple studies suggest that provision of supplemental energy in addition to habitual dietary intake during times of high energy expenditure can support healthy endocrine function (O'Leary, Wardle, and Greeves 2020). While some studies suggest that body composition metrics such as greater BMI or body mass may increase female Service members' risk for MSKi, fitness metrics such as CRF may play a more important role in determining MSKi risk for these individuals (Anderson et al. 2017; Lappe et al. 2001; Schram et al. 2022). Together, these conflicting findings suggest there remains a need for further clarification regarding MSKi risk as it pertains to female Service members; nevertheless, these individuals may have risks, often modifiable in nature, that differ from those of their male counterparts. Importantly,

evidence suggests that access to timely healthcare for treatment of MSKi is a crucial component of Service member readiness (Abiero et al. 2022).

Medical and dental preventive health and non-musculoskeletal injuries and illnesses

In addition to injuries of the musculoskeletal system, Service members may experience other types of injuries due to training, deployment, combat, or the rigors of daily life in the military. Prevention of these injuries is equally important as MSKi prevention, as non-MSKi may also result in lost duty time and reduced Service member readiness. Numerous aspects of medical and dental preventive health directly address this need and include factors such as ensuring Service members have access to timely and regular dental exams (Combes et al. 2010; Federman et al. 2022; Gonzalez Santiago Mdel et al. 2004; Norris et al. 2021; Sauvet et al. 2009; York et al. 2008; Zadik et al. 2010); have access to and use dental protective devices (Zadik et al. 2010); have access to and properly use hearing and vision protection devices (Bailoor et al. 2015; Breeze et al. 2011; Dougherty et al. 2013; Dougherty et al. 2018; Federman and Duhon, 2016; Federman et al. 2022; Grant et al. 2021; Guven and Durukan, 2020; Hsieh et al. 2003; Kim et al. 2021; Lee et al. 2023; Moon et al. 2011; Thomas et al. 2009); are apprised of chronic and unique sex-specific disease risks (Davis et al. 2014; Hunter et al. 2013; Miranda Gonzalez et al. 2023; Nelson et al. 2016; Trego et al. 2018; Wand et al. 2011); and understand the various risks associated with tobacco use (Morger et al. 2010; Robbins et al. 2000; Zajc et al. 2011).

Dental preventive care, oral hygiene, and dental emergencies

Proper oral health care is vital to Service member readiness, and lack of good oral hygiene and/or regular dental exams may result in oral injury or dental emergencies. Given the importance of oral health, many militaries employ dental readiness classification systems designed to systematically identify Service members in need of dental treatment and at risk for dental emergencies and ensure that they remain up to date on oral health examinations (Simecek et al. 2008). This systematic approach is a vital aspect of ensuring readiness, as studies suggest that significant oral pathologies, including missing teeth, dental caries, and periodontitis, may inhibit the ability of Service members to perform, especially in environments that may preclude rapid access to treatment once the pain and discomfort generally associated with these pathologies occurs, and may furthermore have significant operational impacts (Colthirst et al. 2012; Combes et al. 2010; Gonzalez Santiago Mdel et al. 2004; Sauvet et al. 2009). Poor dental behaviors, including tobacco use, may be common in both new recruits and more seasoned Service members, and inconsistent or lack of regular twice-daily toothbrushing, regular consumption of sugary beverages and foods, failing to attend dental appointments, and existing pathologies, including retained third molars, may be risk factors for urgent or extensive dental care needs; thus, intentional focus on quickly and systematically treating military personnel to return them to a state of dental readiness may be an effective means by which to prevent future dental emergencies (Chaffin et al. 2003; Combes et al. 2010; Norris et al. 2021; Simecek et al. 2008; York et al. 2008; Zajc et al. 2011). Poor oral health may also affect Service members of different Service branches and MOS differently. For instance, exposure to atmospheric pressure changes, as encountered by military pilots and divers during flight and

scuba diving, respectively, may result in significant barodontalgia, or tooth pain associated with changes in barometric pressure. For military flight or diving personnel with oral pathologies, this condition could substantially impact their ability to perform operational-specific duties (Gonzalez Santiago Mdel et al. 2004; Nakdimon and Zadik 2019). Additionally, dental emergencies occurring when Service members are deployed to austere environments or environments otherwise inaccessible by dental officers may require the afflicted Service member to be medically evacuated, which may adversely impact mission needs and place the Service members facilitating transport in danger (Deutsch 2008; Gunepin et al. 2011; Simecek et al. 2014). Although early attempts to quickly identify military personnel with greater risk for poor dental health or dental emergencies via simple questionnaires have been unsuccessful, the preventable nature of many dental emergencies lends itself to the effectiveness of programs designed to educate military recruits and Service members on the benefits of good oral health in a prevention-focused manner, which may decrease dental emergencies (Armstrong and Dermont, 2021; Callison, 2005; Morger et al. 2010; Norris et al. 2021).

Oral Health Research in the General Population

Oral health is a vital component of overall health, and can influence, and be influenced by, systemic conditions, emphasizing the importance of preventive dental appointments and maintaining a healthy lifestyle. Existing and emerging evidence from general population studies demonstrates oral health's association with cognitive function, mental health and depression, atherogenic cardiovascular disease, type 2 diabetes, inflammatory bowel conditions, respiratory tract infections, rheumatoid arthritis, preterm birth, low birth weight, and various systemic conditions (Daalderop et al. 2018; Kalaigian and Chaffee 2023; Lohiya et al. 2023). Some of these associations, such as that between diabetes and oral health, may even be bi-directional in nature (Borgnakke 2019). Moreover, longitudinal studies conducted with large general population cohorts such as NHANES suggest oral health conditions such as periodontitis may increase all-cause mortality risk for persons with diabetes and/or chronic kidney disease (Sharma et al. 2016).

In addition to daily oral hygienic practices such as twice-daily brushing and flossing, evidence supports the importance of preventive practices, including regular dental check-ups and visits with a primary care physician, and use of mouthguards while participating in strenuous activities (e.g., contact sports) that increase risk for damage to the teeth and other oral structures for preserving oral health (Groome et al. 2011; Tanaka, Tsugawa, and Maeda 2016; Peterson et al. 2019; Mat Zainal et al. 2024). Regular dental and primary care visits provide opportunities to screen for oral cancer and may improve likelihood of early detection, leading to better outcomes (Groome et al. 2011; Peterson et al. 2019). Although athletes may be hesitant to use mouthguards, citing adverse impacts on oral functions and potential for painful oral ulceration resulting from poor fit, provision of custom-fitted mouthguards may improve uptake and consistent use by decreasing discomfort and communication deficits over time (Mat Zainal et al. 2024).

Medical preventive health and hearing-related injury prevention

Prevention of hearing loss injuries or other trauma to the external, middle, or inner ear is another means by which medical and dental preventive health factors may contribute to Service member readiness. Hearing capacity within normal thresholds is vital for situational awareness, and noise exposure or trauma impacting functional and effective hearing or resulting in the development of chronic and often debilitating tinnitus may significantly impact Service members' ability to perform optimally (Henry et al. 2019). Additionally, significant hearing threshold shifts and/or tinnitus resulting from blast exposures can adversely influence Service member sleep, which may have compounding consequences on not only the ability of military personnel to perform occupational duties, but also on psychological outcomes (Henry et al. 2019; Job et al. 2018; MacGregor et al. 2021). Given the various potential noise and trauma exposures that may be common for Service members, efforts targeting hearing preservation, including education about and access to quality, effective HPDs, have been an important focus of military hearing loss and tinnitus prevention efforts, although the reported effectiveness of such programs and activities has been mixed (Batchelor et al. 2020; Cleveland, 2009; Dougherty et al. 2013; Federman and Duhon, 2016; Jones and Pearson, 2016; Moon et al. 2011; Mrena et al. 2009; Muhr et al. 2016). Nevertheless, ongoing efforts to educate Service members and promote the importance of consistent and proper HPD use remain important, given studies suggesting that blast-exposed Service members wearing HPD at the time of exposure may have substantially lower risks for tympanic membrane rupture, other types of middle or inner trauma, concussion, or potentially long-term consequences such as development of chronic tinnitus (Dougherty et al. 2013; Dougherty et al. 2018). Consistent use of properly fitting HPDs may be of particular importance for Service members with pre-existing hearing loss or identified significant threshold shifts in hearing capacity, as these individuals may be at greater risk for significant hearing loss following high-risk noise exposure or injury (Gubata et al. 2013; Joseph et al. 2023).

Medical preventive health and vision-related injury prevention

Like hearing, vision is a vital component of Service member situational awareness and readiness. While ensuring that Service members are regularly screened for new or ongoing vision problems in order to provide necessary interventions and mitigate the effects of such problems, providing military personnel with access to properly fitting and *effective* eye protection may mean the difference between mild versus catastrophic injury or even loss of one or both eyes following combat or other physically traumatic events such as firearm cartridge ejection accidents during training (Bailoor et al. 2015; Breeze et al. 2012; Guven and Durukan, 2020; Hsieh et al. 2003; Thomas et al. 2009). Results from a systematic review suggest that ocular trauma was the fourth most common injury sustained by wounded U.S. Service members, supporting the importance of eye protection use, especially in combat situations (Lee et al. 2023). Another study of combat-exposed Service members found that those recorded as not wearing eye protection at the time of injury were significantly more likely to have sustained an ocular injury as compared with Service members who were wearing eye protection (Thomas et al. 2009). For Service members who did sustain an eye injury while wearing protective eye

wear, the injury was more likely to be categorized as least severe, suggesting that severe trauma was mitigated by the use of protective eyewear (Thomas et al. 2009). These findings are supported by a retrospective cohort study in which British military personnel not wearing ballistic eye protection were 9.9 times more likely to sustain an eye injury from explosive fragmentation as compared with those who wore it (Breeze et al. 2012). Analyses from this study suggest the use of *proper* protective eyewear is important, as there was no significant reduction in the incidence of eye injuries for Service members wearing *non-ballistic* eyewear versus those not wearing eyewear at the time of injury (Breeze et al. 2012). Nevertheless, studies demonstrate the challenges associated with encouraging Service members to consistently use protective eyewear, with non-use rate estimates ranging from 18.0% to 90.3%, suggesting that continued efforts are still needed to educate Service members about the risks associated with non-use or use of non-protective eyewear (Hsieh et al. 2003; Thomas et al. 2009; Weinstein et al. 2019). Evidence suggests Service member acceptance of protective eyewear may be increasing, possibly owing to the development of eyewear designed to improve protection while also addressing concerns with utility and the effects of eye protection on visual fields, fogging, and discomfort (Breeze et al. 2015; Breeze et al. 2011; Weinstein et al. 2019).

Medical preventive screening and non-musculoskeletal injury prevention

Preventive medical screening may also support Service member physical health by identifying a range of developing disease processes or elevated risk for such disease processes. These include screening for cardiovascular structural and functional abnormalities such as atrial fibrillation and mitral valve prolapse, which may have different implications for Service members depending on Service and MOS, identification of sickle cell trait in African American Service members, as well as screening for various forms of cancer, including skin, breast, and prostate cancers (Boos et al. 2012; Cronrath et al. 2017; Davis et al. 2014; Hoffman et al. 2022; Hunter et al. 2013; Lovejoy et al. 2024; Lovejoy et al. 2021; Miranda Gonzalez et al. 2023; Nelson et al. 2016). Atrial fibrillation, which may increase risk for stroke and other cardiovascular complications, may be relatively common in military Service members who may have predisposing behavioral factors, including high caffeine intake and excessive alcohol use, or may be at increased risk due to MOS (e.g., physiological stresses of high gravity acceleration forces experienced by Air Force fighter pilots). While this cardiac rhythm abnormality may occur infrequently or even just once, identification of individuals who may be at higher risk for chronic atrial fibrillation is important given the potential long-term sequelae and possible career-related limitations that common therapies such as ablation or medications such as warfarin, a blood thinner, may have (Hunter et al. 2013). Similarly, a study of male Israeli Air Force personnel suggests high-performance aviators may be at higher risk for complications associated with mitral valve prolapse, a relatively common, asymptomatic finding in the general population (Wand et al. 2011). Moreover, progression of valvular regurgitation originating at the mitral or other cardiac valves in these Service members may be significant in nature and warrant consistent clinical follow-up (Davis et al. 2014). Thus, cardiovascular screening, which may include regular echocardiogram depending on Service member MOS, may be important for ensuring Service member medical health, especially given evidence suggesting that, although relatively uncommon, significant cardiovascular disease development or progression may

necessitate medical evacuation for deployed Service members (Boos et al. 2012; Clark et al. 2019). Other types of screening to identify persons who may carry the sickle cell trait, may also help to reduce injury risk by ensuring affected Service members take the proper precautions during training to prevent the development of exertional rhabdomyolysis, as evidence suggests that these personnel may be at increased risk (Nelson et al. 2016).

Medical preventive screening and early cancer detection

Ensuring all Service members attend yearly screening appointments as considered appropriate by governing medical guidelines is important for identifying developing neoplasms and preventing growth and possible metastasis of cancers through early intervention (Dennis et al. 2009; Lovejoy et al. 2021). To support compliance with regular cancer screening, evidence suggests the importance of Service members having sufficient knowledge and understanding of their risks and the screening methods used to identify potential cancers. Further, ensuring healthcare providers deliver timely, correct, and adequate information to military personnel about cancer screening recommendations may encourage patients to comply, as suggested in a study of male U.S. Service members examining factors that increased the likelihood of participation in prostate cancer screening (Joseph, 2006). Identification of individuals who may be at increased risk for development of cancers, such as Servicewomen with higher genetic-based risk for breast cancer, through pre-screening practices such as detailed family history-taking for those under age 40 may help to ensure they are able to continue in their military careers, thus contributing to Force readiness (Lovejoy et al. 2021). Similarly, screening for specific human papilloma virus (HPV) serotypes associated with increased risk for cancer such as HPV-2 may help to identify male military personnel at increased risk for prostate cancer before they reach the recommended prostate cancer screening age (Dennis et al. 2009). While the military health system may effectively eliminate socioeconomic barriers to medical access common in the general population, addressing possible stigmas and other barriers associated with receiving medical care or screening, such as those associated with prostate cancer screenings, is vital for maintaining Service member readiness (Joseph, 2006).

Medical preventive health, immunization, and communicable disease prevention

Communicable diseases are illnesses spread from one person to another or that can be passed from animals or surfaces to humans. Given the close quarters in which many Service members live and work, especially those in junior enlisted ranks who often live together in barracks, prevention of communicable diseases within military populations is a significant factor influencing Force readiness (Peterson et al. 2018; Zivich et al. 2018). As part of communicable disease prevention, DoDI 6205.02, *DoD Immunization Program,* mandates that military personnel receive a variety of immunizations, with the specific vaccines and frequency determined by medical guidelines specific to their current position in the military lifecycle or duty/deployment location (DoD 2023). However, Force protection is not the only factor when considering vaccine preventable diseases. Historically, military populations, which are highly mobile and often deployed to foreign and/or remote locations, have been notable transmitters of a variety of viral and bacterial pathogens, often with severe consequences for previously

unexposed resident civilian populations (Chaufan et al. 2021; Zemke et al. 2019). Military vaccination programs designed to limit the number of potential pathogen carriers are a crucial component of protecting the military population and resident civilian populations in areas to which Service members may be deployed (Zemke et al. 2019). Vaccines are generally effective for the prevention of serious illness and are safe, even when multiple vaccines are administered within the same medical or immunization appointment or in a deployment setting (Payne et al. 2007; Sever et al. 2004; Gibson 2004).

In addition to duty location, determination of vaccine requirements or recommendations may include predisposing characteristics or conditions. Some military populations, such as younger Service members who are sexually active and possibly more likely to engage in risky behaviors (e.g., unprotected sex) may benefit from vaccination against HPV, given how easily it is spread and the known association between infection with some HPV serotypes and increased cancer risk, including prostate and cervical cancers (Agan et al. 2013; Korzeniewski et al. 2020). However, the risk factor-dependent approach to identification of Service member sub-groups who may benefit from vaccination may not translate to all vaccine types; evidence suggests that some vaccines, such as influenza vaccines, may be equally beneficial and effective regardless of risk factors or health-related behaviors, suggesting blanket requirements for immunization may be warranted (Lee et al. 2019; Woolpert et al. 2014).

The importance of immunization cannot be understated, and while vaccine effectiveness may vary depending on the vaccine target and type (e.g., modified-live, killed, subunit, molecular, etc.), there is evidence from military population studies supporting the ability of vaccines to decrease risk of serious illness from infectious diseases (Broderick et al. 2015; Gilbert-Ouimet et al. 2011; Moon et al. 2017; Ryan et al. 2003; Wang et al. 2009; Woolpert et al. 2014). Seasonal influenza vaccines, required yearly for all U.S. Service members, have been shown in a longitudinal tri-Service study of more than 1,000,000 Service members to be effective at reducing incidence rates for not only influenza-associated pneumonia hospitalization, but also overall healthcare encounters for influenza (Wang et al. 2009). Evidence supports the safety of providing pandemic influenza virus-specific vaccines concurrent to or following immunization against seasonal influenza when warranted, as pandemic-specific vaccine significantly reduced the risk for influenza-like illness without decreasing efficacy of the seasonal influenza vaccine (Lee et al. 2019). Immunization against other respiratory viruses, such as adenovirus, may also be effective for the prevention of febrile illness in military Service members. Immunization against various adenovirus serotypes, which may be of particular concern among military recruits undergoing arduous physical training, has been shown to be highly effective for reducing the incidence of respiratory illness in this population (Radin et al. 2014; Shephard et al. 2001). Additionally, studies of incoming recruits and the effect of immunization programs designed to decrease the incidence of morbidity from infectious agents including varicella zoster (i.e., chickenpox), meningococcal disease, and Hepatitis B suggest that such programs are effective (Oelschlager, 2022; Broderick, 2015; Ryan, 2003). Of particular concern are the highly transmissible measles, mumps, and rubella (MMR) viruses, commonly considered diseases of childhood for which children are vaccinated prior to attending school. However, in a study of more than 32,000 U.S. Air Force recruits, antibody seropositivity for these viruses, a measure of

circulating antibodies against the individual MMR viruses, ranged from 80% to 82%, significantly lower than the levels required for herd immunity (Lewis et al. 2015). While all U.S. Service members are required to have received the MMR vaccine either in childhood or upon entry into the military, mandatory screening for MMR antibody seropositivity may help to identify those with waning protection and in need of re-vaccination to help ensure continued immunity. This approach has been demonstrated to be effective in the prevention and control of both mumps and tetanus in studies of Chinese and South Korean military personnel (Moon et al. 2017; Tong et al. 2021). Gastrointestinal viruses such as the highly transmissible norovirus may also cause significant morbidity in military personnel living in close quarters. A computer simulation modeling study of norovirus transmission suggests that vaccination of recruits and barracks staff immediately upon initial arrival to military service could prevent as much as 15% of norovirus cases over a 10-year period (Burgess et al. 2021).

Barriers to Service member immunization and communicable disease prevention

Despite the documented benefits of vaccination for the prevention of severe illness, there remain barriers to ensuring all Service members are fully immunized. Among Service members, lack of knowledge about vaccine preventable diseases and perceptions of vaccine safety and personal risk for contracting such diseases are repeatedly identified in studies as common barriers to Service member immunization, especially for recommended, but not required, vaccinesy (Halista et al. 2020; Polak et al. 2011; Porter et al. 2013). In a cross-sectional study of almost 2,000 male and female U.S. Service members across three branches, almost 20% of respondents reported they would decline all pre-deployment vaccines if they could, while 2% reported avoiding all pre-deployment vaccines, with respondents citing perceptions of lack of vaccine safety, vaccine ineffectiveness, or low disease risk as reasons for such avoidance (Polak et al. 2011). Evidence from a study of more than 6,000 male and female U.S. Military personnel across the DoD (predominantly Army, 84.0%) further suggests Service members' perceptions of vaccine safety and efficacy may be stronger predictors of willingness to be vaccinated than perceived disease risk (Porter et al. 2013). These concerns were echoed by respondents in a study of U.S. Air Force personnel only, in which 43% and 82% of individuals who were hesitant to receive a COVID-19 vaccine reported concerns with short- or long-term side effects of the vaccine, respectively (Theis et al. 2022). Those who were vaccine- hesitant were significantly younger than those who did not report hesitance to receive the COVID-19 vaccine, and it is possible that lower perceived risk of mortality or severe disease contributed to vaccine hesitance in these participants (Theis et al. 2022). Misconceptions about actual versus perceived morbidity or mortality risk associated with contracting a vaccine-preventable illness may also influence vaccine hesitance (Porter et al. 2008). Even in instances where Service members recognize the importance of immunization, there may still be some degree of cognitive dissonance around the *personal* need for vaccination, and the compulsory nature of routine and pre-deployment immunization for Service members may result in psychological friction concerning the receipt of medical procedures that an individual may feel unnecessary or even concerning (Riddle et al. 2008). However, evidence also suggests that programs designed to educate Service members about the effectiveness of vaccines and realities of their risks of infection and serious morbidity or mortality may increase knowledge, which may be useful for

improving Service member uptake of vaccination and willingness to comply with advice from the medical community (Batie et al. 2023; Porter et al. 2020; Ward et al. 2023). Healthcare providers and military leaders may play an important role in ensuring Service members are able to make informed decisions, as evidence from studies conducted with Navy and Air Force personnel suggests that receiving vaccine information from a healthcare provider versus the internet or social media, and receiving support for a vaccine from company commanders, may be independent predictors of vaccine uptake (Buechel and Connelly 2018; Halista et al. 2020).

Medical preventive health and sexually transmitted disease prevention

Given the young age and greater propensity for risk-taking often observed with military Service members, an important consideration for communicable diseases within military populations is the spread of sexually transmitted infections (STIs) (Boyer et al. 2008; Korzeniewski et al. 2020). Moreover, asymptomatic infections such as chlamydia and gonorrhea may be of particular concern in these populations, given lack of awareness and the ease with which they are spread, and screening may be the best way to control these STIs (Korzeniewski et al. 2020). Interventions and health promotion programs designed to promote sexual and reproductive health through the dissemination of high-quality and relevant information may ultimately serve to increase mission readiness (Boyer et al. 2022; Rodriguez and Mitchell, 2023; Vargas et al. 2020). However, there is a relative lack of research in this area, as noted by a 2020 systematic review that identified only 15 studies examining the effectiveness of preventive sexual health and behavior interventions among U.S. Service members (Vargas et al. 2020). Given the prevalence of STIs within the U.S. Service member population and the adverse effects of these diseases on Force readiness, additional research into effective prevention strategies designed to reach those at highest risk are warranted.

Finally, a discussion of communicable disease risk and protective factors would be incomplete without the inclusion of tobacco use and how it may influence risk for community-acquired infections, particularly respiratory infections, as suggested in general population literature (Baskaran et al. 2019). For example, a study of Turkish military personnel suggests the level of tobacco dependence may predict the likelihood of developing community acquired pneumonia (Tas et al. 2008), and a large study of more than 800,000 male and female U.S. Service members reported that dual tobacco use (i.e., use of both cigarettes and vaping products) may further increase this risk (Sanou et al. 2020). Paradoxically, tobacco smoking was reported in a study of French Navy personnel to be a *protective* factor for COVID-19 infection, even in fully adjusted multivariable logistic regression models; however, this study was cross-sectional in nature, precluding causality, and it is likely that other lifestyle factors unaccounted for in the study may have contributed to the nature of this association (Paleiron et al. 2021). Nevertheless, these studies suggest there is a need for additional research on the topic of tobacco use and infection risk in military populations given the high prevalence of tobacco use by Service members, particularly those who live in close or confined quarters such as military barracks or transport vessels such as ships and submarines.

Medical and dental preventive health and deployability

Deployability may be influenced by numerous aspects of medical and dental preventive health, including accessibility of health care, completion of immunization and dental appointments, and other specific needs (Abiero et al. 2022; Polak et al. 2011; Witkop et al. 2023). Furthermore, effective identification of personnel who may have medical or dental conditions that could worsen during deployment is important for meeting mission demands, as evidence from studies with both foreign and U.S. Military personnel suggests that military personnel granted medical waivers are significantly more likely to be medically evacuated as compared with those who are not, potentially resulting in adverse impacts to operational capabilities (Cronrath et al. 2017; Sauvet et al. 2009). Clinical diagnoses most frequently identified as adversely influencing deployable status and addressed by medical and dental preventive health include MSKi, hypertension, and hearing loss, with lower risk for non-deployability associated with conditions such as atrial fibrillation (Cleveland, 2009; Clifton et al. 2023; Hunter et al. 2013; Keithler et al. 2023; Keithler et al. 2022; Nelson et al. 2020; Papworth et al. 2020; Wang et al. 2012). Importantly, many of these conditions may also be preventable through the lifestyle and behavioral tenets supported across the domains of health and fitness, including physical training, healthy dietary approaches, tobacco abstinence, and proper use of protective equipment (Bornstein et al. 2019; Buckingham et al. 2003; Haddock et al. 2007; Hsieh et al. 2003; McGinnis et al. 2018; Zajc et al. 2011).

Medical preventive health, Servicewomen, and deployability

Like many other areas of Service member readiness, military Servicewomen may have unique needs in terms of ensuring deployability through medical and dental preventive health. These include hygiene and urinary tract infection prevention and access to contraception and healthcare providers well-versed in the various forms of contraception and how to prescribe or administer them (Carty et al. 2019; de Kanter et al. 2019; Deans et al. 2019; Heitmann et al. 2017; Kostas-Polston et al. 2022; Seymour et al. 2021; Trego et al. 2018; Witkop et al. 2023). However, evidence suggests that some Servicewomen may face barriers to accessing this type of healthcare in the military setting, including contraception, as a result of lacking physician knowledge, contraceptive access or availability, or even cognitive dissonance about the realities of deployment life for Servicewomen, the consequences of which can range from the inconvenience of menstruation in the field to occupational, social, and financial detriments resulting from unintended pregnancy or abortion (Holt et al. 2011; Phillips and Lynn, 2022; Ricker et al. 2021; Seymour et al. 2019; Wilson et al. 2021).

Medical preventive health and physical resilience

Physical resilience is the ability to withstand or recover quickly and efficiently from acute or chronic physical challenges or stressors (Whitson et al. 2018). The ability to identify factors that support and detract from resilience is essential to Service member health and readiness given the types and magnitude of physical demands during both training and the performance of occupational tasks. While physical resilience may be challenging to quantify, surrogate measures such as HRV may inform factors that either improve or degrade Service member resilience

(Tomes et al 2020). Among protective factors for physical resilience, access to timely medical care may promote readiness by ensuring Service members receive necessary treatments and recovery from injuries, allowing them to transition to medical readiness more quickly (Abiero et al. 2022). Similarly, use of protective devices such as ballistic eyewear may also support physical resilience by either preventing eye injuries or ensuring that, when eye injuries occur, they are less severe in nature (Breeze et al. 2011; Hsieh et al. 2003). Current efforts to further improve the effectiveness of protective wear for Service members will likely serve to further improve the physical resilience of military personnel exposed to potentially harmful blasts and projectile objects during training and while in combat (Breeze et al. 2015; Breeze et al. 2012). Likewise, improved understanding of factors that may degrade Service member physical resilience, such as excess weight gain during pregnancy or the various stressors associated with pregnancy and the postpartum period, and approaches to mitigating these factors, including lengthening of the time that military Servicewomen have between childbirth and their first required fitness test, may further support physical resilience (Armitage et al. 2014; Armitage and Smart, 2012; Miller et al. 2017). Identification of individuals with elevated risk for certain cancers may lead to the promotion of preventive treatments to prevent the development of malignant and/or difficult-to-treat cancers, decreasing risk of significant disease and supporting physical resilience (Lovejoy et al. 2021). Finally, evidence suggests tobacco use may degrade resilience by increasing risk for poor recovery following injury and related medical and surgical interventions, an important tenet of physical resilience and one of great importance to Service members' occupational trajectory, including disability, following such injuries (Nelson et al. 2020). Numerous studies assessing factors related to successful surgical repair of joint or muscle injuries suggest tobacco use is a predictor of failed recovery after surgery, reinjury, and/or return to duty, although some evidence suggests that other factors such as surgical technique, preoperative BMI, or even pre-operative pain ratings may play more substantial roles in predicting such outcomes (Antosh et al. 2020; Antosh et al. 2018; Thomas et al. 2019; Waterman et al. 2017; Waterman et al. 2016; Zarkadis et al. 2018). Nevertheless, when taken together, evidence supports tobacco use as an important target for health promotion programs aiming to improve Service members' physical resilience.

Medical and dental preventive health and mortality

Among the various outcomes supported by the medical and dental preventive health and fitness domain, helping Service members live long, productive lives is perhaps the outcome that most transcends their military service. Although research on mortality risk is relatively limited with respect to military populations, studies conducted with military Service members can provide insight into Service-specific factors that may contribute to mortality risk or longevity. While it is likely that most components of medical and dental preventive health contribute to Service member longevity, there is evidence in the current literature supporting associations of immunization and communicable disease prevention, health screening, tobacco use, and use of PPE such as ballistic eyewear with reduced mortality risk (Agan et al. 2013; Breeze et al. 2012; Breeze et al. 2011; Knapik and Bedno, 2018; Lovejoy et al. 2024; Lovejoy et al. 2021; Tong et al. 2021; Webber et al. 2022; Zivich et al. 2018). For example, immunization against some oncogenic viruses such as HPV may help to decrease mortality risk by preventing the primary

infection events required for future development of some cancers (Agan et al. 2013). While viral infections such as HPV may have long latency periods between the time of initial infection and oncogenesis, other pathogens, such as *Clostridium tetani*, the causative agent of tetanus, and *Streptococcus pneumoniae* may have more immediate and direct mortality risks. This suggests ensuring timely immunization and adequate antibody levels against such organisms may have more direct, beneficial protective effects in terms of mortality risk (Tong et al. 2021; Zivich et al. 2018). Likewise, screening for cancers such as colorectal, breast, and prostate cancers may lower mortality risk, as provision of regular screening can help to identify cancers earlier in their development and improve and improve survival (Lovejoy et al. 2024; Lovejoy et al. 2021; Webber et al. 2022). Notably, while studies may suggest higher incidence of cancers in some miliary populations, including younger Service members, this may be related more to the provision of healthcare in the military and adherence to earlier and more regular preventive screenings, allowing for earlier cancer detection rather than a true increased incidence as compared with the general population (Lovejoy et al. 2024). Finally, the use of proper PPE may also decrease Service member mortality risk; for example, use of ballistic eyewear during combat may prevent death associated with eye or facial injuries, such as the entry of explosive projectiles through the orbital socket (Breeze et al. 2012; Breeze et al. 2011).

Nutritional Health and Physical Health

Nutritional health is an important factor in physical health, particularly in body composition, injury, chronic health conditions, and sleep.

Nutritional health and body composition

Research with both the general population and military Service members suggests significant associations among nutrition-related behaviors, body composition, obesity status, and ultimately overall physical health (Barrington and Beresford, 2019; Berryman et al. 2017; Jayne et al. 2020; Jayne et al. 2021; Pasiakos et al. 2015). There is evidence that meeting or exceeding protein requirements as outlined in the Military Dietary Reference Intake is associated with lower BMI, waist circumference, and cardiometabolic disease risk, and higher high-density lipoprotein cholesterol compared to diets lower in protein (Pasiakos et al. 2015; HQ DANAF 2017), and a study of Army recruits in training supports the use of whey protein supplementation as opposed to carbohydrate supplementation for fat mass reduction (McAdam et al. 2018). However, military studies suggest that supplementing energy-adequate, higher-protein diets with additional protein results in no improvement in fat-free mass restoration following acute negative energy balance, suggesting protein supplementation may not be necessary for fat-free mass recovery, especially when Service Members already exceed minimum protein recommendations (Berryman et al. 2017).

Attention to frequency, timing, and composition of snacking can be a simple yet significant approach for population-level obesity prevention (Barrington and Beresford, 2019). Studies with Service members also suggest there may be a possible mediating effect of emotional eating behaviors on the direct association between perceived stress, BMI, and military body

composition standards failure (Jayne et al. 2020). Modifiable behaviors such as eating rate, location, and attention to internal satiety cues have possible implications for Service member body composition and physical performance and may be educational leverage points for improving Service member physical health (Jayne et al. 2021). Eating behaviors such as eating speed, attunement to satiety signals, and cognitive restraint may worsen for some individuals after entering military service, especially given the culture of "hurry up and eat" often enforced early in military training (Fagnant et al. 2019; Koltun et al. 2023; Troncoso et al. 2023). Consumption of fast or convenience foods may also be relatively common for Service members and contribute to less healthy body composition (Troncoso et al. 2023), as suggested by a study of U.S. Soldiers in which participants who endorsed regularly consuming these foods were 75% more likely to fail Army body composition standards (Jayne et al. 2021). Importantly, Service members may attempt to compensate for poor eating behaviors or dietary choices prior to fitness testing or weight screening through unhealthy weight management behaviors such as restrictive dieting or use of fat burners, which have been linked to weight cycling, which may in turn increase risk for obesity (Allen et al. 2022). In severe cases, the desire to meet body composition standards or fitness requirements may lead to extreme eating behaviors such as eating disorders or disordered eating habits for both male and female Service members; though often underreported, these behaviors can be grounds for military discharge (Gavaria and Ammerman 2023).

Nutritional health and musculoskeletal injury

Understanding potential relationships between nutritional health and MSKi risk is important for ensuring Service member readiness. Evidence suggests use of vitamin and joint health supplements may be associated with increased likelihood for nervous and musculoskeletal system disease or injuries among active-duty Service members; however, as this was a cross-sectional study and the possibility for reverse causation in these associations cannot be ruled out (Humphreys et al. 2019). Conversely, twice daily supplemental protein or carbohydrate intake has been shown to potentially mitigate MSKi risk during BMT, with increased caloric intake and nutrient timing playing more important roles in this effect than the specific macronutrient content of the supplements (McGinnis et al. 2018). These studies suggest that healthy eating behaviors to include optimal nutrient timing and additional caloric intake from more frequent meals or dietary supplementation may reduce risk of MSKi among military personnel.

Nutritional health and non-musculoskeletal injury and illness

Nutritional supplementation may influence infectious disease risk through improvements in immune status and function, as suggested in an investigation of vitamin D supplementation during Marine Corps basic training. This study reported that recruits receiving daily doses of 1000 IU of vitamin D3 exhibited enhanced salivary immune responses, particularly in the form of increased salivary secretory immunoglobulin A levels, despite the immunosuppressive challenges encountered in the early stages of training (Scott et al. 2019). Additionally, nutritional supplementation of omega-3 fatty acids and some micronutrients, including zinc,

vitamin D, and vitamin C, may help improve local immune response following acute injury (Smith et al. 2018). Further research in this area will be important for validation of these findings and improved understanding of the mechanism underpinning this association.

Nutritional health and chronic health conditions

Research with both the general population and military Service members suggests significant associations between nutrition behavior, risk of developing chronic health conditions, and ultimately overall physical health (Knapik et al. 2022; Purvis et al. 2013; Rong et al. 2019; Smith et al. 2010). Fostering effective weight management is essential in preventing chronic health conditions, as is identifying unique approaches to support Service member weight management. A study of male and female U.S. Soldiers suggests meal replacement use may be one such approach when used adjunct to weight loss programs, with high adherence and satisfaction reported for the program examined (Smith et al, 2010). However, overall dietary behaviors may also impact Service member outcomes, as suggested in a large study of more than 13,000 male and female U.S. Army personnel, which identified associations between healthy eating habits such as regularly eating breakfast and drinking recommended quantities of water, engagement in healthy activity behaviors including meeting recommended weekly exercise recommendations, and body composition and fitness measures (Purvis et al. 2013).

Dietary supplement use, prevalent in military populations, may also impact Service member physical health, but not always in positive ways. Among U.S. Service members with clinically diagnosed medical conditions, evidence from one cross-sectional study suggests that a higher number of diagnoses may be associated with increased use of dietary supplements concurrent with prescription medications, important given the poor understanding of how dietary substances and prescription medications may interact (Knapik et al. 2022). In this study of more than 26,000 male and female U.S. Service members across the DoD, users of protein/amino acid supplements and combination products containing mixtures of dietary, weight loss, and bodybuilding supplements were noted as being primarily male, younger, and more physically active, factors that potentially reduce the likelihood of utilizing medical services, which could adversely impact long-term physical health (Knapik et al. 2022).

Nutritional health and sleep

Research with the military Service member population suggests significant associations between sleep behaviors and obesity risk, which together may impact overall physical health. One study of U.S. Soldiers attending an Army weight loss program reported that 80% of participants slept fewer than 6 hours each night while more than half did not consume the recommended amounts of fruits and vegetables (Piche et al. 2014), unhealthy behaviors that evidence suggests may also cluster (Kao et al. 2021). These findings suggest concurrent sleep and dietary behaviors may have important implications for both weight management and physical health. Further, Service members not meeting dietary and sleep recommendations may be at greater risk for use of suboptimal methods of weight loss, including use of diet pills, skipping meals, fasting, and use of sweat suits or saunas (Piche et al. 2014).

General Population Research: Nutritional Behaviors, Dietary Patterns, and Mortality Risk

Although there are few studies currently available specific to military populations regarding the association of nutritional behaviors and dietary patterns with mortality risk, there is evidence from the general population that nutritional behaviors including skipping breakfast and underconsuming omega-3 fatty acids are associated with increased risk of all-cause mortality (McBurney et al. 2021; Rong et al. 2019; Cartolano et al. 2021). Omega-3 fatty acids have been shown to both lower risk for total mortality as well as improve total mortality risk prediction (McBurney et al. 2021). Another study found that omega-3 supplementation significantly reduced cardiovascular risk associated with high-density lipoprotein functionality (Cartolano et al. 2021), emphasizing to individuals with high cardiovascular risk the importance of incorporating more omega-3-rich foods into their diets. Eating breakfast is also an effective approach to reduce cardiovascular and overall mortality risk. Individuals who skip breakfast face a significantly heightened risk of cardiovascular and all-cause mortality, underscoring the importance of this meal in promoting cardiovascular health (Rong et al. 2019).

Physical Fitness and Physical Health

Physical fitness is an important factor in body composition, self-reported health, injury, chronic disease, sleep, deployability, and physical resilience.

Physical training and body composition

Several studies address the complex relationship between body composition and physical fitness among Service members (Anderson et al. 2014; Foulis et al. 2021; Szivak et al. 2023; Wuerdeman et al. 2023), and further explore how this relationship may be influenced by intrinsic biological factors such as age and sex (Anderson et al. 2014; Staub et al. 2015; Wuerdeman et al. 2023) or by external and socioeconomic factors such as access to exercise outside the home during a pandemic or even military rank (Wuerdeman et al. 2023). While at least one study of male and female U.S. Army recruits has reported that the rigorous physical nature of military training can induce significant changes in body composition (Foulis et al. 2021), the influence of other health behaviors on Service member body composition also matters, as factors such as nutrition may significantly impact body composition despite high activity levels (Tomczak et al. 2016). Furthermore, Service members may overestimate their levels of activity or fail to account for other factors that attribute to body composition, such as diet (Szivak et al. 2023). Even mandatory physical training programs may not result in significant

weight loss for obese Service members if other behaviors such as sleep and dietary behaviors are not appropriately addressed (Shrestha et al. 2013). Nevertheless, studies support the importance of regular participation in both aerobic and strength training activities for Service members to maintain healthy body composition and to ensure compliance with military body composition standards (Anderson et al. 2014; Foulis et al. 2021; Hanson et al. 2021; Kraemer et al. 2004; Szivak et al. 2023; Warr et al. 2013).

Physical fitness and self-reported or perceived health

Existing evidence suggests direct associations of self-reported fitness and/or activity levels with Service members' perceptions of their health. For example, in studies of U.S. Army personnel, BMI was inversely correlated with self-reported weekly activity levels and concern over both health and appearance (Golenbock et al. 2017; Szivak et al. 2023). Given the importance of perceived health for self-efficacy (Abadi et al. 2022), further understanding how physical fitness may influence Service members' perceptions of their health may be important for supporting readiness.

Physical fitness and musculoskeletal injury

Musculoskeletal injuries are a significant concern in military settings, affecting both operational performance and long-term health outcomes (Taanila et al. 2015; Teyhen et al. 2020). Studies suggest factors such as CRF (Giovannetti et al. 2012; Grier et al. 2017; Lisman et al. 2013; Rappole et al. 2017), body composition (Anderson et al. 2015; Jones et al. 2017; Krauss et al. 2017; Taanila et al. 2015; Teyhen et al. 2020; C. D. Tomes et al. 2020) occupational performance (Anderson, Grier, Dada, et al. 2017; Teyhen et al. 2018), and physical training modalities (Bergeron et al. 2011; Childs et al. 2010; Grier et al. 2022; Grier et al. 2013; Heard et al. 2020; Jensen et al. 2019; Molloy et al. 2012; Roach et al. 2023; Robitaille et al. 2021; Roy et al. 2014; Sefton et al. 2016; Walker et al. 2011) play crucial roles in MSKi risk among military personnel. While there is considerable evidence suggesting a protective effect of greater CRF, often operationalized in the military setting as better performance on 1- or 2-mile runs, on MSKi risk (Anderson, Grier, Dada, et al. 2017; Giovannetti et al. 2012; Grier et al. 2017; Lisman et al. 2013; Rappole et al. 2017), some studies have also paradoxically suggested that greater CRF may be indicative of greater MSKi risk, possibly due to associations between greater CRF and high training volume, which has been shown to increase risk for injury (Giovannetti et al. 2012; Grier et al. 2013; Grier et al. 2017). In fact, evidence suggests there may be a U-shaped relationship between running volume and MSKi risk, such that those endorsing the lowest and highest volumes of running may have greater risk for MSKi (Roy et al. 2014). There is also evidence that other physical fitness factors such as BMI and body composition and demographic or occupational factors such as age or MOS may further contribute to injury risk (Anderson, Grier, Dada, et al. 2017; Jones et al. 2017; Rappole et al. 2017; Teyhen et al. 2018). In fact, both obese and underweight BMI have been linked to increased risk for MSKi during intensive physical training (Krauss et al. 2017; Taanila et al. 2015). There is also evidence that individual components of military fitness tests such as 2-mile run time may effectively predict injury risk during training (Tomes et al. 2020; Wyss et al. 2012). Additionally, studies of U.S. Army and

Marine Corps personnel have shown that assessments evaluating individual movement patterns and fitness levels may have promise for the prediction of MSKi risk (Lisman et al. 2013; Sefton et al. 2016).

Physical training and musculoskeletal injury prevention

To prevent MSKi injury, novel physical training modalities, such as extreme conditioning programs and weight training, have been evaluated for their impact on injury risk, with varying results (Bergeron et al. 2011; Grier et al. 2022; Grier et al. 2013; Molloy et al. 2012; Roy et al. 2014; Sefton et al. 2016). Evidence from at least one study of predominantly male (90.0%) U.S. Soldiers suggests novel training modalities that increase the volume or intensity of training may increase risk for MSKi (Grier et al. 2013), while in a cluster-randomized trial conducted with male and female U.S. Army personnel, a program implementing core stabilization exercises training was reported to decrease lower back injury risk (Childs et al. 2010). Importantly, MSKi has been shown to be particularly common during BMT, especially for recruits with poor fitness, and enhanced conditioning of military recruits prior to entry into BMT may be a means by which to mitigate this risk (Oliver et al 2017; Molloy et al 2012). Other strategies to decrease MSKi risk may include evidence-based training programs, risk stratification models (Roach et al. 2023), and personalized physical training regimens (Heard et al 2020). However, while studies suggest implementing evidence-based training programs can lead to fewer injuries and better outcomes for military trainees (Robitaille et al. 2021), injury risk factors are multifaceted and may involve demographic, fitness, and occupational performance variables (Anderson, Grier, Dada, et al. 2017; Grier et al. 2017; Teyhen et al. 2018). It is essential to understand and address these contributing factors to develop effective injury prevention strategies in military settings (Roach et al. 2023). Table 8 provides some examples of such MSKi risk and protective factors as noted in the scientific literature.

Table 8. MSKi Risk and Protective Factors

MSKi Factor	Protective Factor or Risk Factor	Citations
CRF	Mixed evidence for being a protective factor (top list of PMIDs), other studies indicate it being a risk factor (lower list of PMIDs)	Giovannetti et al. 2012; Grier et al. 2017; Lisman et al. 2013; Rappole et al. 2017
		Giovannetti et al. 2012; Grier et al. 2013; Grier et al. 2017
BMI and Body Composition	Risk Factor	Krauss et al. 2017; Taanila et al. 2015
Components of Military Fitness Tests	Risk Factor	Lisman et al. 2013; Sefton et al. 2016; CD Tomes et al. 2020; Wyss et al. 2012
		Grier et al. 2013

Physical Training Modalities	Mixed Evidence (top PMID indicates risk factor, bottom indicates protective factor)	Childs et al. 2010
Evidence-Based Training Programs and Risk Stratification Models	Protective Factors	Roach et al. 2023; Robitaille et al. 2021
Personalized Physical Training Regimens	Protective Factor	Heard et al. 2020

Physical fitness and chronic health conditions

Various studies have explored the relationship between chronic health conditions and physical fitness on military personnel. Research supports linkage between physical fitness and chronic health conditions. In a study of more than 26,000 military Service members from all branches of Service, those identified as having obesity via high BMI (i.e., BMI greater than or equal to 30.0 kg/m2) were reported to have significantly increased likelihood of a diagnosed medical condition, particularly conditions related to metabolic and/or cardiometabolic function (e.g., type 2 diabetes) or musculoskeletal disease (Knapik et al. 2023). Moreover, this association increased in a dose-dependent manner, such that as BMI increased, MSKi risk increased (Knapik et al. 2023).

A study of more than 250,000 male and female active-duty U.S. Army personnel comparing cardiovascular disease risk factors between Service members and U.S. civilians (NHANES, 2011–2012 cycle) has suggested that Service members may have high prevalence of risk factors for cardiovascular disease, including obesity and hypertension (Shrestha et al. 2019). However, modifiable cardiovascular risk factors may be improved through regular exercise (Stiegmann et al. 2023). Participation in regular moderate intensity exercise may also improve serum lipoprotein profile and insulin sensitivity, both of which may protect against the development of cardiovascular disease and T2DM (Collette et al. 2022; Stanton et al. 2022).

In addition to chronic illnesses, chronic pain is a common condition for military Service members. However, exercise therapy and avoidance of sedentary behavior may be an effective non-pharmacological method by which Service members can manage low back pain during the sub-acute phase of injury (Talbot et al. 2023). Furthermore, a study of more than 65,000 predominantly male (92.2%) U.S. Army personnel suggests that exercise therapies may also reduce the risk of harmful outcomes, including drug or alcohol abuse, suicide ideation, or self-harm, commonly associated with chronic pain (Meerwijk et al. 2022).

Physical fitness and sleep

Given the adverse effects of inadequate sleep on Service member health, factors that may limit the impact of sleep deficiency are important. To this end, evidence from a study of 54 male U.S. active-duty, reserve, and National Guard Service members and ROTC cadets suggests a greater degree of CRF may buffer against the adverse effects of military operational stress, including

sleep deprivation (Beckner et al. 2021). Despite the generally high degree of fitness present in most active-duty Service members, this population may have a high prevalence of insomnia that may not be overcome by being physically fit, suggesting that health screenings and other health promotion programs designed to identify and address sleep problems in Service members may be important for preserving their physical health and readiness (Russell et al. 2019).

Physical fitness and deployability

Guaranteeing that Service members are ready to deploy at a moment's notice is a vital part of Force lethality and mission readiness. However, research suggests a need for specialized training programs to address the increasing prevalence of overweight recruits and enhance physical fitness levels of military personnel, among which the prevalence of obesity may be relatively high (Hruby et al. 2020; Molloy et al. 2012; Santtila et al. 2019). Furthermore, specialized training programs designed to increase upper body strength of Servicewomen while maintaining their overall physical fitness may help close the strength gap between male and female Service members and may be of particular importance for ensuring the deployability and occupational performance of those in combat MOS (Kelly and Jameson, 2016).

Physical fitness and physical resilience

Physical resilience is a key factor for ensuring Service members recover effectively and efficiently from the rigors of military service, training, and combat. Physical fitness and training may support physical resilience, with evidence demonstrating the importance of physical activity for influencing resilience and physical performance during stressful military operations, which may be facilitated through, in part, modulation of corticospinal excitability (Proessl et al. 2022). Aerobic and strength training are likely to be important for effective performance of and recovery from military occupational tasks (Friedl et al. 2015). There is also evidence from a study of approximately 200 Australian Army recruits that resistance training, specifically compound-focused lifts, and high-intensity interval training may improve physical function and resilience through reduction of MSKi risk for both male and female Service members (Burley et al. 2020). Together, these findings suggest that physical training incorporating both aerobic and strength components may be important for the improvement of physical resilience among military Service members.

Psychological Health and Physical Health

Evidence supports linkages, often bi-directional in nature, between psychological health-related factors such as well-being, mental illness, and resilience with Service member physical health.

Psychological well-being, mental illness, and body composition

Psychological well-being may have important impacts on various health behaviors, as self-reported symptoms of PTSD, depression, and generalized anxiety disorder have been associated, in a bi-directional fashion, with increased risk for obesity and lower levels of physical activity, as suggested in a study of more than 12,000 U.S. Service members from across the DoD

(Hruby et al. 2021). In a systematic review of prospective evidence from more than 40 individual studies representing more than 32,000 participants with 1 to 23 years of follow-up, abnormally blunted cardiovascular reactivity to stress was associated with greater incidence of obesity, suggesting psychological stress and responses to that stress may have long-term implications for physical health (Turner et al. 2020). The literature on this topic is relatively limited and warrants further exploration.

Psychological health and chronic health conditions

The military environment is a highly stressful work environment that can increase military Service members' susceptibility to chronic health conditions (Lopez-de-Uralde-Villanueva et al. 2017). In fact, evidence supports stress reactivity as a predictor of chronic health conditions, including obesity and cardiovascular disease (Suvarna et al. 2020; Turner et al. 2020). Moreover, there is also a significant association between allostatic load and various adverse health outcomes and behaviors, including obesity, substance use, physical inactivity, and sleep impairments. Evidence from a systematic review suggests increased allostatic load may also increase risk for coping through the practice of poor health behaviors, which could in turn increase risk for chronic conditions (Suvarna et al. 2020). Chronic pain may also interact with psychological factors. For instance, when conditions such as chronic neck pain are accompanied by high levels of kinesiophobia, or fear of movement, the likelihood of Service members experiencing both functional limitations and psychological distress, including depression and anxiety, is increased (Lopez-de-Uralde-Villanueva et al. 2017).

Reciprocal relationships between psychological and physical resilience and their impact on physical health

Physical resilience is influenced by a variety of factors, including psychological coping and emotional regulation (Crane et al. 2019), mental health and stress (Hourani et al. 2020; Ligeza et al. 2022; Mota et al. 2012) and practicing mindfulness (Goldberg et al. 2020). Resilience and stress have an inverse association such that higher levels of resilience may reduce the impact of stress on Service members, as shown in a study of more than 100 male and female U.S. Air National Guard personnel (Ligeza et al. 2022). In a study of Australian military officer cadets, effective strategies for strengthening physical resilience included healthy coping behaviors and emotional regulation, such as self-reflection (Crane et al. 2019). There is also evidence that health-related behaviors such as physical activity may act as a protective factor against psychological stress; however, resilience may also act as a driver for the practice of health-related behaviors, and Service members with lower resilience may be less likely to practice the health behaviors that might benefit them (Ligeza et al. 2022). Finally, evidence suggests that there may be important sex-related differences in the prevalence of some mental health disorders, including PTSD, depression, and mood or anxiety disorders, specifically that Servicewomen may be at greater risk for these disorders as compared with their male counterparts (Mota et al. 2012). However, at least one study suggests that the higher rates of sexual harassment, sex-based discrimination, and sexual assault experienced by female U.S. Service members as compared with male Service members may explain this difference, even

attenuating differences observed for male versus female Service members in models predicting mental health disorders when such exposures are considered (Jaycox et al. 2023). Given the mental health benefits that may be associated with increased physical resilience, it is important to implement effective strategies to increase physical resilience.

Social Health and Physical Health

Social health factors, such as marital status, leadership, and social support, can have an important effect on physical health.

Marital status and physical health

Healthy social ties, including those among immediate family members, are important for physical health of Service members and their families. For example, in the Millennium Cohort Family Study of U.S. Service members and their families, which included almost 10,000 military spouses of U.S. Service members, perceptions of adequate social and military support were associated with healthy BMI and practice of healthier behaviors among military spouses (Corry et al. 2019). Thus, tailored programming for military spouses may be a key contributor to physical health and well-being of military couples (Corry et al. 2019).

Social support, moral injury, and physical health

Lack of social support and psychological factors such as distress may mediate associations between moral injury and adverse health outcomes including sleep disturbances, pain, burnout, and treatment-seeking behaviors (Hall et al. 2022). These findings suggest that factors such as social support networks may benefit Service members by moderating the magnitude of impact moral injury may have on physical health outcomes.

Leadership and physical health

Evidence suggests that leadership may have important impacts on the physical health of military Service members, especially given the unique, strong hierarchical structure of the military (Fosse et al. 2019). In one systematic review, active forms of destructive leadership, such as abusive supervision, were reported to be predictors of reduced well-being and health, while, conversely, constructive leadership styles were associated with improved well-being and health (Fosse et al. 2019). Additionally, leadership provision of role clarity to subordinates may also decrease the physical stress of military occupational demands, as suggested in a study of U.S. Army cadets in which role clarity decreased the negative impact of high job demands on perceived physical strain (Lang et al. 2007).

Interaction of the Health and Fitness Domains and Physical Health

Table 9. Interaction of Health and Fitness Domains and Their Influence on Physical Health

Outcome	Interacting Domains	Findings	Reference
Physical Health (overall)	Social Health Physical Fitness	Marital status, social support, and family support, may have significant effects on physical health.	Corry et al. 2019; Guo et al. 2023; NA Hall et al. 2022
	Medical/Dental Health Psychological Health	Blunted cardiovascular reactivity to stress is associated with greater incidence of obesity, suggesting psychological stress and responses to that stress may have long-term implications for physical health.	Turner et al. 2020
	Psychological Health (Sleep) Nutritional Health Physical Fitness	Unhealthy behaviors may have important implications for both weight management and physical health.	Kao et al. 2021; Piche et al. 2014
	Nutritional Health Medical/Dental Health	A higher number of medical condition diagnoses may be associated with increased use of dietary supplements concurrent with prescription medications.	Knapik et al. 2022
	Social Health Psychological Health	Active forms of destructive leadership are predictors of reduced well-being and health. Constructive leadership styles are associated with improved well-being and health.	Fosse et al. 2019
Body Composition	Nutritional Health Physical Fitness	Nutrition behaviors may impact body composition, healthy eating habits, engagement in healthy activity behaviors. Body. Body composition and fitness measures may also impact Service member outcomes.	Purvis et al. 2013; Tomczak et al. 2016
Chronic Health Conditions	Physical Fitness Medical/Dental Health	Participation in regular moderate intensity exercise may protect against the development of cardiovascular disease and T2DM.	Collette et al. 2022; Stanton et al. 2022
	Medical/Dental Health Psychological Health	Chronic pain can interact with psychological factors - when conditions such as chronic neck pain are accompanied by fear of movement, the likelihood of Service members experiencing both	Lopez-de-Uralde-Villanueva et al. 2017

		functional limitations and psychological distress is increased.	
Occupational Performance, Non-MSKi Injury, Heat exposure, High Altitude	Environmental Health Medical/Dental Health	Exposure to high altitude, as encountered during flight, may result in tooth pain associated with changes in barometric pressure for military flight personnel with oral pathologies.	Gonzalez Santiago Mdel et al. 2004
	Environmental Health Nutritional Health	Dietary choices such as caffeine consumption, which may influence exercise-induced physiological strain, insufficient energy/nutrient intake, and proper fluid and electrolyte intake are factors that mediate risk for EHI.	Kazman et al. 2020; Lee et al. 2022
	Social Health Psychological Health	Leadership provision of role clarity to subordinates may decrease the physical stress of military occupational demands.	Lang et al. 2007
Deployability	Physical Fitness Psychological Health Medical/Dental Health Nutritional Health Environmental Health	Many health conditions may be preventable through the lifestyle and behavioral tenets supported across the domains of health and fitness, including physical training, healthy dietary approaches, tobacco abstinence, and proper use of protective equipment.	Bornstein et al. 2019; Buckingham et al. 2003; Haddock et al. 2007; Hsieh et al. 2003; McGinnis et al. 2018; Zajc et al. 2011
Sleep	Psychological Health Environmental Health	Conducting missions in extreme cold environments may worsen the adverse influence on sleep quality, increasing risk for sleep disorders, sleep latency, daytime impairment, and poor subjective sleep quality.	Wang et al. 2020
	Medical/Dental Health Psychological Health	Evidence suggests health screenings and promotion designed to address sleep problems in Service members may be important.	Russell et al. 2019
	Physical Fitness Psychological Health	Evidence suggests that a greater degree of CRF may buffer against the adverse effects of military operational stress, including sleep deprivation, on Service member cognition.	Beckner et al. 2021

Physical Resilience	Physical Fitness Psychological Health	Physical fitness and training may support physical resilience, with evidence demonstrating the importance of physical activity for influencing resilience and physical performance during stressful military operations through, in part, modulation of corticospinal excitability. Strategies for strengthening physical resilience may include healthy coping behaviors and emotional regulation, such as self-reflection.	Crane et al. 2019; Proessl et al. 2022

Gaps and Calls to Action in Physical Health

Despite the importance of physical health for military Service members, there remain gaps in the understanding of how best to positively influence outcomes aligned with physical health across the eight domains of health and fitness. Identified gaps in the evidence and potential areas for additional study include:

1. *The influence of the built environment on Service member physical health.* There is little peer-reviewed research examining how factors such as military installation and community design impact Service member physical health. Additionally, few, if any, published, peer-reviewed studies have investigated potential effects of office and workspace environments, including ergonomic and natural light availability considerations, on the physical health and well-being of the Service members who work in such environments. Given the increasing amount of time some Service members may spend working at desks or computer stations (e.g., administrative and other office workers, drone pilots), understanding potentially adverse impacts of such exposures on physical health will be an important part of designing means by which to mitigate such impacts.

2. *The influence of deployment on asthma and other respiratory ailments among Service members*. The studies pertaining to the relationship between deployment and asthma included in this review focused on new-onset asthma diagnosis, and the findings were mixed. There is evidence that Service members have an increased susceptibility to chronic conditions, which includes an increased risk for respiratory symptoms and airway diseases such as asthma. It will be important for future studies to investigate this existing gap in the literature to fully understand if deployment does have a significant influence on asthma diagnosis.

2. *The associations of allostatic load with stress and PTSD, and surrogate measures for objectively evaluating this association*. There is evidence in the military literature that combat exposure increases allostatic load, and research suggests that the relationship between highly stressful, traumatic events and psychological disorders such as PTSD may be mediated to some extent by allostatic load. However, current literature examining the nature of this relationship provides mixed findings, possibly because of inconsistent methods for determining allostatic load or defining and identifying PTSD (Carbone et al.

2022). To better capture objective measures of allostatic load, identification of viable surrogate measures for this factor are needed. Although HRV has been identified as one such potential factor, there is a considerable need for additional research to definitively establish this relationship and determine the most representative and repeatable components of HRV measurement for assessing allostatic load.

3. *The influence of spiritual health on physical health*. While there is a small amount of literature providing evidence of linkage between spiritual health with Service member physical health, the outcomes examined in these studies were broad and somewhat nebulous concepts of physical health rather than well-defined, concrete outcomes such as chronic disease risk or physical injury (Koenig 2023; Moore et al. 2013). Given the importance of spiritual health on holistic Service member wellness and readiness, future research examining such associations will be important to improve understanding of which physical health outcomes may be influenced by spiritual health so that these associations may be conveyed to Service members and their families as part of health promotion campaigns intended to increase buy-in to the importance of this domain for health and readiness.

4. *The influence of healthy lifestyle choices on overall physical health.* There is evidence in the general population literature that engaging in proactive, healthful behaviors improves overall physical health. While literature provides evidence regarding adverse impacts of harmful health behaviors, there is a gap in research on how lifestyle choices and a lifestyle medicine approach to care for Service members could beneficially influence overall physical health. Given the importance of prioritizing and ensuring optimal Service member health, future research providing in-depth examination of these associations will be important to determine the effectiveness of using evidence-based behavioral interventions to prevent and address chronic disease and ultimately overall health among Service members.

Recruitment and Retention

Health and Fitness Domains with Evidence Pertaining to Recruitment and Retention

Environmental	Financial	Medical/ Dental	Nutritional	Physical	Psychological	Social	Spiritual
	★	★		★	★	★	

Introduction

The recruitment of potential Service members and retention of trained Service members are important issues and ongoing challenges for the U.S. Military. A recent Government Accountability Office report noted only 1 in 4 people in the U.S. between the ages of 17 and 24

can meet recruitment requirements for military service, and that the DoD faces challenges retaining active-duty Service members due to issues including quality of life and competition with the civilian sector (GAO 2023). More research is needed to understand perceptions of the military among young adults and inform initiatives undertaken to ensure the military is seen as a viable career path. Furthermore, once Service members have either enlisted or have been commissioned as officers, it is equally important to ensure trained personnel are not lost. Understanding how the multiple domains of health and fitness influence retention will be important for attracting and retaining talented Service members.

Financial Health and Recruitment and Retention

The literature indicates important associations between Service member financial health and a variety of factors important for the recruitment and retention of military personnel.

Financial health and food insecurity

Financial health may play an important role in ensuring the retention of Service members, as those with low financial health may be more likely to not re-enlist. Periods of financial insecurity or economic uncertainty may be more common among military households as a result of frequent relocations that are a typical hallmark of military life; these periods of financial instability may contribute to military households' vulnerability to food insecurity, which may in turn adversely affect Service member re-enlistment (Beymer et al. 2021; Rabbitt et al. 2022). In a study examining food insecurity and intentions to leave the military, food insecurity was significantly associated with anxiety, depression, and suicidal ideation, which was in turn associated with intentions to leave, an association observed for both male and female Service members (Beymer et al. 2021). However, food insecurity is a complex, multi-factorial condition, and it is important to recognize that connections between financial health and food insecurity noted in these studies were often indirect in nature. More research is needed to identify and better understand risk factors for food insecurity among Service members and any causal relationships that may exist between financial health factors and food insecurity.

Military recruiting and retention via return on educational investment

Evidence suggests financial considerations may be important for recruiting and retaining personnel and ensuring that the military is seen as a viable career option. This may be particularly true for professional occupations such as physicians, as military service may be a way for those seeking medical training to avoid accruing financial debt, and the required military service following completion of training may be an attractive trade-off for the eventual return on investment for some individuals. A study of military and civilian physicians reported that, for some, medical specialties, including general internal medicine and psychiatry, a military career had a net value on the educational investment as compared with civilian careers. Notably, this study demonstrated differences in the retention of medical specialists within various field, largely attributable to the incomes associated with civilian as compared with military careers in these respective sub-specialties. After eight years, the military retained roughly 20% of attendings in subspecialties such as gastroenterology, cardiology, and

hematology/oncology (i.e., sub-specialties with very high return on investment in the civilian sector), and although military retention rates were highest among those in primary care specialties such as psychiatry and internal medicine (i.e., substantially lower return on investment in the civilian sector), only 35% of these physicians remained in the military system after eight years (Cronin et al. 2010). In a study of medical student awareness of and attitudes towards DoD economic assistance programs for medical training, not only were graduating medical students unaware of or uninterested in such programs despite significant financial debt (in some cases as much as $151,000), attitudes towards military service were decidedly negative, with more than half of respondents noting that they would not be willing to serve in the military in any capacity (Heinrich, Bale, and Swan 2008). Together, these studies highlight not only concerns regarding the recruitment and retention of military physicians, but also those regarding national healthcare, as significant financial indebtedness has led to a preference for medical students to seek specialty training, resulting in a substantial gap in the availability of primary care physicians (Heinrich, Bale, and Swan 2008).

Medical and Dental Preventive Health and Recruitment and Retention

Aspects of medical and dental preventive health can affect retention, including prevention and treatment of conditions such as musculoskeletal injury and atrial fibrillation, and tobacco use.

Medical preventive health, musculoskeletal injury, and Service member retention

MSKi and medical interventions to treat such injuries, including anterior cruciate ligament reconstruction and meniscal allograft transplantation, may have substantial impact on retention, as many Service members may have considerable activity limitations or be unable to return to duty following the procedure (Antosh et al. 2020; Antosh et al. 2018). For example, from 1998 to 2000, MSKi was the leading diagnosis submitted to the Physical Evaluation Board (Bohnker et al. 2003). However, not all surgical procedures for relatively common MSKi sustained by Service members, such as bulging disks, affect retention; in many cases, Service members are able to return to unrestricted full active duty (Tumialan et al. 2019). Nevertheless, strategies to prevent MSKi, which may include modifications to training programs to prevent overuse injuries, are likely to aid in the retention of trained military personnel, as MSKi is a significant factor influencing medical downgrading or discharge (Clifton et al. 2023; Papworth et al. 2020; Walker et al. 2011).

The influence of atrial fibrillation on Service member retention

Multiple studies have examined the relationship between atrial fibrillation and retention in Air Force Service members, a population that may be at increased risk for atrial fibrillation due to the rigors of flight in high performance aircraft. While studies suggest that the incidence of atrial fibrillation in Air Force personnel is similar to that of the general population, they also suggest that Air Force Service members may be diagnosed at younger ages. Nevertheless, almost 70% of Service members diagnosed with atrial fibrillation continue to meet military retention standards after medical board evaluation (Hunter et al. 2013; Keithler et al. 2023; Keithler et al. 2022).

Tobacco use and military discharge

Evidence suggests that tobacco use may be an important predictor of military retention. While tobacco use does not directly lead to discharge, cigarette smoking has been reported to be a strong predictor of military discharge (Talcott et al. 2015). Moreover, DoD spent approximately $1.6 billion per year on tobacco-related medical care, hospitalizations, and lost workdays among active-duty Service members (Talcott et al. 2015). Tobacco use may also influence military retention through its adverse effect on Service member physical resilience following injury, as tobacco use has repeatably been cited a predictor of poor outcomes following medical intervention for MSKi, which may result in medical discharge of military personnel (Anderson et al. 2021; Antosh et al. 2020; Chin et al. 2015; Clifton et al. 2023; Kardouni et al. 2016; Robbins et al. 2000; Yepson et al. 2020). Studies suggest counseling in conjunction with nicotine replacement treatment appear to be beneficial for supporting tobacco cessation in Service member populations (Talcott et al. 2015).

Physical Fitness and Recruitment and Retention

Evidence suggests that physical fitness, namely body composition, may be a key influencing factor in predicting military discharge as a result of failing fitness tests and/or body composition standards.

Body composition and military discharge

Studies of Finnish military personnel suggest associations of poor body composition and low fitness levels with discharge from military service (Santtila et al. 2019; Taanila et al. 2011). In studies of U.S. Soldiers, U-shaped associations have been observed between BMI and medical and all-cause discharge rates, both rates appear to be higher for those with either an underweight or obese BMI as compared with those having BMI within normal range (Packnett et al. 2011). In fact, the highest rates of all-cause discharge were for BMI less than 18, even BMI approaching the lower bound of normal was found to have significantly higher odds for both medical and all-cause discharge. There may be long-term, adverse carryover effects of obese BMI for Service members, as even those who lost weight after failing military BMI standards had increased likelihood of premature discharge (Packnett et al. 2011).

Psychological Health and Recruitment and Retention

Mental health can impact retention, and mental health can be impacted by the type of military discharge.

Mental health and military discharge

A study of U.S. Soldiers found those who screened positive for anxiety, depression, or suicidal ideation were more likely to report intentions to leave the Army (Beymer et al. 2021). Moreover, in a study of more than 7,000 deployed U.S. Service members, a history of suicide-related aeromedical evacuation was associated with significant increased risk for military separation as

compared with evacuation for other psychiatric conditions (Straud et al. 2020). Sleep may also contribute to military retention. A study of survey responses from more than 55,000 U.S. Service members who reported sleeping fewer than 6 hours per night were significantly more likely to separate from the military early (Seelig et al. 2016). It is important to consider the inverse of this relationship after Service members leave the military. Newly separated veterans may report chronic physical or mental health conditions despite reporting relatively high vocational and social well-being, with men more likely to endorse a physical condition such as high blood pressure and women more likely to endorse a mental health condition such as anxiety or depression. (Vogt et al. 2020). Interventions such as mindfulness training may be important in supporting long-term mental health (Goldberg et al. 2020). The type of discharge experienced by a Service member may also have a profound effect on psychological health. In a Veterans Health Administration study of data from 443,360 veterans, those who had non-routine military discharge, including disqualification or misconduct discharge, had significantly greater likelihood of mental health disorder, substance use disorder, and suicidality, while disability-discharged veterans had higher likelihood of anxiety disorders and bipolar or psychotic disorders (Brignone et al. 2017).

Social Health and Recruitment and Retention

Social factors, such as community and family factors, can impact retention.

Community and retention

A Service members involvement in both the military and their own community can affect reenlistment. A study on Air Force personnel found that affective commitment, or an emotional attachment to, identification with, and involvement with the military, was associated with the decision to stay in the Air Force (Smith et al 2011). On the other hand, Air Force personnel who were embedded in the community were more likely to separate. For Service members facing the reenlistment decision, those who were more embedded in the community were more likely to separate then those who were not (Smith et al 2011).

Family factors and recruitment and retention

The strongest predictor of military service in the United States is having a family member who has or is serving, and 80% of new recruits across the different Services have a family member who has served (Rossiter et al 2022). Families can also play a strong role in retention. For example, in a study looking across branches of Service, the number of children, spouse bothered by finances, and Service member months away from home were associated with increased likelihood of Service member voluntary separation (Woodall et al 2022). Service members with spouses who reported higher levels of social support were significantly less likely to voluntarily separate (Woodall et al 2022, Sims et al 2024). A study looking at Army families found that spouses whose needs were unmet after seeking help experienced greater stress, and spouse unmet needs and reports of greater stress were associated with worse general attitudes toward the military. These attitudes toward the military were associated with less inclination to stay a military family, which in turn predicted soldier turnover almost two years later (Sims et al

2024). Children with specific health care needs can also play a role in retention. A study looking across the Services found that parents of children with complex or non-complex chronic diseases served in the military longer than parents of children with chronic disease. Specifically, parents of children with complex chronic disease served 4.8 months longer, and parents of children with non-complex chronic disease served parents of children with non-complex chronic disease served 4 months longer over the 8-year study period (Perkins et al 2023).

Interaction of the Health and Fitness Domains and Recruitment and Retention

Table 10. Interaction of Health and Fitness Domains and Their Influence on Recruitment and Retention

Outcome	Interacting Domains	Findings	Reference
Early separation from military	Financial Health Nutritional Health	Food insecurity is an important indicator of financial health, and is associated with anxiety, depression, and suicidal ideation, which was in turn associated with intentions to leave.	Beymer et al. 2021; Rabbitt et al. 2022
	Medical/Dental Health Physical Fitness	Low fitness levels, as well as too low or too high BMI, are associated with increased odds for medical and all-cause discharge.	Packnett et al. 2011; Santtila et al. 2019; Taanila et al. 2011
	Medical/Dental Health Physical Fitness	MSKi increases the risk for early separation, and modifications to training programs to prevent overuse injuries can be implemented to reduce MSKi risk.	Clifton et al. 2023; Papworth et al. 2020; Walker et al. 2011
	Medical/Dental Health Social Health	Parents of children with complex or non-complex chronic diseases served in the military longer than parents of children with chronic disease.	Perkins et al 2023
Well-being after separation	Psychological Health Physical Fitness Social Health	Newly separated veterans may report chronic physical or mental health conditions despite reporting relatively high vocational and social well-being.	Goldberg et al. 2020; Vogt et al. 2020

Gaps and Calls to Action in Recruitment and Retention

1. *Studies examining factors influencing military recruitment and/or retention.* Despite the importance of recruitment to a volunteer military, there is a lack of published peer-reviewed literature on factors affecting U.S. Military recruitment. Furthermore, the Government Accountability Office noted in March 2023 that DoD has not collected or tracked sufficient data to support decisions related to recruitment and retention, does not have sufficient strategies to guide recruitment and retention efforts, and is not

positioned to fully monitor the effectiveness of recruitment and retention (GAO 2023). A more careful examination of a perceived culture of health, including the potential for financial, environmental, social, spiritual, and medical and dental preventive health, could provide leaders and military recruiters with information regarding the beneficial nature of military service that might be used to positively impact recruitment.

2. *Studies examining military perceptions by the eligible U.S. population.* Future studies focused on the recruitment-age youth perceptions of the military as a viable career path may be warranted. Particularly, studies examining youths' perceptions of the health and well-being of Service members may help elucidate the connection between recruitment and the domains of health and fitness.

3. *Studies examining how factors within the social, physical, psychological, spiritual, and environmental health and fitness domains might be leveraged to support both recruitment and retention efforts.* These types of studies would be appropriate to understand how the U.S. Military can recruit talented youth and retain qualified personnel.

Community and Family Readiness

Health and Fitness Domains with Evidence Pertaining to Community and Family Readiness

Introduction

In the previous sections, the focus was on outcomes related primarily to the individual Service member. This section will focus on outcomes that affect the family and broader community. This includes how Service members function within a unit, relationships between leaders and subordinates, satisfaction with the military community, how families function through the domains of health and fitness, how Service members and families interact with the health care system, and overall quality of life, defined as “an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns” (WHO 2023).

Environmental Health and Community and Family Readiness

Factors such as community water quality may have significant impacts on the readiness of Service members and their families.

Water quality and community readiness

Water quality is an important aspect of environmental health that contributes to community readiness by ensuring that military communities have consistent access to clean, safe drinking water. A variety of factors can adversely affect drinking water quality and safety, including contamination by birds, animals, or chemicals (e.g., jet fuel, per- and polyfluoroalkyl substances, volatile organic compounds) and inadequate chlorination (DeFraites et al. 2014; Maslia et al. 2016; Filipovic et al 2015; Miko et al. 2023). Drinking water is commonly obtained from groundwater sources, which may become contaminated with volatile organic compounds as a result of military fire training exercises, explosives detonation or improper industrial waste disposal; consumption of such chemically contaminated water supplies may have adverse consequences on the health and well-being of military communities (Sonnefield, Hertz-Picciotto, and Kaye 2001; Walsh et al. 2013; Bove et al. 2014; Ruckart, Bove, and Maslia 2014; Ruckart et al. 2015; Anderko and Pennea 2020; Miko et al. 2023; Ruyle et al. 2023; Bove et al 2024). Consequences of exposures to chemically contaminated drinking water, which can include not only consumption of the water, but also its use for hygiene purposes such as bathing and teeth brushing, may include reproductive problems, developmental problems for fetuses and children, somatic symptoms such headaches, nausea, vomiting, dizziness, fatigue, and neurological symptoms, increased risk for certain cancers, and even increased long-term mortality risk (Sonnefield, Hertz-Picciotto, and Kaye 2001; Bove et al. 2014; Ruckart et al. 2014; Ruckart et al. 2015; Anderko and Pennea 2020; Miko et al 2023; Bove et al. 2024). Moreover, water contamination events can result in the displacement of military communities and interruption of the daily lives of military families, can contribute to a sense of frustration with and mistrust in public health officials, and may have long-term adverse psychological and social effects (Miko et al. 2023). Many of these chemical contaminants may be especially difficult to remediate and may persist in soils and groundwater for long periods of time (Walsh et al. 2013; Filipovic et al. 2015; Darlington, Barth, and McKernan 2018; Ruyle et al. 2023).

In addition to chemical contamination, contamination of water sources with microorganisms from the environment or vectors such as birds or animals, especially when coupled with inadequate water filtration and/or treatment techniques, can have deleterious effects on community health (Jones et al. 2006; DeFraites et al. 2014; Watier-Grillot et al. 2022). Such contamination events, often occurring when residual chlorine levels of drinking water are very low or even undetectable, have been associated with outbreaks of waterborne illness caused by organisms such as *Campylobacter jejuni*, *Cryptosporidium hominis*, and enterotoxigenic *E. coli* spp. infections that often result in severe gastroenteric disease or even death (Jones et al. 2006; DeFraites et al. 2014; Watier-Grillot et al. 2022). Splash pads, which have become more common on some military installations as sources of entertainment for military families, may be another source of waterborne illnesses when water treatment is not managed properly or patrons partake in unhygienic practices, especially in cases of recirculating water splash pad designs (Hardcastle, Perry, and Browne 2015). This is particularly important since children, who are more likely to frequent splash pads, may be more susceptible to severe illness following infection by these pathogens; for this reason, oversight of these types of water features on

military bases by preventive medicine personnel may be ideal (Hardcastle, Perry, and Browne 2015).

Spotlight on Environmental Health: Effects of the Camp Lejeune and Red Hill Drinking Water Contamination Crises

Drinking water supply contamination at Marine Corps Base Camp Lejeune and the Red Hill Shaft of the Joint Base Pearl Harbor-Hickam water distribution system are two important examples of how chemical contamination of groundwater near or on a military installation can impact Service members and the military community at large.

Early in the 1980s, high concentrations of volatile organic compounds, including the known carcinogen benzene, were detected in both ground and drinking water supplies for two of three water treatment plants serving Camp Lejeune. Contamination of the groundwater supplying these water treatment plants was likely due to historical base operations and hazardous waste disposal practices, such as chemical disposal by an off-base dry-cleaning company (Maslia et al. 2016). While the EPA's maximum contamination limit for the volatile organic compound trichloroethylene is 5 µg/L (ppb), concentrations of this compound in drinking water samples from Camp Lejeune were as high as 1,400 µg/L (ppb) (Maslia et al. 2016). It is likely that exposure to contaminated ground and drinking waters started in 1953 and continued until 1985 (Maslia et al. 2016). Beginning in 1995 epidemiological investigations of the long-term effects of ground and drinking water contamination at Camp Lejeune have revealed increased incidence of birth defects and childhood cancers, low birth weight and other adverse birth outcomes, male breast cancer, and increased mortality risk for Marines, Sailors, and civilian personnel who lived and worked at Camp Lejeune as compared with those stationed at other Marine Corps bases (Sonnefeld et al. 2001; Ruckart et al. 2013; Bove et al. 2014; Ruckart et al. 2014; Ruckart et al. 2015; Maslia et al. 2016; Bove et al. 2024).

In late 2021, contamination of the Red Hill Shaft of the Joint Base Pearl Harbor-Hickam water distribution system with the jet fuel JP-5 was confirmed following complaints of illness and a fuel-like odor in the tap water made to the Hawaii Department of Health (Miko et al. 2023). Testing of the water system, including samples obtained from elementary schools, revealed petroleum product contamination at levels more than 350 times the action level (Miko et al. 2023). The Joint Base Pearl Harbor-Hickam water distribution system serves more than 9,600 civilian and military households, as well as multiple schools and businesses, all of which were

issued drinking water advisories (Miko et al 2023). Pursuant to discovery of the contamination, drinking water advisories lasted for 118 days, resulting in the displacement of thousands of households (Troeschel et al. 2022). A survey provided to affected households, more than half of which were military, revealed that routes of exposure included ingestion of contaminated water through oral hygiene, drinking, cooking, and dermal exposure during showering or bathing (Troeschel et al. 2022; Miko et al 2023). Self-reported symptoms for adults and/or children affected included new or worsening mental health symptoms, including depression and anxiety, headache, dry or itchy skin, skin rash, fatigue, diarrhea, vomiting, and dizziness (Miko et al. 2023). Schools, daycares, medical facilities, community centers, and other businesses reported concerns about disruption of daily activities, distrust of official communications, need for resources, financial losses, increased tardiness and absences from school, and concerns about resolution timeline and long-term effects (Miko et al. 2023). Little is known in terms of long-term effects of petroleum product exposure, especially in children, and longitudinal studies will be needed to better understand the full breadth of the impacts the Red Hill petroleum spill will have on military families in this community.

These two drinking water contamination scenarios highlight the importance of protecting drinking water supplies and systems and provide evidence of how ground and drinking water contamination can have significant and far-reaching adverse consequences for those affected.

Financial Health and Community and Family Readiness

Financial health is an important factor in family readiness and can also impact transition to civilian life.

Financial health of Reserve Components

Financial health may have a significant effect on family readiness for all military components, active and reserve, and across all Services, although there is a dearth of current research on this topic among active-duty Service members. National Guard and Reserve Service members generally need a primary source of income outside of the military, and this can be disrupted during deployments. For example, Reservists who own businesses continue to shoulder most business-related expenses, especially in the case where they are the sole proprietor, and in some cases extended deployment may even lead to closing of the business (Petinaux 2008). Service-related injury can also be detrimental to Reservists' financial stability and family well-being and may have compounding effects on military and civilian employment (Gorman et al. 2016). Together, these considerations emphasize the importance of comprehensive support for

National Guard and Reserve Service members and their families (Gorman et al. 2016).

Financial education and health of Active Components

Evidence suggests that, as compared with their civilian counterparts of comparable age and socioeconomic status, U.S. Soldiers may have more types of savings accounts, more problematic credit card behaviors, and similar use of alternative financial services such as payday loans (Skimmyhorn 2016a). Junior enlisted Service members with lower income, less education, and larger families have been reported to endorse more financial hardship and fewer positive financial behaviors (Riviere, Sinclair, and Graham 2024). However, the literature also demonstrates that financial education, such as provided during BMT or in military academy courses, may have beneficial effects on the financial knowledge, self-efficacy, and health of Service members, including lower likelihood of having credit account balances, delinquencies, and adverse legal actions, following course attendance although these effects may subside over time (Skimmyhorn 2016b; Skimmyhorn et al. 2016). Financial education regarding, and automatic enrollment or enrollment assistance into, retirement savings accounts may have long lasting beneficial effects, with one study conducted among U.S. Army enlistees demonstrating increased retirement savings rates and average monthly contributions to retirement savings accounts that persisted for at least 2 years following enrollment (Skimmyhorn 2016b).

Spousal employment and financial health

While active-duty Service members have a steady income, military spouses may have difficulty seeking and maintaining employment, especially given frequent changes of station common for military personnel. This type of migration is associated with a 10% and 6% decline in employment among all female and male civilian spouses, respectively, and a four- or more hours' decrease in hours worked per week among female and male civilian spouses who remain employed (Cooke and Speirs 2005). Furthermore, this problem was exacerbated by the COVID-19 pandemic, with 36% of Army Soldiers reporting their spouse/partner had reduced work hours, and 23% noting their spouse/partner no longer worked outside the home (Gomez et al. 2023). Interruptions in employment may also increase food insecurity (Rabbitt et al. 2022). Spouse employment may also increase risk for intimate partner violence, as suggested by a study of female aggression towards male partners which indicated a 60% greater risk of severe violence by female Service members when a spouse was unemployed (Newby et al. 2003).

General Population Research: Financial Health

Financial health involves the skills, knowledge, and tools to make sound financial decisions (Cohen 2024). Low financial health can lead to financial strain, which can have detrimental effects on health and quality of life (Nykiforuk 2023) and can influence other domains of health and fitness, such as medical and dental preventive care. A qualitative study found that financial strain was the most important factor in health decision-making, with underserved adults noting the trade-off between healthcare and household or individual needs, using alternative remedies as affordable substitutes, and perceiving stigma to discussing financial strain in clinical settings (Nguyen et al. 2018). Considering mental health, there is evidence that financial strain may be associated with depression, anger, and anxiety (Bierman, Upenieks, and Lee 2023), with a systematic review of 48 studies reporting a significant association between financial strain and higher likelihood of depression (Ettman et al. 2023). Furthermore, the National Epidemiologic Survey on Alcohol and Related Conditions found that cumulative financial strain was predictive of suicide attempts and suicide ideation (Elbogen et al. 2020). Economic strain is considered a social determinant of health by the Centers for Disease Control and Prevention and is an indicator of health tracked by *Healthy People 2030*. Leading health indicators for economic stability include "Increase employment in working-age people" and "Reduce household food insecurity and hunger." Additional finance-related metrics include—

- Reduce the proportion of people living in poverty.
- Reduce the proportion of families that spend more than 30% of income on housing.
- Reduce work-related injuries resulting in missed days of work.

The Center for Healthy Communities at the University of Alberta developed a framework to address financial wellbeing and financial strain, identifying calls to action for the government, organizational and political culture, socioeconomic and political context, social and cultural circumstances, and life circumstances (Centre for Healthy Communities (CHC) & Centre for Health Equity Training 2022), which can help improve financial health.

Financial health and the transition to civilian life

Financial health may also influence how well active-duty military families transition to civilian life. Key indicators of financial status immediately post-separation may include stable housing, the ability to pay for necessities, keeping up with creditors, insurance for catastrophic events, saving for retirement, and setting aside three months of salary (Elbogen et al. 2022). At military separation, as many as 13% of veterans may have troubled financial status, having achieved no more than two of these financial goals, while another 38% may have moderate financial status, which may predict future financial functioning, satisfaction, and difficulty with community adjustment (Elbogen et al. 2022). Disability may further impact this transition, as veterans with service-related disability may experience greater financial distress, less life satisfaction, and poorer mental health as compared with their non-disabled counterparts (Bond et al. 2022).

Medical and Dental Preventive Health and Community and Family Readiness

Medical and dental preventive health can have an impact on community and family readiness through access to and engagement with the military health system and can improve Service member quality of life.

Access to and engagement with the Military Health System

There is an abundance of literature examining associations between medical and dental preventive health and access, help-seeking, or engaging with the health system. Healthcare models such as the patient-centered medical home may be leveraged to provide vital timely access and continuity of care to medical treatment and preventive services within military medical treatment facilities in support of Service member medical readiness (Taylor-Clark et al. 2023). However, at least one study suggests there remains work to be done in terms of ensuring that military personnel and their beneficiaries have timely access to care within the patient-centered medical home model in the Military Health System, as access to medical appointments within the 24-hour requirement fell outside of the benchmark standard set by the Military Health System—delays that could hinder Service member medical readiness (Tanekkia et al. 2023). Access to and provision of care by civilian sector medical services has been suggested to be a means by which to improve Service member physical and mental health outcomes, particularly given that access these providers may be more readily available and not carry with it concerns about reprisal for seeking care (Waitzkin et al. 2018). Nevertheless, evidence suggests that medical treatment facility beneficiaries have better inpatient quality of care and safety as compared with civilian treatment facilities, highlighting the importance of access to the Military Health System for ensuring the health and readiness of Service members and their families (Zogg et al., 2021). Telehealth has been shown to be an important means to improve Service member access to care, particularly in deployed environments where rapid access to healthcare may be limited, and allows hands-on care under remote supervision, expanding this capability (Madsen, Poropatich, and Kehlmoos. 2023). Importantly, patient perception to access to care has been positively correlated with patient satisfaction and better mental health status

in Service members, while mistrust of the medical system may adversely influence Service member self-reported health status (Moore et al. 2013).

While untreated dental issues can result in lost days during deployment and even the need for medical evacuation (Sauvet et al. 2009), active-duty Service members are more likely to have preventive dental care compared to recent veterans and the general population, likely owing to the provision of universal military dental care (Wiener et al. 2014). New recruits, however, have greater dental needs than active-duty Service members, as suggested by a 2008 Department of Defense Recruit Oral Health Survey in which more than half of incoming recruits were classified as being non-deployable based on dental readiness, with the majority perceiving the need for dental care but not receiving it due to the expense (Leiendecker et al. 2011).

Vaccine hesitancy and engagement with the Military Health System

Immunization is an important aspect of medical and dental preventive health that may influence how Service members interact with the military health system. Even prior to the COVID-19 pandemic, hesitancy and negative perceptions of vaccines existed in the military. This was suggested by a 2011 study of U.S. Service members, which reported that 20% of respondents would decline pre-deployment vaccines if they could (Polak et al. 2011). Vaccine hesitancy in the U.S. Military population seems to be driven largely by concerns with vaccine safety and efficacy (Batie et al. 2023; Polak et al. 2011; Porter et al. 2013; Theis et al. 2022), although these perceptions may differ by vaccine-preventable disease, as self-reported endorsement of at least one dose of HPV vaccine in a sample of U.S. Navy personnel was higher than that of the general population (Buechel and Connelly 2018). Vaccine endorsement and hesitancy have also been shown to differ between officers and enlisted personnel, suggesting that education may play a role in vaccine perceptions (Porter et al. 2020). This is further supported by surveys of active-duty Service members, where lack of knowledge surrounding both the HPV vaccine as well as HPV itself were associated with vaccine hesitancy (Halista et al. 2020; Porter et al. 2020; Ward et al. 2023). Evidence suggests that educational interventions to increase Service member knowledge about vaccine efficacy and safety may help combat misinformation and support readiness (Batie et al. 2023; Porter et al. 2020; Ward et al. 2023).

Female Service member health, access to medical care, and engagement with the Military Health System

Women's health issues, including unintended pregnancy, may substantially impact Service member health, well-being, and readiness (Witkop et al. 2023), but access to family planning and reproductive healthcare services for those of reproductive age may be inconsistent (Carty et al. 2019; Heitmann et al. 2017). For example, provider training on long-acting reversible contraceptives versus self-administered contraceptives may vary (Deans et al. 2019; Heitmann et al. 2017), despite increasing use by active-duty Servicewomen (Lotridge et al. 2021). Enhanced provider education targeting efficacy-based counseling, identification of barriers to access, and provision of multiple contraception choices is needed to reduce these barriers (Deans et al. 2019; Seymour et al. 2019).

Women's health during deployment is particularly important, as Servicewomen may have unique health needs in austere environments (Trego et al. 2018). For example, a large proportion of women demonstrate an interest in menstrual suppression during deployment or training (Phillips and Lynn 2022; Ricker et al. 2021). However, there may be barriers to the provision of this care for some Servicewomen (Seymour et al. 2021), including physician deployment experience, knowledge, personal biases, and lack of research (Phillips and Lynn 2022), demonstrating the need for consistent, standardized, and evidence-based pre-deployment processes and expanded resources in deployed environments for Servicewomen (de Kanter et al. 2019).

Medical and dental preventive health and quality of life

Medical and dental preventive health can impact Service members' general quality of life. Programs such as the Diabetes Prevention Program may improve not only physical health but also quality of life (Kramer et al. 2023), and hearing protection use may prevent the development of lifelong hearing problems and disabilities (Henry et al. 2019). Finally, survey tools such as the oral-health related quality of life may improve understanding of the connection between medical and dental prevention practices and quality of life (Crocombe and Mahoney 2016; Spalj et al. 2012).

Nutritional Health and Community and Family Readiness

Studies suggest that improving access to high quality, nutritious foods may improve Service member diet quality, satisfaction with dining facilities, and feelings of self-efficacy in terms of nutrition.

Nutrition Programs in the Military

mNEAT

Since 2011, the military nutrition environment assessment tool (mNEAT) has been available as a standardized DoD tool to evaluate the food environment of military installations across nine food venue types and three key categories (food policy, food availability, and behavioral design) (https://www.hprc-online.org/nutrition/mne/prep/evolution-and-impact-mneat).

Go for Green®

Per policies, military dining facilities use a color-coded nutrition labeling program such as Go for Green® (G4G) to support human performance optimization. G4G includes strategies to increase access, availability, and awareness of nutritious "Green" menu items that contribute to health, performance, and readiness (https://www.hprc-online.org/nutrition/go-green).

Food insecurity and community and family readiness

Research shows that about 26% of military personnel report food insecurity and that the percentage of Service members reporting food insecurity was almost three times greater than comparable civilians (Asch et al. 2023). Service members at greatest risk for food insecurity include enlisted personnel with paygrades of E4 to E6 (Asch et al. 2023) and single-parent or dual-parent households with a greater number of children (Wax and Stankorb 2016).

Dining facilities and access to high quality nutrition on military installations

Evidence suggests that improving the quality of foods offered at military dining facilities can help to ensure Service members in installation communities have access to healthy, nutritious foods and may improve their perceptions regarding the feasibility of healthy eating (Crombie et al 2013; Belanger and Kwan 2016; Cole et al. 2018; Chuckwura et al. 2019). Moreover, in studies of military dining facilities in which menu standards were changed to improve food quality, Service members were more likely to consume fewer calories and fats while increasing their intake of fruits, vegetables, and protein as a percentage of their total caloric intake and were more likely to report satisfaction with the dining facility offerings (Crombie et al. 2013; Belanger and Kwan 2016; Cole et al. 2018). In studies of installation nutrition environments, increased access to fast food restaurants and vending machines was associated with lower quality dietary patterns, with study respondents noting that limited nutrition options in many military work environments made eating healthy seem unrealistic (Chuckwura et al. 2019).

Physical Fitness and Community and Family Readiness

Evidence shows that leadership can provide a culture that embraces physical fitness.

Leadership and a culture of physical fitness

While evidence is lacking regarding the influence of physical fitness on leadership, leadership promotion of a culture of fitness may improve fitness-related outcomes such as military fitness test performance (Anderson et al. 2017; Matthews et al. 2022), and may be accomplished through encouraging activities such as individual physical training and supporting physical training during the workday (Anderson et al. 2017; Matthews et al. 2022).

Psychological Health and Community and Family Readiness

Psychological health is an important factor in leadership and quality of life, highlighting the value of help-seeking and engaging with the military health system.

Psychological health and leadership

Psychological health may be particularly important for leaders, who have the added stress of ensuring both mission success and the readiness and well-being of subordinates. Evidence suggests training to improve psychological health, such as mindfulness training, may have a

positive effect on leaders' transformational leadership behaviors, resilience, and perceived effectiveness (Ihme and Sundstrom 2021). However, a high degree of job stress may degrade subordinates' perceptions about the abilities of supervisors and commanders, highlighting the importance of implementing approaches to manage such stressors for the mental health of both leaders and their subordinates (Pflanz and Ogle 2006).

Research suggests that positive military experiences, including social support and cohesion before deployment can play an important role in predicting positive affect, with the establishment of trust, support, pride, and belonging being an important foundation that helps Service members thrive and feel part of their larger mission and purpose (Maguen et al. 2008). Perceived cohesion may be indicative of Service members' awareness of mental health in others and a willingness to discuss mental health matters (Jones et al. 2018). Interpersonal relationships, particularly with supervisors, and unit support may be important for psychological well-being and possibly even mitigation of PTSD severity (Brooks and Greenberg 2018; Geuzinge et al. 2020; Zang et al. 2017). Conversely, poor leadership and low cohesion may serve as barriers to care by increasing stigma (Jones et al. 2018), particularly regarding the perception of seeking mental health services (Warner et al. 2008), and destructive leadership may adversely impact leadership performance, as well as subordinate behavior, health, and wellbeing (Fosse et al. 2019).

Psychological health and help-seeking behaviors, facilitators, and barriers

Help-seeking and engagement with the medical system are important for psychological health, and most military personnel believe that behavioral health treatment is effective, with Service members reporting they would respond truthfully to behavioral health screening (Bogaers et al. 2022; Warner et al. 2008). This suggests attitudes towards mental health care may have changed over time. In a 2004 study of Service members deployed to Afghanistan, of the 16% meeting screening criteria for a mental illness, only between 38% and 45% indicated an interest in receiving help, and only 23% to 40% reported having received professional help (Hoge et al. 2004); however, in a 2008 study, nearly two-thirds of Soldier participants reported they would seek mental health care if they thought they had a problem (Warner et al. 2008). However, there remain barriers to care, such as the preference for handling problems oneself, differential treatment stigma, negative perceptions and beliefs about medication, and practice barriers (Britt et al. 2020; McLean et al. 2022; Zinzow et al. 2015). Those with a history of emotional trauma and parental absence or separation or sexual trauma and PTSD were less likely to seek help (Duncan et al. 2020). On the other hand, there are some facilitators to help-seeking for mental health, such as unit cohesion, a prior history of seeking help, and a larger social network, representing important intersections between psychological, medical, and social health (Duncan et al. 2020; Jones et al. 2018).

Psychological health and quality of life

Psychological health may also influence overall quality of life, as demonstrated in a study in which depression modified the relationship between military service and life satisfaction (Britton et al. 2012). Quality of life is an important consideration for Service members, as it may

modify the relationship between adverse experiences such as recalled childhood ADHD symptoms or diagnosis and suicide ideation, self-harm, and suicide attempts (Tai and Gau 2017). Thus, identifying and addressing factors that influence Service member quality of life may promote better mental health outcomes in this population. Among such factors, PTSD stands out, given research suggesting that PTSD diagnosis may adversely impact health-related quality of life and may be predicated by the types of injuries sustained by Service members, such as TBI, which may increase risk for subsequent PTSD diagnosis (McCabe et al. 2021). Sexual trauma can significantly increase the risk for PTSD symptoms and/or diagnosis, as well as symptoms such as chronic pain, depression, and sleep difficulties affecting quality of life (Kelly et al. 2011).

Social Health and Community and Family Readiness

Social health may contribute to several community and family readiness factors including unit cohesion, leadership, satisfaction with the community, and risk for child mistreatment.

Social health through cohesion

Cohesion can manifest differently across military units, as units sharing similar MOS generally rely on professional competence for better cohesion outcomes, while those with varied occupations tend to place more emphasis on leadership, teamwork, and shared experiences. Moreover, the link between shared experiences and communication for the establishment of teamwork in these units indicates that communication has social-affective importance through recognition of similarity, highlighting the vital nature of communication in unit cohesion and the need to foster this skill, as cohesion can buffer the effects of combat stress, PTSD, depressive symptoms, and suicide ideation (Anderson et al. 2019; Campbell-Sills et al. 2022; Dempsey et al. 2021; McAndrew et al. 2017; Reed-Fitzke and Lucier-Greer 2020). Furthermore, unit cohesion may be associated with agency and life satisfaction (Gutierrez and Adler 2022). Leaders who foster skills that support and enhance unit cohesion are especially important for female Service members, who may report lower levels of unit cohesion and self-efficacy, as suggested in a study of more than 24,000 male and female U.S. Air Force personnel (Welsh et al. 2019). Furthermore, active efforts by military leadership and programs to build relationships between withdrawn or alienated Service members and others in their unit can serve to increase perceived unit cohesion, potentially reducing trauma, depression, and anxiety symptoms (Grady et al. 2018; Holliday et al. 2022).

Social health and leadership

A Service member's social support system is integral to their well-being and can influence their occupational performance. Social and interpersonal support within the workplace facilitated through positive relationships with colleagues and leaders may significantly influence occupational well-being and performance and may be particularly important for younger generations of Service members (Brooks and Greenberg 2018; Smaliukiene and Bekesiene 2020). Evidence suggests leadership is an important factor for social health and demonstrates leadership as a significant antecedent to cohesion (Fors Brandebo et al. 2022) through provision of meaning, difference moderation, and standard setting, which together define what it means

to be part of a team (Schilling 2022). High social support from unit leaders has been shown to moderate associations between depressive symptoms and negative deployment experiences and to increase satisfaction with the military in U.S. Air Force Service members (Welsh et al. 2015), while destructive leadership may degrade job satisfaction and job performance (Fosse et al. 2019). Improved ratings of non-commissioned officer leadership have been positively associated with well-being, and changes in perceived organizational support may further improve agency and work effectiveness (Gutierrez and Adler 2022).

Social health and the military community

In addition to unit cohesion and leadership, the military community can impact Service members' ability to cope with military culture and its demands, which may further influence both individual and military family well-being (Gribble et al. 2019; O'Neal et al. 2020). The military community is especially important to military spouses and children, and perceptions of military community connections may influence civilian spouses' satisfaction with military life (O'Neal et al. 2020) and provide them with a sense of mastery and control in a constantly changing environment (Wang et al. 2015). Community support may also be associated with fewer child and parent psychosocial symptoms (Conforte et al. 2017).

General Population Research: Social Networks

Social networks are defined as systems of family, friends, neighbors, coworkers, acquaintances, and other individuals in our lives; social network-based interventions rely on modifying social networks to effect positive changes in health (Hunter et al. 2019). A meta-analysis demonstrated that social-network interventions were effective for sexual health outcomes, alcohol misuse, well-being, change in hemoglobin A1c, and smoking cessation but found no effect for drug use (Hunter et al. 2019). While public health interventions often focus on targeting individual behavior, despite how strongly we are influenced by group behavior, the results of this meta-analysis indicate that altering social networks has the potential to improve individuals' health behaviors (Hunter et al. 2019).

A central concept to understanding social fitness is group cohesion, defined as a group's unity and key to understanding how groups operate (Forsyth 2021). A literature review of general population studies on group cohesion highlights its power to facilitate group performance, its role in group psychotherapy outcomes, and the part it plays in group identity (Forsyth 2021). The author recommends that researchers clearly define group cohesion itself, distinguishing it from its causes and indicators, proposing the use of the Unitary Cohesion Index, which directly assesses group members' perceptions of their group's cohesion, differentiating between the defining conditions of cohesion and the causes of cohesion (Forsyth 2021). As humans are social animals, improving our research methodology for studying group cohesion will likely confer actionable insights for developing public health interventions.

Child maltreatment in the military setting

While military children are resilient, they are also vulnerable. Frequent moves may build resilience, but combat deployments can increase the risk for abuse, neglect, attachment problems, and inadequate coping (Johnson and Ling, 2013). Evidence suggests that children with parents injured during military service may have decreased preventive care visits and increased rates of medical visits for injuries, maltreatment, mental health care, and psychiatric medication use (Hisle-Gorman et al. 2019). Healthcare professionals can support the physical and mental health of children by normalizing expectations and using the ICARE (Identify, Correlate, Ask, Ready Resources, Encourage) strategy to facilitate prevention and encourage early engagement with available resources (Johnson and Ling, 2013), to which increased access may help struggling military families (Sullivan et al. 2021).

Spiritual Health and Community and Family Readiness

Spiritual health may improve Service member overall quality of life.

Quality of life

Spiritual health is an important factor when considering overall quality of life. Spiritual well-being is associated with lower PTSD symptoms (Wood et al. 2018). This relationship may also be bi-directional, as psychologically fit Service members report a stronger sense of purpose in life (Bufford et al. 2023). Leaders may also foster spiritual health through provision of a sense of purpose and meaning, which have been linked to lower levels of suicidal ideation (Trachik et al. 2021). Veterans who find meaning and purpose through perceptions of positive public sentiment may also be at decreased risk for depression and increase self-efficacy and subjective life satisfaction (Markowitz et al. 2020). Chaplain-provided resources for spiritual health may improve Service member spirituality, resilience, family coping, marital satisfaction, and military satisfaction (Cafferky et al. 2017).

Interaction of the Health and Fitness Domains and Community and Family Readiness

Table 11. Health and Fitness Domains with Evidence Pertaining to Community and Family Readiness

Outcome	Interacting Domains	Findings	Reference
Spousal Employment	Environmental Health Financial Health	Military spouses may have difficulty seeking and maintaining employment given the frequent changes of station common for military personnel.	Cooke and Speirs 2005

	Financial Health Nutritional Health	Interruptions in employment may increase food insecurity.	Rabbitt et al. 2022
	Financial Health Psychological Health	Spouse unemployment may also increase risk for intimate partner violence.	Newby et al. 2003
Transition to Civilian Life	Financial Health Psychological Health	Veterans with service-related disability may experience greater financial distress, less life satisfaction, and poorer mental health as compared with their non-disabled counterparts.	Bond et al. 2022
Health System Engagement	Medical/Dental Health Financial Health	Incoming recruits tend to have higher dental needs, with many perceiving the need for dental care but not receiving it due to the expense.	Leiendecker et al. 2011
		Increased knowledge and awareness of HPV and the HPV vaccines can reduce vaccine hesitancy among Service members.	Batie et al. 2023; Porter et al. 2020; Ward et al. 2023
	Medical/Dental Health Social Health Psychological Health	Children of parents injured during military service may have decreased preventive care visits and increased rates of medical visits for injuries, maltreatment, mental health care, and psychiatric medication use.	Hisle-Gorman et al. 2019
Quality of Life	Medical/Dental Health Psychological Health	Treatment for common dermatologic disorders may improve Service members' body image, affecting quality of life and mental health.	Brahe 2022
	Spiritual Health Psychological Health	Spiritual well-being is associated with lower PTSD symptoms, and workplace spirituality is related to higher positive affectivity, resilience, self-efficacy, work engagement, and may reduce burnout.	Dal Corso et al. 2020; Wood et al. 2018
Community Support	Psychological Health Social Health	The military community can impact Service members' ability to cope with military culture and its demands. Community support may	Conforte et al. 2017; Gribble et al. 2019; O'Neal et al. 2020

		also be associated with fewer child and parent psychosocial symptoms.	
Leadership	Psychological Health Social Health	Mindfulness training may have a positive effect on leaders' behaviors, resilience, and perceived effectiveness. Perceived cohesion may be indicative of Service members' awareness of mental health in others and a willingness to discuss mental health matters, and interpersonal relationships, particularly with supervisors.	Brooks and Greenberg, 2018; Geuzinge et al. 2020; Ihme and Sundstrom, 2021; Jones et al. 2018
Leadership Help-seeking behavior	Psychological Health Social Health Medical/Dental Health Psychological Health	Unit support may be important for well-being and possibly mitigation of PTSD severity.	Zang et al. 2017
		Improved ratings of NCO leadership have been positively associated with well-being.	Gutierrez and Adler, 2022
		Those with a history of emotional trauma and parental absence or separation or sexual trauma and PTSD are less likely to seek help for PTSD.	Duncan et al. 2020
Help-seeking behavior Agency and Life-satisfaction	Medical/Dental Health Psychological Health Social Health	Unit cohesion and a larger social circle are associated with help-seeking behavior.	Duncan et al. 2020; Jones et al. 2018
	Psychological Health Social Health	Unit cohesion and the need to foster this skill, as cohesion can buffer the effects of combat stress, PTSD, depressive symptoms, and suicide ideation.	Anderson et al. 2019; Campbell-Sills et al. 2022; Dempsey et al. 2021; Gutierrez and Adler 2022; McAndrew et al. 2017; Reed-Fitzke and Lucier-Greer 2020

Gaps and Calls to Action in Community and Family Readiness

While there is a growing body of literature exploring how various military community and family-related factors may influence Service member health, well-being, and readiness, there remain gaps in the understanding of how all domains of health and fitness may contribute to

the health of the military community and families as means by which to prevent adverse Service member outcomes. These gaps include—

1. *Environmental factors influencing community and family readiness*. There is a lack of published, peer-reviewed literature examining how factors within the environmental domain, such as the built community, influence military communities and family well-being.

2. *Influence of behaviors, practices, and beliefs on military family readiness and well-being.* There is a need for additional understanding of how different health factors may influence unhealthy relationship patterns in military communities and families, including domestic partner violence and child maltreatment and abuse.

3. *Factors that may improve unit cohesion.* There is a need for further understanding of factors that may improve unit cohesion and how leaders may best leverage these factors, especially in instances where cohesion may have been degraded or nonexistent.

4. *Influence of social support and access to resources on community and family readiness.* There is a need to better understand how access to resources and a strong social support network can improve family readiness.

Conclusion

Effective, holistic Force protection requires an evidence-based approach that is both proactive and broadly applicable to all branches of military service. The application of a multi-dimensional health and fitness framework to organize the contributions of all aspects of health and well-being addresses this need by acknowledging the interrelated nature of modifiable factors that can be leveraged to bolster and support the readiness, health, and well-being of all Service members. Prior to this review, there had not been a comprehensive investigation of the scientific literature regarding how Service member health ans fitness-related behaviors, practices, and beliefs aligned with multiple domains may be related to military-relevant outcomes. The comprehensive synthesis of peer-reviewed scientific literature presented in this narrative literature review satisfies this gap and may serve as a foundational document supporting the application of health-aligned factors to Force protection programs, efforts, and policies. Perhaps most germane to this function, the scientific evidence included in this review identified various recurring key protective factors that crosscut the eight domains discussed in this review to influence multiple outcomes, provided in Table 12.

Deficits in any one or more of the eight domains of health and fitness may substantially degrade the readiness of Service members and the communities in which they live and serve, owing to the interrelated nature of the domains and complexity of Service member readiness, health, and well-being. The associations of health-related behaviors, practices, and beliefs with military-relevant outcomes discussed in this literature review provide empirical evidence of the need for a holistic approach as set forth by a multi-dimensional framework for health and fitness. Moreover, they highlight the importance of not only developing programs and other efforts

designed to collectively address Service member fitness across the eight domains, but also implementing standard practices and policies that ensure a holistic, multi-dimensional framework is used to guide the development of such efforts. Finally, although the body of literature included in this review is substantial, it is not without gaps. Research is needed to address these remaining questions, many of which are identified and discussed within this literature review. Ongoing military research efforts, especially those centered on understanding factors that may protect or degrade Service member readiness, health, and well-being, may use this review to assess program alignment with this framework and to inform investigations relevant to current Force protection and readiness needs.

Table 12. Key Protective Factors Spanning Multiple Outcomes and Domains of Health and Fitness		
Factor	**Interacting Domains**	**Outcomes**
Effective acclimatization to extreme environments (e.g., heat, cold, high altitude)	Environmental Medical and Dental Preventive Psychological Physical Performance	● Preservation of cognitive and physical performance. ● Preservation of mental and physical health (e.g., prevention of mood decrements, AMS, and EHI). ● Improved physical and occupational performance while in extreme environments.
PPE (e.g., HPD, ballistic eyewear, permethrin-treated uniforms) education/training and PPE use	Environmental Medical and Dental Preventive Psychological Social	● Preservation of physical health (e.g., injury, illness, and hearing loss prevention). ● Preservation of mental health (e.g., prevention of hearing loss, preservation of quality of life). ● Preserve occupational performance (e.g., prevention of hearing loss). ● Supports military retention by preventing career-ending injuries. ● Ensure Service members can transition to civilian life with no or few long-term disabilities.
Financial literacy	Financial Psychological Social	● Improved mental health outcomes. ● Improved quality of life and military satisfaction. ● Improved nutrition and decreased risk for food insecurity. ● Leverage point for suicide prevention. ● Supports military retention efforts. ● Key factor for predicting successful transition to civilian life.

Medical and Dental provider education	Medical and Dental Preventive Physical Psychological	• Increase Service member engagement with healthcare system. • Decreases barriers to accessing care and ensures timely and effective preventive care and treatment. • Decrease provider misconceptions or biases. • Increases deployability and decreases need for medical waivers. • Decreases risk for medical evacuation while in-theater. • Supports military retention efforts.
Service member education and training about disease risk and prevention strategies	Environmental Medical and Dental Preventive Physical Social	• Decreases Service member misconceptions, biases, and stigmas (e.g., screening exams, immunizations). • Increases willingness to participate in screening (e.g., prostate) and uptake of immunizations, especially those not mandated by policy (e.g., HPV). • Increase willingness to encourage others in social and family circles to receive screenings or other preventive healthcare. • Preserves physical health. • Increases readiness. • Supports military retention efforts.
Help-seeking, to include engagement with military healthcare system	Financial Medical and Dental Preventive Physical Psychological Social	• Supports physical health. • Provides opportunities for healthcare providers to identify those with financial needs such as food insecurity. • Provides healthcare providers opportunities to provide support in cases of child maltreatment or other military family needs.

		• Supports psychological health through opportunities for substance use intervention or provision of healthcare that can improve mental health outcomes.
Tobacco use cessation and prevention	Environmental Financial Medical and Dental Preventive Physical Psychological	• Decrease injury risk. • Improve likelihood of recovery and return to duty after injury. • Supports financial health. • Supports better behavioral health. • Improved ability to acclimatize and perform in extreme environments. • Improved physical and occupational performance. • Supports long-term health, even after transition to civilian life.
Healthy dietary patterns and eating behaviors (e.g., consuming high quality diet and eating breakfast)	Medical and Dental Preventive Physical Psychological	• Supports ideal Service member body composition and ability to meet military body composition standards. • Supports rigorous military physical training requirements. • Supports physical and occupational task performance. • Prevention of chronic diseases. • Decreased risk of injury (e.g., improved fitness and adequate macro- and micronutrient intake to support muscle development and skeletal strength). • Supports military retention efforts through injury risk reduction.
Physical fitness components (e.g., CRF, muscular endurance and strength, power, agility)	Environmental Medical and Dental Physical	• Support physical and occupational task performance. • Supports ability to acclimatize to extreme climates and reduces risk for EHI, AMS.

	Psychological	• Supports physical and psychological resilience. • Reduces injury and chronic disease risk. • Supports military retention efforts.
Physical activity participation and leisure time physical activities (e.g., sports participation)	Physical Psychological Social	• Supports physical health and fitness. • Supports physical performance. • Supports development of social connections. • Can act as healthy psychological stress coping mechanism. • Supports better mood and decreased symptoms associated with depression, anxiety, and PTSD.
Behavioral health	Environmental Financial Medical and Dental Preventive Nutritional Physical Psychological Social Spiritual	• Contributes to fitness in each of the remaining seven Health and Fitness domains. • Many relationships with behavioral health are reciprocal in nature (e.g., behavioral health supports participation in physical activity and participation in physical activity supports behavioral health). • Supports uptake and practice of many health behaviors. • Supports development and interaction with social networks. • Supports feelings of inclusion, meaning, and sense of purpose.
Psychological resilience	Physical Psychological	• Supported by grit and mental toughness; supports successful completion of rigorous military training and missions.

	Spiritual	• Can buffer against the development of mental illness (e.g., PTSD) following traumatic experiences. • Can buffer against development of moral injury.
Social networks	Medical and Dental Preventive Physical Psychological Social Spiritual	• Can play an integral part in determining which healthy behaviors Service members adopt and practice. • Can serve as key facilitators (or barriers) to the uptake of modifiable health behaviors. • Can decrease risk for suicidal behavior. • Can support unit cohesion.
Social connectedness	Psychological Social Spiritual	• Supports physical and behavioral health. • Possibly a key leverage point for suicide prevention. • Can act as a buffer against the effects of traumatic experiences, such as those experienced during combat.
Strong, supportive leadership	Medical and Dental Preventive Physical Psychological Social	• Increases Service member motivation. • Buffers against feelings of burnout and emotional exhaustion. • Improve social connectedness and feelings of inclusion. • Improves and supports unit cohesion. • Can decrease suicide risk. • Supports uptake and practice of healthy behaviors, including engagement of healthcare system and other help-seeking behaviors.
Feelings of meaning and purpose	Psychological	• Often fostered through both social connectedness and spirituality/ideology.

	Social Spiritual	● Acts as powerful factor in support of Service member resilience and may serve as a buffer against the psychological and physical sequelae associated with burnout, emotional exhaustion, and traumatic experiences.

References

A

Aandstad A. 2020. "Association Between Performance in Muscle Fitness Field Tests and Skeletal Muscle Mass in Soldiers." *Mil Med* 185(5-6):e839-e846. https://doi.org/10.1093/milmed/usz437

Abadi M, B Richard, S Shamblen, C Drake, A Schweinhart, B Bokhour, R Bauer, and D Rychener. 2022. "Achieving Whole Health: A Preliminary Study of TCMLH, a Group-Based Program Promoting Self-Care and Empowerment Among Veterans." *Health Educ Behav* 49(2):347-357. https://doi.org/10.1177/1090198121101104

Abel SM. 2008. "Barriers to hearing conservation programs in combat arms occupations." *Aviat Space Environ Med* 79(6):591-8. https://doi.org/10.3357/asem.2262.2008

Abhar R, L Hassani, M Montaseri, and MP Ardakani. 2022. "The Effect of an Educational Intervention Based on the Health Belief Model on Preventive Behaviors of Prostate Cancer in Military Men." *Community Health Equity Res Policy* 42(2):127-134. https://doi.org/10.1177/0272684X20974196

Abiero B, M Gliner, S Beamer, A Sackett, K Marshall-Aiyelawo, J Ellison, T McDavid, and J de Geus. 2022. "Military Medical Readiness and Patient Experience with Access to Care." *Med J (Ft Sam Houst Tex)* (Per 22-01/02/03):3-10.

Achamrah N, G Colange, J Delay, A Rimbert, V Folope, A Petit, S Grigioni, P Déchelotte, and M Coëffier. 2018. “Comparison of body composition assessment by DXA and BIA according to the body mass index: A retrospective study on 3655 measures.” *PLoS One* 12;13(7):e0200465. doi: 10.1371/journal.pone.0200465

Adam GE, R Carter, SN Cheuvront, DJ Merullo, JW Castellani, HR Lieberman, and MN Sawka. 2008. "Hydration effects on cognitive performance during military tasks in temperate and cold environments." *Physiol Behav* 93(4-5):748-56. https://doi.org/10.1016/j.physbeh.2007.11.028

Adams RS, EJ Dietrich, JC Gray, CS Milliken, N Moresco, and MJ Larson. 2019. “Post-Deployment Screening In The Military Health System: An Opportunity To Intervene For Possible Alcohol Use Disorder.” *Health Aff* 38(8):1298-1306. doi: 10.1377/hlthaff.2019.00284

Adams TG, J Forte, BM Fogle, SM Southwick, and RH Pietrzak. 2020. "Self-reported exercise frequency and PTSD: Results from the National Health and Resilience in Veterans Study." *Acta Psychiatr Scand* 142(6):486-495. https://doi.org/10.1111/acps.13234

Adler AB, BC Gunia, PD Bliese, PY Kim, and ML LoPresti. 2017. "Using actigraphy feedback to improve sleep in soldiers: an exploratory trial." *Sleep Health* 3(2):126-131. https://doi.org/10.1016/j.sleh.2017.01.001

Adler Amy B, CA LeardMann, KA Roenfeldt, IG Jacobson, D Forbes, and Team Millennium Cohort Study. 2020. "Magnitude of problematic anger and its predictors in the Millennium Cohort." *BMC public health* 20(1):1168-2. https://doi.org/10.1186/s12889-020-09206-2

Adler Amy B, CA LeardMann, J Villalobos, IG Jacobson, D Forbes, and Team Millennium Cohort Study. 2022. "Association of Problematic Anger With Long-term Adjustment Following the Military-to-Civilian Transition." *JAMA network open* 5(7):e2223236. https://doi.org/10.1001/jamanetworkopen.2022.23236

Aebi MR, N Bourdillon, P Noser, GP Millet, and D Bron. 2020. "Cognitive Impairment During Combined Normobaric vs. Hypobaric and Normoxic vs. Hypoxic Acute Exposure." *Aerosp Med Hum Perform* 91(11):845-851. https://doi.org/10.3357/AMHP.5616.2020

Agan BK, GE Macalino, H Nsouli-Maktabi, X Wang, JC Gaydos, A Ganesan, MG Kortepeter, and JL Sanchez. 2013. "Human papillomavirus seroprevalence among men entering military service and seroincidence after ten years of service." *MSMR* 20(2):21-4.

Aggarwal S, J Wright, A Morgan, G Patton, and N Reavley. 2023. "Religiosity and spirituality in the prevention and management of depression and anxiety in young people: a systematic review and meta-analysis." *BMC Psychiatry* 23(1):729. https://doi.org/10.1186/s12888-023-05091-2

Aherne BB, C Zhang, WS Chen, and DG Newman. 2018. "Pilot Decision Making in Weather-Related Night Fatal Helicopter Emergency Medical Service Accidents." *Aerosp Med Hum Perform* 89(9):830-836. https://doi.org/10.3357/AMHP.4991.2018

Ahmed M, I Mandic, E Desilets, I Smith, W Sullivan-Kwantes, PJ Jones, L Goodman, I Jacobs, and M L'Abbe. 2020. "Energy Balance of Canadian Armed Forces Personnel during an Arctic-Like Field Training Exercise." *Nutrients* 12(6). https://doi.org/10.3390/nu12061638

Ahroon WA, ME Hill, and DP Goodes. 2011. "Analysis of army-wide hearing conservation database for hearing profiles related to crew-served and individual weapon systems." *Noise Health* 13(50):76-83. https://doi.org/10.4103/1463-1741.73992

Ainslie PN, SJ Lucas, and KR Burgess. 2013. "Breathing and sleep at high altitude." *Respir Physiol Neurobiol* 188(3):233-56. https://doi.org/10.1016/j.resp.2013.05.020

Akter S, MR Islam, MM Rahman, T Rouyard, RS Nsashiyi, F Hossain, and R Nakamura. 2023. "Evaluation of Population-Level Tobacco Control Interventions and Health Outcomes: A Systematic Review and Meta-Analysis." *JAMA Netw Open* 6(7):e2322341. https://doi.org/10.1001/jamanetworkopen.2023.22341

Al-Bashaireh AM, LG Haddad, M Weaver, DL Kelly, X Chengguo, and S Yoon. 2018. "The Effect of Tobacco Smoking on Musculoskeletal Health: A Systematic Review." *J Environ Public Health* 2018:4184190. https://doi.org/10.1155/2018/4184190

Albright DL, K Godfrey, JT McDaniel, KL Fletcher, KH Thomas, J Bertram, DI Cobb, and TM Stephens. 2020. "Oral health among student veterans: Effects on mental and physical health." *J Am Coll Health* 68(3):263-270. https://doi.org/10.1080/07448481.2018.1540985

Alele F, B Malau-Aduli, A Malau-Aduli, and M Crowe. 2020a. "Systematic review of gender differences in the epidemiology and risk factors of exertional heat illness and heat tolerance in the armed forces." *BMJ Open* 6;10(4):e031825. https://doi.org/10.1136/bmjopen-2019-031825

Alele FO, BS Malau-Aduli, AEO Malau-Aduli, and MJ Crowe. 2020b. "Epidemiology of Exertional Heat Illness in the Military: A Systematic Review of Observational Studies." *Int J Environ Res Public Health* 17(19). https://doi.org/10.3390/ijerph17197037

Alele FO, BS Malau-Aduli, AEO Malau-Aduli, and MJ Crowe. 2021a. "Haematological, Biochemical and Hormonal Biomarkers of Heat Intolerance in Military Personnel." *Biology (Basel)*10(10). https://doi.org/10.3390/biology10101068

Alele FO, BS Malau-Aduli, AEO Malau-Aduli, and MJ Crowe. 2021b. "Individual Anthropometric, Aerobic Capacity and Demographic Characteristics as Predictors of Heat Intolerance in Military Populations." *Medicina (Kaunas)* 57(2). https://doi.org/10.3390/medicina57020173

Alhazmi A, E Stojanovski, M McEvoy, and ML Garg. 2014. "The association between dietary patterns and type 2 diabetes: a systematic review and meta-analysis of cohort studies." *J Hum Nutr Diet* 27(3):251-60. https://doi.org/10.1111/jhn.12139

Allen ES, GK Rhoades, SM Stanley, and HJ Markman. 2011. "On the home front: stress for recently deployed Army couples." *Family Process* 50(2):235-247. https://doi.org/10.1111/j.1545-5300.2011.01357.x

Allen JT, J Jayne, JP Karl, SM McGraw, K O'Connor, A DiChiara, and RE Cole. 2022. "Weight management behaviours mediate the relationship between weight cycling, BMI and diet quality among US Army Soldiers." *Br J Nutr* 128 (3): 569-576. https://doi.org/10.1017/S000711452100338X

Al-Omari AS, HM Al-Khalaf, and NFM Hussien. 2018. "Association of Flying Time with Hearing Loss in Military Pilots." Saudi J Med Med Sci 6(3):155-159. https://doi.org/10.4103/sjmms.sjmms_10_18

Alpert HR, ME Slater, YH Yoon, CM Chen, N Winstanley, and MB Esser. 2022. "Alcohol Consumption and 15 Causes of Fatal Injuries: A Systematic Review and Meta-Analysis." *Am J Prev Med* 63(2):286-300. https://doi.org/10.1016/j.amepre.2022.03.025

Alvarez-Bueno C, CH Hillman, I Cavero-Redondo, M Sanchez-Lopez, DP Pozuelo-Carrascosa, and V Martinez-Vizcaino. 2020. "Aerobic fitness and academic achievement: A systematic review and meta-analysis." *J Sports Sci* 38(5):582-589. https://doi.org/10.1080/02640414.2020.1720496

American Dental Association (ADA), "Home Oral Care," last modified August 8, 2024. https://www.ada.org/resources/ada-library/oral-health-topics/home-care

American Medical Association (AMA), "What is behavioral health?" last reviewed August 22, 2022. https://www.ama-assn.org/delivering-care/public-health/what-behavioral-health

Ames D, Z Erickson, C Geise, S Tiwari, S Sakhno, AC Sones, Chaplain G Tyrrell et al. 2021. "Treatment of Moral Injury in U.S. Veterans with PTSD Using a Structured Chaplain Intervention." *J Relig Health* 60(5):3052-3060. https://doi.org/10.1007/s10943-021-01312-8

Ames D, Z Erickson, NA Youssef, I Arnold, Chaplain S Adamson, AC Sones et al. 2019. "Moral Injury, Religiosity, and Suicide Risk in U.S. Veterans and Active Duty Military with PTSD Symptoms." *Mil Med* 184(3-4):e271-e278. https://doi.org/10.1093/milmed/usy148

Anderko L and E Pennea. 2020. "Exposures to per-and polyfluoroalkyl substances (PFAS): Potential risks to reproductive and children's health. Curr Probl Pediatr Adolesc Health Care." 50(2):100760. https://doi: 10.1016/j.cppeds.2020.100760

Anderson AB, MJ Braswell, AJ Pisano, NI Watson, JF Dickens, MD Helgeson, DI Brooks, and SC Wagner. 2021. "Factors Associated With Progression to Surgical Intervention for Lumbar Disc Herniation in the Military Health System." *Spine (Phila Pa 1976)* 46(6):E392-E397. https://doi.org/10.1097/BRS.0000000000003815

Anderson GS, PM Di Nota, D Groll, and RN Carleton. 2020. "Peer Support and Crisis-Focused Psychological Interventions Designed to Mitigate Post-Traumatic Stress Injuries among Public Safety and Frontline Healthcare Personnel: A Systematic Review." *Int J Environ Res Public Health* 17(20). https://doi.org/10.3390/ijerph17207645

Anderson L, L Campbell-Sills, RJ Ursano, RC Kessler, X Sun, SG Heeringa, MK Nock et al. 2019. "Prospective associations of perceived unit cohesion with postdeployment mental health outcomes." *Depress Anxiety* 36(6):511-521. https://doi.org/10.1002/da.22884

Anderson MK, T Grier, M Canham-Chervak, TT Bushman, and BH Jones. 2015. "Physical training, smoking, and injury during deployment: a comparison of men and women in the US Army." *US Army Med Dep J*:42-8. https://www.ncbi.nlm.nih.gov/pubmed/26101905

Anderson MK, T Grier, M Canham-Chervak, TT Bushman, and BH Jones. 2014. "Risk factors associated with higher body fat in US Army female soldiers." *US Army Med Dep J*:75-82. https://www.ncbi.nlm.nih.gov/pubmed/24706247

Anderson MK, T Grier, M Canham-Chervak, TT Bushman, BC Nindl, and BH Jones. 2017. "Effect of Mandatory Unit and Individual Physical Training on Fitness in Military Men and Women." *Am J Health Promot* 31(5):378-387. https://doi.org/10.1177/0890117116666977

Anderson MK, T Grier, EO Dada, M Canham-Chervak, and BH Jones. 2017. "The Role of Gender and Physical Performance on Injuries: An Army Study." *Am J Prev Med* 52(5):e131-e138. https://doi.org/10.1016/j.amepre.2016.11.012

Ando S, T Komiyama, M Sudo, Y Higaki, K Ishida, JT Costello, and K Katayama. 2020. "The interactive effects of acute exercise and hypoxia on cognitive performance: A narrative review." *Scand J Med Sci Sports* 30(3):384-398. https://doi.org/10.1111/sms.13573

Ang BO, A Monnier, and K Harms-Ringdahl. 2009. "Neck/shoulder exercise for neck pain in air force helicopter pilots: a randomized controlled trial." *Spine (Phila Pa 1976)* 34(16):E544-51. https://doi.org/10.1097/BRS.0b013e3181aa6870

Angevaren M, G Aufdemkampe, HJ Verhaar, A Aleman, and L Vanhees. 2008. "Physical activity and enhanced fitness to improve cognitive function in older people without known cognitive impairment." *Cochrane Database Syst Rev* (3):CD005381. https://doi.org/10.1002/14651858.CD005381.pub3

Antosh IJ, KL Cameron, NA Marsh, MA Posner, TM DeBerardino, SJ Svoboda, and BD Owens. 2020. "Likelihood of Return to Duty Is Low After Meniscal Allograft Transplantation in an Active-duty Military Population." *Clin Orthop Relat Res* 478(4):722-730. https://doi.org/10.1097/CORR.0000000000000915

Antosh IJ, JC Patzkowski, AW Racusin, JK Aden, and SM Waterman. 2018. "Return to Military Duty After Anterior Cruciate Ligament Reconstruction." *Mil Med* 183(1-2):e83-e89. https://doi.org/10.1093/milmed/usx007

Aoun O, C Roqueplo, and C Rapp. 2014. "Spectrum and impact of health problems during deployment: a prospective, multicenter study of French soldiers operating in Afghanistan, Lebanon and Cote d'Ivoire." *Travel Med Infect Dis* 12(4):378-84. https://doi.org/10.1016/j.tmaid.2014.05.002

Appolonio KK, and R Fingerhut. 2008. "Postpartum depression in a military sample." *Mil Med* 173(11):1085-91. https://doi.org/10.7205/MILMED.173.11.1085

Arbyn M, L Xu, C Simoens, and PP Martin-Hirsch. 2018. "Prophylactic vaccination against human papillomaviruses to prevent cervical cancer and its precursors." *Cochrane Database Syst Rev* 5(5): CD009069. https://doi.org/10.1002/14651858.CD009069.pub3

Armed Forces Health Surveillance Center. 2012. "Health of women after wartime deployments: correlates of risk for selected medical conditions among females after initial and repeat deployments to Afghanistan and Iraq, active component, U.S. Armed Forces." *MSMR* 19(7):2-10.

Armitage NH, BM Severtsen, R Vandermause, and DA Smart. 2014. "Training for the Air Force fitness assessment: the experience of postpartum women." *Mil Med* 179(7):766-72. https://doi.org/10.7205/MILMED-D-13-00437

Armitage NH and DA Smart. 2012. "Changes in Air Force fitness measurements pre- and post-childbirth." *Mil Med* 177(12):1519-23. https://doi.org/10.7205/MILMED-D-12-00248

Armstrong S and M Dermont. 2021. "Does prevention-focused dental care provision during recruit training reduce adverse dental outcomes in UK Armed Forces personnel? A retrospective cohort analysis." *Br Dent J* 230(7):400-406. https://doi.org/10.1038/s41415-021-2741-5

Aronson NE, JW Sanders, and KA Moran. 2006. "In harm's way: infections in deployed American military forces." *Clin Infect Dis* 43(8):1045-51. https://doi.org/10.1086/507539

Asch BJ, S Rennane, TE Trail, L Berdie, JM Ward, D Troyanker, C Gadwah-Meaden, and J Kempf. 2023. *Food Insecurity Among Members of the Armed Forces and Their Dependents*. Rand Corporation.

Ashwell M, P Gunn, and S Gibson. 2012. “Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis.” *Obes Rev* 13(3):275-86. https://doi.org/10.1111/j.1467-789X.2011.00952.x

Ashworth ET, JD Cotter, and AE Kilding. 2021. "Impact of elevated core temperature on cognition in hot environments within a military context." *Eur J Appl Physiol* 121(4):1061-1071. https://doi.org/10.1007/s00421-020-04591-3

Ashworth ET, JD Cotter, and AE Kilding. 2020. "Methods for improving thermal tolerance in military personnel prior to deployment." *Mil Med Res* 7(1):58. https://doi.org/10.1186/s40779-020-00287-z

Austin KG, SM McGraw, and HR Lieberman. 2014. "Multivitamin and protein supplement use is associated with positive mood states and health behaviors in US Military and Coast Guard personnel." *J Clin Psychopharmacol* 34(5):595-601. https://doi.org/10.1097/JCP.0000000000000193

B

Bailoor S, R Bhardwaj, and TD Nguyen. 2015. "Effectiveness of eye armor during blast loading." *Biomech Model Mechanobiol* 14(6):1227-37. https://doi.org/10.1007/s10237-015-0667-z

Bakker-Dyos J, S Vanstone, and AJ Mellor. 2016. "High altitude adaptation and illness: military implications." *J R Nav Med Serv* 102(1):33-9. https://www.ncbi.nlm.nih.gov/pubmed/29984977

Balldin U, R Tutt, T Dart, J Whitmore, J Fischer, R Harrison, E Anderson, J Smith, A Workman, and A Pinchak. 2007. AFRL-HE-BR-TR-2007-0047, *The Effects of 12 Hours of Low-Grade Hypoxia at 10,000 ft at Night in Special Operations Forces Aircraft Operations on Cognition, Night Vision, Goggle Vision and Subjective Symptoms*. https://apps.dtic.mil/sti/pdfs/ADA470142.pdf

Bardwell WA, WY Ensign, and PJ Mills. 2005. "Negative mood endures after completion of high-altitude military training." *Ann Behav Med* 29(1):64-69. https://doi.org/10.1207/s15324796abm2901_9

Barkley LC and P Reams. 2021. "Exercise and Chronic Disease Management." *Curr Sports Med Rep* 20(8):387-388. https://doi.org/10.1249/JSR.0000000000000865

Barringer ND, RS Kotwal, MD Lewis, LK Funderburk, TR Elliott, SF Crouse, SB Smith, M Greenwood, and RB Kreider. 2016. "Fatty Acid Blood Levels, Vitamin D Status, Physical Performance, Activity, and Resiliency: A Novel Potential Screening Tool for Depressed Mood in Active Duty Soldiers." *Mil Med* 181(9):1114-20. https://doi.org/10.7205/MILMED-D-15-00456

Barringer ND, CJ McKinnon, NC O'Brien, and JR Kardouni. 2019. "Relationship of Strength and Conditioning Metrics to Success on the Army Ranger Physical Assessment Test." *J Strength Cond Res* 33(4):958-964. https://doi.org/10.1519/JSC.0000000000003044

Barrington WE and SAA Beresford. 2019. "Eating Occasions, Obesity and Related Behaviors in Working Adults: Does it Matter When You Snack?" *Nutrients* 11(10). https://doi.org/10.3390/nu11102320

Bartone PT and SV Bowles. 2020. "Coping with recruiter stress: Hardiness, performance and well-being in US Army recruiters." *Mil Psychol* 32(5):390-397. https://doi.org/10.1080/08995605.2020.1780061

Bartsch P and ER Swenson. 2013. "Clinical practice: Acute high-altitude illnesses." *N Engl J Med* 368(24):2294-302. https://doi.org/10.1056/NEJMcp1214870

Baskaran V, RL Murray, A Hunter, WS Lim, and TM McKeever. 2019. "Effect of tobacco smoking on the risk of developing community acquired pneumonia: A systematic review and

meta-analysis." *PLoS One* 14(7):e0220204. https://doi.org/10.1371/journal.pone.0220204

Batchelor EA, GG Wolff, EA McKenna, and DA Williams. 2020. "Hearing conservation measures of effectiveness across the Department of Defense." *MSMR* 27(7):2-6. https://www.ncbi.nlm.nih.gov/pubmed/32726108

Bates MJ, S Bowles, J Hammermeister, C Stokes, E Pinder, M Moore, M Fritts et al. 2010. "Psychological Fitness." *Mil Med* 175(suppl_8):21-38. https://doi.org/10.7205/MILMED-D-10-00073

Batie CM, CN Hintz, SH Catchings, JA Thompson, and VK Sabol. 2023. "COVID-19 Vaccination in a Military Population: Evaluation of a Quality Improvement Initiative to Increase Vaccine Confidence and Reduce Hesitancy." *Mil Med* 188(9-10):e2885-e2890. https://doi.org/10.1093/milmed/usac333

Battles AR, ML Kelley, JD Jinkerson, HC Hamrick, and BF Hollis. 2019. "Associations Among Exposure to Potentially Morally Injurious Experiences, Spiritual Injury, and Alcohol Use Among Combat Veterans." *J Trauma Stress* 32(3):405-413. https://doi.org/10.1002/jts.22404

Beckner ME, WR Conkright, SR Eagle, BJ Martin, AM Sinnott, AD LaGoy, F Proessl, et al. 2021. "Impact of simulated military operational stress on executive function relative to trait resilience, aerobic fitness, and neuroendocrine biomarkers." *Physiol Behav* 236:113413. https://doi.org/10.1016/j.physbeh.2021.113413

Beckner ME, HR Lieberman, A Hatch-McChesney, JT Allen, PJ Niro, LA Thompson, JP Karl et al. 2023. “Effects of energy balance on cognitive performance, risk-taking, ambulatory vigilance and mood during simulated military sustained operations (SUSOPS).” *Physiol Behav* 258:114010. https://doi.org/10.1016/j.physbeh.2022.114010

Bedno SA, R Jackson, X Feng, IL Walton, MR Boivin, and DN Cowan. 2017. "Meta-analysis of Cigarette Smoking and Musculoskeletal Injuries in Military Training." *Med Sci Sports Exerc* 49(11):2191-2197. https://doi.org/10.1249/MSS.0000000000001349

Bedno SA, DA Nelson, LM Kurina, and YS Choi. 2019. "Gender differences in the associations of body mass index, physical fitness and tobacco use with lower extremity musculoskeletal injuries among new US Army soldiers." *Inj Prev* 25(4):295-300. https://doi.org/10.1136/injuryprev-2017-042669

Bedno SA, N Urban, MR Boivin, and DN Cowan. 2014. "Fitness, obesity and risk of heat illness among army trainees." *Occup Med (Lond)* 64(6):461-7. https://doi.org/10.1093/occmed/kqu062

Beer JMA, BS Shender, D Chauvin, TS Dart, and J Fischer. 2017. "Cognitive Deterioration in Moderate and Severe Hypobaric Hypoxia Conditions." *Aerosp Med Hum Perform* 88(7):617-626. https://doi.org/10.3357/AMHP.4709.2017

Beiter KJ, ZJ Wentlent, AR Hamouda, and BN Thomas. 2019. "Nonconventional opponents: a review of malaria and leishmaniasis among United States Armed Forces." *PeerJ* 7:e6313. https://doi.org/10.7717/peerj.6313

Belanger BA and J Kwon. 2016. "Effectiveness of Healthy Menu Changes in a Nontrainee Military Dining Facility." *Mil Med* 181(1):82-9. https://doi.org/10.7205/MILMED-D-15-00027

Bell MM, JS Nelson, SM Spann, CJ Molloy, SL Britt, and BS Nelson-Goff. 2014. "The impact of financial resources on soldiers' well-being." *Financ Couns Plan* 25(1):41-52. https://psycnet.apa.org/record/2014-35707-004

Ben-Avraham R, A Afek, NB Cohen, A Davidov, T Van Vleet, J Jordan, AB Yehudah, Y Gilboa, and M Nahum. 2022. "Feasibility and preliminary effectiveness of mobile cognitive control training during basic combat training in the military." *Mil Psych* 34(1):55-67. https://doi.org/10.1080/08995605.2021.1969162

Bennett T, G Bathalon, D Armstrong 3rd, B Martin, R Coll, R Beck, T Barkdull, K O'Brien, and PA Deuster. 2001. "Effect of creatine on performance of militarily relevant tasks and soldier health." *Mil Med* 166(11):996-1002. https://pubmed.ncbi.nlm.nih.gov/11725330/

Bergeron MF, B. C Nindl, PA Deuster, N Baumgartner, SF Kane, WJ Kraemer, LR Sexauer, WR Thompson, and FG O'Connor. 2011. "Consortium for Health and Military Performance and American College of Sports Medicine consensus paper on extreme conditioning programs in military personnel." *Curr Sports Med Rep* 10(6):383-9. https://doi.org/10.1249/JSR.0b013e318237bf8a

Berman R, CS Rose, GP Downey, BJ Day, and HW Chu. 2021. "Role of Particulate Matter from Afghanistan and Iraq in Deployment-Related Lung Disease." *Chem Res Toxicol* 34(12):2408-2423. https://doi.org/10.1021/acs.chemrestox.1c00090

Bernhardt KA, AM Kelley, KA Feltman, and IP Curry. 2019. "Rest and Activity Patterns of Army Aviators in Routine and Operational Training Environments." *Aerosp Med Hum Perform* 90(1):48-52. https://doi.org/10.3357/AMHP.5193.2019

Bernstein SA, M Lo, and WS Davis. 2017. "Proposing Using Waist-to-Height Ratio as the Initial Metric for Body Fat Assessment Standards in the U.S. Army." *Mil Med* 182(S1):304-309. https://doi.org/10.7205/MILMED-D-16-00049

Berryman CE, JJ Sepowitz, HL McClung, HR Lieberman, EK Farina, JP McClung, AA Ferrando, and SM Pasiakos. 2017. "Supplementing an energy adequate, higher protein diet with protein does not enhance fat-free mass restoration after short-term severe negative

energy balance." *J Appl Physiol* 122(6):1485-1493. https://doi.org/10.1152/japplphysiol.01039.2016

Beymer MR, JJ Reagan, MP Rabbitt, AE Webster, and EY Watkins. 2021. "Association between Food Insecurity, Mental Health, and Intentions to Leave the US Army in a Cross-Sectional Sample of US Soldiers." *J Nutr* 151(7):2051-2058. https://doi.org/10.1093/jn/nxab089

Bierman A, L Upenieks, and Y Lee. 2023. "Perceptions of Increases in Cost of Living and Psychological Distress Among Older Adults." *J Aging Health*: 8982643231195924. https://doi.org/10.1177/08982643231195924

Bliemsrieder K, EM Weiss, R Fischer, H Brugger, B Sperner-Unterweger, and K Hufner. 2022. "Cognition and Neuropsychological Changes at Altitude-A Systematic Review of Literature." *Brain Sci* 12(12). https://doi.org/10.3390/brainsci12121736

Blosnich JR, AE Montgomery, ME Dichter, AJ Gordon, D Kavalieratos, L Taylor, B Ketterer, and RM Bossarte. 2020. "Social Determinants and Military Veterans' Suicide Ideation and Attempt: a Cross-sectional Analysis of Electronic Health Record Data." *J Gen Intern Med* 35(6):1759-1767. doi: 10.1007/s11606-019-05447-z

Bøg M, T Filges and AMK Jørgensen. 2018. "Deployment of personnel to military operations: impact on mental health and social functioning." *Campbell Syst Rev* 14(1):1-127. https://doi.org/10.4073/csr.2018.6

Bogaers R, E Geuze, N Greenberg, F Leijten, P Varis, J van Weeghel, D van de Mheen, A Rozema, and E Brouwers. 2022. "Seeking treatment for mental illness and substance abuse: A cross-sectional study on attitudes, beliefs, and needs of military personnel with and without mental illness." *J Psychiatr Res* 147:221-231. https://doi.org/10.1016/j.jpsychires.2022.01.028

Bogaers R, E Geuze, J van Weeghel, F Leijten, D van de Mheen, N Greenberg, AD Rozema, and E Brouwers. 2023. "Mental health issues and illness and substance use disorder (non)disclosure to a supervisor: a cross-sectional study on beliefs, attitudes and needs of military personnel." *BMJ Open* 13(4):e063125. https://doi.org/10.1136/bmjopen-2022-063125

Bohnker BK, T Telfair, JA McGinnis, MA Malakooti, and DM Sack DM. 2003. "Analysis of Navy Physical Evaluation Board diagnoses (1998-2000)." *Mil Med* 168(6):482-5. https://doi.org/10.1093/milmed/168.6.482

Bond GR, M Al-Abdulmunem, RE Drake, LL Davis, T Meyer, DM Gade, BC Frueh, RB Dickman, and DR Ressler. 2022. "Transition from Military Service: Mental Health and Well-being Among Service Members and Veterans with Service-connected Disabilities." *J Behav Health Serv Res* 49(3):282-298. https://doi.org/10.1007/s11414-021-09778-w

Boos CJ, Y Jamil, M Park, W Moy, V Khanna, AC Timperley, and S Sharma. 2012. "Electrocardiographic abnormalities in medically screened military aircrew." *Aviat Space Environ Med* 83(11):1055-9. https://doi.org/10.3357/asem.3276.2012

Booth-Kewley S and GE Larson. 2005. "Predictors of psychiatric hospitalization in the Navy." *Mil Med* 170(1):87-93. https://doi.org/10.7205/milmed.170.1.87

Borges CC, PR Dos Santos, PM Alves, RCM Borges, G Lucchetti, MA Barbosa, CC Porto, and MR Fernandes. 2021. "Association between spirituality/religiousness and quality of life among healthy adults: a systematic review." *Health Qual Life Outcomes* 19(1):246. https://doi.org/10.1186/s12955-021-01878-7

Borgnakke WS. 2019. "IDF Diabetes Atlas: Diabetes and oral health - A two-way relationship of clinical importance." *Diabetes Res Clin Pract* 157:107839. doi: 10.1016/j.diabres.2019.107839

Bormann JE, L Liu, SR Thorp, and AJ Lang. 2012. "Spiritual wellbeing mediates PTSD change in veterans with military-related PTSD." *Int J Behav Med* 19(4):496-502. https://doi.org/10.1007/s12529-011-9186-1

Bornstein DB, GL Grieve, MN Clennin, AC McLain, LP Whitsel, MW Beets, KG Hauret, BH Jones, and MA Sarzynski. 2019. "Which US States Pose the Greatest Threats to Military Readiness and Public Health? Public Health Policy Implications for a Cross-sectional Investigation of Cardiorespiratory Fitness, Body Mass Index, and Injuries Among US Army Recruits." *J Public Health Manag Pract* 25(1):36-44. https://doi.org/10.1097/PHH.0000000000000778

Bouak F, O Vartanian, K Hofer, and B Cheung. 2018. "Acute Mild Hypoxic Hypoxia Effects on Cognitive and Simulated Aircraft Pilot Performance." *Aerosp Med Hum Perform* 89(6):526-535. https://doi.org/10.3357/AMHP.5022.2018

Bove FJ, A Greek, R Gatiba, RC Boehm, and MM Mohnsen. 2024. "Evaluation of mortality among Marines, Navy personnel, and civilian workers exposed to contaminated drinking water at USMC base Camp Lejeune: a cohort study." *Environ Health* 23(1):61. doi: 10.1186/s12940-024-01099-7

Bove FJ, PZ Ruckart, M Maslia, and TC Larson. 2014. "Mortality study of civilian employees exposed to contaminated drinking water at USMC Base Camp Lejeune: a retrospective cohort study." *Environ Health* 13:68. doi: 10.1186/1476-069X-13-68

Boyer CB, CA Gaydos, AB Geller, EC Garges, and SH Vermund. 2022. "Sexually Transmitted Infections in the U.S. Military: A Sexual Health Paradigm to Address Risk Behaviors, Unintended Pregnancy, Alcohol Use, and Sexual Trauma." *Mil Med* 187(5-6):140-143. https://doi.org/10.1093/milmed/usab407

Boyer CB, LM Pollack, J Becnel, and MA Shafer. 2008. "Relationships among sociodemographic markers, behavioral risk, and sexually transmitted infections in U.S. female Marine Corps recruits." *Mil Med* 173(11):1078-84. https://doi.org/10.7205/milmed.173.11.1078

Bradbury KE, KE Coffman, KM Mitchell, AJ Luippold, CS Fulco, and RW Kenefick. 2019. "Separate and combined influences of heat and hypobaric hypoxia on self-paced aerobic exercise performance." *J Appl Physiol* 127(2):513-519. https://doi.org/10.1152/japplphysiol.00023.2019

Brahe C. 2022. "Cutaneous Body Image: How the Mental Health Benefits of Treating Dermatologic Disease Support Military Readiness in Service Members." *Cutis* 109(6):310-313. https://doi.org/10.12788/cutis.0541

Bravo A J, MR Pearson, and ML Kelley. 2018. "Mindfulness and Psychological Health Outcomes: A Latent Profile Analysis among Military Personnel and College Students." *Mindfulness* 9(1):258-270. https://doi.org/10.1007/s12671-017-0771-5

Bray RM, MR Pemberton, ME Lane, LL Hourani, MJ Mattiko, and LA Babeu. 2010. "Substance use and mental health trends among U.S. military active duty personnel: key findings from the 2008 DoD Health Behavior Survey." *Mil Med* 175(6):390-9. https://doi.org/10.7205/milmed-d-09-00132

Breeze J, LC Allanson-Bailey, AE Hepper, and EA Lewis. 2015. "Novel method for comparing coverage by future methods of ballistic facial protection." *Br J Oral Maxillofac Surg* 53(1):3-7. https://doi.org/10.1016/j.bjoms.2014.04.017

Breeze J, LS Allanson-Bailey, NC Hunt, MJ Midwinter, AE Hepper, A Monaghan, and AJ Gibbons. 2012. "Surface wound mapping of battlefield occulo-facial injury." *Injury* 43(11):1856-60. https://doi.org/10.1016/j.injury.2011.07.001

Breeze J, I Horsfall, A Hepper, and J Clasper. 2011. "Face, neck, and eye protection: adapting body armour to counter the changing patterns of injuries on the battlefield." *Br J Oral Maxillofac Surg* 49(8):602-6. https://doi.org/10.1016/j.bjoms.2010.10.001

Bremault-Phillips S, A Pike, F Scarcella, and T Cherwick. 2019. "Spirituality and Moral Injury Among Military Personnel: A Mini-Review." *Front Psychiatry* 10:276. https://doi.org/10.3389/fpsyt.2019.00276

Brennan SF, MM Cantwell, CR Cardwell, LS Velentzis, and JV Woodside. 2010. "Dietary patterns and breast cancer risk: a systematic review and meta-analysis." *Am J Clin Nutr* 91(5):1294-302. https://doi.org/10.3945/ajcn.2009.28796

Brignone E, JD Fargo, RK Blais, ME Carter, MH Samore, and AV Gundlapalli. 2017. "Non-routine Discharge From Military Service: Mental Illness, Substance Use Disorders, and Suicidality." *Am J Prev Med* 52(5):557-565. https://doi.org/10.1016/j.amepre.2016.11.015

Brintz CE, S Miller, KR Olmsted, M Bartoszek, J Cartwright, PN Kizakevich, M Butler, N Asefnia, A Buben, SA Gaylord. 2020. “Adapting Mindfulness Training for Military Service Members With Chronic Pain.” *Mil Med* 185(3-4):385-393. https://doi.org/10.1093/milmed/usz312

Britch SC, KJ Linthicum, A Anyamba, CJ Tucker, EW Pak, FA Maloney, Jr. K Cobb, et al. 2008. "Satellite vegetation index data as a tool to forecast population dynamics of medically important mosquitoes at military installations in the continental United States." *Mil Med* 173(7):677-83. https://doi.org/10.7205/MILMED.173.7.677

Britt TW, AB Adler, G Sawhney, and PD Bliese. 2017. "Coping Strategies as Moderators of the Association Between Combat Exposure and Posttraumatic Stress Disorder Symptoms." *J Trauma Stress* 30(5):491-501. https://doi.org/10.1002/jts.22221

Britt TW, ML Sipos, Z Klinefelter, and AB Adler. 2020. "Determinants of mental and physical health treatment-seeking among military personnel." *Br J Psychiatry* 217(2):420-426. https://doi.org/10.1192/bjp.2019.155

Britton PC, PC Ouimette, and RM Bossarte. 2012. "The effect of depression on the association between military service and life satisfaction." *Qual Life Res* 21(10):1857-62. https://doi.org/10.1007/s11136-011-0104-4

Broderick MP, C Phillips, and D Faix. 2015. "Meningococcal disease in US military personnel before and after adoption of conjugate vaccine." *Emerg Infect Dis* 21(2):77-9. https://doi.org/10.3201/eid2102.141037

Brooks RD, T Grier, EO Dada, and BH Jones. 2019. "The Combined Effect of Cigarette Smoking and Fitness on Injury Risk in Men and Women." *Nicotine Tob Res* 21(12):1621-1628. https://doi.org/10.1093/ntr/nty155

Brooks SK and N Greenberg. 2022. “Mental health and psychological wellbeing of maritime personnel: a systematic review.” *BMC Psychol* 10(1):139. doi: 10.1186/s40359-022-00850-4

Brooks SK and N Greenberg. 2018. "Non-deployment factors affecting psychological wellbeing in military personnel: literature review." *J Ment Health* 27(1):80-90. https://doi.org/10.1080/09638237.2016.1276536

Brown HA, TH Topham, B Clark, LG Ioannou, AD Flouris, JW Smallcombe, RD Telford, O Jay, and JD Periard. 2024. "Quantifying Exercise Heat Acclimatisation in Athletes and Military Personnel: A Systematic Review and Meta-analysis." *Sports Med* 54(3):727-741. https://doi.org/10.1007/s40279-023-01972-4

Brown JC, K Winters-Stone, A Lee, and KH Schmitz. 2012. "Cancer, physical activity, and exercise." *Compr Physiol* 2(4):2775-809. https://doi.org/10.1002/cphy.c120005

Bruehlman-Senecal E, CJ Hook, JH Pfeifer, C FitzGerald, B Davis, KL Delucchi, J Haritatos, and DE Ramo. 2020. "Smartphone App to Address Loneliness Among College Students: Pilot Randomized Controlled Trial." *JMIR Ment Health* 7(10):e21496. https://doi.org/10.2196/21496

Bryan CJ, and AO Bryan. 2019. "Financial Strain, Suicidal Thoughts, and Suicidal Behavior Among US Military Personnel in the National Guard." *Crisis* 40(6):437-445. https://doi.org/10.1027/0227-5910/a000592

Bu Y, J Qu, S Ji, J Zhou, M Xue, J Qu, H Sun, and Y Liu. 2022. "Dietary patterns and breast cancer risk, prognosis, and quality of life: A systematic review." *Front Nutr* 9:1057057. https://doi.org/10.3389/fnut.2022.1057057

Buckingham RS, D McDuffie, K Whitwell, and RB Lee. 2003. "Follow-up study on vision health readiness in the military." *Mil Med* 168(10):789-91. https://www.ncbi.nlm.nih.gov/pubmed/14620640

Buechel JJ and CD Connelly. 2018. "Determinants of Human Papillomavirus Vaccination Among U.S. Navy Personnel." *Nurs Res* 67(4):341-346. https://doi.org/10.1097/NNR.0000000000000282

Bufford RK, A Frise, RF Paloutzian, TJ Mulhearn, N Scheuneman, W Chappelle, K Galloway, and L Prince. 2023. "Psychological and spiritual factors affecting well-being among military personnel engaged in remote combat." *Psychol Trauma* 15(8):1334-1345. https://doi.org/10.1037/tra0001352

Bulmer S, SL Corrigan, JR Drain, JL Tait, B Aisbett, S Roberts, PB Gastin, and LC Main. 2022. "Characterising Psycho-Physiological Responses and Relationships during a Military Field Training Exercise." *Int J Environ Res Public Health* 19(22):14767. https://doi.org/10.3390/ijerph192214767

Bulzacchelli MT, SI Sulsky, R Rodriguez-Monguio, LH Karlsson, and MO Hill. 2014. "Injury during U.S. Army basic combat training: a systematic review of risk factor studies." *Am J Prev Med* 47(6):813-22. https://doi.org/10.1016/j.amepre.2014.08.008

Buoite Stella A, and SA Morrison. 2022. "Marine Survival in the Mediterranean: A Pilot Study on the Cognitive and Cardiorespiratory Response to Sudden Cool Water Immersion." *Int J Environ Res Public Health* 19(3):1601. https://doi.org/10.3390/ijerph19031601

Burgess C, L Nelis, and C Huang. 2021. "Modeling the Potential Impact of Norovirus Vaccination Among DoD Forces." *Mil Med* 186(Suppl 1):91-99. https://doi.org/10.1093/milmed/usaa381

Burley SD, JR Drain, JA Sampson, BC Nindl, and H Groeller. 2020. "Effect of a novel low volume, high intensity concurrent training regimen on recruit fitness and resilience." *J Sci Med Sport* 23(10):979-984. https://doi.org/10.1016/j.jsams.2020.03.005

Burtscher M, Hefti U, Hefti JP. 2021. “High-altitude illnesses: Old stories and new insights into the pathophysiology, treatment and prevention.” *Sports Med Health Sci* 16;3(2):59-69. doi: 10.1016/j.smhs.2021.04.001

Bush T, JC Lovejoy, M Deprey, and KM Carpenter. 2016. "The effect of tobacco cessation on weight gain, obesity, and diabetes risk." *Obesity* 24(9):1834-41. https://doi.org/10.1002/oby.21582

C

Cable GG. 2003. "In-flight hypoxia incidents in military aircraft: causes and implications for training." *Aviat Space Environ Med* 74(2):169-72. https://www.ncbi.nlm.nih.gov/pubmed/12602449

Cafferky B, A Norton, and WJ Travis. 2017. "Air Force Chaplains' Perceived Effectiveness on Service Member's Resilience and Satisfaction." *J Health Care Chaplain* 23(2):45-66. https://doi.org/10.1080/08854726.2016.1250521

Caldwell JN, L Engelen, C van der Henst, MJ Patterson, and NA Taylor. 2011. "The interaction of body armor, low-intensity exercise, and hot-humid conditions on physiological strain and cognitive function." *Mil Med* 176(5):488-93. https://doi.org/10.7205/milmed-d-10-00010

Callison GM. 2005. "Is a Dental Health Risk Assessment predictive of dental health?" *Mil Med* 170(1):26-30. https://doi.org/10.7205/milmed.170.1.26

Campbell-Sills L, PJ Flynn, KW Choi, THH Ng, PA Aliaga, C Broshek, S Jain, et al. 2022a. "Unit cohesion during deployment and post-deployment mental health: is cohesion an individual- or unit-level buffer for combat-exposed soldiers?" *Psychol Med* 52(1):121-131. https://doi.org/10.1017/S0033291720001786

Campbell-Sills L, RC Kessler, RJ Ursano, X Sun, CT Taylor, SG Heeringa, MK Nock, et al. 2018. "Predictive validity and correlates of self-assessed resilience among U.S. Army soldiers." *Depress Anxiety* 35(2):122-131. https://doi.org/10.1002/da.22694

Campbell-Sills L, X Sun, RC Kessler, RJ Ursano, S Jain, and MB Stein. 2023. "Exposure to Bullying or Hazing During Deployment and Mental Health Outcomes Among US Army Soldiers." *JAMA Netw Open* 6(1):e2252109. https://doi.org/10.1001/jamanetworkopen.2022.52109

Campbell-Sills L, RJ Ursano, RC Kessler, X Sun, SG Heeringa, MK Nock, NA Sampson, S Jain, and MB Stein. 2018. "Prospective risk factors for post-deployment heavy drinking and alcohol or substance use disorder among US Army soldiers." *Psychol Med* 48(10):1624-1633. https://doi.org/10.1017/S0033291717003105

Carbone JT, NA Dell, M Issa, and MA Watkins. 2022. "Associations between Allostatic Load and Posttraumatic Stress Disorder: A Scoping Review." *Health Soc Work* 47(2):132-142. https://doi.org/10.1093/hsw/hlac001

Carbone S, MG Del Buono, C Ozemek, and CJ Lavie. 2019. "Obesity, risk of diabetes and role of physical activity, exercise training and cardiorespiratory fitness." *Prog Cardiovasc Dis* 62(4):327-333. https://doi.org/10.1016/j.pcad.2019.08.004

Cardenas-Egusquiza AL and D Berntsen. 2022. "Sleep well, mind wander less: A systematic review of the relationship between sleep outcomes and spontaneous cognition." *Conscious Cogn* 102:103333. https://doi.org/10.1016/j.concog.2022.103333

Carswell AT, SJ Oliver, LM Wentz, DS Kashi, R Roberts, JCY Tang, RM Izard, et al. 2018. "Influence of Vitamin D Supplementation by Sunlight or Oral D3 on Exercise Performance." *Med Sci Sports Exerc* 50(12):2555-2564. https://doi.org/10.1249/MSS.0000000000001721

Cartolano FC, GD Dias, S Miyamoto, and NRT Damasceno. 2021. "Omega-3 Fatty Acids Improve Functionality of High-Density Lipoprotein in Individuals With High Cardiovascular Risk: A Randomized, Parallel, Controlled and Double-Blind Clinical Trial." *Front Nutr* 8:767535. https://doi.org/10.3389/fnut.2021.767535

Carty JR, TS Batig, RJ Heitmann, CB Hammons, and AL Batig. 2019. "Women's Health and Contraceptive Practices of Army Physician Assistants." *Mil Med* 184(3-4):e169-e174. https://doi.org/10.1093/milmed/usy191

Castellani JW, MN Sawka, DW DeGroot, and AJ Young. 2010. "Cold thermoregulatory responses following exertional fatigue." *Front Biosci* 2(3):854-65. https://doi.org/10.2741/s106 .

Castellani JW and MJ Tipton. 2015. "Cold Stress Effects on Exposure Tolerance and Exercise Performance." *Compr Physiol* 6(1):443-69. https://doi.org/10.1002/cphy.c140081

Castellani JW and AJ Young. 2016. "Human physiological responses to cold exposure: Acute responses and acclimatization to prolonged exposure." *Auton Neurosci* 196:63-74. https://doi.org/10.1016/j.autneu.2016.02.009

Cawley J and JC Maclean. 2012. "Unfit for service: the implications of rising obesity for US military recruitment." *Health Econ* 21(11):1348-66. https://doi.org/10.1002/hec.1794

Centers for Disease Control and Prevention (CDC), “Adult Physical Inactivity Outside of Work,” last modified January 31, 2025. https://www.cdc.gov/physical-activity/php/data/inactivity-maps.html

CDC, “Dental Visits,” last reviewed August 2, 2024. https://www.cdc.gov/nchs/hus/topics/dental-visits.htm

CDC National Center for Health Statistics (NCHS). 2022. NCHS Data Brief No. 443, August 2022. *Physical Activity Among Adults Aged 18 and Over: United States, 2020*. https://www.cdc.gov/nchs/data/databriefs/db443.pdf

Centre for Healthy Communities (CHC) and Centre for Health Equity Training, Research andEvaluation (CHETRE). 2022. *Action-Oriented Public Health Framework on Financial Wellbeing and Financial Strain - Executive Summary.* https://www.ualberta.ca/framework_eng_2022

Cermak NM, PT Res, LC de Groot, WH Saris, and LJ van Loon. 2012. "Protein supplementation augments the adaptive response of skeletal muscle to resistance-type exercise training: a meta-analysis." *Am J Clin Nutr* 96(6):1454-64. https://doi.org/10.3945/ajcn.112.037556

Chae JS, CM Kim, EH Kim, EJ Hur, TA Klein, TK Kang, HC Lee, and JW Song. 2003. "Molecular epidemiological study for tick-borne disease (Ehrlichia and Anaplasma spp.) surveillance at selected U.S. military training sites/installations in Korea." *Ann N Y Acad Sci* 990:118-25. https://doi.org/10.1111/j.1749-6632.2003.tb07349.x

Chaffin MA, T Marburger, and D Fretwell. 2003. "Dental class 3 intercept clinic: a model for treating dental class 3 soldiers." *Mil Med* 168(7):548-52. https://doi.org/10.1093/milmed/168.7.548

Chairman of the Joint Chiefs of Staff. 2011. Chairman of the Joint Chiefs of Staff Instruction 3405.01, *Chairman's Total Force Fitness*. https://www.jcs.mil/Portals/36/Documents/Library/Instructions/3405_01.pdf?ver=2016-02-05-175032-517

Chastin SFM, U Abaraogu, JG Bourgois, PM Dall, J Darnborough, E Duncan, J.Dumortier, et al. 2021. "Effects of Regular Physical Activity on the Immune System, Vaccination and Risk of Community-Acquired Infectious Disease in the General Population: Systematic Review and Meta-Analysis." *Sports Med* 51(8):1673-1686. https://doi.org/10.1007/s40279-021-01466-1

Chaufan C, IA Dutescu, H Fekre, S Marzabadi, and KJ Noh. 2021. "The military as a neglected pathogen transmitter, from the nineteenth century to COVID-19: a systematic review." *Glob Health Res Policy* 6(1):48. https://doi.org/10.1186/s41256-021-00232-0

Cheuvront SN, R Carter 3rd, and MN Sawka. 2003. “Fluid balance and endurance exercise performance.” *Curr Sports Med Rep* 2(4):202-8. https://doi.org/10.1249/00149619-200308000-00006

Childs JD, DS Teyhen, PR Casey, KA McCoy-Singh, AW Feldtmann, AC Wright, JL Dugan, SS Wu, and SZ George. 2010. "Effects of traditional sit-up training versus core stabilization exercises on short-term musculoskeletal injuries in US Army soldiers: a cluster randomized trial." *Phys Ther* 90(10):1404-12. https://doi.org/10.2522/ptj.20090389

Chin LM, L Chan, JG Woolstenhulme, EJ Christensen, CN Shenouda, and RE Keyser. 2015. "Improved Cardiorespiratory Fitness With Aerobic Exercise Training in Individuals With Traumatic Brain Injury." *J Head Trauma Rehabil* 30(6):382-90. https://doi.org/10.1097/HTR.0000000000000062

Chou HW, WC Tzeng, YC Chou, HW Yeh, HA Chang, YC Kao, SY Huang, CB Yeh, WS Chiang, and NS Tzeng. 2016. "Stress, Sleep and Depressive Symptoms in Active Duty Military Personnel." *Am J Med Sci* 352(2):146-53. https://doi.org/10.1016/j.amjms.2016.05.013

Chu KM, OV Emasealu, Z Hu, FL O'Donnell, and LL Clark. 2015. "Risk of Mental Health Disorders Following an Initial Diagnosis of Postpartum Depression, Active Component, U.S. Armed Forces, 1998-2010." *MSMR* 22(6):6-12. https://www.ncbi.nlm.nih.gov/pubmed/26115169

Chukwura CL, TJ Santo, CN Waters, and A Andrews. 2019. "'Nutrition is out of our control': soldiers' perceptions of their local food environment." *Public Health Nutr* 22(15):2766-2776. https://doi.org/10.1017/S1368980019001381

Clark LL, GT Oh and S Stahlman. 2019. "Cardiovascular disease-related medical evacuations, active and reserve components, U.S. Armed Forces, 1 October 2001–31 December 2017." *MSMR* 26(1):12-16. https://www.ncbi.nlm.nih.gov/pubmed/30681880

Clasing JE and JG Casali. 2014. "Warfighter auditory situation awareness: effects of augmented hearing protection/enhancement devices and TCAPS for military ground combat applications." *Int J Audiol* 53 Suppl 2:S43-52. https://doi.org/10.3109/14992027.2013.860489

Clayton DJ and LJ James. 2016. "The effect of breakfast on appetite regulation, energy balance and exercise performance." *Proc Nutr Soc* 75(3):319-27. https://doi.org/10.1017/S0029665115004243

Cleveland L. 2009. "Fort Carson: an Army Hearing Program success story." *US Army Med Dep J*:67-75. https://www.ncbi.nlm.nih.gov/pubmed/20088040

Clifford RE, D Baker, VB Risbrough, M Huang, and KA Yurgil. 2019. "Impact of TBI, PTSD, and Hearing Loss on Tinnitus Progression in a US Marine Cohort." *Mil Med* 184(11-12):839-846. https://doi.org/10.1093/milmed/usz016

Clifton DR, DA Nelson, YS Choi, DB Edgeworth, KJ Nelson, D Shell, and PA Deuster. 2023. "Risk factors for musculoskeletal-related occupational disability among US Army soldiers." *BMJ Mil Health* 169(4):327-334. https://doi.org/10.1136/bmjmilitary-2021-001900

Clouston SA, P Brewster, D Kuh, M Richards, R Cooper, R Hardy, MS Rubin, and SM Hofer. 2013. "The dynamic relationship between physical function and cognition in longitudinal aging cohorts." *Epidemiol Rev* 35(1):33-50. https://doi.org/10.1093/epirev/mxs004

Cohen R, C Bavishi, and A Rozanski. 2016. "Purpose in Life and Its Relationship to All-Cause Mortality and Cardiovascular Events: A Meta-Analysis." *Psychosom Med* 78(2):122-33. https://doi.org/10.1097/PSY.0000000000000274

Cole RE, AS Bukhari, CM Champagne, SM McGraw, AM Hatch, and SJ Montain. 2018. "Performance Nutrition Dining Facility Intervention Improves Special Operations Soldiers' Diet Quality and Meal Satisfaction." *J Nutr Educ Behav* 50(10):993-1004. doi: 10.1016/j.jneb.2018.06.011

Collette TL, JL Judkins, M Gettle, BA Moore, M Lee, D Beckman, MA Dyal, A Rouskais, J Tate, and JL Wardian. 2022. "A Retrospective, Epidemiological Review of Type 2 Diabetes Mellitus in a Military Population." *Med J (Ft Sam Houst Tex)* 17-22. https://www.ncbi.nlm.nih.gov/pubmed/34940964

Colthirst P, P DeNicolo, R Will, and JW Simecek. 2012. "Use of the dental disease nonbattle injury encounter module to assess the emergency rate on an Army military installation within the United States." *Mil Med* 177(9):1100-4. https://doi.org/10.7205/milmed-d-12-00113

Combes J, E McColl, B Cross, and RJ McCormick. 2010. "Third molar-related morbidity in deployed Service personnel." *Br Dent J* 209(4):E6. https://doi.org/10.1038/sj.bdj.2010.724

Conforte AM, JL Bakalar, LM Shank, J Quinlan, MB Stephens, T Sbrocco, and M Tanofsky-Kraff. 2017. "Assessing Military Community Support: Relations Among Perceived Military Community Support, Child Psychosocial Adjustment, and Parent Psychosocial Adjustment." *Mil Med* 182(9):e1871-e1878. https://doi.org/10.7205/MILMED-D-17-00016

Conner KR, MD McCarthy, A Bajorska, ED Caine, XM Tu, and KL Knox. 2012. "Mood, anxiety, and substance-use disorders and suicide risk in a military population cohort." *Suicide Life Threat Behav* 42(6):699-708. https://doi.org/10.1111/j.1943-278X.2012.00125.x

Consumer Financial Protection Bureau (CFPB), "Measuring financial well-being: A guide to using the CFPB Financial Well-being Scale," last reviewed August 29, 2024. https://www.consumerfinance.gov/data-research/research-reports/financial-well-being-scale/

Cooke TJ and K Speirs. 2005. "Migration and Employment Among the Civilian Spouses of Military Personnel." *Soc Sci Q* 86(2):343-355. http://www.jstor.org/stable/42956067

Corbett J, J Wright, and MJ Tipton. 2023. "Sex differences in response to exercise heat stress in the context of the military environment." *BMJ Mil Health* 169(1):94-101. https://doi.org/10.1136/jramc-2019-001253

Corrigan SL, S Roberts, S Warmington, J Drain, and LC Main. 2021. "Monitoring stress and allostatic load in first responders and tactical operators using heart rate variability: a systematic review." *BMC Public Health* 21(1):1701. https://doi.org/10.1186/s12889-021-11595-x

Corry NH, S Radakrishnan, CS Williams, AC Sparks, KA Woodall, JA Fairbank, and VA Stander. 2019. "Association of military life experiences and health indicators among military spouses." *BMC Public Health* 19(1):1517. https://doi.org/10.1186/s12889-019-7804-z

Corry NH, CS Williams, S Radakrishnan, HS McMaster, AC Sparks, E Briggs-King, SS Karon, and VA Stander. 2021. "Demographic Variation in Military Life Stress and Perceived Support Among Military Spouses." *Mil Med* 186 (Suppl 1):214-221. https://doi.org/10.1093/milmed/usaa386

Coulter I, P Lester and J Yarvis. 2010. "Social Fitness." *Mil Med* 175(suppl_8):88-96. https://doi.org/10.7205/milmed-d-10-00278. https://doi.org/10.7205/MILMED-D-10-00278

Crane MF, D Boga, E Karin, DF Gucciardi, F Rapport, J Callen, and L Sinclair. 2019. "Strengthening resilience in military officer cadets: A group-randomized controlled trial of coping and emotion regulatory self-reflection training." *J Consult Clin Psychol* 87(2):125-140. https://doi.org/10.1037/ccp0000356

Crawford C, C Boyd, B Avula, YH Wang, IA Khan, and PA Deuster. 2020. "A Public Health Issue: Dietary Supplements Promoted for Brain Health and Cognitive Performance." *J Altern Complement Med* 26(4):265-272. https://doi.org/10.1089/acm.2019.0447

Crawford C, C Boyd, and PA Deuster. 2021. "Dietary Supplement Ingredients for Optimizing Cognitive Performance Among Healthy Adults: A Systematic Review." *J Altern Complement Med* 27(11):940-958. https://doi.org/10.1089/acm.2021.0135

Crawford C, C Boyd, L Brown, R Costello, J Cordell, K Frushour, C Junker, I Khan, J Ross, PA Deuster. 2021. "Prioritized research recommendations and potential solutions: addressing gaps surrounding dietary supplement ingredients for boosting brain health and optimizing cognitive performance." *Nutr Res* 96:9-19. https://doi.org/10.1016/j.nutres.2021.10.001

Crocombe LA and GD Mahoney. 2016. "Does optimal access to dental care counteract the oral health-related quality of life social gradient?" *Aust Dent J* 61(4):418-424. https://doi.org/10.1111/adj.12393

Crombie AP, LK Funderburk, TJ Smith, SM McGraw, LA Walker, CM Champagne, HR Allen, et al. 2013. "Effects of modified foodservice practices in military dining facilities on ad libitum nutritional intake of US army soldiers." *J Acad Nutr Diet* 113(7):920-7. https://doi.org/10.1016/j.jand.2013.01.005

Cronin WA, JA Morgan, and WB Weeks. 2010. "The cost of pursuing a medical career in the military: a tale of five specialties." *Acad Med* 85(8):1316-20. https://doi.org/10.1097/ACM.0b013e3181e5d6b8

Cronrath CM, J Venezia, TJ Rund, TH Cho, NM Solana, and JA Benincasa. 2017. "Medical Redeployment in Soldiers With and Without Medical Deployment Waivers." *Mil Med* 182(3):e1704-e1708. https://doi.org/10.7205/MILMED-D-16-00182

Crowley SK, LL Wilkinson, LT Wigfall, AM Reynolds, ST Muraca, SH Glover, NR Wooten, et al. 2015. "Physical fitness and depressive symptoms during army basic combat training." *Med Sci Sports Exerc* 47(1):151-8. https://doi.org/10.1249/MSS.0000000000000396

Csete J, A Kamarulzaman, M Kazatchkine, F Altice, M Balicki, J Buxton, J Cepeda, et al. 2016. "Public health and international drug policy." *Lancet* 387(10026):1427-1480. https://doi.org/10.1016/S0140-6736(16)00619-X

Currier JM, JM Holland, and J Malott. 2015. "Moral injury, meaning making, and mental health in returning veterans." *J Clin Psychol* 71(3):229-40. https://doi.org/10.1002/jclp.22134

Currier JM, RC McDermott, WH McCormick, MC Churchwell and L Milkeris. 2018. "Exploring cross-lagged associations between spiritual struggles and risk for suicidal behavior in a community sample of military veterans." *J Affect Disord* 230:93-100. https://doi.org/10.1016/j.jad.2018.01.009

D

Daalderop LA, BV Wieland, K Tomsin, L Reyes, BW Kramer, SF Vanterpool, and JV Been. 2018. "Periodontal Disease and Pregnancy Outcomes: Overview of Systematic Reviews." *JDR Clin Trans Res* 3(1):10-27. https://doi.org/10.1177/2380084417731097

Daanen HAM, S Racinais, and JD Periard. 2018. "Heat Acclimation Decay and Re-Induction: A Systematic Review and Meta-Analysis." *Sports Med* 48(2):409-430. https://doi.org/10.1007/s40279-017-0808-x

Dai X, GF Gil, MB Reitsma, NS Ahmad, JA Anderson, C Bisignano, S Carr, et al. 2022. "Health effects associated with smoking: a Burden of Proof study." *Nat Med* 28(10):2045-2055. https://doi.org/10.1038/s41591-022-01978-x

Dal Corso L, A De Carlo, F Carluccio, D Colledani, and A Falco. 2020. "Employee burnout and positive dimensions of well-being: A latent workplace spirituality profile analysis." *PLoS One* 15(11):e0242267. https://doi.org/10.1371/journal.pone.0242267

Darlington R, E Barth, and J McKernan. 2018. "The Challenges of PFAS Remediation." *Mil Eng* 110(712):58-60. https://pubmed.ncbi.nlm.nih.gov/29780177/

Davis SM, ED Davenport, JT Haynes, and RL Alvarado. 2014. "Regurgitant valvular disease prevalence and progression found on echocardiogram in military aviators." *Aviat Space Environ Med* 85(10):1013-8. https://doi.org/10.3924/ASEM.3924.2014

Day AL and HA Livingstone. 2001. "Chronic and acute stressors among military personnel: do coping styles buffer their negative impact on health?" *J Occup Health Psychol* 6(4):348-60. https://www.ncbi.nlm.nih.gov/pubmed/11605828

de Aquino Lemos V, HK Antunes, RV dos Santos, FS Lira, S Tufik, and MT de Mello. 2012. "High altitude exposure impairs sleep patterns, mood, and cognitive functions." *Psychophysiology* 49(9):1298-306. https://doi.org/10.1111/j.1469-8986.2012.01411.x

DeFraites RF, JL Sanchez, CA Brandt, RP Kadlec, RL Haberberger, JJ Lin, and DM Taylor DN. 2014. "An outbreak of Campylobacter enteritis associated with a community water supply on a U.S. military installation." *MSMR* 21(11):10-5.

de Kanter CB TA Roberts, S Raiciulescu, SM Ali, JJ Arnold, C Witkop, and DA Klein. 2019. "Military Family Physicians' Practices and Perceptions About Reproductive Health Services for Deploying Women." *Mil Med* 184(5-6):e424-e430. https://doi.org/10.1093/milmed/usy244

De Vita A, A Belmusto, F Di Perna, S Tremamunno, G De Matteis, F Franceschi, M Covino, and Climps Group. 2024. "The Impact of Climate Change and Extreme Weather Conditions on Cardiovascular Health and Acute Cardiovascular Diseases." *J Clin Med* 13(3):759. https://doi.org/10.3390/jcm13030759

Deans EI, AL Batig, S Cordes, AN Scribner, PE Nielsen, DJ Jamieson, E Lathrop, and C Cwiak. 2019. "A Survey of Family Planning Training, Knowledge, and Practices Among Health Care Providers Within the Military Health System at Joint Base Lewis-McChord." *Mil Med* 184(5-6):e394-e399. https://doi.org/10.1093/milmed/usy255

DeBeer BB, D Davidson, EC Meyer, NA Kimbrel, SB Gulliver, and SB Morissette. 2017. "The Association Between Toxic Exposures and Chronic Multisymptom Illness in Veterans of the Wars of Iraq and Afghanistan." *J Occup Environ Med* 59(1):54-60. https://doi.org/10.1097/JOM.0000000000000922

Defense Centers for Public Health–Aberdeen (DCPH-A). 2023. *2022 Health of the Force*. ph.health.mil/Periodical Library/2022-hof-report-web.pdf

Defense Health Agency (DHA), "Total Force Fitness," last reviewed 15 August 2024. https://www.health.mil/Military-Health-Topics/Health-Readiness/Public-Health/Total-Force-Fitness

DeGroot D, K Henderson, and F O'Connor. 2022. "Exertional heat illness at Fort Benning, GA: Unique insights from the Army Heat Center." *MSMR* 29(4):2-7. https://www.ncbi.nlm.nih.gov/pubmed/35608507

DelVecchio SP, J. F Collen, LL Zacher, and MJ Morris. 2015. "The impact of combat deployment on asthma diagnosis and severity." *J Asthma* 52(4):363-9. https://doi.org/10.3109/02770903.2014.973502

Dempsey CL, DM Benedek, MK Nock, KL Zuromski, DA Brent, J Ao, PA Aliaga, et al. 2021. "Social closeness and support are associated with lower risk of suicide among U.S. Army soldiers." *Suicide Life Threat Behav* 51(5):940-954. https://doi.org/10.1111/sltb.12778

Dennis LK, JA Coughlin, BC McKinnon, TS Wells, CA Gaydos, E Hamsikova, and GC Gray. 2009. "Sexually transmitted infections and prostate cancer among men in the U.S. military." *Cancer Epidemiol Biomarkers Prev* 18(10):2665-71. https://doi.org/10.1158/1055-9965.EPI-08-1167

Denova-Gutierrez E, L Mendez-Sanchez, P Munoz-Aguirre, KL Tucker, and P Clark. 2018. "Dietary Patterns, Bone Mineral Density, and Risk of Fractures: A Systematic Review and Meta-Analysis." *Nutrients* 10(12):1922. https://doi.org/10.3390/nu10121922

Department of Defense (DoD). 2023. DoD Instruction (DoDI) 6205.02, *DoD Immunization Program*. https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/620502p.pdf

DoD. 2022a. DoDI 6025.19, *Individual Medical Readiness Program*. https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/602519p.pdf?ver=R2OKfDXWHtMkQ9hrl8wdOw%3D%3D

DoD. 2022b. DoDI 6130.03, Volume 1, *Medical Standards for Military Service: Appointment, Enlistment, or Induction*. https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/613003_vol1.PDF

DoD. 2022c. Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy, *2022 Demographics Profile of the Military Community*. https://www.militaryonesource.mil/data-research-and-statistics/military-community-demographics/

DoD. 2021. DoDI 1322.34, *Financial Readiness of Service Members*. https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/132234p.PDF?ver=ja9vCcfvKd9gtFxbkWzCdA%3D%3D

DoD. 2019. DoDI 6055.12, *Hearing Conservation Program (HCP).* https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/605512p.pdf?ver=MMbEgkCmoKoUiDfYVGBtqQ%3d%3d

DoD. 2018. DoDI 6130.03, *Medical Standards for Military Service: Appointment, Enlistment, or Induction.* https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/613003_vol01.pdf?ver=B0uhh9e1k_MDTz4PuNU8Aw%3d%3d

DoD. 2014. DoDI 1010.10, *Health Promotion and Disease Prevention*. https://www.esd.whs.mil/portals/54/documents/dd/issuances/dodi/101010p.pdf

Deslandes A, H Moraes, C Ferreira, H Veiga, H Silveira, R Mouta, FA Pompeu, ES Coutinho, and J Laks. 2009. "Exercise and mental health: many reasons to move." *Neuropsychobiology* 59(4):191-8. https://doi.org/10.1159/000223730

Deutsch WM. 2008. "Dental events during periods of isolation in the U.S. submarine force." *Mil Med* 173(1 Suppl):29-37. https://doi.org/10.7205/milmed.173.supplement_1.29

Dinkeloo E, TL Grier, RD Brooks, and BH Jones. 2020. "Vaping, Smoking, and the Physical Fitness of Active Young Men." *Am J Prev Med* 58(1):e31-e37. https://doi.org/10.1016/j.amepre.2019.08.015

"Division of Behavioral and Social Health Outcomes Practice (BSHOP)," Defense Health Agency Public Health (DHAPH), last reviewed August 15, 2024.

Dominguez LJ, N Veronese, and M Barbagallo. 2024. "The link between spirituality and longevity." *Aging Clin Exp Res* 36(1):32. https://doi.org/10.1007/s40520-023-02684-5

Donald PR, JF Schoeman, and A O'Kennedy. 1987. "Hepatic toxicity during chemotherapy for severe tuberculosis meningitis." *Am J Dis Child* 141(7):741-3. https://doi.org/10.1001/archpedi.1987.04460070043019

Donham BP, SB.Frankfurt, RA Cartier, SM O'Hara, and VC Sieg. 2020. "Low Incidence of Death and Renal Failure in United States Military Service Members Hospitalized with Exertional Heat Stroke: A Retrospective Cohort Study." *Mil Med* 185(Suppl 1):362-367. https://doi.org/10.1093/milmed/usz214

Doody CB, L Robertson, KM Cox, J Bogue, J Egan, and KM Sarma. 2021. "Pre-deployment programmes for building resilience in military and frontline emergency service personnel." *Cochrane Database Syst Rev* 12(12):CD013242. https://doi.org/10.1002/14651858.CD013242.pub2

Dos Santos Bunn P, F de Oliveira Meireles, R de Souza Sodre, AI Rodrigues, and EB da Silva. 2021. "Risk factors for musculoskeletal injuries in military personnel: a systematic review with meta-analysis." *Int Arch Occup Environ Health* 94(6):1173-1189. https://doi.org/10.1007/s00420-021-01700-3

Dougherty AL, AJ MacGregor, PP Han, E Viirre, KJ Heltemes, and MR Galarneau. 2013. "Blast-related ear injuries among U.S. military personnel." *J Rehabil Res Dev* 50(6):893-904. https://doi.org/10.1682/JRRD.2012.02.0024

Dougherty AL, AJ MacGregor, E Viirre, MC Clouser, PP Han, KH Quinn, and MR Galarneau. 2018. "Preliminary study of hearing protection and non-impact, blast-induced concussion in US

military personnel." *Brain Inj* 32(11):1423-1428. https://doi.org/10.1080/02699052.2018.1496476

Dretsch MN, D Johnston, RS Bradley, H MacRae, PA Deuster, and WS Harris. 2014. "Effects of omega-3 fatty acid supplementation on neurocognitive functioning and mood in deployed U.S. soldiers: a pilot study." *Mil Med* 179(4):396-403. https://doi.org/10.7205/MILMED-D-13-00395

Drolet M, E Benard, N Perez, M Brisson, and HPV Vaccination Impact Study Group. 2019. "Population-level impact and herd effects following the introduction of human papillomavirus vaccination programmes: updated systematic review and meta-analysis." *Lancet* 394(10197):497-509. https://doi.org/10.1016/S0140-6736(19)30298-3

Dunbar MS, MS Schuler, SO Meadows, and CC Engel. 2022. "Associations Between Mental and Physical Health Conditions and Occupational Impairments in the U.S. Military." *Mil Med* 187(3-4):e387-e393. https://doi.org/10.1093/milmed/usab021

Duncan JM, K Reed-Fitzke, AJ Ferraro, AS Wojciak, KM Smith, and J Sanchez. 2020. "Identifying Risk and Resilience Factors Associated With the Likelihood of Seeking Mental Health Care Among U.S. Army Soldiers-in-Training." *Mil Med* 185(7-8):e1247-e1254. https://doi.org/10.1093/milmed/usz483

E

Easterbrook B, A Brown, H Millman, S Van Blyderveen, R Lanius, A Heber, M McKinnon, and C O'Connor. 2022. "The mental health experience of treatment-seeking military members and public safety personnel: a qualitative investigation of trauma and non-trauma-related concerns." *Health Promot Chronic Dis Prev Can* 42(6):252-260. https://doi.org/10.24095/hpcdp.42.6.03

Ebbert JO, CK Haddock, M Vander Weg, RC Klesges, WS Poston, and M DeBon. 2006. "Predictors of smokeless tobacco initiation in a young adult military cohort." *Am J Health Behav* 30(1):103-12. https://doi.org/10.5555/ajhb.2006.30.1.103

Economides M, J Martman, MJ Bell, and B Sanderson. 2018. "Improvements in Stress, Affect, and Irritability Following Brief Use of a Mindfulness-based Smartphone App: A Randomized Controlled Trial." *Mindfulness* 9(5):1584-1593. https://doi.org/10.1007/s12671-018-0905-4

Edwards ER, B Coolidge, D Ruiz, G Epshteyn, A Krauss, D Gorman, B Connelly, C Redden, P El-Meouchy, and J Geraci. 2023. "Situational stress and suicide attempt behavior in Army soldiers and veterans: Insights from the Army Study to Assess Risk and Resilience in Servicemembers-Longitudinal Study." *Suicide Life Threat Behav* 53(4):642-654. https://doi.org/10.1111/sltb.12970

Elagizi A, S Kachur, S Carbone, CJ Lavie, and SN Blair. 2020. "A Review of Obesity, Physical Activity, and Cardiovascular Disease." *Curr Obes Rep* 9(4):571-581. https://doi.org/10.1007/s13679-020-00403-z

Elbogen EB, M Lanier, AE Montgomery, S Strickland, HR Wagner, and J Tsai. 2020. "Financial Strain and Suicide Attempts in a Nationally Representative Sample of US Adults." *Am J Epidemiol* 189(11):1266-1274. https://doi.org/10.1093/aje/kwaa146

Elbogen EB, JE Zeber, D Vogt, DF Perkins, EP Finley, and LA Copeland. 2022. "Financial Status and Well-being in Recently Separated Military Veterans." *Mil Med* usac030. https://doi.org/10.1093/milmed/usac030

Ellison Craig W. 1983. "Spiritual well-being: Conceptualization and measurement." *Journal of psychology and theology* 11(4): 330-338.

ElSayed NA, G Aleppo, VR Aroda, RR Bannuru, FM Brown, D Bruemmer, BS Collins et al., on behalf of the American Diabetes Association. 2023. "2. Classification and Diagnosis of Diabetes: Standards of Care in Diabetes-2023." *Diabetes Care* 46(Suppl 1):S19-S40. https://doi.org/10.2337/dc23-S002

English LK, JD Ard, RL Bailey, M Bates, LA Bazzano, CJ Boushey, C Brown, et al. 2021. "Evaluation of Dietary Patterns and All-Cause Mortality: A Systematic Review." *JAMA Netw Open* 4(8):e2122277. https://doi.org/10.1001/jamanetworkopen.2021.22277

Erickson KI, C Hillman, CM Stillman, RM Ballard, B Bloodgood, DE Conroy, R Macko, DX Marquez, SJ Petruzzello, KE Powell, and Committee For Physical Activity Guidelines Advisory. 2019. "Physical Activity, Cognition, and Brain Outcomes: A Review of the 2018 Physical Activity Guidelines." *Med Sci Sports Exerc* 51(6):1242-1251. https://doi.org/10.1249/MSS.0000000000001936https://doi.org/10.1249/MSS.0000000000001936https://doi.org/10.1249/MSS.0000000000001936

Ettman CK, AY Fan, AP Philips, GP Adam, G Ringlein, MA Clark, IB Wilson, PM Vivier, and S Galea. 2023. "Financial strain and depression in the U.S.: a scoping review." *Transl Psychiatry* 13(1):168. https://doi.org/10.1038/s41398-023-02460-z

F

Fabiani R, G Naldini, and M Chiavarini. 2019. "Dietary Patterns and Metabolic Syndrome in Adult Subjects: A Systematic Review and Meta-Analysis." *Nutrients* 11(9):2056. https://doi.org/10.3390/nu11092056

Fabries P, D Gomez-Merino, F Sauvet, A Malgoyre, N Koulmann, and M Chennaoui. 2022. "Sleep loss effects on physiological and cognitive responses to systemic environmental hypoxia." *Front Physiol* 13:1046166. https://doi.org/10.3389/fphys.2022.1046166

Fagnant HS, NJ Armstrong, LJ Lutz, AT Nakayama, KI Guerriere, R Ruthazer, RE Cole, JP McClung, E Gaffney-Stomberg, and JP Karl. 2019. “Self-reported eating behaviors of military recruits are associated with body mass index at military accession and change during initial military training.” *Appetite* 142:104348. doi: 10.1016/j.appet.2019

Fagnant HS, LJ Lutz, AT Nakayama, E Gaffney-Stomberg, JP McClung, and JP Karl. 2022. "Breakfast Skipping Is Associated with Vitamin D Deficiency among Young Adults entering Initial Military Training." *J Acad Nutr Diet* 122(6):1114-1128 e1. https://doi.org/10.1016/j.jand.2021.09.016

Fahey MC, MA Little, RC Klesges, GW Talcott, PA Richey, K Mehmet, and RA Krukowski. 2021. "Use of Tobacco for Weight Control across Products among Young Adults in the U.S. Military." *Subst Use Misuse* 56(1):153-161. https://doi.org/10.1080/10826084.2020.1846196

Falck R S. JC Davis, and T Liu-Ambrose. 2017. "What is the association between sedentary behaviour and cognitive function? A systematic review." *Br J Sports Med* 51(10):800-811. https://doi.org/10.1136/bjsports-2015-095551

Falla M, A Micarelli, K Hufner, and G Strapazzon. 2021. "The Effect of Cold Exposure on Cognitive Performance in Healthy Adults: A Systematic Review." *Int J Environ Res Public Health* 18(18):9725. https://doi.org/10.3390/ijerph18189725

Falvo MJ, OY Osinubi, AM Sotolongo, and DA Helmer. 2015. "Airborne hazards exposure and respiratory health of Iraq and Afghanistan veterans." *Epidemiol Rev* 37:116-30. https://doi.org/10.1093/epirev/mxu009

Farhadian N, A Moradi, M Nami, K Kazemi, MR Ghadami, A Ahmadi, R Mohammadi, MN Talebi, P Chakrabarti, B Kateb, and H Khazaie. 2022. "The nexus between sleep disturbances and mental health outcomes in military staff: a systematic review." *Sleep Sci* 15(3):356-362. https://doi.org/10.5935/1984-0063.20220063

Farina EK, LA Thompson, JJ Knapik, SM Pasiakos, HR Lieberman, and JP McClung. 2020. "Diet Quality Is Associated with Physical Performance and Special Forces Selection." *Med Sci Sports Exerc* 52(1):178-186. https://doi.org/10.1249/MSS.0000000000002111

Farina EK, LA Thompson, JJ Knapik, SM Pasiakos, JP McClung, and HR Lieberman. 2022. "Anthropometrics and Body Composition Predict Physical Performance and Selection to Attend Special Forces Training in United States Army Soldiers." *Mil Med* 187(11-12):1381-1388. https://doi.org/10.1093/milmed/usab315

Faulde MK, M Rutenfranz, A Keth, J Hepke, M Rogge, and A Görner. 2015. “Pilot study assessing the effectiveness of factory-treated, long-lasting permethrin-impregnated clothing for the prevention of tick bites during occupational tick exposure in highly infested military

training areas, Germany." *Parasitol Res* 114(2):671-8. https://doi.org/10.1007/s00436-014-4232-y

Federman J and C Duhon. 2016. "The viability of hearing protection device fit-testing at navy and marine corps accession points." *Noise Health* 18(85):303-311. https://doi.org/10.4103/1463-1741.195806

Federman J, S Karch, C Duhon, L Hughes, and D Kulinski. 2022. "The Effect of Using an Active Earmuff on High Frequency Hearing in United States Marine Corps Weapons Instructors." *Ann Work Expo Health* 66(1):60-68. https://doi.org/10.1093/annweh/wxab067

Federman J, SJ Karch, and C Duhon. 2021. "How hearing conservation training format impacts personal attenuation ratings in U.S. Marine Corps Training Recruits." *Int J Audiol* 60(2):151-159. https://doi.org/10.1080/14992027.2020.1811407

Feinberg JH, MA Ryan, M Johns, BA Marvin, JE Reading, and MR White. 2015. "Smoking cessation and improvement in physical performance among young men." *Mil Med* 180(3):343-9. https://doi.org/10.7205/MILMED-D-14-00370

Figueiredo PS, IV Sils, JE Staab, CS Fulco, SR Muza, and BA Beidleman. 2022. "Acute mountain sickness and sleep disturbances differentially influence cognition and mood during rapid ascent to 3000 and 4050 m." *Physiol Rep* 10(3):e15175. https://doi.org/10.14814/phy2.15175

Fischer IC, ML Shanahan, AT Hirsh, JC Stewart, and KL Rand. 2020. "The relationship between meaning in life and post-traumatic stress symptoms in US military personnel: A meta-analysis." *J Affect Disord* 277:658-670. https://doi.org/10.1016/j.jad.2020.08.063

Foran HM, RE Heyman, AMS Slep, and Program United States Air Force Family Advocacy Research. 2011a. "Hazardous drinking and military community functioning: identifying mediating risk factors." *J Consult Clin Psychol* 79(4):521-532. https://doi.org/10.1037/a0024110

Foran HM, AMS Slep, and RE Heyman. 2011b. "Hazardous alcohol use among active duty Air Force personnel: identifying unique risk and promotive factors." *Psychol Addict Behav* 25(1):28-40. https://doi.org/10.1037/a0020748

Fors Brandebo M, M Borjesson, and H Hilmarsson. 2022. "Longitudinal studies on cohesion in a military context - A systematic review." *Mil Psychol* 34(6):732-741. https://doi.org/10.1080/08995605.2022.2041995

Forsyth DR. 2021. "Recent advances in the study of group cohesion." *Group Dyn* 25(3):213–228. https://doi.org/https://doi.org/10.1037/gdn0000163

Forys-Donahue KL, RD Brooks, MR Beymer, and J Pecko. 2020. "The association between nutrition and behavioural health in a US Army population." *Public Health Nutr* 23(17):3059-3066. https://doi.org/10.1017/S1368980020001238

Fosse TH, A Skogstad, SV Einarsen, and M Martinussen. 2019. "Active and passive forms of destructive leadership in a military context: a systematic review and meta-analysis." *Eur J Work Org Psychol* 28(5):708-722. https://doi.org/10.1080/1359432X.2019.1634550

Foulis SA, JM Hughes, LA Walker, KI Guerriere, KM Taylor, SP Proctor, and KE Friedl. 2021. "Body mass does not reflect the body composition changes in response to similar physical training in young women and men." *Int J Obes* 45(3):659-665. https://doi.org/10.1038/s41366-020-00730-0

Freeman RC, Jr, N Sukuan, NM Tota, SM Bell, AG Harris, and HL Wang. 2020. "Promoting Spiritual Healing by Stress Reduction Through Meditation for Employees at a Veterans Hospital: A CDC Framework-Based Program Evaluation." *Workplace Health Saf* 68(4):161-170. https://doi.org/10.1177/2165079919874795

Frickmann H and O Herchenroder. 2019. "Chikungunya Virus Infections in Military Deployments in Tropical Settings-A Narrative Minireview." *Viruses* 11(6):550. https://doi.org/10.3390/v11060550

Friedl KE, JJ Knapik, K Hakkinen, N Baumgartner, H Groeller, NA Taylor, AF Duarte, et al. 2015. "Perspectives on Aerobic and Strength Influences on Military Physical Readiness: Report of an International Military Physiology Roundtable." *J Strength Cond Res* 29 Suppl 11:S10-23. https://doi.org/10.1519/JSC.0000000000001025

Fuente A, L Hickson, TC Morata, W Williams, A Khan, and E Fuentes-Lopez. 2019. "Jet fuel exposure and auditory outcomes in Australian air force personnel." *BMC Public Health* 19(1):675. https://doi.org/10.1186/s12889-019-7038-0

Fusar-Poli P, G Salazar de Pablo, A De Micheli, DH Nieman, CU Correll, LV Kessing, A Pfennig, A Bechdolf, S Borgwardt, C Arango, and T van Amelsvoort. 2020. "What is good mental health? A scoping review." *Eur Neuropsychopharmacol* 31:33-46. https://doi.org/10.1016/j.euroneuro.2019.12.105

G

Galvan E, DK Walker, SY Simbo, R Dalton, K Levers, A O'Connor, C Goodenough et al. 2016. “Acute and chronic safety and efficacy of dose dependent creatine nitrate supplementation and exercise performance.” *J Int Soc Sports Nutr* 13:12. https://doi.org/10.1186/s12970-016-0124-0

Gan LSH, PWP Fan, J Zhang, HW Nolte, KE Friedl, BC Nindl, and JKW Lee. 2022. "Changes in energy balance, body composition, metabolic profile and physical performance in a 62-

day Army Ranger training in a hot-humid environment." *J Sci Med Sport* 25(1):9-94. https://doi.org/10.1016/j.jsams.2021.08.005

Ganocy SJ, T Goto, PK Chan, GH Cohen, L Sampson, S Galea, I Liberzon, et al. 2016. "Association of Spirituality With Mental Health Conditions in Ohio National Guard Soldiers." *J Nerv Ment Dis* 204(7):524-9. https://doi.org/10.1097/NMD.0000000000000519

Garcia L, M Pearce, A Abbas, A Mok, T Strain, S Ali, A Crippa, et al. 2023. "Non-occupational physical activity and risk of cardiovascular disease, cancer and mortality outcomes: a dose-response meta-analysis of large prospective studies." *Br J Sports Med* 57(15):979-989. https://doi.org/10.1136/bjsports-2022-105669

Garshick E, and PD Blanc. 2023. "Military deployment-related respiratory problems: an update." *Curr Opin Pulm Med* 29(2):83-89. https://doi.org/10.1097/MCP.0000000000000946

Gauci S, LM Young, L Arnoldy, AC Lassemillante, A Scholey, and A Pipingas. 2022. "Dietary patterns in middle age: effects on concurrent neurocognition and risk of age-related cognitive decline." *Nutr Rev* 80(5):1129-1159. https://doi.org/10.1093/nutrit/nuab047

Gaviria D, and A Ammerman. 2023. "Eating disorders and disordered eating in servicemen and women: A narrative review." *J Clin Psychol* 79 (2): 316-373. https://doi.org/10.1002/jclp.23424

Geijselaers SLC, SJS Sep, CDA Stehouwer, and GJ Biessels. 2015. "Glucose regulation, cognition, and brain MRI in type 2 diabetes: a systematic review." *Lancet Diabetes Endocrinol* 3(1):75-89. https://doi.org/10.1016/S2213-8587(14)70148-2

GeuzingeR, M Visse, J Duyndam, and E Vermetten. 2020. "Social Embeddedness of Firefighters, Paramedics, Specialized Nurses, Police Officers, and Military Personnel: Systematic Review in Relation to the Risk of Traumatization." *Front Psychiatry* 11:496663. https://doi.org/10.3389/fpsyt.2020.496663

Ghodsi R, H Rostami, K Parastouei, M Taghdir, AA Esfahani, and M Nobakht. 2023. "Adherence to healthy dietary patterns and its association with physical fitness in military personnel." *BMJ Mil Health* 169(2):133-138. https://doi.org/10.1136/bmjmilitary-2020-001553

Giannakoulas G, A Katramados, N Melas, I Diamantopoulos, and E Chimonas. 2003. "Acute effects of nicotine withdrawal syndrome in pilots during flight." *Aviat Space Environ Med* 74(3):247-51. https://www.ncbi.nlm.nih.gov/pubmed/12650272

Gibbons SW, EJ Hickling, and DD Watts. 2012. "Combat stressors and post-traumatic stress in deployed military healthcare professionals: an integrative review." *J Adv Nurs* 68(1):3-21. https://doi.org/10.1111/j.1365-2648.2011.05708.x

Gibson OR, L Taylor, PW Watt, and NS Maxwell. 2017. "Cross-Adaptation: Heat and Cold Adaptation to Improve Physiological and Cellular Responses to Hypoxia." *Sports Med* 47(9):1751-1768. https://doi.org/10.1007/s40279-017-0717-z

Gibson WA. 2004. "Mass smallpox immunization program in a deployed military setting." *Am J Emerg Med* 22(4):267-9. doi: 10.1016/j.ajem.2004.04.008

Giguere C, C Laroche, and V Vaillancourt. 2015. "The interaction of hearing loss and level-dependent hearing protection on speech recognition in noise." *Int J Audiol* 54 Suppl 1:S9-S18. https://doi.org/10.3109/14992027.2014.973540

Gilbert-Ouimet M, C Brisson, M Vezina, L Trudel, R Bourbonnais, B Masse, G Baril-Gingras, and CE Dionne. 2011. "Intervention study on psychosocial work factors and mental health and musculoskeletal outcomes." *Healthc Pap* 11 Spec No: 47-66. https://doi.org/10.12927/hcpap.2011.22410

Giles B, PSR Goods, DR Warner, D Quain, P Peeling, KJ Ducker, B Dawson, and DF Gucciardi. 2018. "Mental toughness and behavioural perseverance: A conceptual replication and extension." *J Sci Med Sport* 21(6):640-645. https://doi.org/10.1016/j.jsams.2017.10.036

Giles GE, CR Mahoney, C Caruso, AS Bukhari, TJ Smith, SM Pasiakos, JP McClung, and HR Lieberman HR. 2019. "Two days of calorie deprivation impairs high level cognitive processes, mood, and self-reported exertion during aerobic exercise: A randomized double-blind, placebo-controlled study." *Brain Cogn* 132:33-40. doi: 10.1016/j.bandc.2019.02.003

Giovannetti JM, M Bemben, D Bemben, and J Cramer. 2012. "Relationship between estimated aerobic fitness and injury rates among active duty at an Air Force base based upon two separate measures of estimated cardiovascular fitness." *Mil Med* 177(1):36-40. https://doi.org/10.7205/milmed-d-11-00225

Godby S, R Dierst-Davies, D Kogut, L Degiorgi Winslow, MM Truslow, J Tuttle, P Koeppl, K Marshall-Aiyelawo, and K Elenberg. 2023. "Correlates of e-cigarette use among active duty US military personnel: implications for cessation policy." *BMJ Mil Health* 169(3):197-204. https://doi.org/10.1136/bmjmilitary-2020-001700

Goforth CW and JB Kazman. 2015. "Exertional heat stroke in navy and marine personnel: a hot topic." *Crit Care Nurse* 35(1):52-9. https://doi.org/10.4037/ccn2015257

Goldberg SB, KM Riordan, S Sun, DJ Kearney, and TL Simpson. 2020. "Efficacy and acceptability of mindfulness-based interventions for military veterans: A systematic review and meta-analysis." *J Psychosom Res* 138: 110232. https://doi.org/10.1016/j.jpsychores.2020.110232

Goldstein LA, J Dinh, R Donalson, CL Hebenstreit, and S Maguen. 2017. "Impact of military trauma exposures on posttraumatic stress and depression in female veterans." *Psychiatry Res* 249: 281-285. https://doi.org/10.1016/j.psychres.2017.01.009

Golenbock S, JB Kazman, S Krauss, and PA Deuster. 2017. "General health status in army personnel: relations with health behaviors and psychosocial variables." *Qual Life Res* 26(7):1839-1851. https://doi.org/10.1007/s11136-017-1523-7

Gomez SAQ, MR Beymer, TJ Santo, LA Riviere, AB Adler, JL Thomas, AM Bell, and PJ Quartana. 2023. "Impact of the COVID-19 pandemic on army families: Household finances, familial experiences, and soldiers' behavioral health." *Mil Psychol* 35(5):420-430. https://doi.org/10.1080/08995605.2022.2149190

Gonzalez Santiago Mdel M, A Martinez-Sahuquillo Marquez, and P Bullon-Fernandez. 2004. "Incidence of barodontalgias and their relation to oral/ dental condition in personnel with responsibility in military flight." *Med Oral* 9(2):98-105.

Goodin CA, DM Prendergast, LD Pruitt, DJ Smolenski, NY Wilson, N Skopp, and T Hoyt. 2019. "Financial hardship and risk of suicide among U.S. Army personnel." *Psychol Serv* 16(2):286-292. https://doi.org/10.1037/ser0000201

Gordley LB, G Lemasters, SR Simpson, and JH Yiin. 2000. "Menstrual disorders and occupational, stress, and racial factors among military personnel." *J Occup Environ Med* 42(9):871-81. https://doi.org/10.1097/00043764-200009000-00005

Gorman LA, AJ Huebner, MK Hirschfeld, S Sankar, AJ Blow, D Guty, M Kees, and JS Ketner. 2016. "A Comparative Case Study of Risk, Resiliency, and Coping Among Injured National Guard." *Mil Med* 181(5 Suppl):70-6. https://doi.org/10.7205/MILMED-D-15-00126

Gorman LA, AJ Blow, BD Ames, and PL Reed. 2011. "National Guard families after combat: mental health, use of mental health services, and perceived treatment barriers." *Psychiatr Serv* 62(1):28-34. https://doi.org/10.1176/ps.62.1.pss6201_0028

Gottschall S, JEC Lee, and HJ McCuaig Edge. 2022. "Adverse childhood experiences and mental health in military recruits: Exploring gender as a moderator." *J Trauma Stress* 35(2):659-670. https://doi.org/10.1002/jts.22784

Grady J, A Banford-Witting, A Kim, and S Davis. 2018. "Differences in Unit Cohesion and Combat-Related Mental Health Problems Based on Attachment Styles in US Military Veterans." *Contemp Fam Ther* 40:249–258. https://doi.org/https://doi.org/10.1007/s10591-017-9444-8

Grant KW, LR Kubli, SA Phatak, H Galloza, and DS Brungart. 2021. "Estimated Prevalence of Functional Hearing Difficulties in Blast-Exposed Service Members With Normal to Near-Normal-Hearing Thresholds." *Ear Hear* 42(6):1615-1626. https://doi.org/10.1097/AUD.0000000000001067

Green ZA, U Noor, and F Ahmed. 2020. "The Body–Mind–Spirit Dimensions of Wellness Mediate Dispositional Gratitude and Life Satisfaction." *J Happiness Stud* 21(8):3095-3119. https://doi.org/10.1007/s10902-019-00215-6

Gribble R, L Goodwin, S Oram, and N Fear. 2019. "Happy wife, happy soldier: How the relationship between military spouses and the military institution influences spouse well-being," Chapter 10 in *The Politics of Mlitary Families. State, Work Organizations, and the Rise of the Negotiation Household (1st Edition)*, eds. Rene Moelker, Manon Andres, and Nina Rones. London, England: Routledge.

Grier T, RD Brooks, Z Solomon, and BH Jones. 2022. "Injury Risk Factors Associated With Weight Training." *J Strength Cond Res* 36(2):e24-e30. https://doi.org/10.1519/JSC.0000000000003791

Grier T, M Canham-Chervak, MK Anderson, TT Bushman, and BH Jones. 2015. "The effects of cross-training on fitness and injury in women." *US Army Med Dep J* Apr-Jun:33-41. https://www.ncbi.nlm.nih.gov/pubmed/26101904

Grier T, M Canham-Chervak, V McNulty, and BH Jones. 2013. "Extreme conditioning programs and injury risk in a US Army Brigade Combat Team." *US Army Med Dep J* Oct-Dec:36-47. https://www.ncbi.nlm.nih.gov/pubmed/24146241

Grier TL, M Canham-Chervak, MK Anderson, TT Bushman, and BH Jones. 2017. "Effects of Physical Training and Fitness on Running Injuries in Physically Active Young Men." *J Strength Cond Res* 31(1):207-216. https://doi.org/10.1519/JSC.0000000000001487

Grier TL, S Morrison, JJ Knapik, M Canham-Chervak, and BH Jones. 2011. "Risk factors for injuries in the U.S. Army Ordnance School." *Mil Med* 176(11):1292-9. https://doi.org/10.7205/milmed-d-11-00215

Griffin BJ, N Purcell, K Burkman, BT Litz, CJ Bryan, M Schmitz, C Villierme, J Walsh, and S Maguen. 2019. "Moral Injury: An Integrative Review." *J Trauma Stress* 32(3):350-362. https://doi.org/10.1002/jts.22362

Gromatsky M, TF Halverson, KH Dillon, LC Wilson, ST LoSavio, S Walsh, C Mellows, AJ Mann, M Goodman, and NA Kimbrel. 2023. "The Prevalence of Nonsuicidal Self-Injury in Military Personnel: A Systematic Review and Meta-Analysis." *Trauma Violence Abuse* 24(5):2936-2952. https://doi.org/10.1177/15248380221119513

Groome PA, SL Rohland, SF Hall, J Irish, WJ Mackillop, and B O'Sullivan. 2011. "A population-based study of factors associated with early versus late stage oral cavity cancer diagnoses." *Oral Oncol* 47(7):642-7. https://doi.org/10.1016/j.oraloncology.2011.04.018

Grosso G, F Bella, J Godos, S Sciacca, D Del Rio, S Ray, F Galvano, and EL Giovannucci. 2017. "Possible role of diet in cancer: systematic review and multiple meta-analyses of dietary

patterns, lifestyle factors, and cancer risk." *Nutr Rev* 75(6):405-419. https://doi.org/10.1093/nutrit/nux012

Gubata ME, ER Packnett, X Feng, DN Cowan, and DW Niebuhr. 2013. "Pre-enlistment hearing loss and hearing loss disability among US soldiers and marines." *Noise Health* 15(66):289-95. https://doi.org/10.4103/1463-1741.116547

Gucciard, DF. 2017. "Mental toughness: progress and prospects." *Curr Opin Psychol* 16:17-23. https://doi.org/10.1016/j.copsyc.2017.03.010

Gucciardi DF, RLJ Lines, KJ Ducker, P Peeling, MT Chapman, and P Temby. 2021. "Mental toughness as a psychological determinant of behavioral perseverance in special forces selection." *Sport Exerc Perform Psychol* 10(1):164-175. https://doi.org/10.1037/spy0000208

Guidi J, M Lucente, N Sonino, and GA Fava. 2021. "Allostatic Load and Its Impact on Health: A Systematic Review." *Psychother Psychosom* 90(1):11-27. https://doi.org/10.1159/000510696

Gunepin M, F Derache, I Ausset, P Berlizot, and J Simecek. 2011. "The rate of dental emergencies in French Armed forces deployed to Afghanistan." *Mil Med* 176(7):828-32. https://doi.org/10.7205/milmed-d-11-00020

Gunther PJ and MS Riddle. 2008. "Effect of combat eye protection on field of view among active-duty U.S. military personnel." *Optometry* 79(11):663-9. https://doi.org/10.1016/j.optm.2008.01.023

Guo X, Y Meng, H Lian, Y Li, Y Xu, R Zhang, J Xu, H Wang, S Xu, W Cai, L Xiao, T Su, and Y Tang. 2023. "Marital status and living apart affect sleep quality in male military personnel: a study of the China's Navy during COVID-19." *Front Psychiatry* 14:1178235. https://doi.org/10.3389/fpsyt.2023.1178235

Gutierrez IA and AB Adler. 2022. "Organizational Context as a Predictor of Positive Adjustment among Soldiers Following Combat Deployment." *Occup Health Sci* 6(3):451-473. https://doi.org/10.1007/s41542-022-00120-0

Guven S and AH Durukan. 2020. "Empty Bullet-Related Ocular Injuries During Military Shooting Training: A 20-Year Review." *Mil Med* 185(5-6):e799-e803. https://doi.org/10.1093/milmed/usz400

H

Haddock CK, WS Poston, KM Heinrich, SA Jahnke, and N Jitnarin. 2016. "The Benefits of High-Intensity Functional Training Fitness Programs for Military Personnel." *Mil Med* 181(11):e1508-e1514. https://doi.org/10.7205/MILMED-D-15-00503

Haddock CK, SA Pyle, WS Poston, RM Bray, and RJ Stein. 2007. "Smoking and body weight as markers of fitness for duty among U.S. military personnel." *Mil Med* 172(5):527-32. https://doi.org/10.7205/milmed.172.5.527

Halista CE, RJ Kline, and J Bepko. 2020. "Understanding Barriers to HPV Vaccination: Perspectives From Air Force Family Medicine Physicians and Active Duty Air Force Males." *Mil Med* 185(5-6):e878-e886. https://doi.org/10.1093/milmed/usz403

Hall NA, AT Everson, MR Billingsley, and MB Miller. 2022. "Moral injury, mental health and behavioural health outcomes: A systematic review of the literature." *Clin Psychol Psychother* 29(1):92-110. https://doi.org/10.1002/cpp.2607

Hammill TL, E McKenna, Q Hecht, K Buchanan, and N Pryor. 2019. "I'm Wearing My Hearing Protection - Am I Still At Risk for Hearing Loss? Lurking Ototoxins in the Military Environment." *Mil Med* 184 (Suppl 1):615-620. https://doi.org/10.1093/milmed/usy329

Hancock PA, JM Ross, and JL Szalma. 2007. "A meta-analysis of performance response under thermal stressors." *Hum Factors* 49(5):851-77. https://doi.org/10.1518/001872007X230226

Hanson JA, G Wagner, and M Dretsch. 2021. "Cognitive disinhibition and infrequent moderate-to-intense physical activity linked with obesity in U.S. soldiers." *Eat Weight Disord* 26(3):973-981. https://doi.org/10.1007/s40519-020-00932-5

Hardcastle LR, M Perry, and A Browne. 2015. “Preventive medicine oversight of splash pads on military installations.” *US Army Med Dep J* Jan-Mar:32-7.

Harrison MF, B Coffey, WJ Albert, and SL Fischer. 2015. "Night vision goggle-induced neck pain in military helicopter aircrew: a literature review." *Aerosp Med Hum Perform* 86(1):46-55. https://doi.org/10.3357/AMHP.4027.2015

Harvey PD 2019. "Domains of cognition and their assessment" *Dialogues Clin Neurosci* 21(3):227-237. https://doi.org/10.31887/DCNS.2019.21.3/pharvey

Hatzfeld JJ, MS Nelson, CM Waters, and BM Jennings. 2016. "Factors influencing health behaviors among active duty Air Force personnel." *Nurs Outlook* 64(5):440-9. https://doi.org/10.1016/j.outlook.2016.05.004

Hauschild VD, DW DeGroot, SM Hall, TL Grier, KD Deaver, KG Hauret, and BH Jones. 2017. "Fitness tests and occupational tasks of military interest: a systematic review of correlations." *Occup Environ Med* 74(2):144-153. https://doi.org/10.1136/oemed-2016-103684

Havenetidis, K. 2016. “The use of creatine supplements in the military.” *J R Army Med Corps* 162(4):242-8. doi: 10.1136/jramc-2014-000400

Headquarters, Departments of the Army, Navy, and Air Force (HQ DANAF). 2017. Army Regulation 40-25/OPNAVINST 10110.1/MCO 10110.49/AFI 44-141, *Nutrition and Menu Standards for Human Performance Optimization.* https://armypubs.army.mil

Heard C, M Willcox, M Falvo, M Blatt, and D Helmer. 2020. "Effects of Linear Periodization Training on Performance Gains and Injury Prevention in a Garrisoned Military Unit." *J Mil Veterans Health* 28(3):23-34. https://www.ncbi.nlm.nih.gov/pubmed/33117460

Hecht SS and DK Hatsukami. 2022. "Smokeless tobacco and cigarette smoking: chemical mechanisms and cancer prevention." *Nat Rev Cancer* 22(3):143-155. https://doi.org/10.1038/s41568-021-00423-4

Heilbronn B, K Doma, W Sinclair, J Connor, L Irvine-Brown, and A Leicht. 2023. "Acute Fatigue Responses to Occupational Training in Military Personnel: A Systematic Review and Meta-Analysis." *Mil Med* 188(5-6):969-977. https://doi.org/10.1093/milmed/usac144

Heileson JL, JM McGowen, JM Moris, TJ Chapman-Lopez, R Torres, LK Funderburk, and JS Forsse. 2022. "Body Composition, Eicosapentaenoic Acid, and Vitamin D are Associated with Army Combat Fitness Test Performance." *J Int Soc Sports Nutr* 19(1):349-365. https://doi.org/10.1080/15502783.2022.2094717

Heinrich GF, AG Bale, and KG Swan. 2008. “Don't know, don't care: revisited.” *Mil Med* 173(3):300-4. doi: 10.7205/milmed.173.3.300

Heinrich KM, AE Streetman, F Kukic, C Fong, BS Hollerbach, BD Goodman, CK Haddock, and WSC Poston. 2022. "Baseline Physical Activity Behaviors and Relationships with Fitness in the Army Training at High Intensity Study." *J Funct Morphol Kinesiol* 7(1):27. https://doi.org/10.3390/jfmk7010027

Heitmann RJ, CB Hammons, and AL Batig. 2017. "Women's Health Knowledge and Skills Among Transitional Year Internship-Trained Military Medical Officers Serving as Independent Health Care Providers." *Mil Med* 182(7):e1808-e1814. https://doi.org/10.7205/MILMED-D-16-00352

Helen J, H Kyrolainen, T Ojanen, K Pihlainen, M Santtila, R Heikkinen, and JP Vaara. 2023. "High-Intensity Functional Training Induces Superior Training Adaptations Compared With Traditional Military Physical Training." *J Strength Cond Res* 37(12):2477-2483. https://doi.org/10.1519/JSC.0000000000004559

Henderson NE, JJ Knapik, SW Shaffer, TH McKenzie, and GM Schneider. 2000. "Injuries and injury risk factors among men and women in U.S. Army Combat Medic Advanced individual training." *Mil Med* 165(9):647-52. https://www.ncbi.nlm.nih.gov/pubmed/11011532

Henning PC, BS Park, and JS Kim. 2011. "Physiological decrements during sustained military operational stress." *Mil Med* 176(9):991-7. https://doi.org/10.7205/milmed-d-11-00053. https://www.ncbi.nlm.nih.gov/pubmed/21987955

Henry JA, SE Griest, C Blankenship, EJ Thielman, SM Theodoroff, T Hammill, and KF Carlson. 2019. "Impact of Tinnitus on Military Service Members." *Mil Med* 184 (Suppl 1):604-614. https://doi.org/10.1093/milmed/usy328

Hepner KA, EL Bloom, S Newberry, JL Sousa, KC Osilla, M Booth, A Bialas, and CM Rutter. 2022. "The Impact of Mindfulness Meditation Programs on Performance-Related Outcomes: Implications for the U.S. Army." *Rand Health Q* 10(1):9. https://www.ncbi.nlm.nih.gov/pubmed/36484076

Hermes ED, TS Wells, B Smith, EJ Boyko, GG Gackstetter, SC Miller, TC Smith, and Team Millennium Cohort Study. 2012. "Smokeless tobacco use related to military deployment, cigarettes and mental health symptoms in a large, prospective cohort study among US service members." *Addiction* 107(5):983-94. https://doi.org/10.1111/j.1360-0443.2011.03737.x

Herrick, MSR and W Chai. 2024. "Extending Air Force Physical Fitness Postpartum Dwell Time Improves Maternal Physical Readiness." *Mil Med* 189(7-8):e1603-e1611. https://doi.org/10.1093/milmed/usad456

Hibbeln JR and RV Gow. 2014. "The potential for military diets to reduce depression, suicide, and impulsive aggression: a review of current evidence for omega-3 and omega-6 fatty acids." *Mil Med* 179 (11 Suppl):117-28. https://doi.org/10.7205/MILMED-D-14-00153

Hickey,BA, T Chalmers, P Newton, CT Lin, D Sibbritt, CS McLachlan, R Clifton-Bligh, J Morley, and S Lal. 2021. "Smart Devices and Wearable Technologies to Detect and Monitor Mental Health Conditions and Stress: A Systematic Review." *Sensors* 21(10):3461. doi: 10.3390/s21103461. https://doi.org/10.3390/s21103461

Hill NE, MJ Stacey, and DR Woods. 2011. "Energy at high altitude." *J R Army Med Corps* 157(1):43-8. https://doi.org/10.1136/jramc-157-01-08

Hisle-Gorman E, A Susi, and GH Gorman. 2019. "The Impact Of Military Parents' Injuries On The Health And Well-Being Of Their Children." *Health Aff* 38(8):1358-1365. https://doi.org/10.1377/hlthaff.2019.00276

Ho ZJ, YF Hwang, and JM Lee. 2014. "Emerging and re-emerging infectious diseases: challenges and opportunities for militaries." *Mil Med Res* 1:21. https://doi.org/10.1186/2054-9369-1-21

Hoffman SS, AW Smith, EE Kent, VP Doria-Rose, SC Kobrin, and MA Mollica. 2022. "Examination of prostate-specific antigen (PSA) screening in military and civilian men: analysis of the 2018 behavioral risk factor surveillance system." *Cancer Causes Control* 33(3):393-402. https://doi.org/10.1007/s10552-021-01533-y

Hoffmire CA, S Borowski, and D Vogt. 2023. "Contribution of veterans' initial post-separation vocational, financial, and social experiences to their suicidal ideation trajectories

following military service." *Suicide and life-threatening behavior* 53(3):443-456. https://doi.org/10.1111/sltb.12955

Hoge CW, CA Castro, SC Messer, D McGurk, DI Cotting, and RL Koffman. 2004. "Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care." *N Engl J Med* 351(1):13-22. https://doi.org/10.1056/NEJMoa040603

Hohenauer E, L Freitag, JT Costello, TB Williams, T Kung, W Taube, M Herten, and R Clijsen. 2022. "The effects of normobaric and hypobaric hypoxia on cognitive performance and physiological responses: A crossover study." *PLoS One* 17(11):e0277364. https://doi.org/10.1371/journal.pone.0277364

Holliday SB, SO Meadows, SL Wrabel, L Werber, CJ Doss, WY Chan, L Dong, and C Brandon. 2022. *Assessing the Association Between Airmen Participation in Force Support Squadron Programs and Unit Cohesion: An Evaluation of the UNITE Initiative.* https://www.rand.org/pubs/research_reports/RRA554-1.html

Holt K, K Grindlay, M Taskier, and D Grossman. 2011. "Unintended pregnancy and contraceptive use among women in the U.S. military: a systematic literature review." *Mil Med* 176(9):1056-64. https://doi.org/10.7205/milmed-d-11-00012

Holzel BK, SW Lazar, T Gard, Z Schuman-Olivier, DR Vago, and U Ott. 2011. "How Does Mindfulness Meditation Work? Proposing Mechanisms of Action From a Conceptual and Neural Perspective." *Perspect Psychol Sci* 6(6):537-59. https://doi.org/10.1177/1745691611419671

Hosokawa Y, DJ Casa, JM Trtanj, LN Belval, PA Deuster, SM Giltz, AJ Grundstein, et al. 2019. "Activity modification in heat: critical assessment of guidelines across athletic, occupational, and military settings in the USA." *Int J Biometeorol* 63(3):405-427. https://doi.org/10.1007/s00484-019-01673-6

Hou R, J Wei, Y Hu, X Zhang, X Sun, EK Chandrasekar, and VS Voruganti. 2019. "Healthy dietary patterns and risk and survival of breast cancer: a meta-analysis of cohort studies." *Cancer Causes Control* 30(8):835-846. https://doi.org/10.1007/s10552-019-01193-z

Hou YP, JL Wu, C Tan, Y Chen, R Guo, and YJ Luo. 2019. "Sex-based differences in the prevalence of acute mountain sickness: a meta-analysis." *Mil Med Res* 6(1):38. https://doi.org/10.1186/s40779-019-0228-3

Houle SA, C Vincent, R Jetly, and AR Ashbaugh. 2021. "Patterns of distress associated with exposure to potentially morally injurious events among Canadian Armed Forces service members and Veterans: A multi-method analysis." *J Clin Psychol* 77(11):2668-2693. https://doi.org/10.1002/jclp.23205

Hourani LL, MI Davila, J Morgan, S Meleth, D Ramirez, G Lewis, PN Kizakevich, R Eckhoff, T Morgan, L Strange, M Lane, B Weimer, and A Lewis. 2020. "Mental health, stress, and

resilience correlates of heart rate variability among military reservists, guardsmen, and first responders." *Physiol Behav* 214: 112734. https://doi.org/10.1016/j.physbeh.2019.112734

Hourani LL, J Williams, V Forman-Hoffman, ME Lane, B Weimer, and RM Bray. 2012. "Influence of spirituality on depression, posttraumatic stress disorder, and suicidality in active duty military personnel." *Depress Res Treat* 2012:425463. https://doi.org/10.1155/2012/425463

Hruby A, L Bulathsinhala, CJ McKinnon, OT Hill, SJ Montain, AJ Young, and TJ Smith. 2017. "Body Mass Index at Accession and Incident Cardiometabolic Risk Factors in US Army Soldiers, 2001-2011." *PLoS One* 12(1):e0170144. https://doi.org/10.1371/journal.pone.0170144

Hruby A, HR Lieberman, and TJ Smith. 2021. "Symptoms of depression, anxiety, and post-traumatic stress disorder and their relationship to health-related behaviors in over 12,000 US military personnel: Bi-directional associations." *J Affect Disord* 283:84-93. https://doi.org/10.1016/j.jad.2021.01.029

Hruby A, HR Lieberman, and TJ Smith. 2020. "Behavioral correlates of self-reported health status in US active duty military." *Prev Med* 131:105930. https://doi.org/10.1016/j.ypmed.2019.105930

Hsieh DA, JW Stout, RB Lee, and JC Gaydos. 2003. "The incidence of eye injuries at three U.S. Army installations." *Mil Med* 168(2):101-5. https://www.ncbi.nlm.nih.gov/pubmed/12636135

Huang, HC, T Nagai, M Lovalekar, C Connaboy, and BC Nindl. 2018. "Physical Fitness Predictors of a Warrior Task Simulation Test." *J Strength Cond Res* 32(9):2562-2568. https://doi.org/10.1519/JSC.0000000000002607

Huberty J, J Green, C Glissmann, L Larkey, M Puzia, and C Lee. 2019. "Efficacy of the Mindfulness Meditation Mobile App "Calm" to Reduce Stress Among College Students: Randomized Controlled Trial." *JMIR Mhealth Uhealth* 7(6):e14273. https://doi.org/10.2196/14273

Hufford DJ, MJ Fritts, and JE Rhodes. 2010. "Spiritual Fitness." *Mil Med* 175(suppl_8):73-87. https://doi.org/10.7205/milmed-d-10-00075

Human Performance Resources by CHAMP at Uniformed Services University (USU). 2024. "Human Performance Resources by CHAMP at USU", last accessed June 25, 2024. https://www.hprc-online.org/

Human Performance Resources by CHAMP at USU. 2022. “What is Total Force Fitness?”, last accessed June 25, 2024. https://www.hprc-online.org/total-force-fitness/tff-strategies/what-total-force-fitness

Human Performance Resources by CHAMP at USU. 2021. "TFF: A holistic approach to health and performance", last accessed June 25, 2024. https://www.health.mil/News/Articles/2021/01/29/TFF-A-holistic-approach-to-health-and-performance

Humphreys, MA, CJ Phillips, and DW Trone. 2019. "Association Between Dietary Supplement Use and ICD-9-CM Code Classification in Active Duty US Navy and Marine Corps Service Members." *Mil Med* 184(9-10):e531-e537. https://doi.org/10.1093/milmed/usz053

Hunt AP, AW Potter, DM Linnane, X Xu, MJ Patterson, and IB Stewart. 2022. "Heat Stress Management in the Military: Wet-Bulb Globe Temperature Offsets for Modern Body Armor Systems." *Hum Factors* 64(8):1306-1316. https://doi.org/10.1177/00187208211005220

Hunter AH, AC Timperley, AN Reid, DC McLoughlin, and E Nicol. 2013. "A 5-year review of atrial fibrillation in military aircrew." *Aviat Space Environ Med* 84(12):1249-54. https://doi.org/10.3357/asem.3690.2013

Hunter RF, K de la Haye, JM Murray, J Badham, TW Valente, M Clarke, and F Kee. 2019. "Social network interventions for health behaviours and outcomes: A systematic review and meta-analysis." *PLoS Med* 16(9):e1002890. https://doi.org/10.1371/journal.pmed.1002890

Hurt L and KA Dorsey. 2014. "The geographic distribution of incident Lyme disease among active component service members stationed in the continental United States, 2004-2013." *MSMR* 21(5):13-5. https://www.ncbi.nlm.nih.gov/pubmed/24885878

Hussain MS and V Tripathi. 2018. "Smoking under hypoxic conditions: a potent environmental risk factor for inflammatory and autoimmune diseases." *Mil Med Res* 5(1):11. https://doi.org/10.1186/s40779-018-0158-5

Hydren JR, AS Borges, and MA Sharp. 2017. "Systematic Review and Meta-Analysis of Predictors of Military Task Performance: Maximal Lift Capacity." *J Strength Cond Res* 31(4):1142-1164. https://doi.org/10.1519/JSC.0000000000001790

I

Ihme KRM and P Sundstrom. 2021. "The mindful shield: The effects of mindfulness training on resilience and leadership in military leaders." *Perspect Psychiatr Care* 57(2):675-688. https://doi.org/10.1111/ppc.12594

Imray CH, P Richards, J Greeves, and JW Castellani. 2011. "Nonfreezing cold-induced injuries." *J R Army Med Corps* 157(1):79-84. https://doi.org/10.1136/jramc-157-01-14

Iobst SE, DC Smith, NI Best, RJ Allard, and LL Trego. 2021. “A Scoping Review of Pregnancy, Childbirth, and the Postpartum Period in Active Duty U.S. Military Women.” *Womens Health Issues* 31 Suppl 1:S81-S92. doi: 10.1016/j.whi.2020.05.005

Irarrazaval S, C Allard, J Campodonico, D Perez, P Strobel, L Vasquez, I Urquiaga, G Echeverria, and F Leighton. 2017. "Oxidative Stress in Acute Hypobaric Hypoxia." *High Alt Med Biol* 18(2):128-134. https://doi.org/10.1089/ham.2016.0119

Irgens-Hansen K, H Gundersen, E Sunde, V Baste, A Harris, M Bratveit, and BE Moen. 2015. "Noise exposure and cognitive performance: A study on personnel on board Royal Norwegian Navy vessels." *Noise Health* 17(78):320-7. https://doi.org/10.4103/1463-1741.165057

Issa AN, NM Herman, RJ Wentz, BJ Taylor, DC Summerfield, and BD Johnson. 2016. "Association of Cognitive Performance with Time at Altitude, Sleep Quality, and Acute Mountain Sickness Symptoms." *Wilderness Environ Med* 27(3):371-8. https://doi.org/10.1016/j.wem.2016.04.008

J

Javidi H and M Yadollahie. 2012. "Post-traumatic Stress Disorder." *Int J Occup Environ Med* 3(1):2-9.

Jaycox LH, AR Morral, A Street, TL Schell, D Kilpatrick, and L Cottrell. 2023. “Gender Differences in Health Among U.S. Service Members: Unwanted Gender-Based Experiences as an Explanatory Factor.” *Rand Health Q* 10(2):8

Jayedi A, S Soltani, A Abdolshahi, and S Shab-Bidar. 2020. "Healthy and unhealthy dietary patterns and the risk of chronic disease: an umbrella review of meta-analyses of prospective cohort studies." *Br J Nutr* 124(11):1133-1144. https://doi.org/10.1017/S0007114520002330

Jayne JM, R Ayala, JP Karl, BA Deschamps, SM McGraw, K O'Connor, AJ DiChiara, and RE Cole. 2020. "Body weight status, perceived stress, and emotional eating among US Army Soldiers: A mediator model." *Eat Behav* 36:101367. https://doi.org/10.1016/j.eatbeh.2020.101367

Jayne JM, JP Karl, SM McGraw, K O'Connor, AJ DiChiara, and RE Cole. 2021. "Eating Behaviors Are Associated With Physical Fitness and Body Composition Among US Army Soldiers." *J Nutr Educ Behav* 53(6):480-488. https://doi.org/10.1016/j.jneb.2021.01.013

Jensen AE, M Laird, JT Jameson, and KR Kelly. 2019. "Prevalence of Musculoskeletal Injuries Sustained During Marine Corps Recruit Training." *Mil Med* 184 (Suppl 1):511-520. https://doi.org/10.1093/milmed/usy387

Jimeno-Almazan A, JG Pallares, A Buendia-Romero, A Martinez-Cava, F Franco-Lopez, BJ Sanchez-Alcaraz Martinez, E Bernal-Morel, and J Courel-Ibanez. 2021. "Post-COVID-19 Syndrome and the Potential Benefits of Exercise." *Int J Environ Res Public Health* 18(10):5329. https://doi.org/10.3390/ijerph18105329

Job A F Cardinal, H Michel, C Klein, E Ressiot, and J Gauthier. 2018. "Tinnitus and Associated Handicaps in the French Mountain Artillery: Assessment by the Tinnitus Handicap Inventory." *Mil Med* 183(9-10):e302-e306. https://doi.org/10.1093/milmed/usy042

Johnson D, C Madsen, A Banaag, DS Krantz, and TP Koehlmoos. 2023. "Pregnancy Weight Gain and Postpartum Weight Retention in Active Duty Military Women: Implications for Readiness." *Mil Med* 188(5-6):e1076-e1083. https://doi.org/10.1093/milmed/usab429

Johnson HL, and CG Ling. 2013. "Caring for military children in the 21st century." *J Am Assoc Nurse Pract* 25(4):195-202. https://doi.org/10.1111/1745-7599.12003

Jones BH, KG Hauret, SK Dye, VD Hauschild, SP Rossi, MD Richardson, and KE Friedl. 2017. "Impact of physical fitness and body composition on injury risk among active young adults: A study of Army trainees." *J Sci Med Sport* 20 Suppl 4:S17-S22. https://doi.org/10.1016/j.jsams.2017.09.015

Jones DE, K Perkins, JH Cook, and AL Ong. 2008. "Intensive coping skills training to reduce anxiety and depression for forward-deployed troops." *Mil Med* 173(3):241-6. https://doi.org/10.7205/milmed.173.3.241

Jones FR, M Ortiz, I Soriano, G Utz, E Saldarriaga, R Cumpa, V Collantes, et al. 2006. “Outbreak of gastroenteritis at a Peruvian naval base.” *Mil Med* 171(11):1095-9. doi: 10.7205/milmed.171.11.1095

Jones GH and CR Pearson. 2016. "The use of personal hearing protection in hostile territory and the effect of health promotion activity: advice falling upon deaf ears." *J R Army Med Corps* 162(4):280-3. https://doi.org/10.1136/jramc-2015-000420

Jones MV, N Smith, D Burns, E Braithwaite, M Turner, A McCann, L Walker, P Emmerson, L Webster, and M Jones. 2022. "A systematic review of resilient performance in defence and security settings." *PLoS One* 17(10):e0273015. https://doi.org/10.1371/journal.pone.0273015

Jones N, B Campion, M Keeling, and N Greenberg. 2018. "Cohesion, leadership, mental health stigmatisation and perceived barriers to care in UK military personnel." *J Ment Health* 27(1):10-18. https://doi.org/10.3109/09638237.2016.1139063

Joseph AR, AJ MacGregor, and AL Dougherty. 2023. "Pre-Existing Audiometric Hearing Loss is a Predictor of Significant Threshold Shift Following Injury During Combat Deployment." *Ear Hear* 44(5):1173-1181. https://doi.org/10.1097/AUD.0000000000001359

Joseph HJ 2006. "Determinants of prostate cancer screening in a sample of African American military servicemen." *Mil Med* 171(5):430-5. https://doi.org/10.7205/milmed.171.5.430

Jouanin JC, C Dussault, P Van Beers, C Pierard, and M Beaumont. 2009. "Short half-life hypnotics preserve physical fitness and altitude tolerance during military mountainous training." *Mil Med* 174(9):964-70. https://doi.org/10.7205/milmed-d-03-1708

Judelson DA, CM Maresh, JM Anderson, LE Armstrong, DJ Casa, WJ Kraemer, and JS Volek. 2007. "Hydration and muscular performance: does fluid balance affect strength, power and high-intensity endurance?" *Sports Med* 37(10):907-21. doi: 10.2165/00007256-200737100-00006

K

Kalaigian A and BW Chaffee. 2023. "Mental Health and Oral Health in a Nationally Representative Cohort." *J Dent Res* 102(9):1007-1014. doi: 10.1177/00220345231171108

Kallinen K and T Ojanen. 2023. "Cognitive Performance changes during a 20-day Winter Military Training Course and the Following 10-day Recovery Period." *Int J Circumpolar Health* 82(1):2225896. https://doi.org/10.1080/22423982.2023.2225896

Kaminsky LA, C German, M Imboden, C Ozemek, JE Peterman, and PH Brubaker. 2022. "The importance of healthy lifestyle behaviors in the prevention of cardiovascular disease." *Prog Cardiovasc Dis* 70:8-15. https://doi.org/10.1016/j.pcad.2021.12.001

Kao TC, JB Kazman, YH Cheng, DD Jeffery, and PA Deuster. 2021. "Healthy lifestyles among military active duty service members, and associations with body-building and weight-loss supplement use." *Ann Epidemiol* 53:27-33. https://doi.org/10.1016/j.annepidem.2020.08.011

Kardouni JR, TL Shing, and DI Rhon. 2016. "Risk Factors for Low Back Pain and Spine Surgery: A Retrospective Cohort Study in Soldiers." *Am J Prev Med* 51(5):e129-e138. https://doi.org/10.1016/j.amepre.2016.06.005

Kaufman LR, GK LeMasters, DM Olsen, and P Succop. 2005. "Effects of concurrent noise and jet fuel exposure on hearing loss." *J Occup Environ Med* 47(3):212-8. https://doi.org/10.1097/01.jom.0000155710.28289.0e

Kazman JB, S Attipoe, BR Kupchak, and PA Deuster. 2020. "Caffeine and heat have additive but not interactive effects on physiologic strain: A factorial experiment." *J Therm Biol* 89:102563. https://doi.org/10.1016/j.jtherbio.2020.102563

Kazman JB, DL Purvis, Y Heled, P Lisman, D Atias, S Van Arsdale, and PA Deuster. 2015. "Women and exertional heat illness: identification of gender specific risk factors." *US Army Med Dep J*:58-66. https://www.ncbi.nlm.nih.gov/pubmed/26101907

Keithler AN, AS Wilson, A Yuan, JM Sosa, and K Bush. 2023. "Characteristics of US military personnel with atrial fibrillation and associated deployment and retention rates." *BMJ Mil Health* 169(e1):e24-e28. https://doi.org/10.1136/bmjmilitary-2020-001665

Keithler AN, AS Wilson, A Yuan, JM Sosa, and KNV Bush. 2022. "Characteristics of United States military pilots with atrial fibrillation and deployment and retention rates." *BMC Cardiovasc Disord* 22(1):100. https://doi.org/10.1186/s12872-022-02542-8

Keller MD, JM Ziriax, W Barns, B Sheffield, D Brungart, T Thomas, B Jaeger, and K Yankaskas. 2017. "Performance in noise: Impact of reduced speech intelligibility on Sailor performance in a Navy command and control environment." *Hear Res* 349:55-66. https://doi.org/10.1016/j.heares.2016.10.007

Kelley ML, JW Chae, AJ Bravo, AL Milam, E Agha, SA Gaylord, C Vinci, and JM Currier. 2021. "Own soul's warning: Moral injury, suicidal ideation, and meaning in life." *Psychol Trauma* 13(7):740-748. https://doi.org/10.1037/tra0001047

Kelly KR, and JT Jameson. 2016. "Preparing for Combat Readiness for the Fight: Physical Performance Profile of Female U.S. Marines." *J Strength Cond Res* 30(3):595-604. https://doi.org/10.1519/JSC.0000000000001269

Kelly UA, K Skelton, M Patel, and B Bradley. 2011. "More than military sexual trauma: interpersonal violence, PTSD, and mental health in women veterans." *Res Nurs Health* 34(6):457-67. https://doi.org/10.1002/nur.20453

Kennedy-Armbruster C, EM Evans, L Sexauer, J Peterson, and W Wyatt. 2013. "Association among functional-movement ability, fatigue, sedentary time, and fitness in 40 years and older active duty military personnel." *Mil Med* 178(12):1358-64. https://doi.org/10.7205/MILMED-D-13-00186

Keralis JM, M Javanmardi, S Khanna, P Dwivedi, D Huang, T Tasdizen, and QC Nguyen. 2020. "Health and the built environment in United States cities: measuring associations using Google Street View-derived indicators of the built environment." *BMC Public Health* 20(1):215. https://doi.org/10.1186/s12889-020-8300-1

Keramidas ME, R Kölegård, and O Eiken. 2020. “Hypoxia gradually augments metabolic and thermoperceptual responsiveness to repeated whole-body cold stress in humans.” *Exp Physiol* 105(12):2123-2140. doi: 10.1113/EP089070

Kim HJ, SY Oh, SY Won, HJ Kim, TK Kim, BC Ko, SY Woo, and EC Park. 2021. "Associations between earplug use and hearing loss in ROK military personnel." *BMJ Mil Health* 167(6):398-401. https://doi.org/10.1136/jramc-2019-001378

Kim KV, J Rehm, MS Kaplan, and S Lange. 2024. "Relationship Between Alcohol Use and Firearm-Involved Suicide: Findings From the National Violent Death Reporting System,

2003-2020." *Am J Prev Med* 66(5):832-839. https://doi.org/10.1016/j.amepre.2023.11.019

Kirk KM, A McGuire, PE Nasveld, and SA Treloar. 2012. "Comparison of self-reported and audiometrically-measured hearing loss in the Australian Defence Force." *Int J Audiol* 51(4):294-8. https://doi.org/10.3109/14992027.2011.625981

Kitchen LW, KL Lawrence, and RE Coleman. 2009. "The role of the United States military in the development of vector control products, including insect repellents, insecticides, and bed nets." *J Vector Ecol* 34(1):50-61. https://doi.org/10.1111/j.1948-7134.2009.00007.x

Klesges RC, M DeBon, MW Vander Weg, CK Haddock, HA Lando, GE Relyea, AL Peterson, and GW Talcott. 2006. "Efficacy of a tailored tobacco control program on long-term use in a population of U.S. military troops." *J Consult Clin Psychol* 74(2):295-306. https://doi.org/10.1037/0022-006X.74.2.295

Klesges RC, D Sherrill-Mittleman, JO Ebbert, GW Talcott, and M Debon. 2010. "Tobacco use harm reduction, elimination, and escalation in a large military cohort." *Am J Public Health* 100(12):2487-92. https://doi.org/10.2105/AJPH.2009.175091

Knapik JJ and SA Bedno. 2018. "Epidemiologic Evidence and Possible Mechanisms for the Association Between Cigarette Smoking and Injuries. Part 2: Is the Relationship Between Smoking and Injuries Causal?" *J Spec Oper Med* 18(2):117-122. https://doi.org/10.55460/MDBC-Z2E9

Knapik JJ and Y Epstein. 2019. “Exertional Heat Stroke: Pathophysiology, Epidemiology, Diagnosis, Treatment, and Prevention.” *J Spec Oper Med* 19(2):108-116. https://doi.org/10.55460/5P2Q-1MBQ

Knapik JJ, EK Farina, RA Steelman, DW Trone, and HR Lieberman. 2023. "The Medical Burden of Obesity and Overweight in the US Military: Association of BMI with Clinically Diagnosed Medical Conditions in United States Military Service Members." *J Nutr* 153(10):2951-2967. https://doi.org/10.1016/j.tjnut.2023.08.023

Knapik JJ, MA Sharp, M Canham-Chervak, K Hauret, JF Patton, and BH Jones. 2001. "Risk factors for training-related injuries among men and women in basic combat training." *Med Sci Sports Exerc* 33(6):946-54. https://doi.org/10.1097/00005768-200106000-00014

Knapik JJ, MA Sharp, and RA Steelman. 2017. "Secular Trends in the Physical Fitness of United States Army Recruits on Entry to Service, 1975-2013." *J Strength Cond Res* 31(7):2030-2052. https://doi.org/10.1519/JSC.0000000000001928

Knapik JJ, DW Trone, RA Steelman, EK Farina, and HR Lieberman. 2022. "Dietary Supplement and Prescription Medication Use Among US Military Service Members With Clinically Diagnosed Medical Conditions: The US Military Dietary Supplement Use Study." *J Acad Nutr Diet* 122(10):1841-1850. https://doi.org/10.1016/j.jand.2022.05.007

Ko FW, W Tam, EHS Siu, KP Chan, JC Ngai, SS Ng, TO Chan, and DS Hui. 2021. "Effect of short-course exercise training on the frequency of exacerbations and physical activity in patients with COPD: A randomized controlled trial." *Respirology* 26(1):72-79. https://doi.org/10.1111/resp.13872

Koban LA and AR Pfluger. 2023. "Per- and polyfluoroalkyl substances (PFAS) exposure through munitions in the Russia-Ukraine conflict." *Integr Environ Assess Manag* 19(2):376-381. https://doi.org/10.1002/ieam.4672

Koenig HG. 2023. ""“Spiritual Readiness” in the U.S. Military: A Neglected Component of Warrior Readiness." *J Relig Health* 62(3):1561-1577. https://doi.org/10.1007/s10943-022-01563-z

Koenig HG and F Al Zaben. 2021. "Moral Injury: An Increasingly Recognized and Widespread Syndrome." *J Relig Health* 60(5):2989-3011. https://doi.org/10.1007/s10943-021-01328-0

Koenig HG and FN Al-Zaben. 2020. "Moral injury from war and other severe trauma." *Asia Pac Psychiatry* 12(2):e12378. https://doi.org/10.1111/appy.12378

Koenig HG, NA Youssef, and M Pearce. 2019. "Assessment of Moral Injury in Veterans and Active Duty Military Personnel With PTSD: A Review." *Front Psychiatry* 10:443. https://doi.org/10.3389/fpsyt.2019.00443

Koenig HG, NA Youssef, D Ames, Rev JP Oliver, F Volk, EJ Teng, and TD Hill. 2019. "Dimensions of Religiosity and PTSD Symptom Clusters in US Veterans and Active Duty Military." *J Relig Health* 58(3):805-822. https://doi.org/10.1007/s10943-019-00817-7

Koenig HG, NA Youssef, Rev JP Oliver, D Ames, K Haynes, F Volk, and EJ Teng. 2018. "Religious Involvement, Anxiety/Depression, and PTSD Symptoms in US Veterans and Active Duty Military." *J Relig Health* 57(6):2325-2342. https://doi.org/10.1007/s10943-018-0692-1

Koenig HG, NA Youssef, Z Smothers, JP Oliver, NA Boucher, D Ames, F Volk, EJ Teng, and K Haynes. 2020. "Hope, Religiosity, and Mental Health in U.S. Veterans and Active Duty Military with PTSD Symptoms." *Mil Med* 185(1-2):97-104. https://doi.org/10.1093/milmed/usz146

Kolka MA, WA Latzka, SJ Montain, WP Corr, KK O'Brien, and MN Sawka. 2003. “Effectiveness of revised fluid replacement guidelines for military training in hot weather.” *Aviat Space Environ Med* 74(3):242-6.

Kollock RO, KE Games, AE Wilson, and JM Sefton. 2016. "Vehicle Exposure and Spinal Musculature Fatigue in Military Warfighters: A Meta-Analysis." *J Athl Train* 51(11):981-990. https://doi.org/10.4085/1062-6050-51.9.13

Koltun KJ, MB Bird, M Lovalekar, BJ Mar□n, Q Mi, and BC Nindl. 2023. "Changes in ea□ng pathology symptoms during ini□al military training in men and women and associa□ons with BMI and injury risk." *Eat Behav* 48: 101687. doi:10.1016/j.eatbeh.2022.101687

Kontogianni MD and DB Panagiotakos. 2014. "Dietary patterns and stroke: a systematic review and re-meta-analysis." *Maturitas* 79(1):41-7. https://doi.org/10.1016/j.maturitas.2014.06.014

Korzeniewski K. 2011. "Health hazards in areas of military operations conducted in different climatic and sanitary conditions." *Int Marit Health* 62(1):41-62. https://www.ncbi.nlm.nih.gov/pubmed/21534225

Korzeniewski K, D Juszczak, and P Paul. 2020. "Sexually transmitted infections in the military environment." *Int Marit Health* 71(3):207-212. https://doi.org/10.5603/IMH.2020.0037

Korzeniewski K, A Nitsch-Osuch, A Chcialowski, and J Korsak. 2013. "Environmental factors, immune changes and respiratory diseases in troops during military activities." *Respir Physiol Neurobiol* 187(1):118-22. https://doi.org/10.1016/j.resp.2013.02.003

Kostas-Polston EA, JJ Buechel, NA Ryan-Wenger, and J Remesz-Guerrette. 2022. "U.S. active-duty service women's urogenital health and operational readiness through the lens of the IBM-WASH model: A systematic integrative review." *Appl Nurs Res* 67:151620. https://doi.org/10.1016/j.apnr.2022.151620

Kraemer WJ, JD Vescovi, JS Volek, BC Nindl, RU Newton, JF Patton, JE Dziados, DN French, and K Hakkinen. 2004. "Effects of concurrent resistance and aerobic training on load-bearing performance and the Army physical fitness test." *Mil Med* 169(12):994-9. https://doi.org/10.7205/milmed.169.12.994

Kramer MK, SC Agee, RG Miller, VC Arena, KK Vanderwood, YL Eaglehouse, EM Venditti, and AM Kriska. 2023. "Translating the Diabetes Prevention Program Lifestyle Intervention to the Military Setting." *Mil Med* 188(5-6):1036-1045. https://doi.org/10.1093/milmed/usac037

Krauss MR, NU Garvin, MR Boivin, and DN Cowan. 2017. "Excess Stress Fractures, Musculoskeletal Injuries, and Health Care Utilization Among Unfit and Overweight Female Army Trainees." *Am J Sports Med* 45(2):311-316. https://doi.org/10.1177/0363546516675862

Kryskow MA, BA Beidleman, CS Fulco, and SR Muza. 2013. "Performance during simple and complex military psychomotor tasks at various altitudes." *Aviat Space Environ Med* 84(11):1147-52. https://doi.org/10.3357/asem.3245.2013

Kyriakidou Y, C Wood, C Ferrier, A Dolci, and B Elliott. 2021. "The effect of Omega-3 polyunsaturated fatty acid supplementation on exercise-induced muscle damage." *J Int Soc Sports Nutr* 18(1):9. https://doi.org/10.1186/s12970-020-00405-1

Kyrolainen H, K Pihlainen, JP Vaara, T Ojanen, and M Santtila. 2018. "Optimising training adaptations and performance in military environment." *J Sci Med Sport* 21(11):1131-1138. https://doi.org/10.1016/j.jsams.2017.11.019

L

Lang J JL Thomas, PD Bliese, and AB Adler. 2007. "Job demands and job performance: the mediating effect of psychological and physical strain and the moderating effect of role clarity." *J Occup Health Psychol* 12(2):16-24. https://doi.org/10.1037/1076-8998.12.2.116

Langhinrichsen-Rohling J, JD Snarr, AMS Slep, RE Heyman, HM Foran, and Program United States Air Force Family Advocacy. 2011. "Risk for suicidal ideation in the U.S. Air Force: an ecological perspective." *J Consult Clin Psychol* 79(5):600-612. https://doi.org/10.1037/a0024631

Lapierre CB, AF Schwegler, and BJ Labauve. 2007. "Posttraumatic stress and depression symptoms in soldiers returning from combat operations in Iraq and Afghanistan." *J Trauma Stress* 20(6):933-43. https://doi.org/10.1002/jts.20278

Lappe JM, MR Stegman, and RR Recker. 2001. "The impact of lifestyle factors on stress fractures in female Army recruits." *Osteoporos Int* 12(1):35-42. https://doi.org/10.1007/s001980170155

LaRocca MA, JW Ashford, RB Katz, and AJ Furst. 2020. "Military Environmental Exposure Concerns, Posttraumatic Stress Disorder, and Somatic Symptoms: Their Interrelation Among Treatment-Seeking Veterans." *J Occup Environ Med* 62(1):74-79. https://doi.org/10.1097/jom.0000000000001767

Larsen B, K Netto, and B Aisbett. 2011. "The effect of body armor on performance, thermal stress, and exertion: a critical review." *Mil Med* 176(11):1265-73. https://doi.org/10.7205/milmed-d-10-00470

Launay JC, Y Besnard, A Guinet-Lebreton, and G Savourey. 2006. “Acclimation to intermittent hypobaric hypoxia modifies responses to cold at sea level.” *Aviat Space Environ Med* 77(12):1230-5

Lee I, B Davis, B Purt, and T DesRosiers. 2023. "Ocular Trauma and Traumatic Brain Injury on the Battlefield: A Systematic Review After 20 Years of Fighting the Global War on Terror." *Mil Med* 188(9-10):2916-2923. https://doi.org/10.1093/milmed/usac226

Lee JKW, B Tan, HB Ogden, S Chapman, and MN Sawka. 2022. "Exertional heat stroke: nutritional considerations." *Exp Physiol* 107(10):1122-1135. https://doi.org/10.1113/EP090149

Lee RU, CJ Phillips, and DJ Faix. 2019. "Seasonal Influenza Vaccine Impact on Pandemic H1N1 Vaccine Efficacy." *Clin Infect Dis* 68(11):1839-1846. https://doi.org/10.1093/cid/ciy812

Leiendecker TM, G Martin, and DL Moss. 2011. "2008 Department of Defense (DoD) recruit oral health survey." *Mil Med* 176(8 Suppl):1-44. https://www.ncbi.nlm.nih.gov/pubmed/21957804

Lennemann LM, KM Sidrow, EM Johnson, CR Harrison, CN Vojta, and TB Walker. 2013. "The influence of agility training on physiological and cognitive performance." *J Strength Cond Res* 27(12):3300-3309. https://doi.org/10.1519/JSC.0b013e31828ddf06

Lester ME, MA Sharp, WC Werling, LA Walker, BS Cohen, and TM Ruediger. 2014. "Effect of specific short-term physical training on fitness measures in conditioned men." *J Strength Cond Res* 28(3):679-88. https://doi.org/10.1519/JSC.0b013e318299912b

Levin-Rector A, LL Hourani, RA Van Dorn, RM Bray, VA Stander, JK Cartwright, JK Morgan, J Trudeau, and PK Lattimore. 2018. "Predictors of Posttraumatic Stress Disorder, Anxiety Disorders, Depressive Disorders, and Any Mental Health Condition Among U.S. Soldiers and Marines, 2001-2011." *J Trauma Stress* 31(4):568-578. https://doi.org/10.1002/jts.22316

Lewandowski SA, MA Kioumourtzoglou, and JL Shaman. 2022. "Heat stress illness outcomes and annual indices of outdoor heat at U.S. Army installations." *PLoS One* 17(11):e0263803. https://doi.org/10.1371/journal.pone.0263803

Lewandowski SA and JL Shaman. 2022. "Heat stress morbidity among US military personnel: Daily exposure and lagged response (1998-2019)." *Int J Biometeorol* 66(6):1199-1208. https://doi.org/10.1007/s00484-022-02269-3

Lewis MS, KM Reavis, S Griest, KF Carlson, J Gordon, and JA Henry. 2023. "The influence of tinnitus and hearing loss on the functional status of military Service members and Veterans." *Int J Audiol* 62(1):44-52. https://doi.org/10.1080/14992027.2021.2017494

Lewis PE, DG Burnett, AA Costello, CH Olsen, JN Tchandja, and BJ Webber. 2015. "Measles, Mumps, and Rubella Titers in Air Force Recruits: Below Herd Immunity Thresholds?" *Am J Prev Med* 49(5):757-760. https://doi.org/10.1016/j.amepre.2015.04.019

Li Z, ZJ McKenna, MR Kuennen, FC Magalhaes, CM Mermier, and FT Amorim. 2021. "The Potential Role of Exercise-Induced Muscle Damage in Exertional Heat Stroke." *Sports Med* 51(5):863-872. https://doi.org/10.1007/s40279-021-01427-8

Liang P, J Li, Z Li, J Wei, J Li, S Zhang, S Xu, Z Liu, and J Wang. 2024. “Effect of low-frequency noise exposure on cognitive function: a systematic review and meta-analysis.” *BMC Public Health* 24(1):125. doi: 10.1186/s12889-023-17593-5

Lieberman HR, CM Falco, and SS Slade. 2002. “Carbohydrate administration during a day of sustained aerobic activity improves vigilance, as assessed by a novel ambulatory monitoring device, and mood.” *Am J Clin Nutr* 76(1):120-7. doi: 10.1093/ajcn/76.1.120. PMID: 12081825

Lieberman HR, GP Bathalon, CM Falco, FM Kramer, CA Morgan, 3rd, and P Niro. 2005. "Severe decrements in cognition function and mood induced by sleep loss, heat, dehydration, and undernutrition during simulated combat." *Biol Psychiatry* 57(4):422-9. https://doi.org/10.1016/j.biopsych.2004.11.014

Lieberman HR, AS Bukhari, JA Caldwell, MA Wilson, CR Mahoney, SM Pasiakos, JP McClung, and TJ Smith. 2017. “Two Days of Calorie Deprivation Induced by Underfeeding and Aerobic Exercise Degrades Mood and Lowers Interstitial Glucose but Does Not Impair Cognitive Function in Young Adults.” *J Nutr* 147(1):110-116. doi: 10.3945/jn.116.238246

Lieberman HR, CM Caruso, PJ Niro, GE Adam, MD Kellogg, BC Nindl, and FM Kramer. 2008. “A double-blind, placebo-controlled test of 2 d of calorie deprivation: effects on cognition, activity, sleep, and interstitial glucose concentrations.” *Am J Clin Nutr* 88(3):667-76. doi: 10.1093/ajcn/88.3.667

Lieberman HR, JW Castellani, and AJ Young. 2009. "Cognitive function and mood during acute cold stress after extended military training and recovery." *Aviat Space Environ Med* 80(7):629-36. https://doi.org/10.3357/asem.2431.2009

Lieberman HR, JP Karl, PJ Niro, KW Williams, EK Farina, SJ Cable, and JP McClung. 2014. "Positive effects of basic training on cognitive performance and mood of adult females." *Hum Factors* 56(6):1113-23. https://doi.org/10.1177/0018720813519472

Ligeza N, A Larson, and M DeBeliso. 2022. "Resilience, Psychological Stress, Physical Activity, and BMI among United States Air National Guardsmen: The COVID-19 Pandemic." *J Lifestyle Med* 12(1):26-36. https://doi.org/10.15280/jlm.2022.12.1.26

Lin J, K Zhu, PK Hoang, AM Solivan-Ortiz, SL Larsen, SP Irwin, TR Schneid, CD Shriver, and S Lee. 2020. "Electronic Cigarette Use and Related Factors among Active Duty Service Members in the U.S. Military." *Mil Med* 185(3-4):418-427. https://doi.org/10.1093/milmed/usz267

Lin J, K Zhu, AM Solivan-Ortiz, SL Larsen, TR Schneid, CD Shriver, and S Lee. 2018. "Smokeless Tobacco Use and Related Factors: A Study in the US Military Population." *Am J Health Behav* 42(4):102-117. https://doi.org/10.5993/AJHB.42.4.10

Lin KH, YJ Chen, SN Yang, MW Liu, CC Kao, M Nagamine, E Vermetten, and GM Lin. 2020. "Association of Psychological Stress with Physical Fitness in a Military Cohort: The CHIEF Study." *Mil Med* 185(7-8):e1240-e1246. https://doi.org/10.1093/milmed/usz469

Lin Y, J Mutz, PJ Clough, and KA Papageorgiou. 2017. "Mental Toughness and Individual Differences in Learning, Educational and Work Performance, Psychological Well-being,

and Personality: A Systematic Review." *Front Psychol* 8:1345. https://doi.org/10.3389/fpsyg.2017.01345

Lisman P, FG O'Connor, PA Deuster, and JJ Knapik. 2013. "Functional movement screen and aerobic fitness predict injuries in military training." *Med Sci Sports Exerc* 45(4):636-43. https://doi.org/10.1249/MSS.0b013e31827a1c4c

Little MA, MC Fahey, RC Klesges, T McMurry, and GW Talcott. 2020. "Evaluating the Effects of a Brief Tobacco Intervention in the US Air Force." *Nicotine Tob Res* 22(9):1569-1577. https://doi.org/10.1093/ntr/ntaa001

Little MA, GW Talcott, Z Bursac, BD Linde, LA Pagano, EC Messler, JO Ebbert, and RC Klesges. 2016. "Efficacy of a Brief Tobacco Intervention for Tobacco and Nicotine Containing Product Use in the US Air Force." *Nicotine Tob Res* 18(5):1142-9. https://doi.org/10.1093/ntr/ntv242

Little MA, XQ Wang, MC Fahey, KP Wiseman, K Pebley, RC Klesges, and GW Talcott. 2021. "Efficacy of a group-based brief tobacco intervention among young adults aged 18-20 years in the US Air Force." *Tob Induc Dis* 19: 95. https://doi.org/10.18332/tid/143282

Litz BT, Stein N, Delaney E, Lebowitz L, Nash WP, Silva C, and Maguen S. 2009. "Moral injury and moral repair in war veterans: a preliminary model and intervention strategy." *Clin Psychol Rev* 29(8):695-706. doi: 10.1016/j.cpr.2009.07.003

Liu SY, IT Tsai, and YC Hsu. 2021. "Alcohol-Related Liver Disease: Basic Mechanisms and Clinical Perspectives." *Int J Mol Sci* 22(10). https://doi.org/10.3390/ijms22105170

Lohiya DV, AM Mehendale, DV Lohiya, HS Lahoti, and VN Agrawal. 2023. "Effects of Periodontitis on Major Organ Systems." *Cureus* 30;15(9):e46299. doi: 10.7759/cureus.46299

Lombardi C, P Meriggi, P Agostoni, A Faini, G Bilo, M Revera, G Caldara, et al. 2013. "High-altitude hypoxia and periodic breathing during sleep: gender-related differences." *J Sleep Res* 22(3):322-30. https://doi.org/10.1111/jsr.12012

Lopez-de-Uralde-Villanueva I, R Notario-Perez, T Del Corral, B Ramos-Diaz, M Acuyo-Osorio, and R La Touche. 2017. "Functional limitations and associated psychological factors in military personnel with chronic nonspecific neck pain with higher levels of kinesiophobia." *Work* 58(3):287-297. https://doi.org/10.3233/WOR-172634

Lotridge JA, SL Stahlman, DM Patel, AV Chauhan, AA McQuistan, and N Wells. 2021. "Long-acting reversible contraceptive use, active component service women, U.S. Armed Forces, 2016-2020." *MSMR* 28(7):2-10. https://www.ncbi.nlm.nih.gov/pubmed/34542257

Lovejoy LA, CD Shriver, and RE Ellsworth. 2024. "Cancer Incidence and Etiology in the Active Duty Population of U.S. Military." *Mil Med* 189(1-2):e58-e65. https://doi.org/10.1093/milmed/usac297

Lovejoy LA, CE Turner, CD Shriver, and RE Ellsworth. 2021. "Cancer Previvors in an Active Duty Service Women Population: An Opportunity for Prevention and Increased Force Readiness." *Mil Med* 186(7-8):e737-e742. https://doi.org/10.1093/milmed/usaa485

Luha A, T Kaart, E Merisalu, E Indermitte, and H Orru. 2020. "Hearing Problems Among the Members of the Defence Forces in Relation to Personal and Occupational Risk Factors." *Mil Med* 185(11-12):e2115-e2123. https://doi.org/10.1093/milmed/usaa224

Luks AM, SE McIntosh, CK Grissom, PS Auerbach, GW Rodway, RB Schoene, K Zafren, PH Hackett, and Society Wilderness Medical. 2010a. "Wilderness Medical Society consensus guidelines for the prevention and treatment of acute altitude illness." *Wilderness Environ Med* 21(2):146-55. https://doi.org/10.1016/j.wem.2010.03.002

Lutz LJ, E Gaffney-Stomberg, KW Williams, SM McGraw, PJ Niro, JP Karl, SJ Cable, TL Cropper, and JP McClung. 2017. "Adherence to the Dietary Guidelines for Americans Is Associated with Psychological Resilience in Young Adults: A Cross-Sectional Study." *J Acad Nutr Diet* 117(3):396-403. https://doi.org/10.1016/j.jand.2016.09.018

Luxton DD, D Greenburg, J.Ryan, A Niven, G Wheeler, and V Mysliwiec. 2011. "Prevalence and impact of short sleep duration in redeployed OIF soldiers." *Sleep* 34(9):1189-95. https://doi.org/10.5665/SLEEP.1236

Lyons KD, AG Parks, O Dadematthews, N Zandieh, P McHenry, KE Games, MD Goodlett, W Murrah, J Roper, and JM Sefton. 2021. "Core and Whole Body Vibration Exercise Influences Muscle Sensitivity and Posture during a Military Foot March." *Int J Environ Res Public Health* 18(9):4966. https://doi.org/10.3390/ijerph18094966

M

Macedo PA, RK Peterson, and RS Davis. 2007. "Risk assessments for exposure of deployed military personnel to insecticides and personal protective measures used for disease-vector management." *J Toxicol Environ Health A* 70(20):1758-71. https://doi.org/10.1080/15287390701459049

Macera CA, HJ Aralis, AJ Macgregor, MJ Rauh, PP Han, and MR Galarneau. 2011. "Cigarette smoking, body mass index, and physical fitness changes among male navy personnel." *Nicotine Tob Res* 13(10):965-71. https://doi.org/10.1093/ntr/ntr104

MacGregor AJ, AR Joseph, and AL Dougherty. 2020. "Prevalence of Tinnitus and Association with Self-Rated Health among Military Personnel Injured on Combat Deployment." *Mil Med* 185(9-10):e1608-e1614. https://doi.org/10.1093/milmed/usaa103

MacGregor AJ, AR Joseph, RR Markwald, and AL Dougherty. 2021. "The Relationship Between Blast-related Hearing Threshold Shift and Insomnia in U.S. Military Personnel." *Mil Med* 186(9-10):844-849. https://doi.org/10.1093/milmed/usaa567

MacKenzie-Shalders KL, AV Tsoi, KW Lee, C Wright, GR Cox, and RM Orr. 2021. "Free-Living Dietary Intake in Tactical Personnel and Implications for Nutrition Practice: A Systematic Review." *Nutrients* 13(10):3502. doi: 10.3390/nu13103502

Madsen C, R Poropatich, and TP Koehlmoos. 2023. "Telehealth in the Military Health System: Impact, Obstacles, and Opportunities." *Mil Med* 188(Suppl 1):15-23. doi: 10.1093/milmed/usac207

Maghsoudi Z, R Ghiasvand, and A Salehi-Abargouei. 2016. "Empirically derived dietary patterns and incident type 2 diabetes mellitus: a systematic review and meta-analysis on prospective observational studies." *Public Health Nutr* 19(2):230-41. https://doi.org/10.1017/S1368980015001251

Maguen S, NA Skopp, Y Zhang, and DJ Smolenski. 2015. "Gender differences in suicide and suicide attempts among US Army soldiers." *Psychiatry Res* 28;225(3):545-9. doi: 10.1016/j.psychres.2014.11.050

Maguen S, DM Turcotte, AL Peterson, TL Dremsa, HN Garb, RJ McNally, and BT Litz. 2008. "Description of risk and resilience factors among military medical personnel before deployment to Iraq." *Mil Med* 173(1):1-9. https://doi.org/10.7205/milmed.173.1.1

Malfliet A, I Coppieters, P Van Wilgen, J Kregel, R De Pauw, M Dolphens, and K Ickmans. 2017. "Brain changes associated with cognitive and emotional factors in chronic pain: A systematic review." *Eur J Pain* 21(5):769-786. https://doi.org/10.1002/ejp.1003

Malgoyre A, PE Tardo-Dino, N Koulmann, B Lepetit, L Jousseaume, and K Charlot. 2018. "Uncoupling psychological from physiological markers of heat acclimatization in a military context." *J Therm Biol* 77:145-156. https://doi.org/10.1016/j.jtherbio.2018.08.017

Malia M. Cohen, California State Controller. 2024. "Achieving Financial Fitness", accessed June 25, 2024. https://www.sco.ca.gov/eo_achieving_financial_fitness.html#:~:text=What%20is%20financial%20fitness%3F,of%20a%20financially%20fit%20lifestyle

Malle C, P Quinette, M Laisney, C Bourrilhon, J Boissin, B Desgranges, F Eustache, and C Pierard. 2013. "Working memory impairment in pilots exposed to acute hypobaric hypoxia." *Aviat Space Environ Med* 84(8):773-9. https://doi.org/10.3357/asem.3482.2013

Manning C, T Mermagen, and A Scharine. 2017. "The effect of sensorineural hearing loss and tinnitus on speech recognition over air and bone conduction military communications headsets." *Hear Res* 349:67-75. https://doi.org/10.1016/j.heares.2016.10.019

Mantua J, A Bessey, WJ Sowden, R Chabuz, AJ Brager, VF Capaldi, and G Simonelli. 2019. "A Review of Environmental Barriers to Obtaining Adequate Sleep in the Military Operational Context." *Mil Med* 184(7-8):e259-e266. https://doi.org/10.1093/milmed/usz029

Mantzios M. 2014. "Exploring the relationship between worry and impulsivity in military recruits: the role of mindfulness and self-compassion as potential mediators." *Stress Health* 30(5):397-404. https://doi.org/10.1002/smi.2617

Margolis LM, JT Allen JT, A Hatch-McChesney, and SM Pasiakos. 2021. "Coingestion of Carbohydrate and Protein on Muscle Glycogen Synthesis after Exercise: A Meta-analysis." *Med Sci Sports Exerc* 53(2):384-393. https://doi.org/10.1249/MSS.0000000000002476

Margolis LM, NE Murphy, S Martini, Y Gundersen, JW Castellani, JP Karl, CT Carrigan, HK Teien, EH Madslien, SJ Montain, and SM Pasiakos. 2016. "Effects of Supplemental Energy on Protein Balance during 4-d Arctic Military Training." *Med Sci Sports Exerc* 48(8):1604-12. https://doi.org/10.1249/MSS.0000000000000944

Margolis LM, NE Murphy, S Martini, MG Spitz, I Thrane, SM McGraw, JM Blatny, JW Castellani, JC Rood, AJ Young, SJ Montain, Y Gundersen, and SM Pasiakos. 2014. "Effects of winter military training on energy balance, whole-body protein balance, muscle damage, soreness, and physical performance." *Appl Physiol Nutr Metab* 39(12):1395-401. https://doi.org/10.1139/apnm-2014-0212

Margolis LM and SM Pasiakos. 2023. "Low carbohydrate availability impairs hypertrophy and anaerobic performance." *Curr Opin Clin Nutr Metab Care* 26(4):347-352. doi: 10.1097/MCO.0000000000000934

Mariano LC, S Warnakulasuriya, K Straif, and L Monteiro. 2022. "Secondhand smoke exposure and oral cancer risk: a systematic review and meta-analysis." *Tob Control* 31(5):597-607. https://doi.org/10.1136/tobaccocontrol-2020-056393

Marker AM, RG Steele, and AE Noser. 2018. "Physical activity and health-related quality of life in children and adolescents: A systematic review and meta-analysis." *Health Psychol* 37(10):893-903. https://doi.org/10.1037/hea0000653

Markowitz FE, SM Kintzle, CA Castro, and SL Lancaster. 2020. "Effects of Perceived Public Regard on the Well-Being of Military Veterans." *Society and Mental Health* 10(3):291-304. https://doi.org/10.1177/2156869319894372

Maroney K, J Laurent, F Alvarado, A Gabor, C Bell, K Ferdinand, J He, and KT Mills. 2023. "Systematic review and meta-analysis of church-based interventions to improve cardiovascular disease risk factors." *Am J Med Sci* 366(3):199-208. https://doi.org/10.1016/j.amjms.2023.05.010

Marriott BP, TH Turner, JR Hibbeln, JC Newman, M Pregulman, AM Malek, RJ Malcolm, GA Burbelo, and JW Wismann. 2021. "Impact of Fatty Acid Supplementation on Cognitive Performance among United States (US) Military Officers: The Ranger Resilience and Improved Performance on Phospholipid-Bound Omega-3's (RRIPP-3) Study." *Nutrients* 13(6):1854. https://doi.org/10.3390/nu13061854

Marshall AR, JE Rimmer, N Shah, K Bye, C Kipps, DR Woods, J O'Hara, CJ Boos, and M Barlow. 2021. "Marching to the Beet: The effect of dietary nitrate supplementation on high altitude exercise performance and adaptation during a military trekking expedition." *Nitric Oxide* 113-114:70-77. https://doi.org/10.1016/j.niox.2021.05.002

Martin-Maria N, M Miret, FF Caballero, LA Rico-Uribe, A Steptoe, S Chatterji, and JL Ayuso-Mateos. 2017. "The Impact of Subjective Well-being on Mortality: A Meta-Analysis of Longitudinal Studies in the General Population." *Psychosom Med* 79(5):565-575. https://doi.org/10.1097/PSY.0000000000000444

Martin K, E McLeod, J Periard, B Rattray, R Keegan, and DB Pyne. 2019. "The Impact of Environmental Stress on Cognitive Performance: A Systematic Review." *Hum Factors* 61(8):1205-1246. https://doi.org/10.1177/0018720819839817

Martin K, J Périard, B Rattray, and DB Pyne. 2020. “Physiological Factors Which Influence Cognitive Performance in Military Personnel.” *Hum Factors* 62(1):93-123. https://doi.org/10.1177/0018720819841757

Mash HBH, RJ Ursano, RC Kessler, JA Naifeh, CS Fullerton, PA Aliaga, CA Riggs-Donovan, et al. 2021. "Predictors of Suicide Attempt Within 30 Days After First Medically Documented Suicidal Ideation in U.S. Army Soldiers." *Am J Psychiatry* 178(11):1050-1059. https://doi.org/10.1176/appi.ajp.2021.20111570

Maslia ML, MM Aral, PZ Ruckart, and FJ Bove. 2016. “Reconstructing Historical VOC Concentrations in Drinking Water for Epidemiological Studies at a U.S. Military Base: Summary of Results.” *Water* 8(10):449. doi: 10.3390/w8100449

Matthews M, CS Sims, S Robson, M Walsh, S Rennane, and J Snoke. 2022. "Physical Fitness Standards to Support Readiness and Deployability: An Examination of Department of the Air Force Policies and Culture." *Rand Health Q* 10(1):10. https://www.ncbi.nlm.nih.gov/pubmed/36484080

Mat Zainal MK, AKC Liew, D Abdullah, E Soo, B Abdul Hamid, and RAM Ramlee. 2024. “Changes in oral functions and speech when using custom-fitted mouthguards: An uncontrolled before-and-after study.” *Dent Traumatol* 40(4):460-469. doi: 10.1111/edt.12939

Maule AL, KJ Heaton, B Cadarette, KM Taylor, KI Guerriere, CC Haven, MM Scarpaci, RW Kenefick, M Ospina, AM Calafat, and SP Proctor. 2020. "Effect of Environmental Temperature and Humidity on Permethrin Biomarkers of Exposure in U.S. Soldiers

Wearing Permethrin-Treated Uniforms." *Am J Trop Med Hyg* 102(6):1455-1462. https://doi.org/10.4269/ajtmh.19-0543

Maule AL, MM Scarpaci, and SP Proctor. 2019. "Urinary concentrations of permethrin metabolites in US Army personnel in comparison with the US adult population, occupationally exposed cohorts, and other general populations." *Int J Hyg Environ Health* 222(3):355-363. https://doi.org/10.1016/j.ijheh.2019.02.005

Mayo JA, AJ MacGregor, AL Dougherty, and MR Galarneau. 2013. "Role of occupation on new-onset post-traumatic stress disorder and depression among deployed military personnel." *Mil Med* 178(9):945-50. https://doi.org/10.7205/MILMED-D-12-00527

McAdam JS, KD Lyons, DT Beck, CT Haun, MA Romero, PW Mumford, PA Roberson et al. 2022. "Whey Protein Supplementation Effects on Body Composition, Performance, and Blood Biomarkers During Army Initial Entry Training." F*ront Nutr* 7;9:807928. doi: 10.3389/fnut.2022.807928

McAdam JS, KD McGinnis, DT Beck, CT Haun, MA Romero, PW Mumford, PA Roberson, et al. 2018. "Effect of Whey Protein Supplementation on Physical Performance and Body Composition in Army Initial Entry Training Soldiers." *Nutrients* 10(9):1248. https://doi.org/10.3390/nu10091248

McAndrew LM, S Markowitz, SE Lu, A Borders, D Rothman, and KS Quigley. 2017. "Resilience during war: Better unit cohesion and reductions in avoidant coping are associated with better mental health function after combat deployment." *Psychol Trauma* 9(1):52-61. https://doi.org/10.1037/tra0000152

McAndrew LM, RF Teichman, OY Osinubi, JV Jasien, and KS Quigley. 2012. "Environmental exposure and health of Operation Enduring Freedom/Operation Iraqi Freedom veterans." *J Occup Environ Med* 54(6):665-9. https://doi.org/10.1097/JOM.0b013e318255ba1b

McBurney MI, NL Tintle, RS Vasan, A Sala-Vila, and WS Harris. 2021. "Using an erythrocyte fatty acid fingerprint to predict risk of all-cause mortality: the Framingham Offspring Cohort." *Am J Clin Nutr* 114(4): 1447-1454. https://doi.org/10.1093/ajcn/nqab195

McCabe CT, JR Watrous, SL Eskridge, and MR Galarneau. 2021. "Mental and physical health, and long-term quality of life among service members injured on deployment." *Health Qual Life Outcomes* 19(1):220. https://doi.org/10.1186/s12955-021-01852-3

McCarthy MS, EB Elshaw, BM Szekely, and D Raju. 2019. "A Prospective Cohort Study of Vitamin D Supplementation in AD Soldiers: Preliminary Findings." *Mil Med* 184(Suppl 1):498-505. https://doi.org/10.1093/milmed/usy393

McCarthy RG, GH Park, NE Barczak-Scarboro, S Barrientos, RA Chamberlin, A Hansom, and LA Messina. 2023. “Social Fitness and the Social Domain: A Holistic Approach Based on Total Force Fitness.” *J Spec Oper Med* 23(3):85-90. doi: 10.55460/TRM7-423O

McGinnis KD, JS McAdam, CM Lockwood, KC Young, MD Roberts, and JM Sefton. 2018. "Impact of Protein and Carbohydrate Supplementation on Musculoskeletal Injuries in Army Initial Entry Training Soldiers." *Nutrients* 10(12). https://doi.org/10.3390/nu10121938

McLaughlin A, MH Colyer, DS Ryan, RK Sia, ED Weichel, A Spiegelman, SG Eaddy, RA Mazzoli, and KS Bower. 2017. "Self-Reported Visual Quality of Life After Combat Ocular Trauma." *Mil Med* 182(S1):239-242. https://doi.org/10.7205/MILMED-D-16-00139

McLean CL, JA Turchik, and R Kimerling. 2022. "Mental Health Beliefs, Access, and Engagement with Military Sexual Trauma-Related Mental Health Care." *J Gen Intern Med* 37(Suppl 3):742-750. https://doi.org/10.1007/s11606-022-07590-6

McLean CP, Y Zang, L Zandberg, CJ Bryan, N Gay, JS Yarvis, EB Foa, and Strong Star Consortium. 2017. "Predictors of suicidal ideation among active duty military personnel with posttraumatic stress disorder." *J Affect Disord* 208:392-398. https://doi.org/10.1016/j.jad.2016.08.061

McMorris T, BJ Hale, M Barwood, J Costello, and J Corbett. 2017. "Effect of acute hypoxia on cognition: A systematic review and meta-regression analysis." *Neurosci Biobehav Rev* 74(Pt A):225-232. https://doi.org/10.1016/j.neubiorev.2017.01.019

McTiernan A, CM Friedenreich, PT Katzmarzyk, KE Powell, R Macko, D Buchner, LS Pescatello, et al. 2019. "Physical Activity in Cancer Prevention and Survival: A Systematic Review." *Med Sci Sports Exerc* 51(6):1252-1261. https://doi.org/10.1249/MSS.0000000000001937

Meadows SO, T Tanielian, B Karney, T Schell, BA Griffin, LH Jaycox, EM Friedman, et al. 2017. "The Deployment Life Study: Longitudinal Analysis of Military Families Across the Deployment Cycle." *Rand Health Q* 6(2):7. https://www.ncbi.nlm.nih.gov/pubmed/28845345

Meerwijk EL, RS Adams, MJ Larson, KB Highland, and AHS Harris. 2022. "Dose of Exercise Therapy Among Active Duty Soldiers With Chronic Pain Is Associated With Lower Risk of Long-Term Adverse Outcomes After Linking to the Veterans Health Administration." *Mil Med* 188(7-8):e1948-56. https://doi.org/10.1093/milmed/usac074

Mensink B, A van Schagen, N van der Aa, FJJ Ter Heide. 2022. "Moral Injury in Trauma-Exposed, Treatment-Seeking Police Officers and Military Veterans: Latent Class Analysis." *Front Psychiatry* 13:904659. https://doi.org/10.3389/fpsyt.2022.904659

Merriam-Webster Dictionary. 2024. "Ideology." Accessed June 25, 2024. https://www.merriam-webster.com/dictionary/ideology

Messina LA, and GH Park. 2023. "Total Force Fitness Education: A Critical Enabler of Human Performance Optimization." *Mil Med* 188(Suppl 5):12-15. https://doi.org/10.1093/milmed/usad205

Miettinen O, A Kämppi, T Tanner, V Anttonen, P Patinen, J Päkkilä, L Tjäderhane, and K Sipilä. 2021. "Association of Temporomandibular Disorder Symptoms with Physical Fitness among Finnish Conscripts." *Int J Environ Res Public Health* 18(6):3032. https://doi.org/10.3390/ijerph18063032

Miko S, AR Poniatowski, AN Troeschel, DJ Felton, S Banerji, MLF Bolduc, AC Bronstein et al. 2021. "Community health impacts after a jet fuel leak contaminated a drinking water system: Oahu, Hawaii, November 2021." 2023. *J Water Health* 21(7):956-971. https://doi.org/10.2166/wh.2023.109

Military Compensation and Retirement Modernization Commission (MCRMC). 2015. *Report of the Military Compensation and Retirement Modernization Commission. Final Report, January 2015*. Washington, DC. https://apps.dtic.mil/sti/pdfs/ADA625626.pdf

Miller MJ, J Kutcher, and KL Adams. 2017. "Effect of Pregnancy on Performance of a Standardized Physical Fitness Test." *Mil Med* 182(11):e1859-e1863. https://doi.org/10.7205/MILMED-D-17-00093

Milte CM, and SA McNaughton. 2016. "Dietary patterns and successful ageing: a systematic review." *Eur J Nutr* 55(2):423-450. https://doi.org/10.1007/s00394-015-1123-7

Minassian A, AX Maihofer, DG Baker, CM Nievergelt, MA Geyer, VB Risbrough, and Team Marine Resiliency Study. 2015. "Association of Predeployment Heart Rate Variability With Risk of Postdeployment Posttraumatic Stress Disorder in Active-Duty Marines." *JAMA Psychiatry* 72(10):979-86. https://doi.org/10.1001/jamapsychiatry.2015.0922

Miranda Gonzalez EJ, N Bencomo, A Tirado, and V Tucci. 2023. "Ureterocele Diagnosed With Point-of-Care Ultrasound." *Cureus* 15(2):e35283. https://doi.org/10.7759/cureus.35283

Molloy JM, DN Feltwell, SJ Scott, and DW Niebuhr. 2012. "Physical training injuries and interventions for military recruits." *Mil Med* 177(5):553-8. https://doi.org/10.7205/milmed-d-11-00329

Montain SJ, CE Carvey, and MB Stephens. 2010. "Nutritional Fitness." *Mil Med* 175(suppl_8):65-72. https://doi.org/10.7205/milmed-d-10-00127

Moon IS, SY Park, HJ Park, HS Yang, SJ Hong, and WS Lee. 2011. "Clinical characteristics of acoustic trauma caused by gunshot noise in mass rifle drills without ear protection." *J Occup Environ Hyg* 8(10):618-23. https://doi.org/10.1080/15459624.2011.609013

Moon JY, J Jung, and K Huh. 2017. "Universal measles-mumps-rubella vaccination to new recruits and the incidence of mumps in the military." *Vaccine* 35(32):3913-3916. https://doi.org/10.1016/j.vaccine.2017.06.025

Moore AD, JB Hamilton, BJ Pierre-Louis, and BM Jennings. 2013. "Increasing access to care and reducing mistrust: important considerations when implementing the patient-centered medical home in army health clinics." *Mil Med* 178(3):291-8. https://doi.org/10.7205/MILMED-D-12-00443

Moore D, M Jung, CH Hillman, M Kang, and PD Loprinzi. 2022. "Interrelationships between exercise, functional connectivity, and cognition among healthy adults: A systematic review." *Psychophysiology* 59(6):e14014. https://doi.org/10.1111/psyp.14014

Mora C, T McKenzie, IM Gaw, JM Dean, H von Hammerstein, TA Knudson, RO Setter, et al. 2022. "Over half of known human pathogenic diseases can be aggravated by climate change." *Nat Clim Chang* 12(9):869-875. https://doi.org/10.1038/s41558-022-01426-1

Moran DS, DW DeGroot, AW Potter, and N Charkoudian. 2023. "Beating the heat: military training and operations in the era of global warming." *J Appl Physiol (1985)* 135(1):60-67. https://doi.org/10.1152/japplphysiol.00229.2023

Morgan JK, L Hourani, and S Tueller. 2017. "Health-Related Coping Behaviors and Mental Health in Military Personnel." *Mil Med* 182(3):e1620-e1627. https://doi.org/10.7205/MILMED-D-16-00165. https://www.ncbi.nlm.nih.gov/pubmed/28290934

Morger R, CA Ramseier, TD Rees, WB Burgin, and MM Bornstein. 2010. "Oral mucosal findings related to tobacco use and alcohol consumption: a study on Swiss army recruits involving self-reported and clinical data." *Oral Health Prev Dent* 8(2):143-51. https://www.ncbi.nlm.nih.gov/pubmed/20589248

Morris MJ, DW Dodson, PF Lucero, GD Haislip, RA Gallup, KL Nicholson, and LL Zacher. 2014. "Study of active duty military for pulmonary disease related to environmental deployment exposures (STAMPEDE)." *Am J Respir Crit Care Med* 190(1):77-84. https://doi.org/10.1164/rccm.201402-0372OC

Morrow A, SR Gray, HK Bayes, R Sykes, E McGarry, D Anderson, D Boiskin, et al. 2022. "Prevention and early treatment of the long-term physical effects of COVID-19 in adults: design of a randomised controlled trial of resistance exercise-CISCO-21." *Trials* 23(1):660. https://doi.org/10.1186/s13063-022-06632-y

Morze J, A Danielewicz, G Hoffmann, and L Schwingshackl. 2020. "Diet Quality as Assessed by the Healthy Eating Index, Alternate Healthy Eating Index, Dietary Approaches to Stop Hypertension Score, and Health Outcomes: A Second Update of a Systematic Review and Meta-Analysis of Cohort Studies." *J Acad Nutr Diet* 120(12):1998-2031 e15. https://doi.org/10.1016/j.jand.2020.08.076

Mota NP, M Medved, J Wang, GJ Asmundson, D Whitney, and J Sareen. 2012. "Stress and mental disorders in female military personnel: comparisons between the sexes in a male dominated profession." *J Psychiatr Res* 46(2):159-67. https://doi.org/10.1016/j.jpsychires.2011.09.014

Mota NP, M Medved, D Whitney, D Hiebert-Murphy, and J Sareen. 2013. "Protective factors for mental disorders and psychological distress in female, compared with male, service members in a representative sample." *Can J Psychiatry* 58(10):570-8. https://doi.org/10.1177/070674371305801006

Moyer VA, U.S. Preventive Services Task Force. 2014. "Screening for oral cancer: U.S. Preventive Services Task Force recommendation statement." *Ann Intern Med* 160(1):55-60. https://doi.org/10.7326/M13-2568

Mrena R, S Savolainen, H Kiukaanniemi, J Ylikoski, and AA Makitie. 2009. "The effect of tightened hearing protection regulations on military noise-induced tinnitus." *Int J Audiol* 48(6):394-400. https://doi.org/10.1080/14992020902777225

Muhr P, AC Johnson, B Skoog, and U Rosenhall. 2016. "A demonstrated positive effect of a hearing conservation program in the Swedish armed forces." *Int J Audiol* 55(3):168-72. https://doi.org/10.3109/14992027.2015.1117662

Mullen M. 2010. "On Total Force Fitness in War and Peace." *Mil Med* 175(suppl_8):1-2. https://doi.org/10.7205/milmed-d-10-00246

Muller MD, J Gunstad, ML Alosco, LA Miller, J Updegraff, MB Spitznagel, and EL Glickman. 2012. "Acute cold exposure and cognitive function: evidence for sustained impairment." *Ergonomics* 55(7):792-8. https://doi.org/10.1080/00140139.2012.665497

Mullinax LRA, L Grunwald, A Banaag, C Olsen, and TP Koehlmoos. 2023. "A Longitudinal Study of Prevalence Ratios for Musculoskeletal Back Injury Among U.S. Navy and Marine Corps Personnel, 2009-2015." *Mil Med* 188(5-6):e1094-e1101. https://doi.org/10.1093/milmed/usab432

Murphy NE, CT Carrigan, and LM Margolis. 2021. "High-Fat Ketogenic Diets and Physical Performance: A Systematic Review." *Adv Nutr* 12(1):223-233. https://doi.org/10.1093/advances/nmaa101

Myers JE and A Bechtel. 2004. "Stress, wellness, and mattering among cadets at West Point: factors affecting a fit and healthy force." *Mil Med* 169(6):475-82. https://doi.org/10.7205/milmed.169.6.475

Myers J, P Kokkinos, and E Nyelin. 2019. "Physical Activity, Cardiorespiratory Fitness, and the Metabolic Syndrome." *Nutrients* 11(7). https://doi.org/10.3390/nu11071652

N

Nadolny R, J Jones, BJ Taylor, L Bowman, and K Harkins. 2024. “Effects of permethrin-treated uniforms on tick submissions to a military passive tick surveillance program.” *J Med Entomol* 61(6):1524-1533. https://doi.org/10.1093/jme/tjae111

Naifeh JA, HBH Mash, MB Stein, CS Fullerton, RC Kessler, and RJ Ursano. 2019. "The Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS): progress toward understanding suicide among soldiers." *Mol Psychiatry* 24(1):34-48. https://doi.org/10.1038/s41380-018-0197-z

Nakdimon I and Y Zadik. 2019. “Barodontalgia Among Aircrew and Divers.” *Aerosp Med Hum Perform* 90(2):128-131. https://doi.org/10.3357/AMHP.5183.2019

Nation DA, MW Bondi, E Gayles, and DC Delis. 2017. "Mechanisms of Memory Dysfunction during High Altitude Hypoxia Training in Military Aircrew." *J Int Neuropsychol Soc* 23(1):1-10. https://doi.org/10.1017/S1355617716000965

National Interfaith Coalition on Aging. 1975. "Spiritual well-being: A definition." https://snaccooperative.org/view/57527695#biography

Ndanuko RN, LC Tapsell, KE Charlton, EP Neale, and MJ Batterham. 2016. "Dietary Patterns and Blood Pressure in Adults: A Systematic Review and Meta-Analysis of Randomized Controlled Trials." *Adv Nutr* 7(1):76-89. https://doi.org/10.3945/an.115.009753

Nelson DA, PA Deuster, R Carter 3rd, OT Hill, VL Wolcott, and LM Kurina. 2016. "Sickle Cell Trait, Rhabdomyolysis, and Mortality among U.S. Army Soldiers." *N Engl J Med* 375(5):435-42. https://doi.org/10.1056/NEJMoa1516257

Nelson DA, PA Deuster, FG O'Connor, and LM Kurina. 2018. "Timing and Predictors of Mild and Severe Heat Illness among New Military Enlistees." *Med Sci Sports Exerc* 50(8):1603-1612. https://doi.org/10.1249/MSS.0000000000001623

Nelson DA, MC Pflipsen, and LM Kurina. 2020. "Military Occupational Disability Risk Surveillance: A Retrospective Cohort Study of Modifiable Risk Factors." *Mil Med* 185(11-12):e1977-e1985. https://doi.org/10.1093/milmed/usaa175

Nespoulet H, B Wuyam, R Tamisier, C Saunier, D Monneret, J Remy, O Chabre, JL Pepin, and P Levy. 2012. "Altitude illness is related to low hypoxic chemoresponse and low oxygenation during sleep." *Eur Respir J* 40(3):673-80. https://doi.org/10.1183/09031936.00073111

Newby JH, RJ Ursano, JE McCarroll, LT Martin, AE Norwood, and CS Fullerton. 2003. "Spousal aggression by U.S. Army female soldiers toward employed and unemployed civilian husbands." *Am J Orthopsychiatry* 73(3):288-93. https://doi.org/10.1037/0002-9432.73.3.288

Nguyen HH, F Wu, JK Makin, WH Oddy, K Wills, G Jones, and T Winzenberg. 2021. "Associations of dietary patterns with bone density and fractures in adults: A systematic review and meta-analysis." *Aust J Gen Pract* 50(6):394-401. https://doi.org/10.31128/AJGP-02-20-5245

Nguyen OK, RT Higashi, AN Makam, JC Mijares, and SC Lee. 2018. "The Influence of Financial Strain on Health Decision-Making." *J Gen Intern Med* 33(4):406-408. https://doi.org/10.1007/s11606-017-4296-3

Nguyen QC, JM Keralis, P Dwivedi, AE Ng, M Javanmardi, S Khanna, Y Huang, KD Brunisholz, A Kumar, and T Tasdizen. 2021. "Leveraging 31 Million Google Street View Images to Characterize Built Environments and Examine County Health Outcomes." *Public Health Rep* 136(2):201-211. https://doi.org/10.1177/0033354920968799

Nguyen QC, S Khanna, P Dwivedi, D Huang, Y Huang, T Tasdizen, KD Brunisholz, et al. 2019. "Using Google Street View to examine associations between built environment characteristics and U.S. health outcomes." *Prev Med Rep* 14:100859. https://doi.org/10.1016/j.pmedr.2019.100859

Nichter B, M Haller, S Norman, and RH Pietrzak. 2020. "Risk and protective factors associated with comorbid PTSD and depression in U.S. military veterans: Results from the National Health and Resilience in Veterans Study." *J Psychiatr Res* 121:56-61. https://doi.org/10.1016/j.jpsychires.2019.11.008

Nieman DC and CA Sakaguchi. 2022. "Physical activity lowers the risk for acute respiratory infections: Time for recognition." *J Sport Health Sci* 11(6):648-655. https://doi.org/10.1016/j.jshs.2022.08.002

Nindl BC. 2015. "Physical Training Strategies for Military Women's Performance Optimization in Combat-Centric Occupations." *J Strength Cond Res* 29Suppl 11:S101-6. https://doi.org/10.1519/JSC.0000000000001089

Nindl BC, SR Eagle, PN Frykman, C Palmer, E Lammi, K Reynolds, K Allison, and E Harman. 2017. "Functional physical training improves women's military occupational performance." *J Sci Med Sport* 20(Suppl 4):S91-S97. https://doi.org/10.1016/j.jsams.2017.07.012

Niu Z, F Liu, H Yu, S Wu, and H Xiang. 2021. "Association between exposure to ambient air pollution and hospital admission, incidence, and mortality of stroke: an updated systematic review and meta-analysis of more than 23 million participants." *Environ Health Prev Med* 26(1):15. https://doi.org/10.1186/s12199-021-00937-1

Nolte HW, TD Noakes, and K Nolte. 2013. “Ad libitum vs. restricted fluid replacement on hydration and performance of military tasks.” *Aviat Space Environ Med* 84(2):97-103. https://doi.org/10.3357/asem.3378.2013

Norris JN, E Viirre, H Aralis, MK Sracic, D Thomas, and JH Gertsch. 2012. "High altitude headache and acute mountain sickness at moderate elevations in a military population during battalion-level training exercises." *Mil Med* 177(8):917-23. https://doi.org/10.7205/milmed-d-12-00007

Norris JR, SP Irwin, J Park, RA Stephens, ME Moss, and JA Weintraub. 2021. "Risk Indicators of Urgent and Extensive Dental Treatment Needs in U.S. Air Force Recruits." *Mil Med* 186(1-2):e194-e202. https://doi.org/10.1093/milmed/usaa393

Nykiforuk CI, AP Belon, E de Leeuw, P Harris, L Allen-Scott, K Atkey, NM Glenn, et al. 2023. "A Policy-Ready Public Health Guidebook of Strategies and Indicators to Promote Financial Well-Being and Address Financial Strain in Response to COVID-19." *Prev Chron Dis* 23(20)no. 220209. https://doi.org/http://dx.doi.org/10.5888/pcd20.220209

O

Oakey-Frost N, B Trachik, ML Ganulin, ML LoPresti, MN Dretsch, and RP Tucker. 2022. "Indirect effects of soldier healthy eating and physical activity on suicidal ideation through psychological health symptoms in active-duty military." *Mil Psychol* 34(3):305-314. https://doi.org/10.1080/08995605.2021.1902180

O'Brien MJ, Y Zhang, SC Bailey, SS Khan, RT Ackermann, MK Ali, ME Bowen, et al. 2023. “Clinical performance and health equity implications of the American Diabetes Association's 2023 screening recommendation for prediabetes and diabetes.” *Front Endocrinol* 14:1279348. https://doi.org/10.3389/fendo.2023.1279348

O’Connor FG, PA Deuster, DW DeGroot, and DW White. 2010. "Medical and Environmental Fitness." *Mil Med* 175(suppl_8):57-64. https://doi.org/10.7205/milmed-d-10-00072

Oelschlager KA, MS Termini, and C Stevenson. 2022. "Preventing Hepatitis B Virus Infection Among U.S. Military Personnel: Potential Impact of a 2-Dose Versus 3-Dose Vaccine on Medical Readiness." *Mil Med* 188(7-8):e2067-73. https://doi.org/10.1093/milmed/usac389

Ogden HB, AJ Rawcliffe, SK Delves, and A Roberts. 2023. "Are young military personnel at a disproportional risk of heat illness?" *BMJ Mil Health* 169(6):559-564. https://doi.org/10.1136/bmjmilitary-2021-002053

Oglesby LW, AR Gallucci, C Wynveen, K Ylitalo, and N Benson. 2021. "The Relationship Between Spiritual Well-Being and Burnout in Collegiate Athletic Trainers." *J Athl Train* 56(5):518-528. https://doi.org/10.4085/1062-6050-0105-20

Oh RC, DC Bury, and CJ McClure. 2022. "Exertional rhabdomyolysis: an analysis of 321 hospitalised US military service members and its relationship with heat illness." *BMJ Mil Health* e002028. https://doi.org/10.1136/military-2021-002028

O'Hara R, A Henry, J Serres, D Russell, and R Locke. 2014. "Operational stressors on physical performance in special operators and countermeasures to improve performance: a review of the literature." *J Spec Oper Med* 14(1):67-78. https://doi.org/10.55460/NIDG-U4UD

Ojanen, T, K Pihlainen, JP Vaara, and H Kyrolainen. 2023. "Physiological and physical performance changes during a 20-day winter military training course and its subsequent 10-day recovery period." *Int J Circumpolar Health* 82(1):2207287. https://doi.org/10.1080/22423982.2023.2207287

Okpala NC. 2007. "Knowledge and attitude of infantry soldiers to hearing conservation." *Mil Med* 172(5):520-2. doi: 10.7205/milmed.172.5.520.

O'Leary TJ, C Perrett, CV Coombs, RL Double, N Keay, SL Wardle, and JP Greeves. 2022. "Menstrual disturbances in British Servicewomen: A cross-sectional observational study of prevalence and risk factors." *Front Nutr* 9:984541. https://doi.org/10.3389/fnut.2022.984541

Oliver JM, JD Stone, C Holt, SC Jenke, AR Jagim, and MT Jones. 2017. "The Effect of Physical Readiness Training on Reserve Officers' Training Corps Freshmen Cadets." *Mil Med* 182(11):e1981-e1986. https://doi.org/10.7205/MILMED-D-17-00079

Oliver LS, JP Sullivan, S Russell, JM Peake, M Nicholson, C McNulty, and VG Kelly. 2021. "Effects of Nutritional Interventions on Accuracy and Reaction Time with Relevance to Mental Fatigue in Sporting, Military, and Aerospace Populations: A Systematic Review and Meta-Analysis." *Int J Environ Res Public Health* 19(1). https://doi.org/10.3390/ijerph19010307

Olsen T, D Caruana, K Cheslack-Postava, A Szema, J Thieme, A Kiss, M Singh, et al. 2022. "Iraq/Afghanistan war lung injury reflects burn pits exposure." *Sci Rep* 12(1):14671. https://doi.org/10.1038/s41598-022-18252-2

O'Neal CW, EW Richardson, and JA Mancini. 2020. "Community, Context, and Coping: How Social Connections Influence Coping and Well-Being for Military Members and Their Spouses." *Fam Process* 59(1):158-172. https://doi.org/10.1111/famp.12395

Oppert JM, A Bellicha, and C Ciangura. 2021. "Physical activity in management of persons with obesity." *Eur J Intern Med* 93:8-12. https://doi.org/10.1016/j.ejim.2021.04.028

Orak U, A Kayaalp, MH Walker, and K Breault. 2022. "Resilience and Depression in Military Service: Evidence From the National Longitudinal Study of Adolescent to Adult Health (Add Health)." *Mil Med* 187(11-12):1441-1448. https://doi.org/10.1093/milmed/usab364

Orru H, A Luha, M Pindus, R Jogeva, M Vahisalu, U Lekk, E Indermitte, and E Merisalu. 2020. "Hearing loss among military personnel in relation to occupational and leisure noise

exposure and usage of personal protective equipment." *Noise Health* 22(107):90-98. https://doi.org/10.4103/nah.NAH_12_19

P

Paakkonen R and K Lehtomaki. 2005. "Protection efficiency of hearing protectors against military noise from handheld weapons and vehicles." *Noise Health* 7(26):11-20. https://doi.org/10.4103/1463-1741.31644

Packnett ER, DW Niebuhr, SA Bedno, and DN Cowan. 2011. "Body mass index, medical qualification status, and discharge during the first year of US Army service." *Am J Clin Nutr* 93(3):608-14. https://doi.org/10.3945/ajcn.110.007070

Pages F, M Faulde, E Orlandi-Pradines, and P Parola. 2010. "The past and present threat of vector-borne diseases in deployed troops." *Clin Microbiol Infect* 16(3):209-24. https://doi.org/10.1111/j.1469-0691.2009.03132.x

Paixao C, CM Dias, R Jorge, EV Carraca, M Yannakoulia, M de Zwaan, S Soini, JO Hill, PJ Teixeira, and I Santos. 2020. "Successful weight loss maintenance: A systematic review of weight control registries." *Obes Rev* 21(5):e13003. https://doi.org/10.1111/obr.13003

Paleiron N, A Mayet, V Marbac, A Perisse, H Barazzutti, FX Brocq, F Janvier, B Dautzenberg, and O Bylicki. 2021. "Impact of Tobacco Smoking on the Risk of COVID-19: A Large Scale Retrospective Cohort Study." *Nicotine Tob Res* 23(8):1398-1404. https://doi.org/10.1093/ntr/ntab004

Papworth J, L Osborne, MA Shimmings, and CCS Roberts. 2020. "20 Armoured Infantry Brigade downgrade study: epidemiology of principal conditions and plugging leaks in the rehabilitation pipeline." *BMJ Mil Health* 166(5):312-317. https://doi.org/10.1136/jramc-2018-001109

Park HY, WS Jung, SW Kim, J Seo, Y Sun, JH Choi, J Kim, and K Lim. 2022. "Effects of Acute Moderate Hypoxia versus Normoxia on Metabolic and Cardiac Function and Skeletal Muscle Oxygenation during Endurance Exercise at the Same Heart Rate Level." *Metabolites* 12(10). https://doi.org/10.3390/metabo12100975

Parker FNH, NT Fear, SA M. Stevelink, and L Rafferty. 2022. "Self-reported auditory problems are associated with adverse mental health outcomes and alcohol misuse in the UK Armed Forces." *Soc Psychiatry Psychiatr Epidemiol* 57(3):563-573. https://doi.org/10.1007/s00127-021-02169-8

Parsons IT, MJ Stacey, and DR Woods. 2019. "Heat Adaptation in Military Personnel: Mitigating Risk, Maximizing Performance." *Front Physiol* 10:1485. https://doi.org/10.3389/fphys.2019.01485

Pasiakos SM, HR Lieberman, and VL Fulgoni, 3rd. 2015. "Higher-protein diets are associated with higher HDL cholesterol and lower BMI and waist circumference in US adults." *J Nutr* 145(3):605-14. https://doi.org/10.3945/jn.114.205203

Patten C, XQ Wang, JO Ebbert, MA Little, GW Talcott, AS Hryshko-Mullen, and RC Klesges. 2019. "Influence of gender and peer tobacco use on tobacco use intentions after a period of involuntary tobacco abstinence among U.S. Air Force trainees." *Prev Med Rep* 13:270-276. https://doi.org/10.1016/j.pmedr.2019.01.004

Paxton Willing MM, LL Tate, KG O'Gallagher, DP Evatt, and DS Riggs. 2022. "In-Theater Mental Health Disorders Among U.S. Soldiers Deployed Between 2008 and 2013." *MSMR* 29(11):11-17. https://www.ncbi.nlm.nih.gov/pubmed/36790903

Payne DC, A Aranas, MM McNeil, S Duderstadt, and CE Rose, Jr. 2007. "Concurrent vaccinations and U.S. military hospitalizations." *Ann Epidemiol* 17(9):697-703. https://doi.org/10.1016/j.annepidem.2007.03.018

Pearson O, N Uglik-Marucha, KW Miskowiak, SA Cairney, I Rosenzweig, AH Young, and PRA Stokes. 2023. "The relationship between sleep disturbance and cognitive impairment in mood disorders: A systematic review." *J Affect Disord* 327:207-216. https://doi.org/10.1016/j.jad.2023.01.114

Periard JD, D DeGroot, and O Jay. 2022. "Exertional heat stroke in sport and the military: epidemiology and mitigation." *Exp Physiol* 107(10):1111-1121. https://doi.org/10.1113/EP090686

Perkins EM, I Sorensen, A Susi, E Hisle-Gorman. 2023. “The Impact of Having a Child With Special Healthcare Needs on Length of Military Service”. *Mil Med* 188(5-6):e1246-e1251. https://doi.org/10.1093/milmed/usab495. PMID: 34850102

Peterson AL and J Helton. 2000. "Smoking cessation and weight gain in the military." *Mil Med* 165(7):536-8. https://www.ncbi.nlm.nih.gov/pubmed/10920654

Peterson CE, SC Gordon, CW Le Hew, JA Dykens, GD Jefferson, MP Tampi, O Urquhart et al. 2019. “Society of Behavioral Medicine position statement: Society of Behavioral Medicine supports oral cancer early detection by all healthcare providers.” *Transl Behav Med* 9(4):819-822. https://doi.org/10.1093/tbm/iby075

Peterson ME, R Mile, Y Li, H Nair, and MH Kyaw. 2018. "Meningococcal carriage in high-risk settings: A systematic review." *Int J Infect Dis* 73:109-117. https://doi.org/10.1016/j.ijid.2018.05.022

Petersson SD and E Philippou. 2016. "Mediterranean Diet, Cognitive Function, and Dementia: A Systematic Review of the Evidence." *Adv Nutr* 7(5):889-904. https://doi.org/10.3945/an.116.012138

Petinaux B. 2008. "The financial impact of deployments on reserve health care providers." *Mil Med* 173(8):729-33. https://doi.org/10.7205/milmed.173.8.729

Petridou A, A Siopi, and V Mougios. 2019. "Exercise in the management of obesity." *Metabolism* 92:163-169. https://doi.org/10.1016/j.metabol.2018.10.009

Pflanz S. 2001. "Occupational stress and psychiatric illness in the military: investigation of the relationship between occupational stress and mental illness among military mental health patients." *Mil Med* 166(6):457-62. https://www.ncbi.nlm.nih.gov/pubmed/11413719

Pflanz SE and AD Ogle. 2006. "Job stress, depression, work performance, and perceptions of supervisors in military personnel." *Mil Med* 171(9):861-5. https://doi.org/10.7205/milmed.171.9.861

Phillips AK and AB Lynn. 2022. "Scoping Review on Menstrual Suppression Among U.S. Military Service Members." *Mil Med* 187(3-4):e329-e337. https://doi.org/10.1093/milmed/usab200

Phillips C. 2017. "Lifestyle Modulators of Neuroplasticity: How Physical Activity, Mental Engagement, and Diet Promote Cognitive Health during Aging." *Neural Plast* 2017:3589271. https://doi.org/10.1155/2017/3589271

Phillips JB, D Horning, and ME Funke. 2015. "Cognitive and perceptual deficits of normobaric hypoxia and the time course to performance recovery." *Aerosp Med Hum Perform* 86(4):357-65. https://doi.org/10.3357/AMHP.3925.2015

Piazza JR, SD Landes, and RS Stawski. 2022. "Age differences in allostatic load among veterans: The importance of combat exposure." *J Trauma Stress* 35(1):257-268. https://doi.org/10.1002/jts.22731

Piche BM, SM Stankorb, and M Salgueiro. 2014. "Attitudes, beliefs, and behaviors of active duty soldiers attending the ArmyMOVE! weight management program." *Mil Med* 179(8):906-12. https://doi.org/10.7205/MILMED-D-13-00498

Pierce JR, DW DeGroot, TL Grier, KG Hauret, BC Nindl, WB East, MS McGurk, and BH Jones. 2017. “Body mass index predicts selected physical fitness attributes but is not associated with performance on military relevant tasks in U.S. Army Soldiers.” *J Sci Med Sport* 20 Suppl 4:S79-S84. https://doi.org/10.1016/j.jsams.2017.08.021

Pihlainen K, H Kyrolainen, M Santtila, T Ojanen, J Raitanen, and K Hakkinen. 2022. "Effects of Combined Strength and Endurance Training on Body Composition, Physical Fitness, and Serum Hormones During a 6-Month Crisis Management Operation." *J Strength Cond Res* 36(9):2361-2370. https://doi.org/10.1519/JSC.0000000000003902

Pihlainen K, M Santtila, K Hakkinen, and H Kyrolainen. 2018. "Associations of Physical Fitness and Body Composition Characteristics With Simulated Military Task Performance." *J Strength Cond Res* 32(4):1089-1098. https://doi.org/10.1519/JSC.0000000000001921

Pihlainen K, M Santtila, BC Nindl, J Raitanen, T Ojanen, JP Vaara, J Helen, T Nykanen, and H Kyrolainen. 2023. "Changes in physical performance, body composition and physical training during military operations: systematic review and meta-analysis." *Sci Rep* 13(1):21455. https://doi.org/10.1038/s41598-023-48712-2

Pilcher JJ, E Nadler, and C Busch. 2002. "Effects of hot and cold temperature exposure on performance: a meta-analytic review." *Ergonomics* 45(10):682-98. https://doi.org/10.1080/00140130210158419

Pitts BL, V Wen, JM Whealin, BM Fogle, SM Southwick, I Esterlis, and RH Pietrzak. 2020. "Depression and Cognitive Dysfunction in Older U.S. Military Veterans: Moderating Effects of BDNF Val66Met Polymorphism and Physical Exercise." *Am J Geriatr Psychiatry* 28(9):959-967. https://doi.org/10.1016/j.jagp.2020.02.001

Pitts BL, JM Whealin, I Harpaz-Rotem, RS Duman, JH Krystal, SM Southwick, and RH Pietrzak. 2019. "BDNF Val66Met polymorphism and posttraumatic stress symptoms in U.S. military veterans: Protective effect of physical exercise." *Psychoneuroendocrinology* 100:198-202. https://doi.org/10.1016/j.psyneuen.2018.10.011

Pletcher ER, M Lovalekar, LC Coleman, K Beals, BC Nindl, and KF Allison. 2023. "Decreased Percent Body Fat but Not Body Mass is Associated with Beter Performance on Combat Fitness Test in Male and Female Marines." *J Strength Cond Res* 37 (4): 887-893. https://doi.org/10.1519/JSC.0000000000004335

Polak S, MS Riddle, DR Tribble, AW Armstrong, M Mostafa, and CK Porter. 2011. "Pre-deployment vaccinations and perception of risk among US military personnel." *Hum Vaccin* 7(7):762-7. https://doi.org/10.4161/hv.7.7.15574

Ponce T, MRM Mainenti, EL Cardoso, T Ramos de Barros, V Pinto Salerno, and M Vaisman. 2023. "Military field training exercise with prolonged physical activity and sleep restriction causes hormonal imbalance in firefighter cadets." *J Endocrinol Invest* 46(2):381-391. https://doi.org/10.1007/s40618-022-01913-4

Poon BH,S Prakaash, YS Teo, PW Fan, and JK Wei Lee. 2022. “Thermal strain and fluid balance during a 72-km military route march in a field setting.” *Singapore Med J* 63(9):497-502. https://doi.org/10.11622/smedj.2021053

Poorolajal J, M Goudarzi, F Gohari-Ensaf, and N Darvishi. 2022. "Relationship of religion with suicidal ideation, suicide plan, suicide attempt, and suicide death: a meta-analysis." *J Res Health Sci* 22(1):e00537. https://doi.org/10.34172/jrhs.2022.72

Porter CK, MJ Bowens, DR Tribble, SD Putnam, JW Sanders, and MS Riddle. 2008. "Attitudes towards vaccines and infectious disease risk among U.S. troops." *Hum Vaccin* 4(4):298-304. https://doi.org/10.4161/hv.4.4.5802

Porter CK, G Fitamaurice, DR Tribble, AW Armstrong, M Mostafa, and MS Riddle. 2013. "Willingness to receive a hypothetical avian influenza vaccine among US military personnel in mid-deployment." *Hum Vaccin Immunother* 9(12):2613-7. https://doi.org/10.4161/hv.25910

Porter IM, G Stoker, SR Seals, S Drollinger, HM Schutte, JW Bean, and GM Rice. 2020. "Human Papilloma Virus Vaccination Compliance in a Military Aviation Training Community." *Mil Med* 185(7-8):e1155-e1160. https://doi.org/10.1093/milmed/usaa024

Posch M, A Schranz, M Lener, W Senn, BO Ang, M Burtscher, and G Ruedl. 2019. "Prevalence and potential risk factors of flight-related neck, shoulder and low back pain among helicopter pilots and crewmembers: a questionnaire-based study." *BMC Musculoskelet Disord* 20(1):44. https://doi.org/10.1186/s12891-019-2421-7

Poser WM, KA Trautman, ND Dicks, BK Christensen, KJ Lyman, and KJ Hackney. 2019. "Simulated Casualty Evacuation Performance Is Augmented by Deadlift Peak Force." *Mil Med* 184(9-10):e406-e411. https://doi.org/10.1093/milmed/usz050

Poston WSC, CK Haddock, SA Jahnke, N Jitnarin, RE Malone, and EA Smith. 2017. "Perspectives of US military commanders on tobacco use and tobacco control policy." *Tob Control* 26(3):254-259. https://doi.org/10.1136/tobaccocontrol-2015-052829

Proctor SP, AL Maule, KJ Heaton, and GE Adam. 2014. "Permethrin exposure from fabric-treated military uniforms under different wear-time scenarios." *J Expo Sci Environ Epidemiol* 24(6):572-8. https://doi.org/10.1038/jes.2013.65

Proctor SP, AL Maule, KJ Heaton, BS Cadarette, KI Guerriere, CC Haven, KM Taylor, MM Scarpaci, M Ospina, and AM Calafat. 2020. "Permethrin exposure from wearing fabric-treated military uniforms in high heat conditions under varying wear-time scenarios." *J Expo Sci Environ Epidemiol* 30(3):525-536. https://doi.org/10.1038/s41370-019-0120-y

Proctor SP, VT Nguyen, AA Hebert, KM Taylor, HL McClung, KJ Heaton, M Ospina, and AM Calafat. 2023. "Individual-level permethrin exposure biomarkers in U.S. army soldiers: comparison of two treatment formulations for military uniforms." *J Expo Sci Environ Epidemiol* 33(1):132-139. https://doi.org/10.1038/s41370-022-00466-1

Proessl F, MC Canino, ME Beckner, WR Conkright, AD LaGoy, AM Sinnott, SR Eagle, et al. 2022. "Use-dependent corticospinal excitability is associated with resilience and physical performance during simulated military operational stress." *J Appl Physiol (1985)* 132(1):187-198. https://doi.org/10.1152/japplphysiol.00628.2021

Pucci GC, CR Rech, RC Fermino, and RS Reis. 2012. "Association between physical activity and quality of life in adults." *Rev Saude Publica* 46(1):166-79. https://doi.org/10.1590/s0034-89102012000100021

Pun M, V Guadagni, KM Bettauer, LL Drogos, J Aitken, SE Hartmann, M Furian, et al. 2018. "Effects on Cognitive Functioning of Acute, Subacute and Repeated Exposures to High Altitude." *Front Physiol* 9:1131. https://doi.org/10.3389/fphys.2018.01131

Purvis DL, CV Lentino, TK Jackson, KJ Murphy, and PA Deuster. 2013. "Nutrition as a component of the performance triad: how healthy eating behaviors contribute to soldier performance and military readiness." *US Army Med Dep J*:66-78. https://www.ncbi.nlm.nih.gov/pubmed/24146244

Pyle SA, CK Haddock, WS Poston, RM Bray, and J Williams. 2007. "Tobacco use and perceived financial strain among junior enlisted in the U.S. Military in 2002." *Prev Med* 45(6):460-3. https://doi.org/10.1016/j.ypmed.2007.05.012

Pyne JM, JI Constans, MD Wiederhold, DP Gibson, T Kimbrell, TL Kramer, JA Pitcock, et al. 2016. "Heart rate variability: Pre-deployment predictor of post-deployment PTSD symptoms." *Biol Psychol* 121(Pt A):91-98. https://doi.org/10.1016/j.biopsycho.2016.10.008

Q

Qin P, X Luo, Y Zeng, Y Zhang, Y Li, Y Wu, M Han, et al. 2021. "Long-term association of ambient air pollution and hypertension in adults and in children: A systematic review and meta-analysis." *Sci Total Environ* 796:148620. https://doi.org/10.1016/j.scitotenv.2021.148620

R

Rabbitt MP, MR Beymer, JJ Reagan, BP Jarvis, and EY Watkins. 2022. "Food insecurity among active duty soldiers and their families during the coronavirus disease 2019 pandemic." *Public Health Nutr* 25(8):1-8. https://doi.org/10.1017/S1368980022000192

Radin JM, AW Hawksworth, PJ Blair, DJ Faix, R Raman, KL Russell, and GC Gray. 2014. "Dramatic decline of respiratory illness among US military recruits after the renewed use of adenovirus vaccines." *Clin Infect Dis* 59(7):962-8. https://doi.org/10.1093/cid/ciu507

Ramon AE, L Guthrie, and NK Rochester. 2020. "Role of masculinity in relationships between mindfulness, self-compassion, and well-being in military veterans." *Psych of Men and Masc* 21(3):357-368. https://doi.org/10.1037/men0000240

Ransom JC, S Brosz-Hardin, P Calero, N DeFord, and JF Burkard. 2022. "Examining the effects of chronic pain on work performance in the military." *J Am Assoc Nurse Pract* 34(6):827-834. https://doi.org/10.1097/JXX.0000000000000711

Rappole C, T Grier, MK Anderson, V Hauschild, and BH Jones. 2017. "Associations of age, aerobic fitness, and body mass index with injury in an operational Army brigade." *J Sci Med Sport* 20(Suppl 4):S45-S50. https://doi.org/10.1016/j.jsams.2017.08.003

Reed MB, SI Woodruff, Capt G DeMers, Capt M Matteucci, SJ Chavez, M Hellner, and SL Hurtado. 2021 "Results of a Randomized Trial of Screening, Brief Intervention, and Referral to Treatment (SBIRT) to Reduce Alcohol Misuse Among Active-Duty Military Personnel." *J Stud Alcohol Drugs* 82(2):269-278. https://doi.org/10.15288/jsad.2021.82.269

Reed-Fitzke, K, and M Lucier-Greer. 2020. "The Buffering Effect of Relationships on Combat Exposure, Military Performance, and Mental Health of U.S. Military Soldiers: A Vantage Point for CFTs." *J Marital Fam Ther* 46(2):321-336. https://doi.org/10.1111/jmft.12402

Rees B. 2011. "Overview of outcome data of potential meditation training for soldier resilience." *Mil med* 176(11):1232-1242. https://doi.org/10.7205/milmed-d-11-00067

Reid, KJ, KG Baron, B Lu, E Naylor, L Wolfe, and PC Zee. 2010. "Aerobic exercise improves self-reported sleep and quality of life in older adults with insomnia." *Sleep Med* 11(9):934-40. https://doi.org/10.1016/j.sleep.2010.04.014

Renalds A, TH Smith, and PJ Hale. 2010. "A systematic review of built environment and health." *Fam Community Health* 33(1):68-78. https://doi.org/10.1097/FCH.0b013e3181c4e2e5

Reynolds K, J Williams, C Miller, A Mathis, and J Dettori. 2000. "Injuries and risk factors in an 18-day Marine winter mountain training exercise." *Mil Med* 165(12):905-10. https://www.ncbi.nlm.nih.gov/pubmed/11149059

Rezagholizadeh F, K Djafarian, S Khosravi, and S Shab-Bidar. 2017. "*A posteriori* healthy dietary patterns may decrease the risk of central obesity: findings from a systematic review and meta-analysis." *Nutr Res* 41:1-13. https://doi.org/10.1016/j.nutres.2017.01.006

Ribeiro S, KD Renshaw, and ES Allen. 2023. "Military-related relocation stress and psychological distress in military partners." *J Fam Psychol* 37(1):45-53. https://doi.org/10.1037/fam0001030

Rice VJB and PJ Schroeder. 2019. "Self-Reported Sleep, Anxiety, and Cognitive Performance in a Sample of U.S. Military Active Duty and Veterans." *Mil Med* 184(Suppl 1):488-497. https://doi.org/10.1093/milmed/usy323

Richalet JP, P Larmignat, E Poitrine, M Letournel, and F Canoui-Poitrine. 2012. "Physiological risk factors for severe high-altitude illness: a prospective cohort study." *Am J Respir Crit Care Med* 185(2):192-8. https://doi.org/10.1164/rccm.201108-1396OC

Richardson NM, AL Lamson, M Smith, SM Eagan, AM Zvonkovic, and J Jensen. 2020. "Defining Moral Injury Among Military Populations: A Systematic Review." *J Trauma Stress* 33(4):575-586. https://doi.org/10.1002/jts.22553

Ricker EA, CW Goforth, AS Barrett, PA Deuster, and SJ de la Motte. 2021. "Female Military Officers Report a Desire for Menstrual Suppression During Military Training." *Mil Med* 186(Suppl 1):775-783. https://doi.org/10.1093/milmed/usaa339

Riddle MS, SS Patel, JW Sanders, AW Armstrong, SD Putnam, CD Schlett, and DR Tribble. 2008. "Attitudes toward predeployment and experimental vaccinations among troops deployed to Operation Iraqi Freedom and Operation Enduring Freedom." *J Travel Med* 15(2):68-76. https://doi.org/10.1111/j.1708-8305.2007.00173.x

Rippe JM, and S Hess. 1998. "The role of physical activity in the prevention and management of obesity." *J Am Diet Assoc* 98(10 Suppl 2):S31-8. https://doi.org/10.1016/s0002-8223(98)00708-1

Ritland BM, G Simonelli, RJ Gentili, JC Smith, X He, J Mantua, TJ Balkin, and BD Hatfield. 2019. "Effects of sleep extension on cognitive/motor performance and motivation in military tactical athletes." *Sleep Med* 58:48-55. https://doi.org/10.1016/j.sleep.2019.03.013

Rittenhouse M, J Scott, and P Deuster. 2020. "Healthy Eating Index and Nutrition Biomarkers among Army Soldiers and Civilian Control Group Indicate an Intervention Is Necessary to Raise Omega-3 Index and Vitamin D and Improve Diet Quality." *Nutrients* 31;13(1):122. https://doi.org/10.3390/nu13010122

Rivera AC, TM Powell, EJ Boyko, RU Lee, DJ Faix, DD Luxton, RP Rull, and Team Millennium Cohort Study. 2018. "New-Onset Asthma and Combat Deployment: Findings From the Millennium Cohort Study." *Am J Epidemiol* 187(10):2136-2144. https://doi.org/10.1093/aje/kwy112

Riviere LA, A Kendall-Robbins, D McGurk, CA Castro, and CW Hoge. 2011. "Coming home may hurt: risk factors for mental ill health in US reservists after deployment in Iraq." *Br J Psychiatry* 198(2):136-142. https://doi.org/10.1192/bjp.bp.110.084863

Riviere LA, RR Sinclair, and B Graham. 2024. "Financial Hardship, Positive Financial Behaviour, and Behavioural Health Outcomes among US Soldiers." *Journal of Military, Veteran and Family Health* 10 (3): 67–87. https://doi.org/10.3138/jmvfh-2023-0039

Roach MH, MB Bird, MS Helton, and TC Mauntel. 2023. "Musculoskeletal Injury Risk Stratification: A Traffic Light System for Military Service Members." *Healthcare (Basel)* 11(12). https://doi.org/10.3390/healthcare11121675

Robbins AS, VP Fonseca, SY Chao, GA Coil, NS Bell, and PJ Amoroso. 2000. "Short term effects of cigarette smoking on hospitalisation and associated lost workdays in a young healthy population." *Tob Control* 9(4):389-96. https://doi.org/10.1136/tc.9.4.389

Robinson Y, A Khorram-Manesh, N Arvidsson, C Sinai, and F Taube. 2023. "Does climate change transform military medicine and defense medical support?" *Front Public Health* 11: 1099031. https://doi.org/10.3389/fpubh.2023.1099031

Robitaille E, V Larter, S Heipel, T Reilly, E Chasse, and HC Tingelstad. 2021. "The feasibility of implementing an evidence-based physical training program during a Canadian Armed Forces basic infantry course." *J Sci Med Sport* 24(9):886-893. https://doi.org/10.1016/j.jsams.2021.03.012

Rodriguez CA, and JW Mitchell. 2023. "HIV Prevention Research With U.S. Military Service Members: A Systematic Review." *Mil Med* 188(1-2):e100-e107. https://doi.org/10.1093/milmed/usac018

Rodriguez-Monforte M, G Flores-Mateo, and E Sanchez. 2015. "Dietary patterns and CVD: a systematic review and meta-analysis of observational studies." *Br J Nutr* 114(9):1341-59. https://doi.org/10.1017/S0007114515003177

Rong S, LG Snetselaar, G Xu, Y Sun, B Liu, RB Wallace, and W Bao. 2019. "Association of Skipping Breakfast With Cardiovascular and All-Cause Mortality." *J Am Coll Cardiol* 73(16):2025-2032. https://doi.org/10.1016/j.jacc.2019.01.065

Rosmarin DH, CC Kaufman, SF Ford, P Keshava, M Drury, S Minns, C Marmarosh, A Chowdhury, and MD Sacchet. 2022. "The neuroscience of spirituality, religion, and mental health: A systematic review and synthesis." *J Psychiatr Res* 156:100-113. https://doi.org/10.1016/j.jpsychires.2022.10.003

Ross JA, DT Thomas, JD Winters, SD Royer, CJ Halagarda, R Sheppard, J Abt, and NR Heebner. 2020. "Military Protein Intake Related to Strength and Fat Mass Independent of Energy Intake." *Mil Med* 185(9-10):e1671-e1678. https://doi.org/10.1093/milmed/usaa151

Rossiter AG and CG Ling. 2022. “Building resilience in US military families: why it matters.” *BMJ Mil Health* 168(1):91-94. doi: 10.1136/bmjmilitary-2020-001735. Epub 2021 Mar 30. PMID: 33785586.

Roy TC, T Songer, F Ye, R LaPorte, T Grier, M Anderson, and M Chervak. 2014. "Physical training risk factors for musculoskeletal injury in female soldiers." *Mil Med* 179(12):1432-8. https://doi.org/10.7205/MILMED-D-14-00164

Roy TC, BA Springer, V McNulty, and NL Butler. 2010. "Physical Fitness." *Mil Med* 175(suppl_8):14-20. https://doi.org/10.7205/milmed-d-10-00058

Rubenstein A, HG Koenig, DB Marin, V Sharma, I Harpaz-Rotem, and RH Pietrzak. 2021. "Religion, spirituality, and risk for incident posttraumatic stress disorder, suicidal ideation, and hazardous drinking in U.S. military veterans: A 7-year, nationally representative, prospective cohort study." *J Affect Disord* 295:1110-1117. https://doi.org/10.1016/j.jad.2021.08.128

Ruckart PZ, FJ Bove, and M Maslia. 2013. “Evaluation of exposure to contaminated drinking water and specific birth defects and childhood cancers at Marine Corps Base Camp

Lejeune, North Carolina: a case-control study." *Environ Health* 12:104. https://doi.org/10.1186/1476-069X-12-104

Ruckart PZ, FJ Bove, and M Maslia. 2014. "Evaluation of contaminated drinking water and preterm birth, small for gestational age, and birth weight at Marine Corps Base Camp Lejeune, North Carolina: a cross-sectional study." *Environ Health* 13:99. https://doi.org/10.1186/1476-069X-13-99

Ruckart PZ,FJ Bove, E Shanley 3rd, and M Maslia. 2015. "Evaluation of contaminated drinking water and male breast cancer at Marine Corps Base Camp Lejeune, North Carolina: a case control study." *Environ Health* 14:74. https://doi.org/10.1186/s12940-015-0061-4

Ruffing JA, F Cosman, M Zion, S Tendy, P Garrett, R Lindsay, and JW Nieves. 2006. "Determinants of bone mass and bone size in a large cohort of physically active young adult men." *Nutr Metab (Lond)* 3:14. https://doi.org/10.1186/1743-7075-3-14

Rupp TL, NJ Wesensten, PD Bliese, and TJ Balkin. 2009. "Banking sleep: realization of benefits during subsequent sleep restriction and recovery." *Sleep* 32(3):311-21. https://doi.org/10.1093/sleep/32.3.311

Russell DW, J Kazman, and CA Russell. 2019. "Body Composition and Physical Fitness Tests Among US Army Soldiers: A Comparison of the Active and Reserve Components." *Public Health Rep* 134(5):502-513. https://doi.org/10.1177/0033354919867069

Russell DW, JB Kazman, DM Benedek, RJ Ursano, and CA Russell. 2017. "Domestic Civil Support Missions Can Aggravate Negative Mental Health Outcomes Among National Guardsmen: The Moderating Role of Economic Difficulties." *J Trauma Stress* 30(2):195-199. https://doi.org/10.1002/jts.22164

Ruyle BJ, CP Thackray, CM Butt, DR LeBlanc, AK Tokranov, CD Vecitis, and EM Sunderland. 2023. "Centurial Persistence of Forever Chemicals at Military Fire Training Sites." *Environ Sci Technol* 57(21):8096-8106. https://doi.org/10.1021/acs.est.3c00675

Ryan MA, TC Smith, WK Honner, and GC Gray. 2003. "Varicella susceptibility and vaccine use among young adults enlisting in the United States Navy." *J Med Virol* 70(Suppl 1):S15-9. https://doi.org/10.1002/jmv.10314

S

Sabia S, H Nabi, M Kivimaki, MJ Shipley, MG Marmot, and A Singh-Manoux. 2009. "Health behaviors from early to late midlife as predictors of cognitive function: The Whitehall II study." *Am J Epidemiol* 170(4):428-37. https://doi.org/10.1093/aje/kwp161

Salgado RM, KE Coffman, KE Bradbury, KM Mitchell, BR Yurkevicius, AJ Luippold, and TA Mayer, et al. 2020. "Effect of 8 days of exercise-heat acclimation on aerobic exercise

performance of men in hypobaric hypoxia." *Am J Physiol Regul Integr Comp Physiol* 1;319(1):R114-R122. https://doi.org/10.1152/ajpregu.00048.2020

Samadi M, A Askarian, H Shirvani, A Shamsoddini, A Shakibaee, SC Forbes, and M Kaviani. 2022. "Effects of Four Weeks of Beta-Alanine Supplementation Combined with One Week of Creatine Loading on Physical and Cognitive Performance in Military Personnel." *Int J Environ Res Public Health* 29;19(13):7992. https://doi.org/10.3390/ijerph19137992

Sanou AZ, C Ziadeh, S Stahlman, and SS Clausen. 2020. "Acute Respiratory Infections Among Active Component Service Members Who Use Combustible Tobacco Products and/or E-cigarette/Vaping Products, U.S. Armed Forces, 2018-2019." *MSMR* 27(11):2-7. https://www.ncbi.nlm.nih.gov/pubmed/33237791

Santtila M, K Pihlainen, H Koski, T Ojanen, and H Kyrolainen. 2019. "Physical Fitness and Body Anthropometrics Profiles of the Female Recruits Entering to Voluntary Military Service." *Mil Med* 184(1-2):e200-e205. https://doi.org/10.1093/milmed/usy145

Santtila M, K Pihlainen, J Vaara, BC Nindl, R Heikkinen, and H Kyrolainen. 2022. "Aerobic fitness predicted by demographics, anthropometrics, health behaviour, physical activity and muscle fitness in male and female recruits entering military service." *BMJ Mil Health* e002267. https://doi.org/10.1136/military-2022-002267

Sasaki N, K Imamura, TTT Tran, HT Nguyen, K Kuribayashi, A Sakuraya, TM Bui, et al. 2021. "Effects of Smartphone-Based Stress Management on Improving Work Engagement Among Nurses in Vietnam: Secondary Analysis of a Three-Arm Randomized Controlled Trial." *J Med Internet Res* 23(2):e20445. https://doi.org/10.2196/20445

Sauvet F, C Lebeau, S Foucher, O Flusain, JC Jouanin, and JM Debonne. 2009. "Operational impact of health problems observed during a four-month military deployment in Ivory Coast." *Mil Med* 174(9):921-8. https://doi.org/10.7205/milmed-d-05-1008

Savoie FA, RW Kenefick, BR Ely, SN Cheuvront, and ED Goulet. 2017. "Effect of Hypohydration on Muscle Endurance, Strength, Anaerobic Power and Capacity and Vertical Jumping Ability: A Meta-Analysis." *Sports Med* 45(8):1207-27. https://doi.org/10.1007/s40279-015-0349-0

Sawab S, A Yusuf, R Fitryasari, and H Arifin. 2024. "Spirituality and Recovery From Severe Mental Disorders: A Systematic Review." *J Psychosoc Nurs Ment Health Serv* 1-7. https://doi.org/10.3928/02793695-20240227-01

Scarpaci MM, CC Haven, AL Maule, KJ Heaton, KM Taylor, J Rood, M Ospina, AM Calafat, and SP Proctor. 2020. "The Effect of Body Composition and Energy Expenditure on Permethrin Biomarker Concentrations Among US Army National Guard Members." *J Occup Environ Med* 62(3):210-216. https://doi.org/10.1097/JOM.0000000000001801

Schaad KA, AS Bukhari, DI Brooks, JD Kocher, and ND Barringer. 2019. "The relationship between vitamin D status and depression in a tactical athlete population." *J Int Soc Sports Nutr* 16(1):40. https://doi.org/10.1186/s12970-019-0308-5

Schaal NC, RA Salaam, ME Stevens, and AH Stubner. 2019. "Living at Work: 24-hour Noise Exposure Aboard US Navy Aircraft Carriers." *Ann Work Expo Health* 63(3):316-327. https://doi.org/10.1093/annweh/wxz005

Schilling S. 2022. "Visualizing the Ties That Bind Us: A Cross-Sectional Thematic and Visual Analysis of Cohesion Across Three British Military Formations." *AFS* 50(3). https://doi.org/10.1177/0095327X221134644

Schlader ZJ, D Gagnon, E Rivas, VA Convertino, and CG Crandall. 2015. "Fluid restriction during exercise in the heat reduces tolerance to progressive central hypovolaemia." *Exp Physiol* 100(8):926-34. https://doi.org/10.1113/EP085280

Schok ML, RJ Kleber, and GJ Lensvelt-Mulders. 2010. "A model of resilience and meaning after military deployment: personal resources in making sense of war and peacekeeping experiences." *Aging Ment Health* 14(3):328-38. https://doi.org/10.1080/13607860903228812

Schram B, E Canetti, R Orr, and R Pope. 2022. "Risk factors for injuries in female soldiers: a systematic review." *BMC Sports Sci Med Rehabil* 14(1):54. https://doi.org/10.1186/s13102-022-00443-z

Schubert CF, U Schmidt, and R Rosner. 2016. "Posttraumatic Growth in Populations with Posttraumatic Stress Disorder-A Systematic Review on Growth-Related Psychological Constructs and Biological Variables." *Clin Psychol Psychother* 23(6):469-486. https://doi.org/10.1002/cpp.1985

Schubert SL, and VR Melanson. 2020. "Prevalence of Lyme Disease Attributable to Military Service at the USMA, West Point NY: FY2016-2018." *Mil Med* 185(1-2):e28-e34. https://doi.org/10.1093/milmed/usz156

Schuler MS, EC Wong, and R Ramchand. 2022. "Military service branch differences in alcohol use, tobacco use, prescription drug misuse, and mental health conditions." *Drug Alcohol Depend* 235:109461. https://doi.org/10.1016/j.drugalcdep.2022.109461

Schulze C, M Becker, S Finze, C Holtherm, J Hinder, and A Lison. 2017. "An evaluation of the significance of individual endogenous risk factors and medical and orthopaedic conditions on physical fitness in military executives." *US Army Med Dep J* (3-17):105-110. https://www.ncbi.nlm.nih.gov/pubmed/29214628

Schure MB, JG Katon, E Wong, and CF Liu. 2016. "Food and housing insecurity and health status among U.S. adults with and without prior military service." *SSM Popul Health* 2:244-248. https://doi.org/10.1016/j.ssmph.2016.04.003

Schwalm FD, RB Zandavalli, ED de Castro Filho, and G Lucchetti. 2022. "Is there a relationship between spirituality/religiosity and resilience? A systematic review and meta-analysis of observational studies." *J Health Psychol* 27(5):1218-1232. https://doi.org/10.1177/1359105320984537

Schwartz SM. 2024. "Epidemiology of Cancer." *Clin Chem* 70(1):140-149. https://doi.org/10.1093/clinchem/hvad202

Scott, JM, JB Kazman, J Palmer, JP McClung, E Gaffney-Stomberg, and HG Gasier. 2019. "Effects of vitamin D supplementation on salivary immune responses during Marine Corps basic training." *Scand J Med Sci Sports* 29(9):1322-1330. https://doi.org/10.1111/sms.13467

Seelig AD, IG Jacobson, CJ Donoho, DW Trone, NF Crum-Cianflone, and T. J. Balkin. 2016. "Sleep and Health Resilience Metrics in a Large Military Cohort." *Sleep* 39(5):1111-20. https://doi.org/10.5665/sleep.5766

Sefton JM, KR Lohse, and JS McAdam. 2016. "Prediction of Injuries and Injury Types in Army Basic Training, Infantry, Armor, and Cavalry Trainees Using a Common Fitness Screen." *J Athl Train* 51(11):849-857. https://doi.org/10.4085/1062-6050-51.9.09

Sekel NM, ME Beckner, WR Conkright, AD LaGoy, F Proessl, M Lovalekar, BJ Martin, et al. 2023. "Military tactical adaptive decision making during simulated military operational stress is influenced by personality, resilience, aerobic fitness, and neurocognitive function." *Front Psychol* 14:1102425. https://doi.org/10.3389/fpsyg.2023.1102425

Sever JL, AI Brenner, AD Gale, JM Lyle, LH Moulton, BJ Ward, and DJ West. 2004. "Safety of anthrax vaccine: an expanded review and evaluation of adverse events reported to the Vaccine Adverse Event Reporting System (VAERS)." *Pharmacoepidemiol Drug Saf* 13(12):825-40. https://doi.org/10.1002/pds.936

Severson HH, AL Peterson, JA Andrews, JS Gordon, JA Cigrang, BG Danaher, CM Hunter, and M Barckley. 2009. "Smokeless tobacco cessation in military personnel: a randomized controlled trial." *Nicotine Tob Res* 11(6):730-8. https://doi.org/10.1093/ntr/ntp057

Sexton MB, GA Raggio, LB McSweeney, CC Authier, and SAM Rauch. 2017. "Contrasting Gender and Combat Versus Military Sexual Traumas: Psychiatric Symptom Severity and Morbidities in Treatment-Seeking Veterans." *J Womens Health (Larchmt)* 26(9):933-940. https://doi.org/10.1089/jwh.2016.6080

Seymour JW, L Fix, D Grossman, and K Grindlay. 2019. "Facilitators and Barriers to Contraceptive Use Among U.S. Servicewomen Who Had an Abortion." *Mil Med* 184(5-6):e417-e423. https://doi.org/10.1093/milmed/usy340

Seymour JW, L Fix, D Grossman, and K Grindlay. 2021. "Contraceptive use and access among deployed US servicewomen: findings from an online survey." *BMJ Sex Reprod Health* 47(1):61-66. https://doi.org/10.1136/bmjsrh-2019-200569

Sharif K, A Watad, NL Bragazzi, M Lichtbroun, H Amital, and Y Shoenfeld. 2018. "Physical activity and autoimmune diseases: Get moving and manage the disease." *Autoimmun Rev* 17(1):53-72. https://doi.org/10.1016/j.autrev.2017.11.010

Sharifian N, FR Carey, JS Seay, SF Castaneda, EJ Boyko, RP Rull, and Team Millennium Cohort Study. 2023. "Risk and Protective Factors for Cancer Mortality among United States Service Members and Veterans (2001-2018)." *Cancer Epidemiol Biomarkers Prev* 32(5):606-616. https://doi.org/10.1158/1055-9965.EPI-22-0943

Sharma P, T Dietrich, CJ Ferro, P Cockwell, and IL Chapple. 2016. “Association between periodontitis and mortality in stages 3-5 chronic kidney disease: NHANES III and linked mortality study.” *J Clin Periodontol* 43(2):104-13. https://doi.org/10.1111/jcpe.12502

Sharma V, DB Marin, HK Koenig, A Feder, BM Iacoviello, SM Southwick, and RH Pietrzak. 2017. "Religion, spirituality, and mental health of U.S. military veterans: Results from the National Health and Resilience in Veterans Study." *J Affect Disord* 217:197-204. https://doi.org/10.1016/j.jad.2017.03.071

Shaw DM, PM Bloomfield, A Benfell, I Hughes, and N Gant. 2023. "Recovery from acute hypoxia: A systematic review of cognitive and physiological responses during the 'hypoxia hangover'." *PLoS One* 18(8):e0289716. https://doi.org/10.1371/journal.pone.0289716

Shaw DM, G Cabre, and N Gant. 2021. "Hypoxic Hypoxia and Brain Function in Military Aviation: Basic Physiology and Applied Perspectives." *Front Physiol* 12:665821. https://doi.org/10.3389/fphys.2021.665821

Sheffield B, D Brungart, J Tufts, and J Ness. 2017. "The effects of elevated hearing thresholds on performance in a paintball simulation of individual dismounted combat." *Int J Audiol* 56(sup1):34-40. https://doi.org/10.1080/14992027.2016.1255360

Shelef L, AB Klomek, E Fruchter, R Kedem, JJ Mann, and G Zalsman. 2019. “Suicide ideation severity is associated with severe suicide attempts in a military setting.” *Eur Psychiatry* 61:49-55. https://doi.org/10.1016/j.eurpsy.2019.06.005

Shen LT, MW Ge, FH Hu, YJ Jia, W Tang, WQ Zhang, DY Zhao, WQ Shen, and HL Chen. 2023. "The connection between six common air pollution particles and adult brain tumors: a meta-analysis of 26,217,930 individuals." *Environ Sci Pollut Res Int* 30(50):108525-108537. https://doi.org/10.1007/s11356-023-29955-y

Shen YC, J Arkes, and TV Williams. 2012. "Effects of Iraq/Afghanistan deployments on major depression and substance use disorder: analysis of active duty personnel in the US military." *Am J Public Health* 102(Suppl 1):S80-7. https://doi.org/10.2105/AJPH.2011.300425

Shephard RJ, IK Brenner, WA Bateman, and PN Shek. 2001. "Basic recruit training: health risks and opportunities." *Mil Med* 166(8):714-20. https://www.ncbi.nlm.nih.gov/pubmed/11515324

Sherlock LP, and DS Brungart. 2021. "Functional impact of bothersome tinnitus on cognitive test performance." *Int J Audiol* 60(12):1000-1008. https://doi.org/10.1080/14992027.2021.1909760

Shia RM, JA Hagen, LK McIntire, CD Goodyear, LN Dykstra, and L Narayanan. 2015. "Individual differences in biophysiological toughness: sustaining working memory during physical exhaustion." *Mil Med* 180(2):230-6. https://doi.org/10.7205/MILMED-D-14-00363

Shiau DT, JW Sanders, SD Putnam, A Buff, W Beasley, DR Tribble, and MS Riddle. 2007. "Self-reported incidence of snake, spider, and scorpion encounters among deployed U.S. military in Iraq and Afghanistan." *Mil Med* 172(10):1099-102. https://doi.org/10.7205/milmed.172.10.1099

Shin S, Y Yasukochi, H Wakabayashi, and T Maeda. 2020. "Effects of acute hypobaric hypoxia on thermoregulatory and circulatory responses during cold air exposure." *J Physiol Anthropol* 10;39(1):28. https://doi.org/10.1186/s40101-020-00237-7

Shiri R, H Frilander, M Sainio, K Karvala, R Sovelius, T Vehmas, and E Viikari-Juntura. 2015. "Cervical and lumbar pain and radiological degeneration among fighter pilots: a systematic review and meta-analysis." *Occup Environ Med* 72(2):145-50. https://doi.org/10.1136/oemed-2014-102268

Shrestha A, TE Ho, LL Vie, DR Labarthe, LM Scheier, PB Lester, and MEP Seligman. 2019. "Comparison of Cardiovascular Health Between US Army and Civilians." *J Am Heart Assoc* 8(12):e009056. https://doi.org/10.1161/JAHA.118.009056

Shrestha M, T Combest, SJ Fonda, A Alfonso, and A Guerrero. 2013. "Effect of an accelerometer on body weight and fitness in overweight and obese active duty soldiers." *Mil Med* 178(1):82-7. https://doi.org/10.7205/milmed-d-12-00275

Simecek JW, P Colthirst, BE Wojcik, S Eikenberg, AC Guerrero, A Fedorowicz, W Szeszel-Fedorowicz, and P DeNicolo. 2014. "The incidence of dental disease nonbattle injuries in deployed U.S. Army personnel." *Mil Med* 179(6):666-73. https://doi.org/10.7205/MILMED-D-13-00511

Simecek JW, JL McGinley, ME Levine, KE Diefenderfer, and RL Ahlf. 2008. "A statistical method to evaluate dental classification systems used by military dental services." *Mil Med* 173(1 Suppl):51-5. https://doi.org/10.7205/milmed.173.supplement_1.51

Simpson J, V Albani, Z Bell, C Bambra, and H Brown. 2021. "Effects of social security policy reforms on mental health and inequalities: A systematic review of observational studies

in high-income countries." *Soc Sci Med* 272:113717. https://doi.org/10.1016/j.socscimed.2021.113717

Sims CS, TE Trail, and J Coe. 2024 "Predicting soldier retention from army spouse characteristics and attitudes: Soldiering on with spouse support." *Mil Psychol* 1-12. https://doi.org/10.1080/08995605.2024.2319014. Epub ahead of print.

Siu AL, U.S. Preventive Services Task Force. 2016. "Screening for Breast Cancer: U.S. Preventive Services Task Force Recommendation Statement." *Ann Intern Med* 164(4):279-96. doi: 10.7326/M15-2886

Skimmyhorn WL. 2016a. "Comparing Military and Civilian Household Finances: Descriptive Evidence from Recent Surveys." *Journal of Consumer Affairs* 50 (2): 471–83. https://doi.org/10.1111/joca.12109

Skimmyhorn W. 2016b. "Assessing financial education: Evidence from boot camp." *AEJ: Econimic Policy* 8(2):322-343. http://dx.doi.org/10.1257/pol.20140283

Skimmyhorn WL, ER Davies ER, D Mun, and B Mitchell. 2016. "Assessing financial education methods: Principles vs. rules-of-thumb approaches." *The Journal of Economic Education 47*(3): 193–210. https://doi.org/10.1080/00220485.2016.1179145

Skopp NA, KM Holland, JE Logan, CL Alexander, and CF Floyd. 2019. "Circumstances preceding suicide in U.S. soldiers: A qualitative analysis of narrative data." *Psychol Serv* 16(2):302-311. https://doi.org/10.1037/ser0000221

Slep AM, Foran, HM, Heyman, RE, and Snarr, JD. 2010. "Unique risk and protective factors for partner aggression in a large scale air force survey." *J Community Health* 35(4):375-383. https://doi.org/10.1007/s10900-010-9264-3

Smaliukiene R and S Bekesiene. 2020. "Towards Sustainable Human Resources: How Generational Differences Impact Subjective Wellbeing in the Military?" *Sustainability* 12(23):1-21. https://doi.org/https://doi.org/10.3390/su122310016

Smigelsky MA, C Jardin, JA Nieuwsma, M Brancu, KG Meador, KG Molloy, VA Mid-Atlantic MIRECC Workgroup, and EB Elbogen. 2020. "Religion, spirituality, and suicide risk in Iraq and Afghanistan era veterans." *Depress Anxiety* 37(8):728-737. https://doi.org/10.1002/da.23013

Smith A. 2005. "Hypoxia symptoms reported during helicopter operations below 10,000 ft: a retrospective survey." *Aviat Space Environ Med* 76(8):794-8. https://www.ncbi.nlm.nih.gov/pubmed/16110698

Smith C, K Doma, B Heilbronn, and A Leicht. 2022. "Effect of Exercise Training Programs on Physical Fitness Domains in Military Personnel: A Systematic Review and Meta-Analysis." *Mil Med* 187(9-10):1065-1073. https://doi.org/10.1093/milmed/usac040

Smith CD, AD Cooper, DJ Merullo, BS Cohen, KJ Heaton, PJ Claro, and T Smith. 2019. "Sleep restriction and cognitive load affect performance on a simulated marksmanship task." *J Sleep Res* 28(3):e12637. https://doi.org/10.1111/jsr.12637

Smith DR, BC Holtom, TR Mitchell. 2011. "Enhancing precision in the prediction of voluntary turnover and retirement." *Journal of Vocational Behavior, 79*(1), 290–302. https://doi.org/10.1016/j.jvb.2010.11.003

Smith EA, and RE Malone. 2012. "Why strong tobacco control measures "can't" be implemented in the U.S. Military: a qualitative analysis." *Mil Med* 177(10):1202-7. https://doi.org/10.7205/milmed-d-12-00199

Smith TC, CA Leard Mann, B Smith, IG Jacobson, SC Miller, TS Wells, EJ Boyko, and MA Ryan. 2014. "Longitudinal assessment of mental disorders, smoking, and hazardous drinking among a population-based cohort of US service members." *J Addict Med* 8(4):271-81. https://doi.org/10.1097/ADM.0000000000000050

Smith TJ, LE Dotson, AJ Young, A White, L Hadden, GP Bathalon, L Funderburk, and BP Marriott. 2013. "Eating patterns and leisure-time exercise among active duty military personnel: comparison to the Healthy People objectives." *J Acad Nutr Diet* 113(7):907-19. https://doi.org/10.1016/j.jand.2013.03.002

Smith TJ, LD Sigrist, GP Bathalon, S McGraw, JP Karl, and AJ Young. 2010. "Efficacy of a meal-replacement program for promoting blood lipid changes and weight and body fat loss in US Army soldiers." *J Am Diet Assoc* 110(2):268-73. https://doi.org/10.1016/j.jada.2009.10.039

Smith TJ, A White, L Hadden, AJ Young, and BP Marriott. 2014. "Associations between mental health disorders and body mass index among military personnel." *Am J Health Behav* 38 (4): 529-40. https://doi.org/10.5993/AJHB.38.4.6

Smith TJ, MA Wilson, JP Karl, J Orr, CD Smith, AD Cooper, KJ Heaton, AJ Young, and SJ Montain. 2018. "Impact of sleep restriction on local immune response and skin barrier restoration with and without "multinutrient" nutrition intervention." *J Appl Physiol* 124(1):190-200. https://doi.org/10.1152/japplphysiol.00547.2017

Smith-MacDonald LA, JS Morin, and S Bremault-Phillips. 2018. "Spiritual Dimensions of Moral Injury: Contributions of Mental Health Chaplains in the Canadian Armed Forces." *Front Psychiatry* 9:592. https://doi.org/10.3389/fpsyt.2018.00592

Sobell MB, AL Peterson, LC Sobell, A Brundige, CM Hunter, CM Hunter, JL Goodie, S Agrawal, AS Hrysko-Mullen, and WC Isler. 2017. "Reducing alcohol consumption to minimize weight gain and facilitate smoking cessation among military beneficiaries." *Addict Behav* 75:145-151. https://doi.org/10.1016/j.addbeh.2017.06.018

Solfrizzi V, C Custodero, M Lozupone, BP Imbimbo, V Valiani, P Agosti, A Schilardi, et al. 2017. "Relationships of Dietary Patterns, Foods, and Micro- and Macronutrients with Alzheimer's Disease and Late-Life Cognitive Disorders: A Systematic Review." *J Alzheimers Dis* 59(3):815-849. https://doi.org/10.3233/JAD-170248

Soltani S, and A Jayedi. 2022. "Adherence to healthy dietary pattern and risk of kidney disease: a systematic review and meta-analysis of observational studies." *Int J Vitam Nutr Res* 92(3-4):267-279. https://doi.org/10.1024/0300-9831/a000647

Sonnenfeld N, I Hertz-Picciotto, and WE Kaye. 2001. "Tetrachloroethylene in drinking water and birth outcomes at the US Marine Corps Base at Camp Lejeune, North Carolina." *Am J Epidemiol* 154(10):902-8. https://doi.org/10.1093/aje/154.10.902

Spalj S, D Peric, M Mlacovic Zrinski, M Bulj, and D Plancak. 2012. "Predictive value of dental readiness and psychological dimensions for oral health-related quality of life in Croatian soldiers: a cross-sectional study." *Croat Med J* 53(5):461-9. https://doi.org/10.3325/cmj.2012.53.461

Spiering BA, LA Walker, K Larcom, PN Frykman, SC Allison, and MA Sharp. 2021. "Predicting Soldier Task Performance From Physical Fitness Tests: Reliability and Construct Validity of a Soldier Task Test Battery." *J Strength Cond Res* 35(10):2749-2755. https://doi.org/10.1519/JSC.0000000000003222

Stanton KM, V Kienzle, DL M Dinnes, I Kotchetkov, W Jessup, L Kritharides, DS Celermajer, and KA Rye. 2022. "Moderate- and High-Intensity Exercise Improves Lipoprotein Profile and Cholesterol Efflux Capacity in Healthy Young Men." *J Am Heart Assoc* 11(12):e023386. https://doi.org/10.1161/JAHA.121.023386

Staub K, T Wyss, S Lehmann, T Abel, and F Ruhli. 2015. "[Health Status of Young Men in Switzerland: Monitoring Results from Conscription]." *Praxis (Bern 1994)* 104(22):1203-10. https://doi.org/10.1024/1661-8157/a002166

Steck SE, M Guinter, J Zheng, and CA Thomson. 2015. "Index-based dietary patterns and colorectal cancer risk: a systematic review." *Adv Nutr* 6(6):763-73. https://doi.org/10.3945/an.115.009746

Stein JA, TC Hepler, JA DeBlauw, CM Beattie, CD Beshirs, KM Holte, BK Kurtz, and KM Heinrich. 2022. "Lower-body muscular power and exercise tolerance predict susceptibility to enemy fire during a tactical combat movement simulation." *Ergonomics* 65(9):1245-1255. https://doi.org/10.1080/00140139.2022.2025913

Stein KJ and DM Claborn. 2005. "Telephonic survey of surveillance and control procedures for the mosquito vectors of West Nile virus near naval installations in the eastern United States." *Mil Med* 170(8):658-62. https://doi.org/10.7205/milmed.170.8.658

Stein MB, L Campbell-Sills, J Gelernter, F He, SG Heeringa, MK Nock, NA Sampson, X Sun, S Jain, RC Kessler, RJ Ursano, and Starrs Collaborators Army. 2017. "Alcohol Misuse and Co-Occurring Mental Disorders Among New Soldiers in the U.S. Army." *Alcohol Clin Exp Res* 41(1):139-148. https://doi.org/10.1111/acer.13269

Stein RJ, SA Pyle, CK Haddock, WS Poston, R Bray, and J Williams. 2008. "Reported stress and its relationship to tobacco use among U.S. military personnel." *Mil Med* 173(3):271-7. https://doi.org/10.7205/milmed.173.3.271

Steinman Y, M van den Oord, MHW Frings-Dresen, and JK Sluiter. 2017. "Flight Performance During Exposure to Acute Hypobaric Hypoxia." *Aerosp Med Hum Perform* 88(8):760-767. https://doi.org/10.3357/AMHP.4789.2017

Stellingwerff T and GR Cox. 2014. "Systematic review: Carbohydrate supplementation on exercise performance or capacity of varying durations." *Appl Physiol Nutr Metab* 39(9):998-1011. doi: 10.1139/apnm-2014-0027

Stephens MB, S Attipoe, D Jones, CJ Ledford, and PA Deuster. 2014. "Energy drink and energy shot use in the military." *Nutr Rev* 72(Suppl 1):72-7. https://doi.org/10.1111/nure.12139

Stewart R, W Sabbah, G Tsakos, F D'Aiuto, and RG Watt. 2008. "Oral health and cognitive function in the Third National Health and Nutrition Examination Survey (NHANES III)." *Psychosom Med* 70(8):936-41. https://doi.org/10.1097/PSY.0b013e3181870aec

Stiegmann RA, CB Payne, MA Kiel, and SL Stahlman. 2023. "Increased Prevalence of Overweight and Obesity and Incidence of Prediabetes and Type 2 Diabetes During the COVID-19 Pandemic, Active Component Service Members, U.S. Armed Forces, 2018 to 2021." *MSMR* 30(1):11-18. https://www.ncbi.nlm.nih.gov/pubmed/36881565

Storbeck J and GL Clore. 2007. "On the interdependence of cognition and emotion." *Cogn Emot* 21(6):1212-1237. https://doi.org/10.1080/02699930701438020

Straud CL, BA Moore, WJ Hale, M Baker, CL Gardner, AM Shinn, JA Cigrang et al.; STRONG STAR Consortium. 2020. "Demographic and Occupational Risk Factors Associated With Suicide-Related Aeromedical Evacuation Among Deployed U.S. Military Service Members." *Mil Med* 185(11-12):e1968-e1976. https://doi.org/10.1093/milmed/usaa201

Stukenborg MJ, BA Deschamps, JM Jayne, JP Karl, SM McGraw, AJ DiChiara, and RE Cole. 2021. "Exceeding body composition standards is associated with a more negative body image and increased weight cycling in active duty U.S. soldiers." *Eat Behav* 42:101532. https://doi.org/10.1016/j.eatbeh.2021.101532

Suarez-Manzano S, A Ruiz-Ariza, M De La Torre-Cruz, and EJ Martinez-Lopez. 2018. "Acute and chronic effect of physical activity on cognition and behaviour in young people with ADHD: A systematic review of intervention studies." *Res Dev Disabil* 77:12-23. https://doi.org/10.1016/j.ridd.2018.03.015

Sullivan KS, SA Hawkins, TD Gilreath, and CA Castro. 2021. "Mental health outcomes associated with profiles of risk and resilience among U.S. Army spouses." *J Fam Psychol* 35(1):33-43. https://doi.org/10.1037/fam0000702

Sullivan KS, Y Park, S Richardson, J Cederbaum, V Stander, and J Jaccard. 2023. "Early and recent military and nonmilitary stressors associated with posttraumatic stress symptoms among military service members and their spouses." *J Trauma Stress* 36(5):943-954. https://doi.org/10.1002/jts.22958

Sunshine JE, L Dwyer-Lindgren, A Chen, SR Sharar, EB Palmisano, EM Bulger, and AH Mokdad. 2018. "Alcohol-impaired driving in US counties, 2002-2012." *Popul Health Metr* 16(1):2. https://doi.org/10.1186/s12963-018-0158-4

Suvarna B, A Suvarna, R Phillips, RP Juster, B McDermott, and Z Sarnyai. 2020. "Health risk behaviours and allostatic load: A systematic review." *Neurosci Biobehav Rev* 108:694711. https://doi.org/10.1016/j.neubiorev.2019.12.020

Swift DL, NM Johannsen, CJ Lavie, CP Earnest, and TS Church. 2014. "The role of exercise and physical activity in weight loss and maintenance." *Prog Cardiovasc Dis* 56(4):441-7. https://doi.org/10.1016/j.pcad.2013.09.012

Szivak TK, WJ Kraemer, BC Nindl, LA Gotshalk, JS Volek, AL Gomez, C Dunn-Lewis, et al. 2014. "Relationships of Physical Performance Tests to Military-Relevant Tasks in Women." *US Army Med Dep J* April-Jun: 20-26. https://pubmed.ncbi.nlm.nih.gov/24706238/

Szivak TK, MM Thomas, RH Pietrzak, DR Nguyen, DM Ryan, and CM Mazure. 2023. "Obesity Risk Among West Point Graduates Later in Life." J Strength Cond Res 37(6):1284-1291. https://doi.org/10.1519/JSC.0000000000003824

T

Taanila H, AJ Hemminki, JH Suni, H Pihlajamaki, and J Parkkari. 2011. "Low physical fitness is a strong predictor of health problems among young men: a follow-up study of 1411 male conscripts." *BMC Public Health* 11:590. https://doi.org/10.1186/1471-2458-11-590

Taanila H, JH Suni, P Kannus, H Pihlajamaki, JP Ruohola, J Viskari, and J Parkkari. 2015. "Risk factors of acute and overuse musculoskeletal injuries among young conscripts: a population-based cohort study." *BMC Musculoskelet Disord* 16:104. https://doi.org/10.1186/s12891-015-0557-7

Tai YM, and SS Gau. 2017. "Depression and Quality of Life Mediating the Association Between Attention Deficit/Hyperactivity Disorder and Suicidality in Military Recruits." *Mil Med* 182(11):e1912-e1919. https://doi.org/10.7205/MILMED-D-16-00394

Talbot LA, L Webb, VJ Ramirez, C Morrell, M Bryndziar, K Enochs, and EJ Metter. 2023. "Non-pharmacological Home Therapies for Subacute Low Back Pain in Active Duty Military

Personnel: A Randomized Controlled Trial." *Mil Med* 188(1-2):12-19. https://doi.org/10.1093/milmed/usab382

Talcott GW, JO Ebbert, RC Klesges, BD Linde, RW Seals, RA Krukowski, EA Grieser, JY Oh, and DM Martin-Zona. 2015. "Tobacco Research in the Military: Reflections on 20 Years of Research in the United States Air Force." *Mil Med* 180(8):848-50. https://doi.org/10.7205/MILMED-D-14-00501

Tan SCC, WH Ang, LSX Lim, ICC Low, and JKW Lee. 2022. "Efficacy of Isothermic Conditioning over Military-Based Heat Acclimatization and Interval Training in Tropical Native Males." *Med Sci Sports Exerc* 54(11):1925-1935. https://doi.org/10.1249/MSS.0000000000002991

Tanaka Y, T Tsugawa, and Y Maeda. 2017. “Effect of mouthguards on impact to the craniomandibular complex.” *Dent Traumatol* 33(1):51-56. https://doi.org/10.1111/edt.12283

Tang XG, JH Zhang, XB Gao, QN Li, JB Li, J Yu, J Qin, and L Huang. 2014. "Sleep quality changes in insomniacs and non-insomniacs after acute altitude exposure and its relationship with acute mountain sickness." *Neuropsychiatr Dis Treat* 10:1423-32. https://doi.org/10.2147/NDT.S67218

Tarlov E, A Silva, C Wing, S Slater, SA Matthews, KK Jones, and SN Zenk. 2020a. "Neighborhood Walkability and BMI Change: A National Study of Veterans in Large Urban Areas." *Obesity (Silver Spring)* 28(1):46-54. https://doi.org/10.1002/oby.22611

Tarlov E, A Silva, C Wing, S Slater, SA Matthews, KK Jones, and SN Zenk. 2020b. "Neighborhood Walkability and BMI Change: A National Study of Veterans in Large Urban Areas." *Obesity (Silver Spring, Md.)* 28(1):46-54. https://doi.org/10.1002/oby.22611

Tas D, H Sevketbeyoglu, AF Aydin, K Celik, and MA Karaca. 2008. "The relationship between nicotine dependence level and community-acquired pneumonia in young soldiers: a case control study." *Intern Med* 47(24):2117-20. https://doi.org/10.2169/internalmedicine.47.1219

Taylor CT, L Campbell-Sills, RC Kessler, X Sun, MK Nock, RJ Ursano, S Jain, and MB Stein. 2023. "Social network size and personality traits independently and prospectively predict distress disorders and suicidal behavior in U.S. Army soldiers." *Psychol Med* 53(11):5081-5090. https://doi.org/10.1017/S0033291722002082

Taylor MK, AE Markham, JP Reis, GA Padilla, EG Potterat, SP Drummond, and LR Mujica-Parodi. 2008. "Physical fitness influences stress reactions to extreme military training." *Mil Med* 173(8):738-742. https://doi.org/10.7205/milmed.173.8.738

Taylor-Clark TM, LR Hearld, LA Loan, PA Swiger, P Li, and PA Patrician. 2023. “Patient Vs. Soldier-Centered Medical Home: Comparing Access, Continuity, and Communication in the U.S. Army.” *Mil Med* 16;188(5-6):e1232-e1239. https://doi.org/10.1093/milmed/usab515

Temme LA, DL Still, and MT Acromite. 2010. "Hypoxia and flight performance of military instructor pilots in a flight simulator." *Aviat Space Environ Med* 81(7):654-659. https://doi.org/10.3357/asem.2690.2010

Teyhen DS, SL Goffar, SW Shaffer, K Kiesel, RJ Butler, AM Tedaldi, JC Prye, DI Rhon, and PJ Plisky. 2018. "Incidence of Musculoskeletal Injury in US Army Unit Types: A Prospective Cohort Study." *J Orthop Sports Phys Ther* 48(10):749-757. https://doi.org/10.2519/jospt.2018.7979

Teyhen DS, DI Rhon, RJ Butler, SW Shaffer, SL Goffar, DJ McMillian, RE Boyles, KB Kiesel, and PJ Plisky. 2016. "Association of Physical Inactivity, Weight, Smoking, and Prior Injury on Physical Performance in a Military Setting." *J Athl Train* 51(11):866-875. https://doi.org/10.4085/1062-6050-51.6.02

Teyhen DS, SW Shaffer, RJ Butler, SL Goffar, KB Kiesel, DI Rhon, JN Williamson, and PJ Plisky. 2015. "What Risk Factors Are Associated With Musculoskeletal Injury in US Army Rangers? A Prospective Prognostic Study." *Clin Orthop Relat Res* 473(9):2948-58. https://doi.org/10.1007/s11999-015-4342-6

Teyhen DS, SW Shaffer, SL Goffar, K Kiesel, RJ Butler, DI Rhon, and PJ Plisky. 2020. "Identification of Risk Factors Prospectively Associated With Musculoskeletal Injury in a Warrior Athlete Population." *Sports Health* 12(6):564-572. https://doi.org/10.1177/1941738120902991

Theis SR, PC Li, D Kelly, T Ocampo, A Berglund, D Morgan, R Markert, E Fisher, and K Burtson. 2022. "Perceptions and Concerns Regarding COVID-19 Vaccination in a Military Base Population." *Mil Med* 187(11-12):e1255-e1260. https://doi.org/10.1093/milmed/usab230

Thomas D, KA Shaw, and BR Waterman. 2019. "Outcomes After Fresh Osteochondral Allograft Transplantation for Medium to Large Chondral Defects of the Knee." *Orthop J Sports Med* 7(3):2325967119832299. https://doi.org/10.1177/2325967119832299

Thomas R, JG McManus, A Johnson, P Mayer, C Wade, and JB Holcomb. 2009. "Ocular injury reduction from ocular protection use in current combat operations." *J Trauma* 66(4 Suppl):S99-103. https://doi.org/10.1097/TA.0b013e31819d8695

Thomas S, KV Hummel, J Schafer, HU Wittchen, and S Trautmann. 2023. "Harassment and its association with depressive symptoms and suicidal behavior: The role of perceived stigma and nondisclosure." *Psychol Serv* 20(1):84-93. https://doi.org/10.1037/ser0000610

Tikuisis P and AA Keefe. 2005. "Heat strain at high levels does not degrade target detection and rifle marksmanship." *Aviat Space Environ Med* 76(10):963-969. https://www.ncbi.nlm.nih.gov/pubmed/16235880

Tikuisis P and AA Keefe. 2007. "Effects of cold strain on simulated sentry duty and marksmanship." *Aviat Space Environ Med* 78(4):399-407. https://www.ncbi.nlm.nih.gov/pubmed/17484343

Tikuisis P, AA Keefe, J Keillor, S Grant, and RF Johnson. 2002. "Investigation of rifle marksmanship on simulated targets during thermal discomfort." *Aviat Space Environ Med* 73(12):1176-83. https://www.ncbi.nlm.nih.gov/pubmed/12498545

Tomczak A, J Bertrandt, A Klos, and K Klos. 2016. "Influence of Military Training and Standardized Nutrition in Military Unit on Soldiers' Nutritional Status and Physical Fitness." *J Strength Cond Res* 30(10):2774-80. https://doi.org/10.1519/JSC.0000000000000716

Tomes CD, S Sawyer, R Orr, and B Schram. 2020. "Ability of fitness testing to predict injury risk during initial tactical training: a systematic review and meta-analysis." *Inj Prev* 26(1):67-81. https://doi.org/10.1136/injuryprev-2019-043245

Tomes C, B Schram, and R Orr. 2020. "Relationships Between Heart Rate Variability, Occupational Performance, and Fitness for Tactical Personnel: A Systematic Review." *Front Public Health* 8:583336. https://doi.org/10.3389/fpubh.2020.583336

Tong L, Q Jia, B Li, Z Li, J Qi, Z Guo, and Y Liu. 2021. "Investigation of the baseline tetanus antibody level and its persistence in a military unit." *Vaccine* 39(31):4328-4334. https://doi.org/10.1016/j.vaccine.2021.06.026

Trachik B, N Oakey-Frost, ML Ganulin, AB Adler, MN Dretsch, OA Cabrera, and RP Tucker. 2021. "Military suicide prevention: The importance of leadership behaviors as an upstream suicide prevention target." *Suicide Life Threat Behav* 51(2):316-324. https://doi.org/10.1111/sltb.12707

Trego LL, NM Steele, and P Jordan. 2018. "Using the RE-AIM Model of Health Promotion to Implement a Military Women's Health Promotion Program for Austere Settings." *Mil Med* 183(suppl_1):538-546. https://doi.org/10.1093/milmed/usx230

Troeschel AN, B Gerhardstein, A Poniatowski, D Felton, A Smith, K Surasi, AM Cavanaugh, et al. 2022. “Notes from the Field: Self-Reported Health Symptoms Following Petroleum Contamination of a Drinking Water System – Oahu, Hawaii, November 2021-February 2022.” *MMWR Morb Mortal Wkly Rep* 71(21):718-719. https://doi.org/ 10.15585/mmwr.mm7121a4

Troncoso MR, C Wilson, JM Scot, and PA Deuster. 2023. "Exploring Influences of Eating Behaviors Among Emerging Adults in the Military." *J Nutr Educ* 55 (5): 331-342. https://doi.org/10.1016/j.jneb.2023.02.004

Trousselard M, D Claverie, D Fromage, C Becker, JG Houel, JJ Benoliel, and F Canini. 2021. "The Relationship between Allostasis and Mental Health Patterns in a Pre-Deployment French Military Cohort." *Eur J Investig Health Psychol Educ* 11(4):1239-1253. https://doi.org/10.3390/ejihpe11040090

Tsai KZ, SW Lai, CJ Hsieh, CS Lin, YP Lin, SC Tsai, PS Chung, et al. 2019. "Association between mild anemia and physical fitness in a military male cohort: The CHIEF study." *Sci Rep* 9(1):11165. https://doi.org/10.1038/s41598-019-47625-3

Tuch C, T Teubel, R La Marca, L Roos, H Annen, and T Wyss. 2017. "Physical fitness level affects perception of chronic stress in military trainees." *Stress Health* 33(5):490-497. https://doi.org/10.1002/smi.2732

Tumialan LM, RP Ponton, AN Cooper, WM Gluf, and JM Tomlin. 2019. "Rate of Return to Military Active Duty After Single and 2-Level Anterior Cervical Discectomy and Fusion: A 4-Year Retrospective Review." *Neurosurgery* 85(1):96-104. https://doi.org/10.1093/neuros/nyy230

Turner AI, N Smyth, SJ Hall, SJ Torres, M Hussein, SU Jayasinghe, K Ball, and AJ Clow. 2020. "Psychological stress reactivity and future health and disease outcomes: A systematic review of prospective evidence." *Psychoneuroendocrinology* 114:104599. https://doi.org/10.1016/j.psyneuen.2020.104599

Tvaryanas AP, B Greenwell, GJ Vicen, and GM Maupin. 2018. “The Commander's Wellness Program: Assessing the Association Between Health Measures and Physical Fitness Assessment Scores, Fitness Assessment Exemptions, and Duration of Limited Duty.” *Mil Med* 183(9-10):e612-e618. https://doi.org/10.1093/milmed/usx221

Tyler CJ, T Reeve, GJ Hodges, and SS Cheung. 2016. "The Effects of Heat Adaptation on Physiology, Perception and Exercise Performance in the Heat: A Meta-Analysis." *Sports Med* 46(11):1699-1724. https://doi.org/10.1007/s40279-016-0538-5

U

Ungar M and L Theron. 2020. "Resilience and mental health: how multisystemic processes contribute to positive outcomes." *Lancet Psychiatry* 7(5):441-448. https://doi.org/10.1016/S2215-0366(19)30434-1

Ursano RJ, J Wang, CS Fullerton, H Ramsawh, RK Gifford, D Russell, GH Cohen, L Sampson, and S Galea. 2018. "Post-deployment Mental Health in Reserve and National Guard Service

Members: Deploying With or Without One's Unit and Deployment Preparedness." *Mil Med* 183(1-2):e51-e58. https://doi.org/10.1093/milmed/usx002

U.S. Department of Health and Human Services (DHHS). 2024. "Healthy People 2030." Accessed June 25, 2024. https://health.gov/healthypeople/objectives-and-data/browse-objectives/health-care-access-and-quality/increase-proportion-adults-who-get-recommended-evidence-based-preventive-health-care-ahs-08

DHHS. 2018. *Physical Activity Guidelines for Americans*, 2nd edition. Washington, DC: U.S. Department of Health and Human Services.

U.S. Government Accountability Office (GAO). 2023. GAO-23-106551, *National Security Snapshot: DoD Active-Duty Recruitment and Retention Challenges.* https://www.gao.gov/assets/gao-23-106551.pdf

U.S. Preventive Services Task Force (USPSTF), MJ Barry, WK Nicholson, M Silverstein, D Chelmow, TR Coker, EM Davis, KE Donahue, et al. 2023. "Screening and Preventive Interventions for Oral Health in Adults: US Preventive Services Task Force Recommendation Statement." *JAMA* 330(18):1773-1779. https://doi.org/10.1001/jama.2023.21409

USPSTF, SJ Curry, AH Krist, DK Owens, MJ Barry, AB Caughey, KW Davidson, CA Doubeni, et al. 2018. "Screening for Cervical Cancer: US Preventive Services Task Force Recommendation Statement." *JAMA* 320(7):674-686. https://doi.org/10.1001/jama.2018.10897

USPSTF, KW Davidson, MJ Barry, CM Mangione, M Cabana, AB Caughey, EM Davis, KE Donahue, et al. 2021a. "Screening for Chlamydia and Gonorrhea: US Preventive Services Task Force Recommendation Statement." *JAMA* 326(10):949-956. https://doi.org/10.1001/jama.2021.14081

USPSTF, KW Davidson, MJ Barry, CM Mangione, M Cabana, AB Caughey, EM Davis, KE Donahue, et al. 2021b. "Screening for Colorectal Cancer: US Preventive Services Task Force Recommendation Statement." *JAMA* 325(19):1965-1977. https://doi.org/10.1001/jama.2021.6238

USPSTF, AH Krist, KW Davidson, CM Mangione, MJ Barry, M Cabana, AB Caughey, et al. 2020. "Behavioral Counseling Interventions to Promote a Healthy Diet and Physical Activity for Cardiovascular Disease Prevention in Adults With Cardiovascular Risk Factors: US Preventive Services Task Force Recommendation Statement." *JAMA* 324(20):2069-2075. https://doi.org/10.1001/jama.2020.21749

USPSTF, AH Krist, KW Davidson, CM Mangione, MJ Barry, M Cabana, AB Caughey, K Donahue, et al. 2021a. "Interventions for Tobacco Smoking Cessation in Adults, Including Pregnant

Persons: US Preventive Services Task Force Recommendation Statement." *JAMA* 325(3):265-279. https://doi.org/10.1001/jama.2020.25019

USPSTF, AH Krist, KW Davidson, CM Mangione, M Cabana, AB Caughey, EM Davis, KE Donahue, et al. 2021b. "Screening for Hypertension in Adults: US Preventive Services Task Force Reaffirmation Recommendation Statement." *JAMA* 325(16):1650-1656. https://doi.org/10.1001/jama.2021.4987

USPSTF, CM Mangione, MJ Barry, WK Nicholson, M Cabana, TR Coker, KW Davidson, et al. 2022. "Behavioral Counseling Interventions to Promote a Healthy Diet and Physical Activity for Cardiovascular Disease Prevention in Adults Without Cardiovascular Disease Risk Factors: US Preventive Services Task Force Recommendation Statement." *JAMA* 328(4):367-374. https://doi.org/10.1001/jama.2022.10951

USPSTF, DK Owens, KW Davidson, AH Krist, MJ Barry, M Cabana, AB Caughey, SJ Curry, et al. 2019. "Screening for HIV Infection: US Preventive Services Task Force Recommendation Statement." *JAMA* 321(23):2326-2336. https://doi.org/10.1001/jama.2019.6587

V

Vaara JP, H Groeller, J Drain, H Kyrolainen, K Pihlainen, T Ojanen, C Connaboy, M Santtila, P Agostinelli, and BC Nindl. 2022. "Physical training considerations for optimizing performance in essential military tasks." *Eur J Sport Sci* 22(1):43-57. https://doi.org/10.1080/17461391.2021.1930193

Vaara JP, R Kalliomaa, P Hynninen, and H Kyrolainen. 2015. "Physical Fitness and Hormonal Profile During an 11-Week Paratroop Training Period." *J Strength Cond Res* 29(Suppl 11):S163-7. https://doi.org/10.1519/JSC.0000000000001033

Vajdi M and MA Farhangi. 2020. "A systematic review of the association between dietary patterns and health-related quality of life." *Health Qual Life Outcomes* 18(1):337. https://doi.org/10.1186/s12955-020-01581-z

van den Berg E, RP Kloppenborg, RP Kessels, LJ Kappelle, and GJ Biessels. 2009. "Type 2 diabetes mellitus, hypertension, dyslipidemia and obesity: A systematic comparison of their impact on cognition." *Biochim Biophys Acta* 1792(5):470-481. https://doi.org/10.1016/j.bbadis.2008.09.004

Vander Weg MW, RC Klesges, and M DeBon. 2005. "Relationship between smokeless tobacco use and body weight in young adult military recruits." *Nicotine Tob Res* 7(2):301-5. https://doi.org/10.1080/14622200500056317

Vander Weg MW, MA Mengeling, BM Booth, JC Torner, and AG Sadler. 2015. "Prevalence and correlates of cigarette smoking among operation Iraqi freedom-era and operation

enduring freedom-era women from the Active Component military and Reserve/National Guard." *Med Care* 53(4 Suppl 1):S55-62. https://doi.org/10.1097/MLR.0000000000000285

Vargas SE, C Norris, RR Landoll, B Crone, MF Clark, JD Quinlan, and KM Guthrie. 2020. "Interventions to Improve Sexual and Reproductive Health in US Active Duty Military Service Members: A Systematic Review." *Am J Health Promot* 34(5):538-548. https://doi.org/10.1177/0890117120908511

Vickery JP, DR Tribble, SD Putnam, T McGraw, JW Sanders, AW Armstrong, and MS Riddle. 2008. "Factors associated with the use of protective measures against vector-borne diseases among troops deployed to Iraq and Afghanistan." *Mil Med* 173(11):1060-7. https://doi.org/10.7205/milmed.173.11.1060

Vogt DS, FA Tyrell, EA Bramande, YI Nillni, EC Taverna, EP Finley, DF Perkins, and LA Copeland. 2020. "U.S. Military Veterans' Health and Well-Being in the First Year After Service." *Am J Prev Med* 58(3):352-360. https://doi.org/10.1016/j.amepre.2019.10.016

W

Wahid A, N Manek, M Nichols, P Kelly, C Foster, P Webster, A Kaur, C Friedemann Smith, E Wilkins, M Rayner, N Roberts, and P Scarborough. 2016. "Quantifying the Association Between Physical Activity and Cardiovascular Disease and Diabetes: A Systematic Review and Meta-Analysis." *J Am Heart Assoc* 5(9). https://doi.org/10.1161/JAHA.115.002495

Waitzkin H, M Cruz, B Shuey, D Smithers, L Muncy, and M Noble. 2018. “Military Personnel Who Seek Health and Mental Health Services Outside the Military.” *Mil Med* 183(5-6):e232-e240. https://doi.org/10.1093/milmed/usx051

Waldron M, R Fowler, S Heffernan, J Tallent, L Kilduff, and O Jeffries. 2021. "Effects of Heat Acclimation and Acclimatisation on Maximal Aerobic Capacity Compared to Exercise Alone in Both Thermoneutral and Hot Environments: A Meta-Analysis and Meta-Regression." *Sports Med* 51(7):1509-1525. https://doi.org/10.1007/s40279-021-01445-6

Walker LE, E Poltavskiy, JC Janak, CA Beyer, IJ Stewart, and JT Howard. 2019. "US Military Service and Racial/Ethnic Differences in Cardiovascular Disease: An Analysis of the 2011-2016 Behavioral Risk Factor Surveillance System." *Ethn Dis* 29(3):451-462. https://doi.org/10.18865/ed.29.3.451

Walker TB, LM Lennemann, V Anderson, W Lyons, and MF Zupan. 2011. "Adaptations to a new physical training program in the combat controller training pipeline." *J Spec Oper Med* 11(2):37-44. https://doi.org/10.55460/XYKE-P4N6

Wallace JB, PM Newman, A McGarvey, PG Osmotherly, W. Spratford, and TJ Gabbett. 2021. "Factors associated with neck pain in fighter aircrew: a systematic review and meta-

analysis." *Occup Environ Med* 78(12):900-912. https://doi.org/10.1136/oemed-2020-107103

Wallace RF, D Kriebel, L Punnett, DH Wegman, and PJ Amoroso. 2007. "Prior heat illness hospitalization and risk of early death." *Environ Res* 104(2):290-5. https://doi.org/10.1016/j.envres.2007.01.003

Wallen GR, J Park, M Krumlauf, and AT Brooks. 2019. "Identification of Distinct Latent Classes Related to Sleep, PTSD, Depression, and Anxiety in Individuals Diagnosed With Severe Alcohol Use Disorder." *Behav Sleep Med* 17(4):514-523. https://doi.org/10.1080/15402002.2018.1425867

Walsh MR, ME Walsh, CA Ramsey, S Brochu, S Thiboutot, and G Ampleman. 2013. "Perchlorate contamination from the detonation of insensitive high-explosive rounds." *J Hazard Mater* 262:228-33. https:/doi.org/10.1016/j.jhazmat.2013.08.045

Walter KH, NP Otis, TN Ray, LH Glassman, JL Beltran, KT Kobayashi Elliott, and B Michalewicz-Kragh. 2023. "A randomized controlled trial of surf and hike therapy for U.S. active duty service members with major depressive disorder." *BMC Psychiatry* 23(1):109. https://doi.org/10.1186/s12888-022-04452-7

Walter Reed Army Institute of Research (WRAIR), "Sleep Resources," last reviewed 31 July 2025. https://wrair.health.mil/Sleep-Resources/

Wand O, A Prokupetz, A Grossman, and A Assa. 2011. "Natural history of mitral valve prolapse in military aircrew." *Cardiology* 118(1):50-4. https://doi.org/10.1159/000324313

Wang CJ, YX Shen, and Y Liu. 2016. "Empirically Derived Dietary Patterns and Hypertension Likelihood: A Meta-Analysis." *Kidney Blood Press Res* 41(5):570-581. https://doi.org/10.1159/000443456

Wang H, X Li, J Li, Y Gao, W Li, X Zhao, R Wen, J Han, K Chen, and L Liu. 2022. "Sleep, short-term memory, and mood states of volunteers with increasing altitude." *Front Psychiatry* 13:952399. https://doi.org/10.3389/fpsyt.2022.952399

Wang L, A Seelig, SM Wadsworth, H McMaster, JE Alcaraz, and NF Crum-Cianflone. 2015. "Associations of military divorce with mental, behavioral, and physical health outcomes." *BMC Psychiatry* 15:128. https://doi.org/10.1186/s12888-015-0517-7

Wang M, P Nyutu, K Tran, and A Spears. 2015. "Finding Resilience: The Mediation Effect of Sense of Community on the Psychological Well-Being of Military Spouses." *J M Health Couns* 37(2):164-174. https://doi.org/10.17744/mehc.37.2.07054x614489204m

Wang Q and W Zhou. 2021. "Roles and molecular mechanisms of physical exercise in cancer prevention and treatment." *J Sport Health Sci* 10(2):201-210. https://doi.org/10.1016/j.jshs.2020.07.008

Wang T, CM Kroeger, S Cassidy, S Mitra, RV Ribeiro, S Jose, A Masedunskas, AM Senior, and L Fontana. 2023. "Vegetarian Dietary Patterns and Cardiometabolic Risk in People With or at High Risk of Cardiovascular Disease: A Systematic Review and Meta-analysis." *JAMA Netw Open* 6(7):e2325658. https://doi.org/10.1001/jamanetworkopen.2023.25658

Wang X, TA Doherty, and C James. 2023. "Military burn pit exposure and airway disease: Implications for our Veteran population." *Ann Allergy Asthma Immunol* 131(6):720-725. https://doi.org/10.1016/j.anai.2023.06.012

Wang Z, B Chen, W Li, F Xie, AY Loke, and Q Shu. 2020. "Sleep quality and its impacts on quality of life among military personnel in remote frontier areas and extreme cold environments." *Health Qual Life Outcomes* 18(1):227. https://doi.org/10.1186/s12955-020-01460-7

Wang Z, S Tobler, J Roayaei, and A Eick. 2009. "Live attenuated or inactivated influenza vaccines and medical encounters for respiratory illnesses among US military personnel." *JAMA* 301(9):945-53. https://doi.org/10.1001/jama.2009.265

Warber JP, WJ Tharion, JF Patton, CM Champagne, P Mitotti, and HR Lieberman. 2002. “The effect of creatine monohydrate supplementation on obstacle course and multiple bench press performance.” *J Strength Cond Res* 16(4):500-8. https://pubmed.ncbi.nlm.nih.gov/12423177/

Ward M, T Beltran, A Corbo, M Sevilla, S Bedno, and E Penick. 2023. "Knowledge and Attitudes Regarding Human Papillomavirus Among Active Duty Service Members at a Large Military Base." *Mil Med* 188(5-6):1186-1191. https://doi.org/10.1093/milmed/usac190

Warner CH, GN Appenzeller, K Mullen, CM Warner, and T Grieger. 2008. "Soldier attitudes toward mental health screening and seeking care upon return from combat." *Mil Med* 173(6):563-9. https://doi.org/10.7205/milmed.173.6.563

Warner R, A Fuente, and L Hickson. 2015. "Jet Fuel, Noise, and the Central Auditory Nervous System: A Literature Review." *Mil Med* 180(9):950-5. https://doi.org/10.7205/MILMED-D-14-00733.

Warr BJ, DE Scofield, BA Spiering, and BA Alvar. 2013. "Influence of training frequency on fitness levels and perceived health status in deployed National Guard soldiers." *J Strength Cond Res* 27(2):315-22. https://doi.org/10.1519/JSC.0b013e31827e1347

Waterman BR, L Navarro-Figueroa, and BD Owens. 2017. "Primary Repair of Traumatic Distal Biceps Ruptures in a Military Population: Clinical Outcomes of Single- Versus 2-Incision Technique." *Arthroscopy* 33(9):1672-1678. https://doi.org/10.1016/j.arthro.2017.02.008

Waterman BR, N Rensing, KL Cameron, BD Owens, and M Pallis. 2016. "Survivorship of Meniscal Allograft Transplantation in an Athletic Patient Population." *Am J Sports Med* 44(5):1237-42. https://doi.org/10.1177/0363546515626184

Watier-Grillot S, D Costa, C Petit, R Razakandrainibe, S Larréché, C Tong, G Demont, et al. 2022. "Cryptosporidiosis outbreaks linked to the public water supply in a military camp, France." *PLoS Negl Trop Dis* 16(9):e0010776. https://doi.org/10.1371/journal.pntd.0010776

Wauters RH, BE Foster, and TA Banks. 2019. "Environmental Exposures and Asthma in Active Duty Service Members." *Curr Allergy Asthma Rep* 19(9):43. https://doi.org/10.1007/s11882-019-0873-3

Wax SG, and SM Stankorb. 2016. "Prevalence of food insecurity among military households with children 5 years of age and younger." *Public Health Nutr* 19(13):2458-2466. https://doi.org/10.1017/S1368980016000422

Webber BJ, DB Bornstein, PA Deuster, FG O'Connor, S Park, KM Rose, and GP Whitfield. 2023. "BMI and Physical Activity, Military-Aged U.S. Population 2015-2020." *Am J Prev Med* 64(1):66-75.

Webber BJ, MT Pawlak, S Valtier, CC Daniels, CC Tully, EJ Wozniak, WD Roachell, FX Sanchez, AA Blasi, and TL Cropper. 2017. "Prevalence and Seroprevalence of Trypanosoma cruzi Infection in a Military Population in Texas." *Am J Trop Med Hyg* 97(5):1477-1481. https://doi.org/10.4269/ajtmh.17-0109

Webber BJ, CD Tacke, GG Wolff, AE Rutherford, WJ Erwin, JD Escobar, AA Simon, et al. 2022. "Cancer Incidence and Mortality Among Fighter Aviators in the United States Air Force." *J Occup Environ Med* 64(1):71-78. https://doi.org/10.1097/JOM.0000000000002353

Weina, PJ, RC Neafie, G Wortmann, M Polhemus, and NE Aronson. 2004. "Old world leishmaniasis: an emerging infection among deployed US military and civilian workers." *Clin Infect Dis* 39(11):1674-80. https://doi.org/10.1086/425747

Weinstein O, Y Mandel, J Levy, T Lifshitz, A Yitzhak, and M Abu Tailakh. 2019. "Ballistic Eye Protection: Why Are Soldiers Reluctant to Use Them?" *Mil Med* 184(3-4):e211-e216. https://doi.org/10.1093/milmed/usy183

Welsh JA, JR Olson, and DF Perkins. 2019. "Gender Differences in Post-deployment Adjustment of Air Force Personnel: The Role of Wartime Experiences, Unit Cohesion, and Self-efficacy." *Mil Med* 184(1-2):e229-e234. https://doi.org/10.1093/milmed/usy261

Welsh JA, J Olson, DF Perkins, WJ Travis, and L Ormsby. 2015. "The Role of Natural Support Systems in the Post-deployment Adjustment of Active Duty Military Personnel." *Am J Community Psychol* 56(1-2):69-78. https://doi.org/10.1007/s10464-015-9726-y

West SL, L Banks, JE Schneiderman, JE Caterini, S Stephens, G White, S Dogra, and GD Wells. 2019. "Physical activity for children with chronic disease; a narrative review and practical applications." *BMC Pediatr* 19(1):12. https://doi.org/10.1186/s12887-018-1377-3

White AC, RM Salgado, S Schneider, JA Loeppky, TA Astorino, and CM Mermier. 2014. "Does heat acclimation improve exercise capacity at altitude? A cross-tolerance model." *Int J Sports Med* 35(12):975-81. https://doi.org/10.1055/s-0034-1368724

Whitfield T, T Barnhofer, R Acabchuk, A Cohen, M Lee, M Schlosser, EM Arenaza-Urquijo, et al. 2022. "The Effect of Mindfulness-based Programs on Cognitive Function in Adults: A Systematic Review and Meta-analysis." *Neuropsychol Rev* 32(3):677-702. https://doi.org/10.1007/s11065-021-09519-y

Whitson HE, HJ Cohen, KE Schmader, MC Morey, G Kuchel, and CS Colon-Emeric. 2018. "Physical Resilience: Not Simply the Opposite of Frailty." *J Am Geriatr Soc* 66(8):1459-1461. https://doi.org/10.1111/jgs.15233

Wickham KA, PJ Wallace, and SS Cheung. 2021. "Sex differences in the physiological adaptations to heat acclimation: a state-of-the-art review." *Eur J Appl Physiol* 121(2):353-367. https://doi.org/10.1007/s00421-020-04550-y

Wiener RC, U Sambamoorthi, and RJ Jurevic. 2014. "Dental utilization of active duty/previous active duty US military: a cross-sectional analysis of the 2010 Behavior and Risk Surveillance Survey." *Research (Lambertville)* 1. https://doi.org/10.13070/rs.en.1.888

Willard RJ, AM Jeffcoat, PM Benson, and DS Walsh. 2005. "Cutaneous leishmaniasis in soldiers from Fort Campbell, Kentucky returning from Operation Iraqi Freedom highlights diagnostic and therapeutic options." *J Am Acad Dermatol* 52(6):977-87. https://doi.org/10.1016/j.jaad.2005.01.109

Williams VF and GT Oh. 2022. "Update: Heat illness, active component, U.S. Armed Forces, 2021." *MSMR* 29(4):8-14. https://www.ncbi.nlm.nih.gov/pubmed/35608520

Wilson C, AK Phillips, SE Iobst, ER Myers, L Trego, RJ Allard, and R Landoll. 2021. "A Scoping Review of Unintended Pregnancy in Active Duty United States Military Women." *Womens Health Issues* 31(Suppl 1):S66-S80. https://doi.org/10.1016/j.whi.2020.11.006

Windle G, KM Bennett, and J Noyes. 2011. "A methodological review of resilience measurement scales." *Health Qual Life Outcomes* 9:8. https://doi.org/10.1186/1477-7525-9-8

Witkop CT, EA Kostas-Polston, and LC Degutis. 2023. "Improving the Health and Readiness of Military Women." *Mil Med* 188(Suppl 1):8-14. https://doi.org/10.1093/milmed/usac354

Wong JR, TL Crain, RM Brossoit, LB Hammer, TE Bodner, and JM Brady. 2022. "Beyond Just Resilience: The Important Role of Work-Family Resources for Military Service Members." *Occup Health Sci* 6(3):425-450. https://doi.org/10.1007/s41542-022-00111-1

Wood JD, CM Ware, T Correll, JE Heaton, T McBride, and JT Haynes. 2018. "Relationship Between Spiritual Well-being and Post-traumatic Stress Disorder Symptoms in United

States Air Force Remotely Piloted Aircraft and Intelligence Personnel." *Mil Med* 183(9-10):e489-e493. https://doi.org/10.1093/milmed/usx032

Woodall KA, AP Esquivel, TM Powell, LA Riviere, PJ Amoroso, VA Stander. 2023. "Influence of family factors on service members' decisions to leave the military." *Fam Relat* 72(3):1138-1157. https://doi.org/10.1111/fare.12757

Woolpert T, CJ Phillips, C Sevick, NF Crum-Cianflone, PJ Blair, and D Faix. 2014. "Health-related behaviors and effectiveness of trivalent inactivated versus live attenuated influenza vaccine in preventing influenza-like illness among young adults." *PLoS One* 9(7):e102154. https://doi.org/10.1371/journal.pone.0102154

World Health Organization (WHO), "WHOQOL: Measuring Quality of Life," last reviewed July 5, 2024. https://www.who.int/tools/whoqol/whoqol-bref

WHO. 2023. "Climate Change." Accessed June 26, 2024. https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

Wu XY, LH Han, JH Zhang, S Luo, JW Hu, and K Sun. 2017. "The influence of physical activity, sedentary behavior on health-related quality of life among the general population of children and adolescents: A systematic review." *PLoS One* 12(11):e0187668. https://doi.org/10.1371/journal.pone.0187668

Wuerdeman M, A Banaag, ML Janvrin, and TP Koehlmoos. 2023. "A cohort study of BMI changes among U.S. Army soldiers during the COVID-19 Pandemic." *BMC Public Health* 23(1):1547. https://doi.org/10.1186/s12889-023-16460-7

Wyss T, RO Von Vigier, F Frey, and U Mader. 2012. "The Swiss Army physical fitness test battery predicts risk of overuse injuries among recruits." *J Sports Med Phys Fitness* 52(5):513-21. https://www.ncbi.nlm.nih.gov/pubmed/22976738

Y

Yaccobi R, and DH Johnston. 1986. "Garre's osteomyelitis: a case report." *Ont Dent* 63(12):13, 16. https://www.ncbi.nlm.nih.gov/pubmed/3468450

Yan GW, L McAndrew, EA D'Andrea, G Lange, SL Santos, CC Engel, and KS Quigley. 2013. "Self-reported stressors of National Guard women veterans before and after deployment: the relevance of interpersonal relationships." *J Gen Inter Med* 28(Suppl 2):549. https://doi.org/10.1007/s11606-012-2247-6

Yang Y, S Liu, M Ling, and C Ye. 2021. "Prevalence and Potential Risk Factors for Occupational Low Back Pain Among Male Military Pilots: A Study Based on Questionnaire and Physical Function Assessment." *Front Public Health* 9:744601. https://doi.org/10.3389/fpubh.2021.744601

Yanik M, MS Gurel, Z Simsek, and M Kati. 2004. "The psychological impact of cutaneous leishmaniasis." *Clin Exp Dermatol* 29(5):464-7. https://doi.org/10.1111/j.1365-2230.2004.01605.x

Yenerall J, and K Jensen. 2021. "Food Security, Financial Resources, and Mental Health: Evidence during the COVID-19 Pandemic." *Nutrients* 14(1). https://doi.org/10.3390/nu14010161

Yepson H, B Mazzone, S Eskridge, K Shannon, E Awodele, S Farrokhi, and B Mazzone. 2020. "The Influence of Tobacco Use, Alcohol Consumption, and Weight Gain on Development of Secondary Musculoskeletal Injury After Lower Limb Amputation." *Arch Phys Med Rehabil* 101(10):1704-1710. https://doi.org/10.1016/j.apmr.2020.04.022

Yoganandan N, BD Stemper, JL Baisden, FA Pintar, GR Paskoff, and BS Shender. 2015. "Effects of acceleration level on lumbar spine injuries in military populations." *Spine J* 15(6):1318-24. https://doi.org/10.1016/j.spinee.2013.07.486

York AK, DL Moss, and G Martin. 2008. "A longitudinal study of dental experience during the first four years of military experience." *Mil Med* 173(1 Suppl):38-41. https://doi.org/10.7205/milmed.173.supplement_1.38

You M. 2023. "Role of Physical Activity in the Prevention and Treatment of Influenza: A Review." *Sports Med Open* 9(1):115. https://doi.org/10.1186/s40798-023-00660-x

Young AJ and JW Castellani. 2007. "Exertional fatigue and cold exposure: mechanisms of hiker's hypothermia." *Appl Physiol Nutr Metab* 32(4):793-8. https://doi.org/10.1139/H07-041

Young AJ, and JW Castellani. 2001. "Exertion-induced fatigue and thermoregulation in the cold." *Comp Biochem Physiol A Mol Integr Physiol* 128(4):769-76. https://doi.org/10.1016/s1095-6433(01)00282-3

Young-McCaughan S, AL Peterson, J Mintz, WJ Hale, KA Dondanville, EV Borah, TH Blount, et al. 2022. "Testing the role of aerobic exercise in the treatment of posttraumatic stress disorder (PTSD) symptoms in U.S. active duty military personnel: a pilot study." *Cogn Behav Ther* 51(4):309-325. https://doi.org/10.1080/16506073.2021.2001689

Z

Zadik Y, U Jeffet, and L Levin. 2010. "Prevention of dental trauma in a high-risk military population: the discrepancy between knowledge and willingness to comply." *Mil Med* 175(12):1000-3. https://doi.org/10.7205/milmed-d-10-00150

Zafren K. 2021. "Nonfreezing Cold Injury (Trench Foot)." *Int J Environ Res Public Health* 18(19). https://doi.org/10.3390/ijerph181910482

Zajc I, D Brajdic, J Biocic, I Bosan-Kilibarda, V Kopic, S Siber, and D Macan. 2011. "The effect of tobacco use on oral health and dental readiness in the Croatian Army." *J Addict Dis* 30(2):159-68. https://doi.org/10.1080/10550887.2011.554783

Zang Y, T Gallagher, CP McLean, HS Tannahill, JS Yarvis, EB Foa, and Strong Star Consortium. 2017. "The impact of social support, unit cohesion, and trait resilience on PTSD in treatment-seeking military personnel with PTSD: The role of posttraumatic cognitions." *J Psychiatr Res* 86:18-25. https://doi.org/10.1016/j.jpsychires.2016.11.005

Zarkadis NJ, PJ Belmont Jr, MA Zachilli, CA Holland, AR Kinsler, MS Todd, MP Pallis, and BR Waterman. 2018. "Autologous Chondrocyte Implantation and Tibial Tubercle Osteotomy for Patellofemoral Chondral Defects: Improved Pain Relief and Occupational Outcomes Among US Army Servicemembers." *Am J Sports Med* 46(13):3198-3208. https://doi.org/10.1177/0363546518800713

Zemke JN, JL Sanchez, J Pang, and GC Gray. 2019. "The Double-Edged Sword of Military Response to Societal Disruptions: A Systematic Review of the Evidence for Military Personnel as Pathogen Transmitters." *J Infect Dis* 220(12):1873-1884. https://doi.org/10.1093/infdis/jiz400

Zhang D, W Chen, C Cheng, H Huang, X Li, P Qin, C Chen, et al. 2023. "Air pollution exposure and heart failure: A systematic review and meta-analysis." *Sci Total Environ* 872:162191. https://doi.org/10.1016/j.scitotenv.2023.162191

Zhang G, SM Zhou, C Yuan, HJ Tian, P Li, and YQ Gao. 2013. "The effects of short-term and long-term exposure to a high altitude hypoxic environment on neurobehavioral function." *High Alt Med Biol* 14(4):338-41. https://doi.org/10.1089/ham.2012.1091

Zimmermann P, S Firnkes, JT Kowalski, J Backus, S Siegel, G Willmund, and A Maercker. 2014. "Personal values in soldiers after military deployment: associations with mental health and resilience." *Eur J Psychotraumatol* 5:10.3402/ejpt.v5.22939. eCollection 2014. https://doi.org/10.3402/ejpt.v5.22939

Zinzow HM, TW Britt, CL Pury, K Jennings, JH Cheung, and MA Raymond. 2015. "Barriers and Facilitators of Mental Health Treatment-Seeking in U.S. Active Duty Soldiers With Sexual Assault Histories." *J Trauma Stress* 28(4):289-97. https://doi.org/10.1002/jts.22026

Zivich PN, JD Grabenstein, SI Becker-Dreps, and DJ Weber. 2018. "Streptococcus pneumoniae outbreaks and implications for transmission and control: a systematic review." *Pneumonia (Nathan)* 10:11. https://doi.org/10.1186/s41479-018-0055-4

Zogg CK, JH Lichtman, MK Dalton, PA Learn, AJ Schoenfeld, TP Koehlmoos, JS Weissman, and Z Cooper. 2022. “In defense of Direct Care: Limiting access to military hospitals could worsen quality and safety.” *Health Serv Res* 57(4):723-733. https://doi.org/10.1111/1475-6773.13885

Zou L, F Herold, S Ludyga, K Kamijo, NG Muller, MB Pontifex, M Heath, et al. 2023. "Look into my eyes: What can eye-based measures tell us about the relationship between physical activity and cognitive performance?" *J Sport Health Sci* 12(5):568-591. https://doi.org/10.1016/j.jshs.2023.04.003

Zwilling CE, A Strang, E Anderson, J Jurcsisn, E Johnson, T Das, MJ Kuchan, and AK Barbey. 2020. "Enhanced physical and cognitive performance in active duty Airmen: evidence from a randomized multimodal physical fitness and nutritional intervention." *Sci Rep* 10(1):17826. https://doi.org/10.1038/s41598-020-74140-7