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BARRIERS TO SLEEP IN US ARMY SERVICE MEMBERS: A SCOPING REVIEW

Sally Paul
Eastern Kentucky University, sally_paul13@mymail.eku.edu

BARRIERS TO SLEEP IN US ARMY SERVICE MEMBERS: A SCOPING REVIEW

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Sally Paul
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Executive Summary

Background: Insufficient sleep contributes to human health and performance deficits with Active Duty US Army soldiers being at highest risk for poor sleep and subsequent sleep disorders. Research in this area continues to grow and has focused on pathology and intervention, often related to deployment, yet it is vital to understand the barriers to sufficient sleep in healthy soldiers (the majority) in the garrison context, where they will spend most of their time.
Purpose: Explore the current state of literature regarding barriers to sufficient sleep in healthy US Army active duty service members in the garrison setting.
Theoretical Framework. Biopsychosocial Model
Methods. A scoping review was selected to explore and map the literature using the Population Context Content (PCC) and PRIMSA-ScR within Arskey and O'Malley's five stage framework.
Results. Twenty-nine articles were included in the final synthesis with the majority being observational research from self-report surveys. Findings support numerous biopsychosocial factors related to sleep including but not limited to functional impairment, injury, overweight/obesity, mood and anxiety, leadership, training environment, work schedule and physical environment.
Conclusions: Sleep is a complex interaction of biopsychosocial factors, is vital to understand the lived experience of soldiers and how Army publications are being integrated into the formations to effectively address this issue.

EASTERN KENTUCKY UNIVERSITY
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF OCCUPATIONAL SCIENCE AND OCCUPATIONAL THERAPY

CERTIFICATION OF AUTHORSHIP

Submitted to (Faculty Mentor's Name): ___Dr. Dana Howell_____
Student's Name: ___Sally Paul_____
Title of Submission: __Barriers to Sleep in US Army Service Members:
A Scoping Review _____

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Introduction

Military service members experience high rates of sleep loss. The current recommended sleep duration for adults is 7-9 hours daily and 8-10 hours for teenagers to reduce disease risk and optimize health (Watson et al., 2015). Approximately one-third of adults report short sleep duration (SSD), meaning less than 7 hours of daily sleep (CDC, 2020). In contrast, data on military service members suggests that 69-72% experience SSD (Good et al., 2020), resulting in sleep deprivation with nearly one-third reporting a moderate or severe lack of energy attributed to poor sleep (Meadows et al., 2018). Duration of sleep is only one factor; it is also important to consider the quality of sleep, which can be difficult to measure. When sleep is fragmented it can greatly impact the restorative effects of sleep. As scientific knowledge in the field of sleep science emerges, awareness and concern surrounding sleep among military service members has become a growing area of focus, considering the wide-ranging impact that sleep loss can pose to performance, safety and ultimately force readiness (Department of Defense [DOD], 2021).

Data from military sleep literature that focuses on the cognitive and performance outcomes of sleep deprivation are well established and continue to expand (Good et al., 2020), demonstrating that even one night of sleep loss negatively impacts both mental and physical factors. Short-term sleep deprivation has been shown to reduce aerobic capacity, muscular endurance and military task performance such as marksmanship (Grandou et al., 2019). It has also been shown to result in a 25% to 30% drop in testosterone (Mantua et al., 2020). It is well established that poor sleep has an accumulating negative impact on multiple aspects of cognition (Petrofsky et al., 2021). There also appears to be a relationship between injury and sleep loss (Lisman et al., 2022). In the complex and ever evolving arena of national defense, there is increasing pressure to optimize service member health and performance with improved sleep being an obvious target.

Sleep disorders such as insomnia or obstructive sleep apnea (OSA) have been surging in the military population within the previous two decades. Between 2005 and 2019, DOD incidence rates of OSA and insomnia increased 30-fold from 11 to 333 in 2016 and over 45-fold from 6 to 272 in 2015 (per 10,000), respectively (Moore et al., 2021). Chronic sleep loss can co-occur frequently with multiple mental health conditions such as post-traumatic stress disorder (PTSD), traumatic brain injury (TBI), military sexual trauma (MST), anxiety, and depression (DOD, 2021). Recent literature has shown sleep loss is associated with high-risk behavior (Mantua et al., 2021) and suicidal ideation (Paxton et al., 2021; Wang et al., 2019). Additionally, in active duty personnel, SSD was associated with higher odds of any medical condition (Hruby et al., 2018) including hypertension, obesity and diabetes (Hruby et al., 2020; Lewis et al., 2014) as well as pain (Bader et al., 2022; Highland et al., 2022; Ransom et al., 2022). As awareness of population-level challenges and outcomes related to sleep management have increased, so has the literature related to pathology and diagnosis (Moore et al., 2021), treatment interventions such as cognitive behavioral therapy for insomnia or CBT-I (Kelly et al., 2019) and the systemic barriers to care (Abdelwadoud et al., 2022; Mysliwiec et al., 2022).

Research suggests that within the military population, active duty Army soldiers are the highest risk group for SSD (Chapman et al., 2015) and sleep disorders (Cooper et al., 2021; Moore et al., 2021) with nearly half having a sleep-related diagnosis (Devine et al., 2020). Combat exposure and deployment is another established risk factor for disrupted sleep (Markwald et al., 2021; Petrofsky et al., 2021; Troxel et al., 2015). Much of the current knowledge and research surrounding military sleep has a focus on deployment in addition to PTSD and/or TBI (DOD, 2020). The Global War of Terrorism drawdown has significantly decreased the frequency and duration of personnel deployed, with more time spent in the

garrison setting. The garrison context includes the base where soldiers are stationed as well as field training exercises and military training schools. In addition, the garrison settings may include 24-hour duties or shift work, additional tasking details, early work calls, and late evenings (Moore et al., 2021), yet daily operations may be highly variable due to the unit, its mission, military occupations and leadership (Troxel et al., 2015). Environmental factors such as light, noise, air quality, temperature and sleeping surface can also impact sleep duration and quality in this setting (DOD, 2021; Mantua et al., 2019).

The inherent need of active duty US Army soldiers to be mission-ready, coupled with poor sleep, supports a prevalence of 82% reporting consistent caffeine use to maintain levels of alertness and performance (Lieberman et al., 2012). Although caffeine is known to improve performance and mitigate some deficits of sleep loss (Kamimori et al., 2015), it can inhibit the ability to fall asleep as well as decreasing sleep duration and increasing psychiatric symptoms (Chaudhary et al., 2021). There is also a pervasive culture in the military of disregarding the need for sleep in deeply rooted behaviors and beliefs viewing the need for sleep as a weakness that is often stigmatized (DOD, 2021; Good et al., 2020; Teheyan et al., 2021). Attaining sufficient sleep can be further challenged in young adults due to a phase delay in the circadian rhythm, which results in a tendency to fall asleep and sleep in later that is objectively misaligned with the Army daily rhythm (Good et al., 2020).

Army Sleep Initiatives and Publications

Within the last decade, the US Army has introduced holistic evidence-based initiatives that seek to improve soldier performance, readiness and health from the medical facilities to the frontlines (Caravalho, 2015). These include The Performance Triad (US Army, 2013) and more recently the Army-wide Holistic Health and Fitness (H2F) with the field manual 7-22

(Department of the Army [DOA], 2020). Both programs identify sleep as a pillar of health, recommending 7-8 hours of sleep during a 24-hour period and promoting sleep as a mission essential component of operational effectiveness. Specific and strategic recommendations are made including sleep-banking prior to and following nocturnal training exercises through sleep extension; tactical napping to combat sleep loss; and creating a sleep/rest plan for training events as a component of high-quality leadership (DOA, 2020; US Army, 2013; US Army, 2016). Within field training exercises, Army Techniques Publication ATP 3-21.8 states minimum sleep standard is four hours continuous or five hours non-continuous within a 24-hour period (US Army, 2016) as a part of the sleep and rest plan to be developed and carried out by platoon and squad leaders. Despite US Army guidance on sleep, these practices are not formal regulations and that has led to limited implementation and awareness (Good et al., 2020; Troxel et al., 2015).

The Role of Occupational Therapy in Military Sleep Readiness

The disconnect between evidence-based Army publication guidance and the reality within the Army formations is a complex barrier that the H2F implementation seeks to address through embedded interdisciplinary healthcare teams in a performance-based model (DOA, 2020). Within this team, occupational therapists are the primary provider in the sleep readiness and mental readiness domains. Sleep readiness is guided by FM 7-22 including education, promotion, leadership engagement, and planning for periods of insufficient sleep (DOA, 2020), but the directive also allows for individualization. Occupational therapists are uniquely qualified to assess the individual and population needs from a systems-based approach to understand the barriers to optimal occupational performance and providing recommendations and interventions to improve outcomes (American Occupational Therapy Association, 2020).

Problem Statement

While there is increasing research on the issue of sleep disruption within the military setting, the focus is heavily on outcomes of sleep deprivation and the impact of deployment on sleep, often related to a sleep or mental health diagnosis (Good et al., 2020). A recent systematic review (Petrofsky et al., 2021) explored the impact of sleep deprivation on cognitive performance and found the most significant impacts on decreased reaction time, processing speed, response accuracy, and moral decision-making. A congressional report on the effect of sleep deprivation on readiness (DOD, 2020) suggested that sleep may be the most important biological factor to combat readiness and effectiveness within the armed forces. A review by Good et al. (2020) dove deep into the prevalence, co-morbid pathology, and treatment of sleep issues within the military operational setting. One review focused on the environmental barriers to sleep in the operational context finding light, noise, temperature, air quality, and sleeping surface impacting sleep duration and quality (Mantua et al., 2019).

Another scoping review looked at the association between musculoskeletal injuries and sleep (Lisman et al., 2022) and found evidence supporting a relationship between poor sleep and injury. A scoping review on sleep health in military women identified documented gender differences, research gaps and the need to leverage more preventative actions (Siaki, 2021). Recent research indicates military women may experience insomnia at higher rates (Polyne et al., 2021). A military sleep review by Rand Corporation (Troxel et al., 2015) found sleep issues common among service members, particularly post-deployment that can lead to mental health disorders with evidence supporting the use of cognitive behavioral therapy interventions. Recommendations were made to increase education, policy and research related to sleep within the Department of Defense (Troxel et al., 2015).

Most of the current military sleep literature examines various outcomes of insufficient sleep both acutely and chronically. There is a limited focus on the garrison setting, where soldiers spend most of their time, and the barriers that soldiers in garrison without a diagnosed sleep or mental health disorders (the majority of soldiers) face to obtain sufficient sleep. Studies have identified active duty Army soldiers being the most at-risk subgroup (Chapman et al., 2015; Cooper et al., 2021; Moore et al., 2021) and further examination of this population and context is needed.

Aim/Purpose

The purpose of this study is to explore the barriers related to obtaining sleep for active duty US Army soldiers in the garrison context.

Methods

The methodological framework guidance proposed by Arskey and O'Malley (2005) was used to guide this scoping review and further expansion of this model from Leval et al. (2010) to explore and map the current literature in order to clarify the breadth and depth of knowledge on the issue, including gaps in the literature. A scoping review of the barriers in this population and context was chosen over a systematic review based on guidance by Munn et al. (2018) to increase clarification of the issue and refine for future research studies. This information will provide a greater understanding to inform stakeholders, programming and policy related to sleep in this context with implications for more proactively addressing this issue.

Stage 1: Identifying the research question. The aim of this scoping review was to examine the extent and nature of research related to sleep in the general population of active duty US Army soldiers within the garrison context. What is the current state of literature regarding barriers to sufficient sleep in healthy US Army active duty service members in the garrison setting?

Stage 2: Identifying Relevant Studies. The Population-Concept-Context framework (Peters et al., 2015) was used to evaluate peer-reviewed articles for inclusion published between 2012 and 2022. Search terms were tested in an iterative process in consultation with a librarian. A final search was performed in Pubmed and Ebscohost with search terms "United States" AND "Army" AND "Active Duty" AND "Sleep" with exclusion terms of "deployment", "PTSD", "TBI", and "veterans". Only English language studies were included. References lists were examined and a hand search for further articles meeting inclusion criteria. Original peer-reviewed research studies were examined for inclusion (see Table 1).

Table 1. Inclusion and Exclusion Criteria based on the Population-Concept-Context Framework

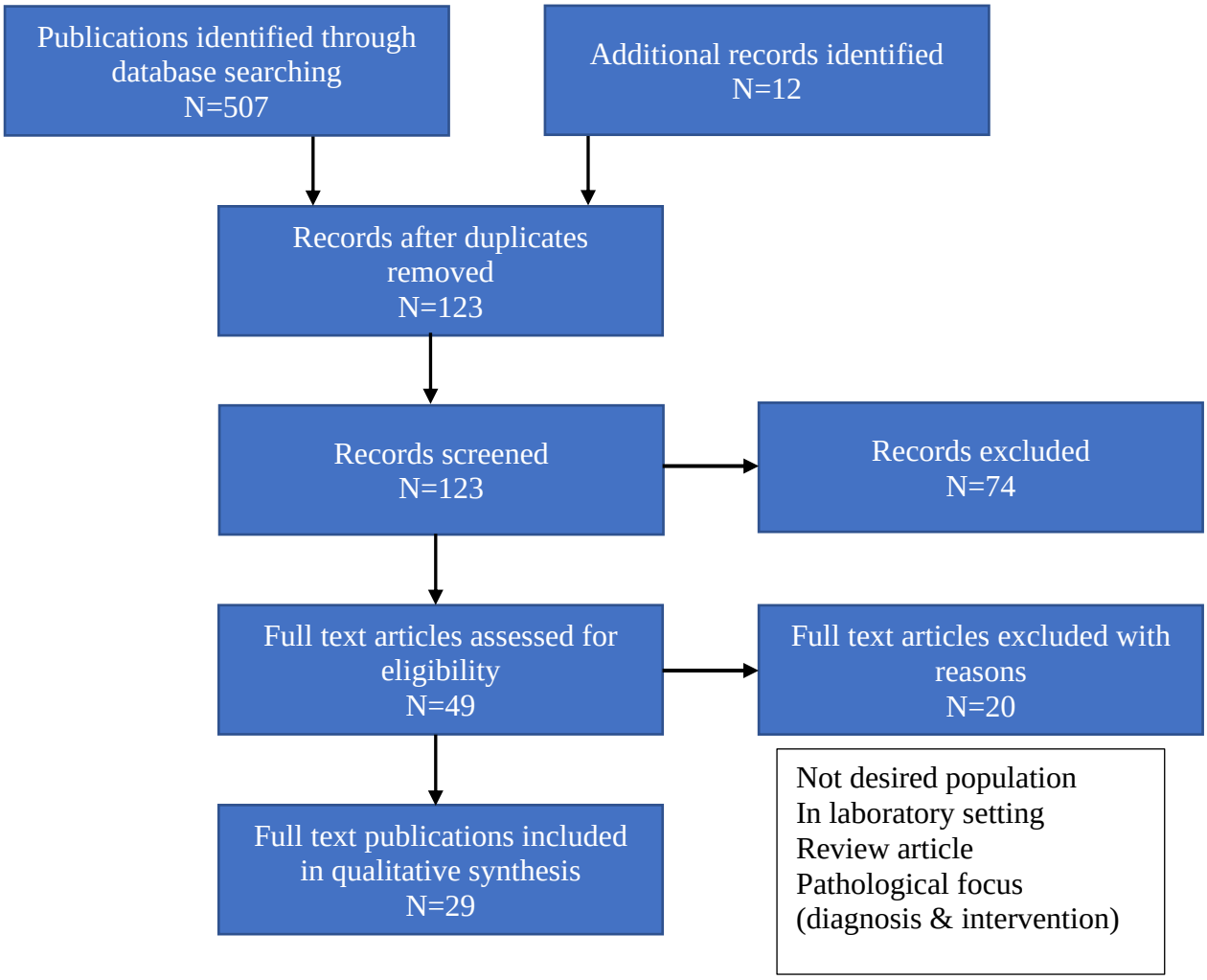
PCC Element	Inclusion and exclusion criteria
Population	Studies of healthy general population US Army active duty soldiers. This did not include reserve, national guard, or veterans.
Concept	Studies that aimed to identify aspects of soldiers' sleep including person and environment barriers, risk factors and associations. Excluded were studies that examined diagnosing and treating sleep disorders.
Context	Studies based in the garrison setting were included, this also covers Army training and schools. Studies conducted related to combat deployment and those that examined sleep in a laboratory or outside the natural setting were excluded.

Stage 3: Study Selection

After removing for duplicates and obviously irrelevant results from the database search, a total of 123 articles abstracts were screened for initial inclusion. Twelve articles from a hand search and reference list review were also screened. A total of 49 articles identified as potentially appropriate were read in full-text and matched against established PCC criteria and research

questions with 29 meeting inclusion criteria for the final synthesis. Reasons for article exclusion include- not desired population, laboratory setting, review article, and/or pathological focus. The PRIMSA diagram describes the review and selection process of articles for this study presented in (Fig. 1).

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRIMSA) extension for Scoping Reviews diagram (Tricco et al, 2018).



Stage 4: Charting the Data

Data for the final 29 articles was extracted into a word table. See Table 2.

Table 2. Description of the Included Articles

Authors	Study Purpose	Design	Population	Data Collection	Findings Related to Sleep
Adler et al., 2021 [2]	Examine the impact of training military leaders in sleep health on leaders and unit members.	Randomized Controlled Trial	N=524 AD Army Leaders and unit members	Leadership and unit member questionnaires.	Leaders improved sleep knowledge and attitudes. More unit members with leaders in training reported 7 hours of sleep per 24 hours and their leaders engaged in sleep behaviors at least sometimes compared to control.
Brager et al., 2021 [7]	Determine the extent of generalized comorbidity of sleep disorders with obesity, tobacco use, and substance abuse across all installations.	Observational	N=471,000 AD Army	Health incidences into percentiles green, amber, red based on location	Large combat arms and training installations of the Southern U.S. were at highest risk for sleep disorder. High co-morbidity with obesity/overweight, tobacco use and substance abuse.
Choynowski et al., 2019 [12]	Investigate sleep during simulated combat and assess whether six armored companies were able to meet the Army minimum standard of sleep each day.	Observational	N=150 AD Army	Actigraphy watch measuring total sleep time.	90% of tankers were unable to meet minimum sleep standards of 4 hours consistently during simulated operation.
Conway et al., 2020 [13]	Examine if disrupted sleep may serve a mechanistic function connecting adverse childhood experiences to functional impairment and poorer mental health.	Observational	N=759	Questionnaire	Evidence for an indirect effect of ACEs on mental health outcomes and functional impairment through disrupted sleep.
Cooper et al., 2020 [15]	Examine the health and health-related behaviors of Army Special Forces personnel in comparison with two distinct, but functionally similar Army groups.	Observational, Longitudinal, Cohort	N=5392 AD Army	PTSD Checklist–Civilian Version, PHQ, Medical Outcomes Short Form 36-Item Health Survey for Veterans (SF-36V), and Health-related behaviors survey.	SF personnel significantly less like to report sleeping 5 or less hours or trouble sleeping compared with infantrymen. Special Forces personnel reported the lowest prevalence of mental disorders, physical health problems, and unhealthy behaviors.
Crowley et al., 2012 [16]	Obtain a qualitative assessment of soldiers' perceptions about their sleep and consequences of	Descriptive, Qualitative	N=66 AD Army Trainees	Focus groups with 9 semi-structured questions pertaining to sleep.	Soldiers reported reductions in their sleep duration and quality, which were attributed to many factors, particularly noise, nighttime work detail, stress, and hunger. These sleep changes had many perceived

	sleep disruption during BCT.				negative effects on performance, mood, and other components of BCT. These effects were more evident in soldiers of lower physical fitness.
Devine et al., 2019 [18]	Identify patterns of sleep before, during and following operations in order to pinpoint how sleep loss affects the mission and in what ways fatigue can be minimized.	Descriptive Quantitative	N=46 AD Army	Actigraphy sleep measurement	Significant sleep loss during 72 hour mission, averaged 3 hours during mission, 5 hours before/after, chronic sleep deficit.
Elliman et al., 2022 [20]	Examine self-reported rates of physical injuries in drill sergeants; rates of treatment-seeking for injuries; perceived barriers toward treatment-seeking; and associated demographic and environmental factors.	Observational	N=726 AD Army Drill Sergeants	Survey of sleep duration, leadership, cohesion and injury status and if they sought medical help	Injuries were less likely in drill sergeants reporting at least 6 hours of sleep (27%) versus those reporting 5 hours (40%) and 4 hours or less (43%).
Golenbock et al., 2017 [22]	Identify correlates of a single-item measure of health in Army personnel.	Observational	N=8070 Army	Army's global assessment tool (GAT) 2.0, self-report of health, single item from survey.	Sleep quality was the largest correlate to self-rated health with those who reported better sleep were approximately 2.5 times more likely to report better overall health.
Grier et al., 2020 [25]	Evaluate the relationship between sleep duration and musculoskeletal injury incidence in a population of physically active men and women.	Observational	N=7576 AD Army Special Operations	Sleep duration and injury status survey.	Soldiers who slept ≤ 4 hours were 2.35 times more likely to experience a musculoskeletal injury compared with those who slept eight ≥ 8 hours.
Hill et al., 2020 [29]	Determine if social media use is associated with insufficient sleep among a sample of U.S. Army soldiers.	Observational	N=9052 AD Army	PHQ-2, GAD-2, weekly media use, sleep duration (hrs), exercise duration, hazardous drinking survey.	No relationship between excessive social media use & insufficient sleep, however, hazardous alcohol consumption, anxiety, and depression were significantly associated.
Hsu et al., 2018 [32]	Assess demographic information, work hours, and knowledge of and	Observational	N=1003 AD Army physicians	Performance Triad (sleep, exercise, nutrition) knowledge	Better sleep was associated with being a staff physician (compared to resident/trainee), working fewer hours per

	adherence to P3 of active duty Army physicians.			and health behaviors survey.	week and belief in supervisor adherence to performance triad.
Lentino et al., 2013 [35]	Assess various health behaviors and habits of US Army Soldiers and their relationship with poor sleep quality.	Observational	N=14148 Army	Global Assessment tool (GAT) including PIRS.	Significant associations between quality of sleep and physical performance, nutritional habits, measures of obesity, lifestyle behaviors and measures of psychosocial status. Poor sleepers significantly more likely to report fair or poor health, be overweight or obese, not meet exercise recommendations and experience the lowest scores in social, emotional, family and spiritual fitness dimensions.
Kelley et al., 2018 [40]	Gauge the extent to which U.S. Army aviators experience subjective fatigue on a regular basis presently as well as their perceptions of their own sleep quality, quantity, and daytime sleepiness.	Descriptive, quantitative	N=214 Army Aviators	125 item Questionnaire, 15 related to fatigue	Reporting less than desired amount of sleep and citing barriers of inconsistent shiftwork, less than optimal levels of rest, and poor sleep quality in the field. Viewed widespread fatigue as an issue, but numbers reduced from 15 years prior.
Mantua et al., 2021a [41]	Examine if insufficient sleep in a military population is linked to high risk behavior.	Observational	N=2,296	PSQI, ISI, sleep duration and High-risk behavior (yes/no)	Poor sleep quality slightly elevated the risk for committing HRBs. Longer sleep duration reduced the risk for HRBs.
Mantua et al. 2021b [44]	Assess the relationship between sleep quality and occupational well-being in active duty military Service Members	Observational, Longitudinal, Cohort	N=60 AD Army Special Operations	PSQI, PSS, Role Overload Scale, WRAIR Soldier Specific Functional Impairment Scale.	Soldiers with poorer sleep quality may be at higher risk for having poorer occupational wellbeing.
Mantua et al., 2021c [45]	Assess whether the sleeping environment in garrison is related to sleep quality, insomnia risk and military readiness.	Observational	N=74 AD Army Special Operations	Survey of sleeping surface comfort, frequency of being awakened at night by excess light, abnormal temperatures and noise. PSQI and ISI, and measures of soldier readiness, including morale, motivation, fatigue, mood and bodily pain.	Temperature and light awakenings associated with poorer sleep, fatigue and body pain. Lower ratings of sleeping surface comfort were associated with poorer sleep quality and lower motivation, lower morale, higher fatigue and higher bodily pain. Those living on base had a poorer sleeping environment than those living off base.

Mantua et al., 2022 [46]	Tested whether a survey can classify U.S. Army Soldiers as cognitively vulnerable or resilient to sleep loss and whether Soldiers in these differentiated groups have the expected allele variants.	Observational	N=75 AD Army Special Operations	Bloodtest genetic alleles, battery of cognitive tests and iRest Iowa Resilience to Sleeplessness Test	82% of soldiers with behavioral vulnerability to sleep loss also had alleles linked to vulnerability. Possible genetic component to sleep loss resilience and vulnerability.
McDonald et al., 2019 [48]	Examine the link between these individual sleep knowledge, goals, and habits and self-reported sleep quantity in a military setting.	Observational	N=2528 AD Army	PSQI (adapted), sleep knowledge, goals and habits questionnaire.	Better sleep knowledge, goals and habits were more likely to report greater than 7 hours of sleep per 24-hour period. Those with a goal of 7 hours, had a 2.8-fold greater chance to meet that.
Mickelson et al., 2020 [50]	Examine the relationship between sleep duration, resilience, and Soldier well-being during a deployment-readiness training event.	Observational	N=76 AD Army Special Operations	N=76, iRest and subjective measures of sleep, Walter Reed Functional Impairment Scale	Less resilience to sleep loss also predicted higher functional impairment. An interaction between sleep duration and resilience predicted Soldier impairment. Individuals with both shorter sleep duration during training and less resilience had the highest functional impairment.
Miller et al., 2012 [51]	Evaluate the effect of accommodating adolescent sleep-wake patterns by altering the timing of the major sleep period of US Army recruits.	Quasi-experimental	N=392 AD Army Trainees	two sleep schedules: 2030-0430 (control) and 2300-0700 (delayed sleep onset) with demographic, psychological and performance measures.	Sleep duration, quality, mood, marksmanship and fatigue all improved in the intervention group.
Ritland et al., 2021a [60]	Examine the sleep health of incoming Army trainees and how it is impacted during basic combat training.	Observational, cohort	N=1346 AD Army Trainees	(PSQI), the Morningness/Evening ness Questionnaire, and the Epworth Sleepiness Scale at beginning BCT and modified PSQI at end.	Significant decrease in sleep duration, as well as worse sleep quality, and daytime dysfunction occurred during training.
Ritland et al., 2021b [61]	Investigate the association between self-reported sleep and musculoskeletal injury in Rangers.	Observational	N=82 AD Army Special Operations	PSQI, ISI and injury status	Those with MSK injuries, more likely to report poor sleep quality with higher with higher PSQI & ISI scores.

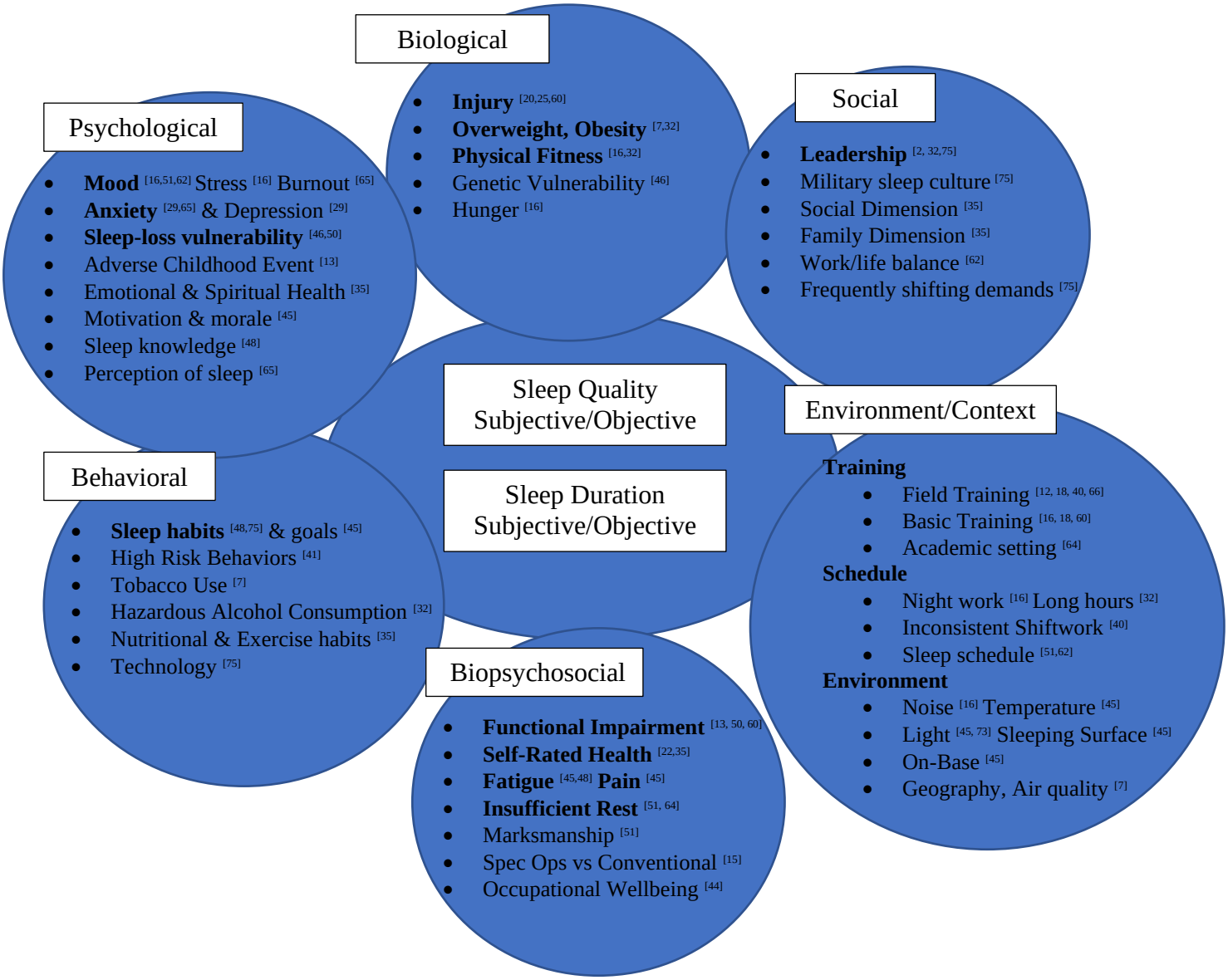
Shattuck et al., 2015 [62]	Assess effectiveness of an alternative, 24-hr-on/72-hr-off schedule on sleep and morale of personnel assigned to the President's Emergency Operations Center (PEOC).	Observational	N=14 AD Military	POMS at 3 intervals, post-study questionnaire and actigraphy.	Shiftwork from 12 hour shift to 24 on 72 off with 5 hour sleep built in. Mood improved significantly. Objective sleep duration not changed, but consistency, work life balance (family time & commute) and subjective feelings of rest improved.
Sipos et al., 2019 [64]	Characterize the stressors facing military students, document their mental health status and well-being, and identify mitigating factors such as coping, social support, time management, and the classroom environment.	Observational	N=759 AD Army students	Self-report surveys including demographics, student experience, mental health and burnout, and mitigating factors.	Over 50% of students report lack of sleep as top concern, as well as meeting expectations and pressure to succeed.
Skeiky et al., 2018 [65]	Measure sleep via self-report and actigraphy, as well as indicators of mental health, during qualification training for a real-world contingency mission in Eastern Europe. Shorter sleep was hypothesized to positively correlate with indicators of poor health such as anxiety, PTSD, burnout, and insomnia.	Observational	N=167	Actigraphy, GAD-7, 4-Item PCL, the Emotional Exhaustion Scale, and the ISI.	Significant difference between self-reported sleep and sleep measured with actigraphy. On average, participants reported 1.53 hours less sleep per day than what was measured with actigraphy. Moreover, there was a negative relationship found between self-reported sleep and the measured health variables of insomnia, anxiety, burnout, PTSD.
St. Pierre et al., 2019 [66]	Examine the variance in subjective sleep quality between groups.	Observational	N=246 AD Army	PSQI, ISI. Test-Retest	Significant sleep decrease T2-T1 and increased sleep issues for 3 of the 4 BNs. One BN reported less sleep issues at T2.

Watkins et al., 2021 [73]	Present a public health case study in the U.S. Army and demonstrate how Army Design Methodology facilitated the subsequent implementation of public health recommendations.	Case Study	AD Army Barracks rooms at Ft Wainwright AK	N/A	Installing blackout curtains at all barracks at an Alaskan Army Base to support healthy sleep/wake cycles.
Woods, Y., & Tennekoon, R., 2018 [75]	Evaluate the effectiveness and perceptions of an occupational therapy–based sleep hygiene program to promote sleep behavior, sleep quality, and occupational performance in service members.	Mixed Methods	N=9	PSQI, ISI, COPM, Interview	Themes: SMs attempting to alter their sleep behaviors and practices: performance and quality of sleep, adapting to frequently shifting demands, the dual role of technology, sleep's role in leadership, and navigating the military's sleep culture.

Stage 5: Results

A total of 29 research articles met inclusion criteria and were included in the final synthesis. All 29 research articles focused on active duty US Army in the garrison context. Further classification of sample groups among the studies were general population soldiers (52%), special operations (24%), basic training or military school (17%) and niche occupations (7%, i.e. aviators, physicians). The majority of research studies (22) were observational research that aimed to examine correlation or association between multiple variables from self-report surveys or questionnaires. There were three descriptive studies, one randomized controlled trial, one quasi-experimental, one mixed method and one case study. Sample size ranged from n=9 to the entire population n=471,000.

Figure 2. Findings of Factors Associated with Sleep Within a Biopsychosocial Model



A biopsychosocial approach was used to examine, interpret and present the findings in this scoping review, presented in Figure 2. The complex experience of sleep is impacted by biological, psychological and social-contextual elements. The biopsychosocial model has been applied to sleep in adolescence (Becker et al., 2015), the age when most individuals enter the Army. This model also serves as the foundation for the Army H2F interdisciplinary

programming, where sleep is a key pillar (DOA, 2020). The biopsychosocial model was developed as framework to understand health and disease through the interacting factors rather than a more reductionistic view of the medical model (Engel, 1977).

Biological

Barriers identified from a biological perspective included associations with being overweight or obese and poor sleep (Lentino et al., 2013). Army soldiers with musculoskeletal injuries were more likely to report poorer sleep, scoring higher on insomnia questionnaires (Ritland et al., 2021b) and soldiers who slept ≤ 4 hours were 2.35 times more likely to experience a musculoskeletal injury compared with those who slept eight ≥ 8 hours (Grier et al., 2020). A study of drill sergeants found injuries less likely in those reporting at least six hours of sleep, compared with five or less (Elliman et al., 2022). Two studies examined and supported the concept of some soldiers being more resilient to sleep loss and others being more vulnerable and assessing for this disposition (Mickelson et al., 2020) and even connecting to genetic markers (Mantua et al., 2022). Those who were more vulnerable, demonstrated increased functional impairment with shorter duration sleep (Mickelson et al., 2020).

Psychological

The findings support psychological barriers associated with poor sleep including burnout and anxiety (Skeiky et al., 2018) and adverse childhood experiences indirectly impacting sleep (Conway et al., 2020). Soldiers' social, emotional and spiritual domains of health were correlated with their sleep (Lentino et al., 2013) as well as their self-report of health (Golenboch et al., 2017), with insufficient sleep associated with poorer outcomes in these areas. One study found over 50% of military students reported lack of sleep as a top stressor to daily life (Sipos et al., 2019). Soldiers that had better sleep knowledge, habits and reported sleep goals were more

likely to report sufficient sleep, and those with a goal of 7 hours of nightly sleep had a 2.8-fold increase of attaining it (McDonald et al., 2019). One study looked at the relationship between social media use and poor sleep and although no association was found, evidence for an association between poor sleep and hazardous alcohol consumption, anxiety and depression was found (Hill et al., 2020). A mega-analysis found longer sleep duration reduced risk for high-risk behavior and poor sleep quality increased risk for high risk behavior and (Mantua et al., 2021a).

Socio-Environmental

The Army social and environmental components were explored or produced findings in 50% of the studies examined, demonstrating a relationship with soldiers' sleep. Multiple studies focused on the field training environment and the notable sleep loss that occurs within these exercises (Choynowski et al., 2019; Devine et al., 2019; Skeiky et al., 2018; St. Pierre et al., 2019) with one study finding that 90% of soldiers were unable to meet the four-hour minimum sleep standard (Choynowski et al., 2019). None of the studies addressed if a sleep and rest plan were a part of the field training exercises as recommended in ATP 3-21.8 (US Army, 2016).

This would be important to understand if the opportunity to sleep was not available or what barriers were present.

Three studies examined sleep within the basic combat training (BCT) setting and found significant changes to soldiers' sleep duration and quality over the course of BCT resulting in daytime dysfunction (Ritland et al., 2021b), and a negative impact on performance, mood, and military tasks, most evident in those with lower physical fitness (Crowley et al., 2012). Another BCT study showed improved sleep and mood with a phase delayed schedule (2300-0700) more aligned to the young adult brain when compared with the standard (2030-0430) (Miller et al., 2012). Longer work duration and shiftwork were also shown to have a significant impact on

sleep in physicians (Hsu et al., 2018), aviators (Kelley et al., 2018) and on guard duty (Shattuck et al., 2015). These findings suggest that initial military training can negatively impact soldier sleep and the specific timing and duration of work beyond the training setting can increase sleep issues.

A study exploring the physical environment found temperature, light and sleeping surface to impact sleep and increased reporting of fatigue and body pain; it also found those living on-base to have poorer sleep (Mantua et al., 2021c). A case study in Alaska used funds to place blackout curtains in all on-base soldiers sleeping quarters to support health circadian sleep/wake cycles (Watkins et al., 2021). A population risk analysis found combat arms units in the southeastern US to be most at risk for disordered sleep (Brager et al., 2021). Leadership was another theme found in three of the studies, suggesting that the culture created by leadership knowledge and attitudes towards sleep and rest had the ability to hinder or support their subordinates sleep (Adler et al., 2021; Hsu et al., 2018; Woods & Tennekoon, 2018).

Multiple Domains

Some articles explored or had findings that fell within two or all areas of the biopsychosocial model. For example, a basic training study found hunger (biological), stress (psychological) as well as noise and nightwork (social-contextual) as barriers to sleep (Crowley et al., 2012). Additional articles that had overlapping findings within the biopsychosocial model include one study found special operations soldiers as having better sleep, mental and physical health compared to conventional forces (Cooper et al., 2020). Another study on special operations soldiers self-reported outcomes of increased functional impairment and reduced occupational wellbeing related to poor sleep (Mantua et al., 2020b). A mixed methods study of an occupational therapy-based sleep program found overlapping biopsychosocial themes of

attempting to change behaviors/practices around sleep, the dynamic and complex challenges of adapting to frequently shifting demands, the dual role of technology, sleep's role in leadership, and navigating the military's sleep culture (Woods & Tennekoon, 2018). Two studies looked at soldiers' "self-report of health" and found sleep quality as the largest correlate to self-rated health with those reporting better sleep being 2.5 times more likely to report better overall health (Golenbock et al., 2017) and the other found poor sleepers significantly more likely to report fair or poor health (Lentino et al., 2013).

Discussion

The findings of this scoping review suggest that barriers to sleep within the active duty garrison context are a complex interaction between psychological, behavioral, social, environmental and biological factors. These person and environment factors impact individual soldiers differently in this setting that is high-risk for suboptimal sleep and rest. Ultimately, this impacts soldier performance and readiness with both the short-term and long-term health consequences. Sleep duration and sleep quality are biological components, yet most of the data is self-report survey that might not be able to fully grasp the lived experience. Additional concerns of how US Army sleep culture could impact individual responses or survey fatigue from an over-surveyed population are possible. The findings suggest that soldiers' perception (psychological) of their sleep duration and quality is central to their daily experience, health, and performance. A study that included self-report sleep duration data compared with actigraphy found soldiers reporting over 1.5 hours less daily sleep than actigraphy measurements (Skeiky et al., 2018). The concern here is that soldiers' perception of their sleep might not be accurate.

The emerging research area of sleep loss vulnerability in the findings suggest that some soldiers may be more resilient to insufficient sleep from a psychological and biological

perspective, which may be important knowledge to leverage, but how would the military leverage that ethically. The psychological impact of poor sleep was found to most associated with mood and connected with stress, anxiety, and burnout which are often the precursors to mental health disorders. Adverse childhood were connected to poor sleep, suggesting that historical trauma, beyond the military diagnosis of PTSD and MST, play a role in individual sleep patterns.

Consistent with current literature, the field training environment was a notable area for sleep loss. One study of four groups in a field training exercise, had one group improve sleep in the field (St. Pierre et al., 2019). This is interesting to understand if they executed a sleep/rest plan or if it was leadership driven that they were able to increase sleep in this setting. Another study looked at sleep prior to, during and post-field training and found chronic sleep loss throughout with soldiers reporting 5 hours nightly sleep pre, post and 3 hours during operation (Devine et al., 2019). Another theme that emerged was the work schedule with work duration, night work, inconsistent shiftwork, and work/sleep schedule impacting sleep quality and duration with connections to insufficient rest and increased fatigue. In this setting, the mission comes first, yet the findings suggest that long, nocturnal, inconsistent and early schedules negatively impact sleep, resulting in reduced mental and physical performance.

Within the military multiple tiers of leadership execute rapidly changing daily operations and multiple studies pointed to the impact that leadership knowledge, behaviors and attitudes towards sleep has on soldiers. This is important to understand within military sleep culture, where minimal sleep has been perceived as a badge of honor signaling importance and/or toughness. When leaders understand the impact of sleep on readiness and performance, a shift can take place with those under their influence leading to real outcomes in sleep improvement.

The social and environmental/contextual findings suggest multiple significant barriers and reveal the need to engage with unit leaders.

The US Military sleep research has heavily focused on pathology including the diagnosis and treatment often in relation to deployment, yet the findings suggest sleep deficits are developing in initial military and continuing to grow within the formations due to multiple, complex individual and environmental factors in this dynamic system. Future research that explores the soldiers in the garrison context deeper can help unveil the day-in-day-out socio-cultural, environmental, psychological, behavioral, and biological components in order to drive more effective policies, education, and interventions that are aimed at prevention, pre-pathology detection, and more accessibility. The findings support the need to get closer to the frontlines in addressing all aspects of sleep health.

Implications for Practice

The current US Army initiatives and publications including the Performance Triad (US Army, 2013), H2F with FM 7-22 (HQ US Army, 2020), and ATP 3-21.8 (US Army, 2016) all contain evidence-based approaches for leaders and soldiers to manage sleep, rest and fatigue in the garrison setting. It is vital to understand how these documents are being utilized within units and increasing their use to support soldier health and performance. Addressing unit specific policies with 24-hour duties, work details, and work call times following nocturnal missions to assess for safety, performance and maximizing force readiness will also be an important path forward. Integrating the educational aspects from these manuals combined with occupational therapists providing embedded care can be frontline tools to promote healthy sleep and improve soldiers' sleep, but the findings suggest this must be integrated within the daily culture through supportive leadership that is aware of the connection between sleep and total soldier health.

Much of the pressure has been on military treatment facilities primary care, behavioral health and sleep providers that are already overloaded. The role of the embedded occupational therapists within H2Fs are uniquely suited to facilitate these advancing endeavors through evidence-based initiatives. The findings suggest that all health-related positions within the units and H2Fs such as medics, physical therapists/assistants, athletic trainers, dieticians, as well as strength coaches may have a role in promoting and addressing the basic tenets of sleep with their soldiers' due to the physical associations and outcomes related to performance, injury and overweight/obesity. The findings support that soldiers with injuries, increased psychological stress and those overweight should also have their sleep patterns addressed. Active duty US Army soldiers need to be rested and ready to engage at the highest level possible under unknown circumstances and insufficient sleep is a factor impacting readiness with both short-term and long-term consequences to mental and physical performance and health.

Occupational therapists must continue to increase the level of education, training and knowledge in the universal daily activity of sleep that touches all other aspects of daily life and health. The US Army is implementing the first large-scale use of occupational therapists as sleep educators and providers. Not only is this an important opportunity for the profession to demonstrate their unique skills in this setting, it is a vital time to advance the interdisciplinary work on a global issue that is the sleep epidemic (Chattu et al., 2018). Success in this programming initiative could have implications for other branches of services, adding occupational therapists within sleep centers or using occupational therapists within outpatient primary care settings to address patients' sleep.

Limitations

This scoping review was limited in the narrow population, content and context focus.

Through inclusion US Army Active Duty context of otherwise healthy subjects, therefore excluded studies that focused on other branches of service such as US Navy, Marines, Airforce, Reserve, veterans or international militaries and those that focused on pathological diagnosis and treatment interventions. This was done to tailor the data to a specific population, but this may have left out relevant studies that could provide additional insight into this context. Furthermore, the exclusion of articles related to combat deployment, PTSD and TBI, but would complicated the purpose of understanding the barriers, risk factors and associations to sleep independent of these known correlated variables. The intent of this scoping review was to gain an understanding of the barriers, risk factors related to sleep from primary sources, yet the exclusion of review articles may have limited the data.

Conclusion

Sleep in the US Military is a known problem, with Active Duty Army service members being most at risk for sleep loss and sleep disorders. Most of the research has focused on pathology often related to deployment and a greater understanding of the complex barriers impacting sleep within garrison context is vital to addressing this issue. The findings of this review suggest multiple biological, psychological and social-contextual factors contribute to the subjective and objective measures of sleep quality and duration for soldiers. The articles in this review are primarily self-report survey and more in-depth exploration of the daily lived experience of soldiers could provide a more holistic view. Using the current Army publications and H2F occupational therapists partnering with multiple levels of leadership is a vital first-line intervention target.

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