



Sleep

IN THE

Military

Promoting Healthy Sleep
Among U.S. Servicemembers



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Preface

Sleep is a vital health behavior, and lack of sleep is reliably and prospectively linked with a host of adverse mental and physical health outcomes, including an increased risk of depression, suicide, accidents and injuries, cardiovascular morbidity, and mortality. Research has shown that sleep problems are prevalent in military populations—particularly among servicemembers who have deployed to combat operations in Iraq and Afghanistan, which is perhaps not surprising, given that sleep problems are a common reaction to stress. Research further suggests that, for many servicemembers, sleep disturbances persist for months or even years after deployments have ended. Thus, it is critical to understand the individual- and system-level factors that contribute to the onset, persistence, and exacerbation of sleep problems, as well as the downstream consequences for servicemembers' mental and physical health and operational readiness. However, no study to date has comprehensively examined the types of sleep problems servicemembers are experiencing, the programs available to servicemembers to promote healthy sleep and treat sleep disorders, or the policy-level factors that may contribute to servicemembers' sleep health across the deployment cycle and specifically in the post-deployment period, when sleep problems may have lasting implications for servicemember resilience.

To address these gaps, a team of researchers from the RAND National Defense Research Institute conducted reviews of the peer-reviewed academic literature and military policies and programs related to sleep. The research team also drew on both quantitative and qualitative data sources, collecting primary data on sleep problems and behaviors from a large sample (N = 1,957) of servicemembers across all Service branches and components; conducting interviews with health policymakers and personnel who work in military medical, operational, and training settings across the U.S. Department of Defense (DoD); and convening a panel of experts in military sleep research and policy. This multimethod approach provided insights and recommendations regarding the prevalence and consequences of sleep problems in military settings, as well as available programs and policies related to sleep. The ultimate goal of this research was to identify promising policy options and best practices for DoD to mitigate the negative consequences of sleep problems and promote greater sleep health among servicemembers.

This report will be of interest to Service and DoD line leaders who are responsible for developing policies and guidance to prevent and address sleep-related problems in the force, as well as sleep researchers and medical professionals who are involved with identifying and treating servicemember sleep problems and educating military personnel on healthy sleep practices and behaviors.

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Summary

In peace and war, the lack of sleep works like termites in a house: below the surface, gnawing quietly and unseen to produce gradual weakening which can lead to sudden and unexpected collapse.

—Major General Aubrey Newman (*Follow Me*, 1981, p. 279)

Significance

Sleep disturbances are a common reaction to stress and are reliably and prospectively linked with a host of adverse mental and physical health outcomes, including increased risk of depression, suicide, posttraumatic stress disorder (PTSD), accidents and injuries, cardiometabolic disorders, and mortality (Bramoweth and Germain, 2013). Given the unprecedented demands placed on the U.S. military over the past 13 years of protracted overseas combat operations in Iraq and Afghanistan, increasing attention has focused on the prevalence and consequences of sleep problems among servicemembers returning from deployments in support of Operation Iraqi Freedom (OIF), Operation Enduring Freedom (OEF), and Operation New Dawn (OND). Perhaps not surprisingly, research suggests that sleep problems—particularly insomnia, short sleep duration, and nightmares—are highly prevalent during combat operations (Bray et al., 2009; McLay, Klam, and Volkert, 2010; Mental Health Advisory Team [MHAT] 9, 2013; Young-McCaughan, Peterson, and Bingham, 2011). Importantly, sleep disturbances are also core symptoms of PTSD, depression, anxiety, and traumatic brain injury (TBI), which are considered among the signature wounds of OIF/OEF deployments (Hoge, Castro, et al., 2004). Research further suggests that, for many servicemembers, sleep problems persist long after deployments have ended and can have a substantial impact on their ability to successfully reintegrate and rebuild their lives post-deployment (Pietrzak, Morgan, and Southwick, 2010; Plumb et al., 2014; Seelig et al., 2010; Swinkels et al., 2013). As the United States continues its drawdown from OIF, OEF, and OND and increasing numbers of servicemembers face the challenges

of reintegration, the military health system is being tasked with identifying and treating the range of physical and mental health consequences of war, including sleep disturbances, that persist into the post-deployment period, and that impact subsequent force readiness. It is therefore critical to understand the role of sleep problems in servicemembers' health and functioning in the post-deployment period, the types of programs available to promote healthy sleep and treat sleep disorders, and the policy-level factors that may contribute to servicemembers' sleep. To date, however, there have been no comprehensive reviews of existing policies and programs across the U.S. Department of Defense (DoD) that affect sleep in the post-deployment period.

Approach

To comprehensively explore these issues and provide a set of actionable recommendations for DoD, researchers, and medical professionals, the RAND National Defense Research Institute (NDRI) conducted a two-year independent study using a multimethod approach. The study examined the prevalence and consequences of post-deployment sleep problems among U.S. servicemembers, current programs and policies related to sleep in the military, barriers to implementing those programs and policies, and evidence-based interventions to treat sleep disturbances in servicemember populations. Our study's conceptual model, presented and discussed in Chapter Two, suggests that there is considerable continuity between sleep problems in the deployed setting and those in the post-deployment period. While research and policies to date have focused primarily on deployed settings (as reviewed in a recent report by Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury [DCoE] titled *Overview of Sleep and Fatigue*, 2012), we focused our analysis (where possible) on the post-deployed environment, because research suggests that chronic and enduring sleep problems (i.e., those that persist after a deployment has ended) are most likely to affect mental and physical health and may impact subsequent operational readiness.

Guided by the conceptual framework and in collaboration with our sponsor, DCoE, we employed a multimethod approach that included literature reviews and quantitative and qualitative research methods to answer the following five research questions:

1. What are the correlates and consequences of sleep problems among servicemembers in the post-deployment period?
2. What are the current programs and policies related to sleep in the military?
3. What are the evidence-based interventions to treat sleep disorders among servicemembers?
4. What are the barriers to achieving healthy sleep for servicemembers?
5. What actions can be taken to promote sleep health among servicemembers?

Specifically, *we reviewed the literature pertaining to the prevalence and consequences of sleep disturbances in servicemember populations in the post-deployment period, as well as evidence-based strategies for treating sleep disturbances in servicemember populations.* We also sought sources and strategies with a particular focus on veterans of OEF/OIF, a population found to be at heightened risk for stress-related sleep disturbances.

In addition, we conducted a *cross-sectional survey* to inform an in-depth analysis of the types of sleep problems and behaviors that are characteristic of servicemember populations, identify specific subgroups of servicemembers who may be at greater risk for sleep problems, and determine whether sleep problems are independently associated with mental and physical health and operational readiness. The survey offered a broad assessment of sleep problems and associated consequences in a large and diverse sample of deployable servicemembers across all four branches of the U.S. armed forces (N = 1,957). We focused on the associations between sleep symptoms or behaviors and several important indicators of servicemember health and readiness. We also included a rich assessment of covariates (e.g., depressive symptoms, presence of traumatic brain injury, shift work, and a host of deployment and sociodemographic characteristics) that are known to covary with sleep problems, well-being, and readiness.

Although deployments may be a precipitating factor in the onset of sleep disturbances for many servicemembers (as highlighted in the study's conceptual model; see Figure 2.1 in Chapter Two), from a policy perspective, it is important to consider more broadly the system-level factors that may contribute to increased vulnerability to sleep problems across the deployment cycle. Therefore, we reviewed *existing DoD and Service-level policies and programs related to sleep in training, operational, and clinical contexts, regardless of deployment status.*

To supplement our review of codified policies and programs related to sleep and the barriers to implementation, we conducted a series of 40 interviews with line leaders and clinicians from all Service branches and convened an expert panel consisting of 31 clinicians, line leaders, and researchers with expertise in sleep in the military. In the following section, we summarize our findings for each of the five study questions.

Findings

What Are the Correlates and Consequences of Sleep Problems Among Servicemembers in the Post-Deployment Period?

Evidence from the reviewed published literature and our survey data suggest that sleep problems are prevalent, debilitating, and persistent in servicemember populations in the post-deployment period. Consistent with the civilian population, the most commonly diagnosed sleep disorders among servicemembers seeking evaluation include insomnia and obstructive sleep apnea (OSA; Capaldi, Guerrero, and Killgore, 2011; Collen et al., 2012; McLay, Klam, and Volkert, 2010; Mysliwiec, Gill, et al., 2013;

Mysliwicz, McGraw, et al., 2013). Servicemembers in general, and those who have deployed, specifically, are at high risk for insufficient sleep duration (i.e., sleeping six hours or less on average; Luxton, Greenburg, et al., 2011; Seelig et al., 2010). This is particularly concerning, given the robust evidence linking short sleep duration with compromised mental and physical health and cognitive impairments, all of which can have a direct impact on operational readiness and servicemember resilience (Wesensten and Balkin, 2013). Perhaps as a consequence of insufficient sleep duration and poor sleep quality, servicemembers are also at high risk for daytime sleepiness and fatigue (Hoge et al., 2008; Toblin, Riviere, et al., 2012). The prevalence of sleep disorders and symptoms in the post-deployment period is higher among servicemembers with comorbid deployment-related injuries or mental health problems than it is for those without such conditions (Bramoweth and Germain, 2013). Our conceptual model (see Figure 2.1 in Chapter Two) and prior research with veterans further indicate that, once initiated, sleep disturbances may follow a persistent course, lasting for years after deployment.

Sleep problems and disorders, in turn, have both short-term and lasting negative effects on physical health, cognitive functioning, and operational readiness. For example, physical health problems, such as obesity and high body mass index (BMI), are particularly prevalent among servicemembers with sleep-related breathing disorders (Brundage, Wertheimer, and Clark, 2010; Engel et al., 2000; Mysliwicz, McGraw, et al., 2013; Seelig et al., 2010). In fact, elevated BMI is a significant risk factor for developing sleep-related breathing disorders (e.g., OSA) in civilian populations (Patel and Hu, 2008; Yu and Berger, 2011). PTSD, depression, and TBI are common disorders associated with sleep problems, but longitudinal evidence further shows that sleep problems can presage the onset of these disorders (Gehrman et al., 2013; Hoge, McGurk, et al., 2008; McLay, Klam and Volkert, 2010; Wallace et al., 2011; Wright et al., 2011b; van Liempt et al., 2013). Beyond increasing the risk of developing a subsequent mental health condition, sleep problems are known to be among the most intractable symptoms of other mental health conditions, such as depression. Moreover, even with successful treatment for a co-occurring mental health condition (e.g., depression), sleep problems can predict poor treatment response or relapse (Manber, Edinger, et al., 2008; Troxel, Kupfer, et al., 2012). Findings from the military's research laboratories have demonstrated the significant effects of sleep deprivation and fatigue on cognition, attention, reaction time, and moral reasoning, all of which are critically important for operational effectiveness (Wesensten and Balkin, 2013).

As mentioned, the existing literature provides suggestive evidence that sleep problems are a prevalent and salient issue among servicemembers and that military deployments may be associated with an increased risk of sleep problems. These findings are generally based on studies that included single or few-item assessments of isolated sleep symptoms (e.g., trouble sleeping or sleep duration). However, sleep is a multidimensional state, including both nocturnal characteristics (e.g., quality, duration, night-

mares) and associated daytime consequences (e.g., sleepiness, fatigue). No study to date has examined multiple dimensions of sleep and associated daytime impairments in a large sample of servicemembers across all Service branches and components. In addition, only a handful of studies have examined sleep problems according to servicemembers' deployment history or characteristics of the deployment that may increase the risk of stress-related sleep disturbances (e.g., exposure to combat). Moreover, the existing literature has generally focused on a single Service branch, which may limit the generalizability of the findings. Finally, given that sleep problems are known to covary with sociodemographic and military characteristics, as well as overall well-being (Bramoweth and Germain, 2013), questions remain about whether sleep is merely a proxy for these co-occurring factors or an independent correlate of key indicators of mental and physical health and operational readiness.

We also conducted a cross-sectional survey to address these gaps and to inform an in-depth analysis of the types of sleep problems and behaviors that characterize servicemember populations, identify specific subgroups of servicemembers who may be at greater risk for sleep problems, and determine the extent to which sleep problems are independently associated with mental and physical health and operational readiness. The survey offered a broad assessment of sleep problems and associated consequences in a large and diverse sample ($N = 1,957$) of servicemembers across all four branches of the U.S. armed forces.

The survey results showed a high prevalence of insufficient sleep duration, poor sleep quality, daytime sleepiness, fatigue, and nightmares in our sample. Approximately 18 percent of the sample reported using sleep medications, which is important to consider given the known side effects of these medications, which may compromise operational effectiveness, and the limited evidence of efficacy or safety in military settings.

We also had a unique opportunity to examine whether the prevalence of sleep problems differed according to deployment history or combat exposure; to date, only a handful of studies have done so. Somewhat surprisingly, we found few statistically significant differences in sleep according to deployment history, though we did find differences according to combat exposure. Specifically, we found only one significant difference according to deployment history. In the Navy sample, those with prior deployments had greater sleep-related daytime impairment than those without a prior deployment. In the Army sample—in which we were able to compare soldiers who had never deployed, those who were currently deployed, and those who had previously deployed—we found no significant differences among the three subgroups on any sleep measure. In contrast to these generally non-significant findings for deployment history, and consistent with the prior literature, we found that higher levels of combat exposure were associated with poorer sleep quality and greater frequency of reporting repeated, disturbing dreams among those who experienced a traumatic event (Plumb et al., 2014; Luxton, Greenburg, et al., 2011; Wright et al., 2011b). These results suggest that it may not be deployment, per se, that is associated with an increased risk of

sleep problems; however, exposure to combat may increase the risk, perhaps as a result of conditioned vigilance and hyperarousal that stems from sustained high operational tempo (OPTEMPO) environments.

As for our survey analyses of outcomes associated with poor sleep, we found that poor sleep quality and sleep-related daytime impairment are associated with poor physical health, probable depression, probable PTSD, and lower perceived unit readiness. These findings are consistent with previous military sleep studies documenting the association between sleep problems and mental health problems, such as depression and PTSD; however, we are not aware of any prior study that included an assessment of perceived readiness. Our findings also extend this work to highlight the robust associations between sleep quality and health outcomes. Collectively, these findings attest to the high prevalence of a myriad of sleep problems, including insufficient sleep duration, poor sleep quality, nightmares, daytime fatigue, and the use of sleep medications among servicemembers. They also add further support to the notion that sleep problems are not merely a proxy for other co-occurring symptoms, but they may confer an independent increased risk of adverse mental and physical health outcomes and compromised operational effectiveness.

What Are the Current Programs and Policies Related to Sleep in the Military?

In our review of DoD-wide and Service-specific policies and programs, we found a range of sleep-related prevention, medical, training, and operational strategies. DoD recognizes sleep as an important contributor to physical and mental health and operational readiness, and it has established several programs and policies to treat and prevent sleep disorders and to promote healthy sleep practices.

DoD medical policies related to sleep include screening for troubled sleep using the Post Deployment Health Assessment (PDHA) and Post Deployment Health Re-Assessment (PDHRA) programs, setting and adhering to medical standards, applying qualifications for initial military service, referring medical conditions to a medical evaluation board, and treating sleep disorders.

We found that service-specific and U.S. Department of Veterans Affairs (VA) medical policies on treating sleep disorders primarily mention sleep as a symptom of other conditions rather than as a primary disorder. Because sleep problems may precede the onset of other psychological and medical conditions, handling sleep as a byproduct of other conditions in medical treatment policies can lead to underdiagnosis and insufficient treatment of sleep problems.

In general, medical policies related to sleep were included in military programs on resiliency and stress management rather than explicitly addressing sleep management. An advantage of this approach is that sleep-related policies and programs are directed at the whole individual from a broader wellness perspective. But a disadvantage is that the lack of a specific focus on sleep in these stress management programs may undermine the importance of sleep, given that many sleep problems present independently

of or even precede the development of mental health problems. This lack of emphasis on sleep may lead to inconsistent guidance on how to help servicemembers achieve optimal sleep duration and quality.

One example of a promising prevention program that puts sleep on equal footing with other key indicators of health is the Army Performance Triad. Perhaps the most comprehensive program to date that promotes sleep health from a prevention perspective, the Performance Triad provides systematic messages about the importance of sleep as a health behavior on par with nutrition and physical activity and promotes the use of objective tools to facilitate sleep monitoring (e.g., actigraphy). To date, however, the program's efficacy has not been evaluated, though research efforts are under way. The program may be a useful platform for other Service branches to develop similarly comprehensive sleep health programs.

Overall, we found that training policies were generally consistent in recommending sleep duration of seven to eight hours per night. However, these policies generally focused on the initial phases of military training (i.e., basic training), and codified policies pertaining to sleep did not necessarily extend to subsequent training environments.

Operational policies—the most common type of policies we identified—relate to sleep during combat operations or exercises. These operational policies focus on prescribing shift-work cycles and the duration of rest periods. These policies also mandate sleep plans, which are part of the process of establishing operational plans and associated risk assessments. However, there was a lack of specific guidance on how to implement these plans. We also found inconsistency in the amount of emphasis placed on sleep in each of the occupational areas within each Service.

What Are the Evidence-Based Interventions to Treat Sleep Disorders Among Servicemembers?

A review of the peer-reviewed academic literature showed that both pharmacologic and non-pharmacologic (i.e., behavioral or cognitive-behavioral) interventions have demonstrated efficacy in treating insomnia in civilian studies. Specifically, meta-analytic studies have found that pharmacologic and non-pharmacologic interventions have comparable efficacy in treating insomnia, with effect sizes in the moderate to large range for reducing insomnia for both types of interventions (Morin, Culbert, and Schwartz, 1994; Irwin, Cole, and Nicassio, 2006; Mitchell et al., 2012). However, the effects of non-pharmacologic interventions tend to be more durable (National Institutes of Health, 2005; i.e., treatment gains persist after active treatment has terminated). Nevertheless, pharmacologic approaches remain the front-line treatment in military and civilian populations, despite the fact that there is a notable lack of evidence supporting the efficacy or safety of pharmacologic approaches in treating insomnia in military settings (Brown, Berry, and Schmidt, 2013; DCoE, 2012). Key informants and expert panelists noted that this lack of systematic evidence is concerning because the safety issues pertaining to medication side effects may be particularly germane to servicemember

populations, given operational demands and occupational hazards (Brown, Berry, and Schmidt, 2013). In contrast, there is a sizable and growing evidence base supporting the efficacy of cognitive-behavioral therapy for insomnia (CBT-I) and imagery rehearsal therapy (IRT) for insomnia, specifically within servicemember populations (see, e.g., Talbot et al., 2014; Margolies, 2011; Gellis and Gehrman, 2011; Koffel and Farrell-Carnahan, 2014; Perlman et al., 2008).

The dissemination of efficacious cognitive-behavioral therapies for sleep disturbances has been limited, partly because of a critical shortage of trained providers in behavioral sleep medicine techniques and a lack of provider awareness of the efficacy of these programs in both civilian and military settings (Siebern and Manber, 2011). Training or hiring a greater number of qualified behavioral health specialists and creating more clinical training opportunities could help decrease this shortage, and efforts are underway both through VA and the Center for Deployment Psychology. Further research using robust randomized controlled trials in military contexts is also greatly needed to establish best-practice guidelines for treating servicemembers and veterans, because the nature of sleep problems and the efficacy of specific treatment strategies may differ for servicemember or veteran populations versus civilian populations. There is also a critical need to develop and validate evidence-based identification and prevention programs, including the use of objective sleep- and fatigue-monitoring devices, to promote healthy sleep behaviors and to provide opportunities for intervention before acute sleep disturbances become chronic and debilitating.

What Are the Barriers to Achieving Healthy Sleep for Servicemembers?

Even with evidenced-based practices and programs to prevent and treat sleep problems in servicemembers and codified policies related to sleep in place, we found cultural, operational, knowledge-related, and medical system barriers across the military context that may impede efforts to promote sleep health and treat sleep disorders in servicemember populations (as discussed in Chapter Six).

Expert panel attendees and interviewees highlighted the importance of military culture as a potential barrier to the promotion of healthy sleep practices. Specifically, they suggested that military cultural attitudes have historically tended to undermine the importance of sleep, which serves as an ongoing challenge to the adoption and implementation of effective sleep policies and programs. For instance, stigma associated with expressing a greater need for sleep may deter servicemembers from self-identifying or seeking help before a sleep problem becomes chronic and debilitating. Screening for sleep disturbances within military contexts is also limited, with sleep being perceived as a low institutional priority in military communities or simply “behind other areas” of war-related health issues.

Operational environments themselves are often barriers to healthy sleep, because of noise, crowded conditions, and the need for vigilance in threatening settings. Furthermore, we found that sleep policies are generally interpreted as “guidance” in opera-

tional contexts and, thus, secondary to operational demands. Although efforts to promote healthy sleep behaviors are important, such efforts must be carefully balanced against the realities of the dynamic, high-risk, and demanding military environment. Also, even where sleep policies are in place, leaders may not have sufficient manpower to allow for proper sleep—threats that are particularly salient given the high OPTEMPO of recent years. However, recent efforts to promote healthy sleep by optimizing crew shift schedules have shown that such strategies actually promote performance. Thus, perceived “trade-offs” may be balanced by improvements in servicemember performance and overall satisfaction.

Our qualitative research informed by expert panel attendees and interviewees suggested that the lack of knowledge about the importance of sleep behaviors and sleep-related policies was a barrier to recognizing and addressing sleep problems. This lack of knowledge or awareness is partly the result of limited education and training among leadership about the importance of sleep and the lack of a centralized DoD-wide resource on sleep policies. A centralized DoD repository could supplement some Service-specific websites that do provide sleep resources¹ to include guidance on the identification and management of sleep problems, as well as how to develop and implement a sleep plan.

Finally, medical and treatment system challenges create barriers. There is a lack of adequate screening tools, procedures, and systems for detecting sleep problems in military contexts. In addition, both continuity of care and shortages in the number of sleep providers and clinics were noted as barriers to promoting sleep health in servicemember populations during our interviews and focus groups.

Understanding these barriers is critical to making well-informed and robust policy recommendations related to preventing, identifying, and clinically managing sleep problems and promoting sleep health in both operational and training settings.

What Actions Can Be Taken to Promote Sleep Health Among Servicemembers?

Based on the findings above, we provide recommendations for filling gaps and overcoming barriers to achieving healthy sleep in servicemembers. To some extent and in certain contexts (e.g., in the combat environment), it is accepted that the unique role and demands of the military will necessarily restrict the opportunity for sufficient sleep duration and quality. Thus, we put forth a set of actionable recommendations that take into account these exigencies while at the same time identifying opportunities for programs and policies to promote sleep health in multiple contexts, including both operational and medical or clinical settings and across a continuum of care from prevention to identification and intervention.

In terms of *preventing sleep problems*, our study found no evidence-based practices to prevent sleep disorders in military or civilian populations, with the possible excep-

¹ For example, see Navy and Marine Corps Public Health Center (undated[b]).

tion of weight loss and management strategies that also reduce the risk of OSA. This dearth of prevention efforts is consistent with the history of sleep medicine and medicine in general, which has tended to focus on physical illnesses or disorders rather than promoting health. Thus, we provide several recommendations to support prevention efforts, with the ultimate goal of promoting sleep health.

As for *increasing the identification and diagnosis of sleep problems*, our study identified several factors that may facilitate the detection of sleep disturbances, including the family as a key mechanism for detection, primary care as a key setting for detection, and the use of objective assessments to quantify insufficient sleep and associated daytime impairment.

In terms of *clinically managing sleep disorders and promoting sleep health*, our study also suggests a need to improve the education of health providers on the assessment, diagnosis, and treatment of sleep problems and disorders; to improve education of servicemembers on healthy sleep-related behaviors, including the appropriate use of stimulants and sleep medications; and to systematically evaluate promising programs and intervention approaches, including the use of technology to monitor and treat sleep disturbances. Policies that support provider training and that offer incentives for specialized sleep medicine training are needed to fill gaps in provider capabilities and the shortage of providers able to confidently deliver care to prevent, identify, and treat sleep disorders among military populations. Moreover, to enhance the dissemination of sleep treatments, trained providers are needed in a variety of contexts, including primary care, rather than in specialty sleep clinics only, where fewer patients are likely to present initially. Although several of these efforts to disseminate evidence-based sleep treatments by providing training for providers are under way within both the VA and DoD, there still is a need for systematic evaluation of the efficacy of these programs in terms of increasing provider knowledge and improving patient outcomes.

Finally, in terms of *improving sleep in training and operational contexts*, our study found that policies related to sleep are generally Service-specific and sometimes inconsistent in the degree of emphasis placed on sleep in each of the occupational areas within each Service. To a certain extent, these observed variations are expected and necessary, given each Service's mission focus (e.g., Air Force air operations) and the associated sleep policy for that military community. Nevertheless, such variation can create challenges for leaders trying to integrate work schedules or manage shift work in a diverse occupational specialty or joint environment. There are clearly unique challenges to achieving quality sleep in the post-deployment setting, and it is in this context that chronic and debilitating sleep disorders are likely to manifest. Thus, efforts are needed—most likely at the DoD level—to communicate overarching guidance to the Services regarding sleep in terms that are consistent with, and coherent within, an operational framework. Our recommendations in this area are geared toward this end.

Table S.1 summarizes the recommendations in the four areas, which are discussed in more detail in Chapter Seven.

Table S.1
Recommendations to Promote Sleep Health

Prevent Sleep Problems
<ol style="list-style-type: none"> 1. Increase servicemember and line leader education about healthy sleep behaviors to increase self-awareness and knowledge about the factors that inhibit or promote adequate, restful sleep. 2. Fund or conduct research to perform longitudinal studies on sleep and effects on operational readiness and resilience.
Increase Identification and Diagnosis of Sleep Problems
<ol style="list-style-type: none"> 3. Educate families on signs and symptoms of sleep disturbances as a way to bolster sleep detection efforts. 4. Improve screening for sleep disturbances in primary care settings, including the routine use of validated screening tools to identify those at high risk for the broad range of sleep disorders.
Clinically Manage Sleep Disorders and Promote Sleep Health
<ol style="list-style-type: none"> 5. Develop provider education programs on preventing, identifying, and treating sleep disorders, with a focus on giving providers the latest findings in the field of sleep science to effectively advise patients on sleep issues and a focus on <i>prevention</i> as well as <i>treatment</i>. 6. Develop a clinical practice guideline for sleep disorders that specifically addresses sleep and discusses prevention, identification, and treatment of sleep disorders. 7. Increase the use of mobile technology for assessing and clinically managing sleep disorders, in particular to monitor sleep and alertness and to identify and manage sleep disorders before they become chronic or debilitating. 8. Continue to research evidenced-based practices for advancing healthy sleep in military populations (e.g., mindfulness, teletherapy) and establish guidelines for treating servicemembers and veterans. 9. Enhance dissemination of evidence-based sleep treatments (e.g., CBT-I, IRT) by training providers in primary care settings as well as behavioral health clinics. 10. Improve continuity of care of sleep disorder treatments, such as through the use of electronic medical records that link records across the deployment cycle.
Improve Sleep in Training and Operational Contexts
<ol style="list-style-type: none"> 11. Make appropriate revisions to existing training and operational policies to minimize inconsistencies and align with current clinical guidelines about optimal sleep duration that recommend that the amount of sleep required among civilians is eight hours. 12. Educate line leaders on creating sleep plans that align with current research on circadian rhythms, consider the physical sleeping environment, and factor in shift schedules of roommates or tent-mates when assigning duty. 13. Create standardized operational and training policies across DoD to increase sleep duration and quality and reduce fatigue-related impairment. 14. Link sleep-related surveillance data on mishaps to evaluate the role of sleep and fatigue. 15. Prioritize sleep in reintegration policies to offer servicemembers a period of recuperation during which they might be able to begin to return to normal sleep habits and potentially prevent the onset of chronic sleep problems that develop well after the initial reintegration period. 16. Disseminate positive messaging about sleep as an operational imperative (a vital sign, such as blood pressure) to increase awareness and reduce cultural barriers.

Final Words

Given the recent drawdown from combat operations in Iraq and Afghanistan, increasing attention has focused on the factors that promote or hinder servicemembers' ability to reintegrate and rebuild their lives post-deployment. This report offers 16 policy recommendations to promote sleep health in the domains of prevention, identification, treatment, and training/operations. These recommendations should be addressed collectively by individual servicemembers, unit leaders, the military health system, training and operational commands, military health researchers, and DoD at large. Implementing these recommendations must go hand in hand with better messaging about the biological and operational necessity of sleep to overcome cultural, environmental, medical, and operational barriers to achieving healthy sleep among servicemembers. Carrying out such an integrated approach is critical for improving sleep, which is an important contributor to resilience and operational readiness in the U.S. military.

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Abbreviations

AASM	American Academy of Sleep Medicine
AETCI	Air Education and Training Command instruction
AFGM	Air Force guidance memorandum
AFI	Air Force instruction
AHI	Apnea-Hypopnea Index
AR	Army regulation
BDI	Beck Depression Inventory
BISS	behaviorally induced insufficient sleep syndrome
BMI	body mass index
CAM	complementary and alternative medicine
CAPS	Clinician-Administered PTSD Scale
CBT	cognitive-behavioral therapy
CBT-I	cognitive-behavioral therapy for insomnia
COSC	combat and operational stress control
CPG	U.S. Department of Veterans Affairs Clinical Practice Guideline
DCoE	Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury
DHHS	U.S. Department of Health and Human Services
DoD	U.S. Department of Defense
DoDD	U.S. Department of Defense directive
DoDI	U.S. Department of Defense instruction
DTIC	Defense Technical Information Center
ESS	Epworth Sleepiness Scale
FAST	Fatigue Avoidance Scheduling Tool
FM	Army field manual

FSS	Fatigue Severity Scale
IRT	imagery rehearsal therapy
ISI	Insomnia Severity Index
J-MHAT	Joint Mental Health Advisory Team
MCO	Marine Corps order
MCRP	Marine Corps reference publication
MHAT	Mental Health Advisory Team
mTBI	mild traumatic brain injury
NATO	North Atlantic Treaty Organization
NCO	noncommissioned officer
NDRI	RAND National Defense Research Institute
NTTP	Navy Tactics, Techniques, and Procedures
OCONUS	outside the continental United States
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OND	Operation New Dawn
OPNAVINST	Chief of Naval Operations instruction
OPTEMPO	operational tempo
OSA	obstructive sleep apnea
OSCAR	Operational Stress Control and Readiness
PCL	PTSD Checklist
PDHA	Post-Deployment Health Assessment
PDHRA	Post-Deployment Health Reassessment
PE	prolonged exposure
PHQ	Patient Health Questionnaire
PRP	Personnel Reliability Program
PSG	polysomnography
PSQI	Pittsburgh Sleep Quality Index
PTSD	posttraumatic stress disorder
REM	rapid eye movement (sleep stage)
RCT	randomized controlled trial
SD	standard deviation
SECNAVIST	Secretary of the Navy instruction
SRIP	Self-Rating Inventory for Posttraumatic Stress Disorder

SSRI	selective serotonin reuptake inhibitor
SSS	Stanford Sleepiness Scale
STOP-BANG	snoring, tiredness, observed apnea, high blood pressure—body mass index, age, neck circumference, and gender
TBI	traumatic brain injury
TRADOC	U.S. Army Training and Doctrine Command
USAFAI	United States Air Force Academy Instruction
VA	U.S. Department of Veterans Affairs
VHA	Veterans Health Administration

Introduction

Background

Adequate sleep duration and quality are vital for optimal mental and physical health, cognitive functioning, and performance. Epidemiologic data show that sleep problems are highly prevalent in society in general and in the military specifically. For instance, the Centers for Disease Control and Prevention recommend seven to eight hours of sleep per night for adults. However, studies suggest that only about two-thirds of the general adult population report sleeping seven to eight hours per night (Krueger and Friedman, 2009). Among servicemembers, studies suggest that only one-quarter to one-third report getting the recommended amount of sleep for adults (Bray et al., 2009; Luxton, Greenburg, et al., 2011; Mysliwiec, McGraw, et al., 2013).

Decades of sleep research on civilian and military populations reveal that sleep disturbances are associated with a host of physical, mental health, and operational readiness factors. Historically, sleep problems have been considered a symptom of some other co-occurring mental or physical illness. However, emerging evidence shows that sleep problems can also serve as a risk factor, increasing the likelihood of developing such health conditions as diabetes and hypertension and contributing to impaired judgment, depression, suicidality, posttraumatic stress disorder (PTSD), and chronic pain (e.g., Boyko et al., 2013; Bramoweth and Germain, 2013; Gehrman et al., 2013; Ribeiro et al., 2012; Seelig et al., 2010; van Liempt et al., 2013; Wright et al., 2011a).

Sleep is especially important in the military, where short sleep duration or poor sleep quality can significantly affect the operational readiness of individual servicemembers and the functioning of the entire unit. In particular, short sleep duration or poor sleep quality can disrupt cognitive functioning, including attention and concentration, and can affect physical and behavioral health (Wesensten and Balkin, 2013; Bramoweth and Germain, 2013), all of which can severely compromise operational effectiveness. There is also evidence to suggest that sleep difficulties are key symptoms of the most prominent deployment-related health conditions, such as PTSD, depression, and traumatic brain injury (TBI), and that sleep difficulties can also *precipitate* the development of mental health conditions and disorders, including an increased risk of suicide (Breslau et al., 1996; Taylor et al., 2005; Weissman et al., 1997).

Given that many of the most prevalent sleep problems, including insufficient sleep duration, insomnia, and nightmares, are stress-related, and given the increasing demands placed on the U.S. military over the past 13 years of combat operations in Iraq and Afghanistan, it is critical to understand the role of sleep in supporting servicemember health and readiness and its specific role in contributing to risk or resilience in the post-deployment period. A recent report released by the Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury (DCoE, 2012) titled *Overview of Sleep and Fatigue* reviewed the literature on sleep disturbances during deployment. However, questions remain regarding the enduring impact of sleep disturbances that persist into the post-deployment period. Thus, the primary focus of this report and literature review is on sleep disturbances in the post-deployed context.

Perhaps not surprisingly, sleep disturbances are highly prevalent among servicemembers in the deployed environment because of environmental conditions, such as inhospitable or threatening sleep environments, and limited opportunity for sleep, given high operational demands. For instance, in a 2008 study of more than 3,000 Army soldiers deployed to Iraq or Afghanistan, 32 percent reported a high level of concern that they were not getting enough sleep in theater (Mental Health Advisory Team [MHAT] V, 2008). Army data collected from those MHAT surveys reveal that while rates of reported sleep concerns were the lowest in 2013 than they were over the previous four surveys (2008–2013), nearly 25 percent of soldiers still reported concerns about not getting enough sleep (MHAT 9, 2013). Soldiers who reported concerns were more likely to meet criteria for psychological or overall health problems. Furthermore, sleep problems were among the most highly treated concerns among U.S. Army personnel in Iraq (Hung, 2008). Other studies with smaller samples of enlisted servicemembers and officers have demonstrated higher rates of sleep problems among deployed servicemembers in combat environments compared with their pre-deployment sleep patterns (Miller, Shattuck, and Matsangas, 2011; Peterson et al., 2008).

For many servicemembers, sleep problems persist long after deployments have ended, partly because of “conditioned” (i.e., learned) hyperarousal (i.e., being extra alert or vigilant when a threat is perceived; for example, when an enemy combatant is approaching or explosions are heard nearby) and behaviors that may be used to compensate for sleep problems in the short term but ultimately serve to perpetuate sleep problems in the long term. Such behaviors include using prescribed or over-the-counter sleep medications, consuming stimulants or highly caffeinated “energy drinks,” and engaging in other stimulating activities (e.g., violent video games)—all of which may promote affective states, including vigilance and alertness, that are antithetical to the sleep state. The end result is that sleep problems may become persistent and debilitating in the post-deployed environment.

Although servicemembers have high rates of sleep problems both during and after deployment (McLay, Klam, and Volkert, 2010), and there are well-known con-

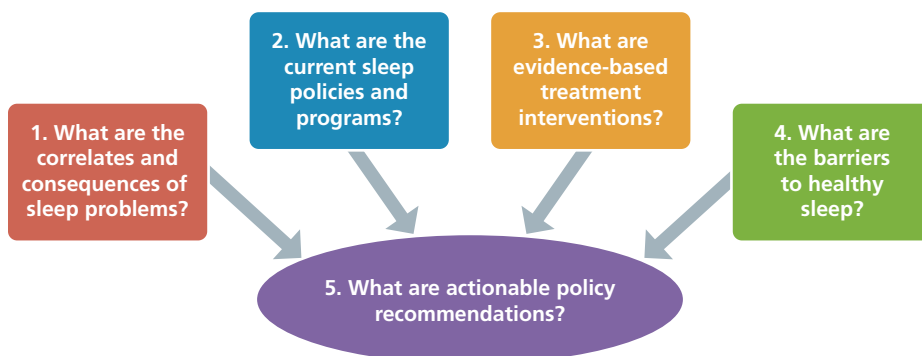
sequences of sleep disruptions on virtually all aspects of health and functioning, there are still notable gaps in the field’s understanding of the prevalence and consequences of sleep-related behaviors and symptoms among servicemembers, as well as which specific subsets of servicemembers may be most vulnerable to deployment-related sleep disturbances. To date, there have been no comprehensive reviews of existing policies and programs related to sleep across DoD. As a result, there are gaps in the military community’s understanding of the types of sleep problems that servicemembers are experiencing, the types of programs available for servicemembers to promote healthy sleep and treat sleep disorders, and the policies that may facilitate or deter normal/healthy sleep during and after deployment.

Research Objective

This research was designed to examine the causes and consequences of sleep problems among servicemembers and to identify promising policy options for the U.S. Department of Defense (DoD) to mitigate the negative consequences of sleep problems and to promote sleep health. Although sleep is an issue throughout the deployment cycle, we focus in particular on the post-deployment period because of an increased awareness that this period may be one of particular risk for chronic sleep problems and downstream mental and physical health consequences. However, policies and programs are not specifically tied to post-deployment, so we expanded the scope of our literature and policy reviews.

To achieve our overall research objective, in collaboration with the sponsor, the RAND team designed a multidimensional research project addressing five research questions, as shown in Figure 1.1.

Figure 1.1
Research Questions to Examine Sleep in the Military



Methods

To address these questions, the study team used five complementary methods: (1) a literature review, (2) primary data collection and analysis of a sleep survey, (3) a policy review, (4) key informant interviews, and (5) working group discussions with invited experts. Each method is described briefly in the following sections and in more detail in later chapters in this report. Table 1.1 provides a crosswalk between the five research questions and the methods used to address each question. Given the variation of sleep terminology used in the literature on military sleep, and to help guide the reader throughout this report, we include definitions of commonly used sleep terms in Appendix A.

Literature Review

We conducted two literature reviews—one on the prevalence and consequences of sleep problems in servicemember populations in the post-deployment period (Chapter Two) and another on evidence-based practices to treat sleep disorders in servicemember populations (Chapter Four). To locate articles for the literature review, we performed comprehensive Internet searches on a broad range of search terms related to the project’s research questions, using multiple databases (e.g., PubMed, PsycInfo). We also searched for “gray literature” using the WorldCat database, which indexes books, reports, and other non-peer-reviewed journal literature, and the Defense Technical Information Center (DTIC) database. We also conducted searches in Google Scholar to locate reports related to sleep in military populations published by such agencies

Table 1.1
A Crosswalk Between Research Questions and Study Methods Used

Research Question	Method				
	Literature Review	Sleep Survey	Policy Review	Key Informant Interviews	Expert Working Group
1. What are the correlates and consequences of sleep problems among servicemembers in the post-deployment period?	X	X		X	X
2. What are the current policies and programs related to sleep in the military?			X	X	X
3. What are the evidence-based interventions to treat sleep disorders among servicemembers?	X			X	X
4. What are the barriers to achieving healthy sleep for servicemembers?				X	X
5. What actions can be taken to promote sleep health among servicemembers?	X	X	X	X	X

as DCoE, the North Atlantic Treaty Organization (NATO) Research and Technology Organization, and the Naval Center for Combat and Operational Stress Control. Then, we performed an iterative search using the reference lists from the publications retrieved from our initial search results to identify articles that we may have missed.

We also located the sleep-related publications of known experts in the field of military health and consulted with these experts to verify that we did not miss any relevant publications. Sources underwent successive rounds of screening, including a title and abstract review, followed by a full-text review, to exclude irrelevant or unsuitable articles. Articles selected for inclusion were then reviewed, and details relating to the focus of our study were abstracted. Appendix B provides more detail on the literature search methods for our review of the epidemiology of sleep in the military, as well as search terms used (Table B.1), studies on the prevalence of sleep problems in the post-deployment period (Table B.2), studies on the purported risk factors for sleep disturbances and cross-sectional studies of correlates of sleep problems (Table B.3), and longitudinal studies of sleep disturbances and mental and physical health and operational readiness (Table B.4). Appendix C provides additional background on evidence-based practices to treat sleep disorders in servicemember populations and includes a list of studies of cognitive-behavioral therapy for insomnia (CBT-I; Table C.1), imagery rehearsal therapy (IRT; Table C.2), complementary and alternative medicine (CAM; Table C.3), and CBT combinations (Table C.4), all of which focused exclusively on servicemember and veteran samples.

Primary Data Collection and Sleep Survey Analysis

We conducted a review of existing surveys to identify self-report measures that have been used in prior sleep research to assess sleep-related disorders, sleep quality and quantity, and sleep-related behaviors (e.g., use of sleep medications or stimulants, inconsistent bedtimes, frequent napping) and that specifically focus on conditions relevant to servicemembers (see Appendix D).

Based on our review of the sleep measures that capture the domains of sleep that are most salient for military populations, we selected a set of items and scales (i.e., the Pittsburgh Sleep Quality Index, or PSQI) that assessed important components of sleep domains and sleep disorders relevant to this population and that could be completed within five to ten minutes (to reduce participant burden).

We added this sleep survey to an ongoing survey of servicemembers enrolled in the Deployment Life Study (see Tanielian et al., 2014). Appendix E provides additional details on the source measures included in the sleep survey, which is described in Chapter Three.

The Deployment Life Study was designed to identify the antecedents, correlates, and consequences of family readiness across the three phases of the deployment cycle: pre-deployment, deployment, and post-deployment. The sleep survey, which was created specifically for this project, was administered to the baseline group of Navy ser-

vicemembers enrolled in the Deployment Life Study beginning in November 2012 and to a follow-up wave of servicemembers from the Army, Air Force, and Marine Corps beginning in January 2013. We analyzed the data to determine the prevalence and correlates of sleep problems in the total sample and also according to specific subgroups, based on deployment history and combat exposure. The Deployment Life Study is a longitudinal design; however, follow-up waves of data including sleep measures were not available within this project's two-year timeline or scope of work. Therefore, the analyses presented are cross-sectional.

Policy Review

Although the focus of the report is on the post-deployed context, for the policy review we included all sleep-related policies and programs, given that few were specifically related to the post-deployment period. We identified and analyzed DoD policies related to sleep by conducting custom searches for publications, issuances, and directives using online search engines and targeted DoD and Service-specific repositories. Appendix F includes a table outlining the DoD policies related to sleep in the Air Force, Army, Navy, and Marine Corps; in DoD generally; and in the U.S. Department of Veterans Affairs (VA).

We used search terms that would be applicable in the military context, such as *instruction, policy, directive, sleep, clinical, prevention, operational, training, fatigue, crew rest, and shift work*. In addition, when programs arose in our searches, we included them even though a program's existence or implementation may not necessarily be dictated or mandated by a policy. Sources below the Service or branch level, such as theater-specific policies, installation-specific policies, and unit-specific standard operating procedures, are likely to be unique to each individual command or unit; we excluded these sources because it can reasonably be inferred that such subordinate policies, at least in writing, would be consistent with higher-echelon guidance. We did not specifically target a review of policies for the National Guard or reserve components of any Service; however, many of these policies are likely applicable to all Service components.

Key Informant Discussions

To augment the literature reviews and to identify barriers to implementing codified (i.e., written) policies pertaining to sleep, we conducted interviews with a sample of 40 individuals, including medical professionals and sleep experts, health policymakers at multiple levels, military operators (e.g., pilots, brigade commanders, naval ship commanding officers), and personnel with military training responsibilities across the Service branches. Our strategy was designed to gather a range of expertise from both the military health system and the military departments. Appendix G provides details on our recruitment strategy, along with our interview guide and protocols. Briefly, the key informant interviews were conducted by phone (each lasting 30–60 minutes), recorded, transcribed, and subsequently coded for thematic content according to the

methods of applied thematic analysis (Guest, MacQueen, and Namey, 2012). Related to the study's primary aims, the interview guide included questions about awareness of sleep-related policies and programs; the process and barriers to prevention, identification, and treatment of sleep problems; and perceived barriers to the implementation and enforcement of policies.

Expert Working Group

We organized and convened a one-day meeting on February 21, 2014, of experts with clinical, operational, and policy backgrounds related to sleep. The meeting included 31 researchers and clinicians, both civilian and military, and other uniformed personnel and RAND staff currently involved with various aspects of sleep and servicemember health research. In consultation with DCoE, the research team developed four focus areas for the meeting and tasked each of the meeting's assigned subgroups to discuss current practices, barriers, and recommendations related to one of the following topic areas: (1) self-identification of sleep problems, (2) prevention of sleep disorders, (3) best sleep practices and programs in operational/training contexts, and (4) best sleep practices and programs in clinical/medical contexts. The research team took notes during the working group meeting and provided the participants with summaries of the discussions and recommendations. Further details about the meeting logistics and the summaries provided are included in Appendix H.

Organization of This Report

Chapters Two and Three evaluate the prevalence and consequences of sleep problems in servicemember populations in the post-deployment period (addressing question 1) using a multi-method approach. Specifically, Chapter Two synthesizes research findings from a literature review with information garnered from key informant discussions and the working group meeting, and Chapter Three presents an overview of the development of the sleep survey and analysis of sleep problems and correlates in the Deployment Life Study servicemember cohort. Chapter Four reviews the current policies and programs to prevent and treat sleep problems among post-deployed servicemembers (question 2), using the results of the literature review, key informant discussions, and our expert working group. Chapter Five presents a review of evidence-based interventions to treat sleep problems among servicemembers (question 3), based on a literature review, key informant discussions, and the expert working group meeting. Chapter Six synthesizes identified barriers to the implementation of sleep-related policies and programs (question 4), based on key informant discussions and the expert working group meeting. Chapter Seven presents a summary of findings and recommendations for promoting sleep health in servicemember populations (question 5), based on a synthesis of findings from all methods used in the study.

This report contains eight appendixes that supplement the analyses presented here. Appendix A contains a list of sleep terms and definitions used throughout the report. It also includes information about the common ways that sleep disturbances are measured in the research literature on military sleep.

Appendix B contains four tables corresponding to the literature review presented in Chapter Two: (1) a table of search terms used for the literature review, (2) a detailed table of studies on the prevalence of sleep problems in the post-deployment period, (3) a detailed table of studies on purported risk factors for sleep disturbances and cross-sectional studies of correlates of sleep problems, and (4) a detailed table of longitudinal studies of sleep disturbances and mental and physical health and operational readiness.

Appendix C is divided into two sections. The first section outlines the methods used to review the literature on interventions for sleep disorders, referenced in Chapter Five. The second section offers additional detail on the studies included in our review of interventions for sleep disorders among military and veteran populations.

Appendix D provides more detail on the instruments used in civilian and military studies to assess sleep parameters and the sleep disturbances that commonly occur among military personnel. We used this information to develop the sleep survey included in the Deployment Life Study and described in Chapter Three. Appendix E includes a detailed description of the source measures included in the sleep survey.

Appendix F provides an overview of DoD policies and programs related to sleep in the Air Force, Army, Navy, Marine Corps, DoD, and VA. Appendix G presents the interview protocol used and described in Chapter Six, and Appendix H includes additional information about the expert working group sessions conducted on February 21, 2014, including meeting logistics and summaries provided by each of the subgroups.

Epidemiology of Sleep Problems in the Military

This chapter specifically informs our first research question: *What are the correlates and consequences of sleep problems among servicemembers in the post-deployment period?* In this chapter, we provide background on the nature and consequences of sleep problems in military populations, with a specific focus on the post-deployed context, given that this has been identified as a high-risk period for sleep problems among active-duty servicemembers and veterans.

As discussed in relation to our conceptual model, which is presented later in this chapter, sleep problems that may be initiated in the deployed environment may perpetuate into the post-deployed environment and have a lasting impact on servicemember health and readiness. For this reason, a better understanding of how factors across all aspects of the deployment cycle may contribute to long-term sleep problems can help to inform policy and programmatic efforts to prevent and reduce these consequences. The conceptual framework presented here provides a useful lens for viewing sleep-related problems in the military context. Our literature review also highlights how most studies focus on sleep-related problems rather than on promoting healthy sleep. In that regard, the conceptual framework may be a useful heuristic for identifying and ultimately modifying sleep-related thoughts and behaviors that perpetuate sleep problems long after a servicemember returns from deployment.

To answer our first research question, we summarize the results of our literature review of military sleep studies published since the beginning of combat operations as part of Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), and Operation New Dawn (OND), including longitudinal and cross-sectional studies on prevalence, risk factors and correlates, and consequences of sleep problems in the post-deployment period. Although sleep research with military samples is burgeoning, the majority of the research targets civilians, who differ from military populations in several ways (e.g., age, gender, combat experience). In most instances, we could not directly compare civilian sleep studies with those that used military samples and therefore are cautious in making any comparisons regarding the prevalence of sleep problems in military and civilian populations. Still, we reference the civilian work to highlight gaps in the military research. We include comments from our key informant interviews and working group meeting to support the military literature search, where

appropriate, and provide substantiating front-line knowledge to interpret these empirical findings. These methods are described in more detail in Appendixes G and H. Finally, we also addressed the first research question by developing and administering a sleep survey to the Deployment Life Study servicemember cohort. That effort and its results are discussed in Chapter Three.

Literature Review Approach

To conduct the literature review, we used the conceptual framework described below, which helped us identify the key questions and search terms that informed our decisions about whether to include or exclude studies. The three key questions were as follows:

1. What are the specific types of sleep problems and disorders prevalent in the post-deployment period?
2. What are the risk factors for post-deployment sleep problems (demographic/military support, health, psychological, and behavioral factors)?
3. What are the consequences of sleep-related disorders, poor sleep quality, and insufficient sleep duration on physical health, mental health, fatigue, and operational readiness?

To locate articles for the literature review, we performed comprehensive Internet searches for studies published between 2001 and 2012,¹ using a broad range of search terms, such as *sleep disorders*, *nightmares*, *mental health*, *insomnia*, *military*, and *veterans*. We selected these years to focus on sleep problems following contemporary military operations—mainly those affecting military servicemembers in conflicts since September 11, 2001 (OEF, OIF, and OND). Table B.1 in Appendix B offers a detailed description of our literature search methodology, including search terms, search engines, and inclusion and exclusion criteria.

Prevalence studies were primarily cross-sectional and included samples of general military personnel and servicemembers in clinical settings (e.g., those seeking treatment for sleep problems). Studies on risk factors, correlates, and consequences of sleep disturbances included both cross-sectional and longitudinal research with military samples. However, in reviewing the literature, we placed greater emphasis on the longitudinal findings, given that cross-sectional studies cannot address temporal ordering

¹ While our original search was conducted in late 2012 and included articles through December 2012, we consistently checked the literature using the same search strategies identified here every three months during the drafting of this report to stay up-to-date on new literature in the field. We revised the draft report as new literature was identified. This report includes literature published through February 2014.

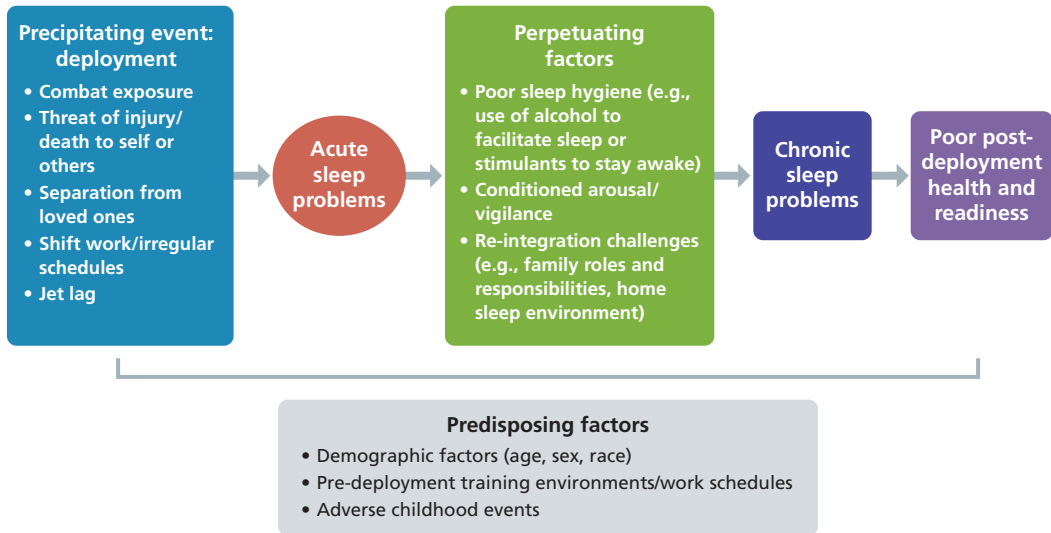
or the directionality of relationships (e.g., whether sleep increases the risk of adverse mental health outcomes or vice versa).

Much of the broad civilian research base on insomnia and other sleep problems, as well as the research highlighting the consequences of sleep problems or disorders, could theoretically apply to military populations. However, several unique issues, including operational factors and safety concerns, are particularly salient to sleep among military populations, and the civilian research may be less informative when it comes to these factors. However, there is a substantial research base on the prevalence and consequences of poor sleep among servicemembers—a research base that has grown considerably over the past 15 years. Both research bases can inform policies tailored to the unique needs of military populations; thus, we drew from research on both of these populations in our review. It is noteworthy that none of the studies reviewed directly compared civilian and servicemember samples. This precluded us from drawing meaningful inferences regarding the relative prevalence of sleep problems among servicemember and civilian populations. In addition to the literature reviewed, we also considered the unique perspectives of our key informants and working group participants, which are incorporated throughout the chapter as corroborating evidence to support findings in the literature. Finally, we also further evaluated the prevalence and problems of servicemembers by developing and administering a sleep survey through the Deployment Life Study servicemember cohort; that survey is described in greater detail in Chapter Three.

A Conceptual Model of Post-Deployment Sleep Problems

To provide a conceptual framework for understanding deployment-related sleep problems and to guide the literature review, we drew from an influential model of insomnia developed by Spielman and colleagues (Spielman, Caruso, and Glovinsky, 1987; Spielman and Glovinsky, 1991). Researchers have recently adapted the model to focus on sleep problems that are relevant to military populations (Bramoweth and Germain, 2013). We further refined this model for our framework, as shown in Figure 2.1. We consider this framework to be particularly valuable for considering how sleep problems persist into the post-deployment period, given that more than 2 million servicemembers have deployed to combat arenas in response to the wars in Iraq and Afghanistan over the past 13 years and that sleep problems have emerged as a major concern among these servicemembers after deployment (DCoE, 2012; Schmitz, Browning, and Webb-Murphy, 2009; Young-McCaughan, Peterson, and Bingham, 2011).

According to Spielman's original 3P model (Spielman, Caruso, and Glovinsky, 1987; Spielman and Glovinsky, 1991), *predisposing factors* are stable or enduring characteristics (e.g., anxious temperament, gender) that increase one's vulnerability to developing insomnia. *Precipitating factors* are situations or events that trigger the initiation

Figure 2.1**Adaptation of Spielman's 3P Model to Understand Post-Deployment Sleep Problems Among Servicemembers**

SOURCES: Adapted from Spielman, Caruso, and Glovinsky, 1987, and Spielman and Glovinsky, 1991.

RAND RR739-2.1

of insomnia and may include major life events (e.g., divorce, death of a loved one), psychological or environmental factors (e.g., work-related stress, change to a new location with an adverse sleeping environment), or medical factors (e.g., illness, new medication). Predisposing and precipitating factors are similar to those in a diathesis-stress model, in which vulnerability interacts with environmental stressors to lead to the manifestation of a clinical disorder (Ingram and Luxton, 2005). Predisposing and precipitating factors are often not amenable to change. However, *perpetuating factors* are often modifiable thoughts or behaviors and, thus, represent potential targets for behavioral intervention. Specifically, Spielman posits that to cope with acute sleep disturbances, individuals often develop compensatory behaviors (e.g., spending more time in bed, taking naps, using caffeine or stimulants to stay awake during the day, worrying about daytime consequences if they cannot get a good night's sleep), which ultimately serve to perpetuate the sleep disturbance.

Longitudinal research with civilians has supported the 3P model of insomnia. For example, such factors as a family history of insomnia, genetic susceptibility, and anxious temperament can serve as predisposing factors for sleep problems (LeBlanc et al., 2009; Drake, Friedman, et al., 2011). Precipitating events, like adverse childhood experiences and severe illness, have also been shown in longitudinal studies to contribute to insomnia (Healey et al., 1981; Gregory et al., 2006). Perpetuating factors, like the use of alcohol to fall asleep or the use of daytime caffeine to combat sleepiness, may

help in the short term but are linked to long-term sleep problems (Roehrs and Roth, 2001; Aurora et al., 2012; Bonnet and Arand, 1992; Bonnet et al., 2005). Predisposing factors and precipitating factors, such as stressful events, have been shown to combine to contribute to a greater risk of developing insomnia (Morin, Rodrigue, and Ivers, 2003), and predisposing factors may exacerbate the effects of perpetuating factors on poor sleep (e.g., physiological reaction to caffeine; Bonnet and Arand, 2003).

Prevalence and Types of Specific Sleep Problems in the Post-Deployment Period

Research on the prevalence of sleep problems among servicemembers in the post-deployment period falls into two groups: (1) studies of sleep disorders, which are diagnosable clinical phenomena, and (2) studies of the symptoms of sleep problems, which are isolated sleep disturbances (e.g., difficulty initiating and maintaining sleep, nightmares). As for the former (sleep disorders), we focus on the specific sleep disorders that have a research base specific to military populations (i.e., insomnia and obstructive sleep apnea [OSA]) rather than the full scope of sleep disorders. Regarding the latter type of research, symptoms of sleep problems may or may not reflect an underlying sleep disorder and also may or may not reflect an underlying co-occurring mental health diagnosis, such as PTSD or depression, or a physical health condition (e.g., hypoglycemia). Table B.2 in Appendix B offers additional details on the prevalence studies we reviewed.

Diagnosed Sleep Disorders

The *International Classification of Sleep Disorders Diagnostic and Coding Manual* (American Academy of Sleep Medicine, 2005) is the diagnostic manual for sleep disorders. It currently contains more than 80 clinical sleep disorders in eight categories, including insomnias, sleep-related breathing disorders, hypersomnias, circadian rhythm sleep disorders, parasomnias, and sleep-related movement disorders. There has been limited research on diagnosable sleep disorders in military populations, with the available evidence focusing on two of the most common sleep disorders in the general population: insomnia and OSA.

Insomnia

Insomnia is characterized by a persistent sleep complaint (lasting one month or longer), with associated daytime impairment. What distinguishes insomnia from sleep deprivation or insufficient sleep duration is that, in the former, there are adequate opportunities to sleep but the *ability* to sleep is compromised. In contrast, sleep deprivation is characterized by a restricted opportunity to sleep (e.g., because of lifestyle or shift work), despite adequate ability. This distinction is very important when considering the prevalence of insomnia in military populations, because such factors as opera-

tional demands, training environments, shift-work schedules, and cultural attitudes may restrict the opportunity for sleep among servicemembers, though the *ability* to sleep may remain intact.

Epidemiological studies on the prevalence of insomnia often vary widely, both in civilian and military populations. Some studies report on isolated symptoms of insomnia (which are considerably more prevalent than diagnosable disorders), whereas far fewer studies report on the insomnia disorder as defined by its stringent diagnostic criteria (Ohayon, 1997). Even with these more stringent diagnostic criteria, insomnia is still the most prevalent sleep disorder in the general U.S. population, affecting between 9 and 12 percent of Americans (National Institutes of Health, 2005; Ohayon, 1997). However, estimates are considerably higher (up to 20–40 percent) in primary care medical settings (Shochat, Umphress, et al., 1999; Simon and VonKorff, 1997; Arroll et al., 2012). Among active-duty personnel, insomnia is one of the most frequent reasons for mental health referrals and the most common complaint reported by servicemembers post-deployment (Collen et al., 2012; McLay, Klam and Volkert, 2010; Mysliwiec, Gill, et al., 2013; Mysliwiec, McGraw, et al., 2013; Seelig et al., 2010).

DoD medical surveillance data between 2000 and 2009 document a marked increase in new diagnoses of insomnia across all Services (Armed Forces Health Surveillance Center, 2010b). In fact, the diagnostic rates of insomnia increased 19-fold over the nine-year surveillance period. Mysliwiec, Gill, et al. (2013) reported that 24 percent of OEF/OIF servicemembers referred for sleep studies received a diagnosis of insomnia.

Consistent with civilian samples, evidence from military populations also shows an even higher prevalence of insomnia in comorbid medical or psychiatric populations. In particular, mild traumatic brain injury (mTBI), chronic pain, anxiety, depression, and PTSD have been common diagnoses among servicemembers returning from OEF/OIF/OND operations. Not surprisingly, evidence suggests that insomnia diagnoses are even more prevalent among servicemembers with PTSD and pain syndromes (Mysliwiec, McGraw, et al., 2013). While data from these clinical samples is compelling, few comparisons can be made between insomnia prevalence in military and civilian samples, and more research is needed to understand insomnia diagnosis rates outside of clinical samples. Additionally, information about the use of validated diagnostic criteria by a clinician or mental health specialist is not always well documented in studies of insomnia.

Obstructive Sleep Apnea

OSA is characterized by the collapsing of the upper airway during sleep, which leads to nocturnal symptoms of gasping for air or loud snoring and daytime sleepiness. OSA has a reported prevalence of between 2 and 7 percent in civilian samples (Punjabi, 2008). Prevalence data on OSA are somewhat inconsistent, depending on how the condition is measured (e.g., with gold-standard, in-laboratory polysomnographic mon-

itoring or a self-report screening instrument), the population being studied, and the specific criteria used to define the presence or absence of symptoms. There is also a critical shortage of prevalence data on OSA rates among active-duty U.S. servicemembers. The existing studies of OSA prevalence among servicemember populations are either from non-U.S. samples (e.g., 2.9 percent of British soldiers reported symptoms consistent with OSA in Okpala, Walker, and Hosni, 2011) or from reports of population incidence rates among servicemembers hospitalized for sleep-related disorders. For example, medical surveillance data collected between 2000 and 2009 demonstrate a sharp increase in OSA cases among active-duty servicemembers (Brundage, Wertheimer, and Clark, 2010), but individual rates are not known.

The rates of OSA among military samples referred to sleep centers are similar to those in civilian sleep centers. For example, civilian studies indicate a 67.8-percent rate of OSA among those referred for diagnostic sleep testing in sleep center settings (Punjabi, Welch, and Strohl, 2000). In military samples, OSA prevalence rates range from 51.2 to 76.8 percent among those referred for diagnostic sleep screening (Capaldi, Guerrero, and Killgore, 2011; Mysliwicz, Gill, et al., 2013; Mysliwicz, McGraw, et al., 2013). A recent study of 725 OEF/OIF servicemembers referred to medical care for sleep disturbances found an OSA prevalence rate of 51.2 percent (27.2 percent mild; 24.0 percent moderate to severe; Mysliwicz, McGraw, et al., 2013). A follow-up study (Mysliwicz, Gill, et al., 2013) found that 62.7 percent of active-duty servicemembers referred for sleep testing within 18 months of their most recent deployment were diagnosed with OSA. A small sample of overweight Army combat veterans from the conflicts in Iraq and Afghanistan referred for evaluation of sleep disturbances reported a 76.8-percent OSA prevalence rate (Capaldi, Guerrero, and Killgore, 2011). While these rates are high, it is important to note that servicemembers referred for evaluation are likely to show significant symptoms during the initial screening assessment, which would increase the probability of a positive diagnosis for the disorder. There are also concerns about the implications of rising OSA diagnoses and the impact on disability benefits; for instance, disability claims for OSA likely cost the VA more than \$1.5 billion in 2013 (Philpott, 2014). Still, as with insomnia diagnoses, population-based studies using validated screening assessments are needed to estimate OSA risk at the population level (Chung et al., 2008; Netzer et al., 1999), because rates based on clinic referrals are subject to a number of biases.²

Symptoms of Sleep Problems

Research on sleep disturbance symptoms includes studies on insufficient (i.e., short) sleep duration, sleepiness, fatigue, poor sleep quality, and nightmares.

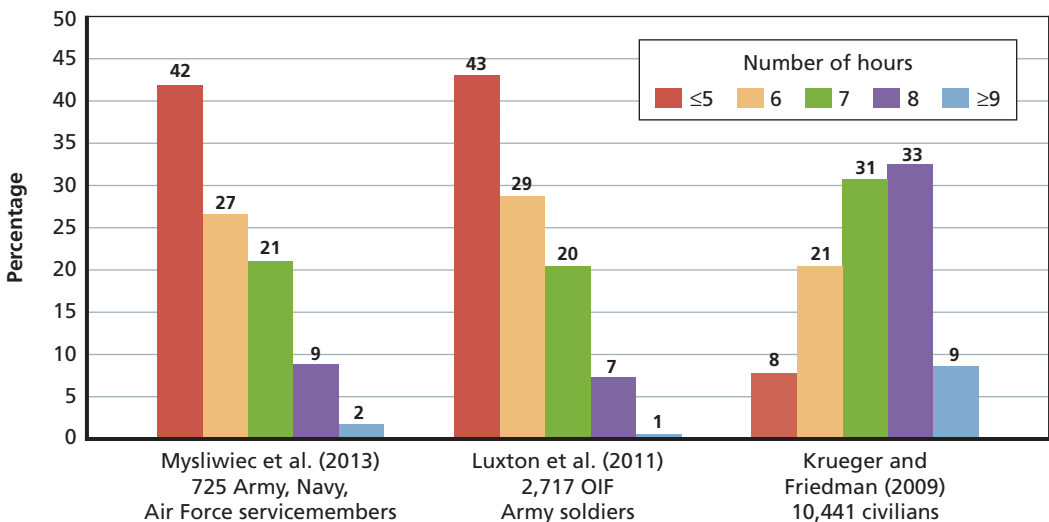
² Validated screening assessments include the self-report Berlin Questionnaire, a ten-item screening tool to assess the risk (low to high) of sleep-disordered breathing (Ahmadi et al., 2008; Netzer et al., 1999), and the STOP-BANG (snoring, tiredness, observed apnea, high blood pressure–body mass index, age, neck circumference, and gender) questionnaire (Chung et al., 2008).

Short Sleep Duration

The U.S. Department of Health and Human Services (DHHS, 2005) and the Centers for Disease Control and Prevention (McKnight-Eily et al., 2009) recommend that adults get approximately seven to eight hours of sleep per night. However, military personnel who have previously deployed report total sleep durations markedly below these recommended levels. For instance, in a sample of 2,717 Army servicemembers, 72 percent reported getting less than seven hours of sleep, on average, during the post-deployment period, with 23 percent reporting less than six hours of sleep (Luxton, Greenburg, et al., 2011). Servicemembers screened for sleep problems also report very short sleep durations. For example, 41.8 percent of a clinical sample of more than 700 Army, Air Force, and Navy servicemembers with combat experience reported sleep durations of less than five hours per night (Mysliwicz, McGraw, et al., 2013).

Notably, only about 24 percent of servicemembers report sleeping the optimal seven to eight hours per night (Bray et al., 2009). Short sleep duration is a problem that extends to the general population as well, with approximately one out of three U.S. adults reporting sleep duration of less than seven hours per night (McKnight-Eily et al., 2009). Figure 2.2 shows average self-reported sleep duration in two studies with military samples (a general military population and a clinical sample) and one large-scale study of civilians (Krueger and Friedman, 2009). A higher percentage of servicemembers reported short sleep durations compared with the general population. However, such comparisons should be interpreted cautiously, given that these studies are not matched on key characteristics that are known to distinguish civilian and mili-

Figure 2.2
Comparison of Sleep Duration (in hours) Across Three Studies



SOURCES: Mysliwicz, McGraw, et al., 2013; Luxton, Greenburg, et al., 2011; Krueger and Friedman, 2009.

tary populations and that are known risk factors for short sleep duration (e.g., age, sex, employment characteristics).

Recalling the conceptual model, deployment may serve as a key precipitating event to sleep problems (including insufficient sleep duration), but other factors associated with the military lifestyle (e.g., training environments, work schedules) may also increase the risk for insufficient sleep duration across the deployment cycle. There is limited evidence to suggest that deployed servicemembers and those in the post-deployment period have shorter sleep durations than those who have never deployed (Seelig et al., 2010); however, few studies have addressed this important question.

Poor Sleep Quality

Population-based studies of insomnia-related symptoms, including poor sleep quality and difficulty falling or staying asleep, suggest that these types of sleep problems are common in the post-deployment period (Luxton, Greenburg, et al., 2011; Seelig et al., 2010). For instance, 27 percent of a large sample of 9,264 active-duty servicemembers returning from OEF/OIF deployments reported trouble sleeping (Seelig et al., 2010). A small sample of post-deployed OEF/OIF servicemembers and veterans found that 89 percent of participants were classified as “poor sleepers” (Plumb et al., 2014), as assessed by the standardized sleep questionnaire, the PSQI (Buysse, Reynolds, et al., 1989). The 2012 Fleet and Marine Corps Health Risk assessment survey of nearly 200,000 Navy, Marine Corps, and Coast Guard personnel found that 39 percent of Navy and 42 percent of Marine Corps personnel surveyed reported frequently not getting enough restful sleep to function well at work and in their personal lives. Surveys of other veteran populations, including Gulf War veterans, confirm that insomnia-related symptoms are a common symptom reported by servicemembers post-deployment (Engel et al., 2000; Neylan et al., 1998; Yesavage et al., 2012; Polley, Frank, and Smith, 2012). Studies of Vietnam veterans further suggest that sleep problems are often intractable symptoms, with over half of sample participants reporting enduring sleep difficulties, even ten years after deployment (Neylan et al., 1998; Yesavage et al., 2012). Problems may persist if they go untreated as servicemembers transition to civilian life as veterans. For example, a recent survey of 2,866 middle-aged veterans found that although the majority reported symptoms consistent with poor sleep quality or insomnia (74 percent), 28 percent of these veterans reported that they had never discussed their sleep problems with a health care provider (Polley, Frank, and Smith, 2012). The most prominent reasons for not seeking help included “I don’t want to take a sleeping medication” (33 percent), “I don’t like going to the doctor” (24 percent), “I don’t want to be labeled” (23 percent), and “I don’t think any treatment will work” (23 percent).

Nightmares

Few studies have documented the prevalence of nightmares among servicemembers specifically in the post-deployment period. However, frequent, distressing dreams are

one of the cardinal symptoms of PTSD, which affects approximately 15 percent of post-deployed servicemembers (Ramchand, Schell, et al., 2010). For example, one sample of 201 OEF/OIF veterans identified by primary care providers as needing behavioral health assessments revealed a nightmare prevalence rate of nearly 51 percent (31.8 percent severe, 18.9 percent moderate; Gellis et al., 2010). Most of these individuals had comorbid PTSD (59.7 percent of the sample met the criteria); thus, the prevalence of nightmares independent of PTSD in the post-deployment period remains unknown.

Daytime Sleepiness and Fatigue

In a population with relatively high rates of sleep disorders, including insomnia and OSA, and markedly high rates of insufficient sleep duration, it is perhaps not surprising that reports of daytime sleepiness and fatigue are also highly prevalent among servicemembers in the post-deployment period. In fact, sleep problems (32.8 percent) and fatigue (32.3 percent) were two of the three most common physical health complaints reported by a large sample of 1,532 Army personnel assessed six months post-deployment (Toblin, Riviere, et al., 2012). Fatigue is particularly prevalent post-deployment for those with comorbid conditions, including PTSD, TBI, and physical injuries (Hoge, McGurk, et al., 2008; Wallace et al., 2011). For example, among veterans seeking care through the Veterans Health Administration (VHA), 60 percent of those with PTSD and TBI, and 33 percent of those with PTSD alone, reported daytime sleepiness. Approximately 53 percent of those with deployment injuries leading to unconsciousness reported fatigue three to four months post-deployment, compared with 25 percent of servicemembers without deployment injuries (Hoge, McGurk, et al., 2008).

Such high rates of daytime sleepiness and fatigue are particularly concerning in servicemember populations, given the known consequences of sleepiness and fatigue on cognitive functioning and judgment (Neu et al., 2011; Riedel and Lichstein, 2000). Because operational readiness is of high importance to the military and its personnel, we review the studies of sleep and operational readiness in the section “Correlates and Consequences of Sleep Disturbances in the Post-Deployment Period,” later in this chapter, with a general conclusion that sleepiness and fatigue can contribute to reduced performance and impaired cognitive functioning.

Risk Factors for Sleep Problems in the Post-Deployment Period

In this section, we review the evidence on purported risk factors of sleep disturbances in the post-deployment period. As demonstrated in our conceptual model (Figure 2.1), deployment itself is likely a key precipitating factor that can trigger the onset of sleep problems for many servicemembers. There are a number of environmental and social challenges to sleep in the deployed environment, including travel across multiple time zones; uncomfortable or otherwise inhospitable sleeping environments; combat expo-

sure; threat of injury to the self or others, which requires heightened and sustained vigilance and arousal; and separation from family and loved ones—all of which can precipitate the onset of insomnia and nightmares (DCoE, 2012; Lindsay and Dyche, 2012; Schmitz, Browning, and Webb-Murphy, 2009; Young-McCaughan, Peterson, and Bingham, 2011). In fact, surveys of Army and Marine Corps personnel deployed in Afghanistan have found that the factors that most interfere with sleep while deployed were poor sleep environments, nighttime duties, high operational tempo (OPTEMPO), stress related to personal life, and stress related to combat (Joint MHAT [J-MHAT] 7, 2011; MHAT 9, 2013).

Our interviewees emphasized that the research on shift work is not properly being incorporated into military practice. In published work, sleep experts have called for more longitudinal research on the impact of deployments and military service on chronic sleep problems post-deployment (Shattuck and Brown, 2013). Although limited evidence suggests that deployed and post-deployed servicemembers report poorer sleep than those with no deployment experience (Seelig et al., 2010), there is still no clear-cut longitudinal evidence directly linking deployment itself as a causal factor leading to sleep problems post-deployment. Without longitudinal studies, one cannot discern whether these factors increase the risk of developing sleep problems, co-occur with the development of sleep problems, or are consequences of poor sleep. Taking care not to imply causation or draw conclusions from cross-sectional work, we review studies on (1) stable demographic characteristics, (2) operational and military support factors, and (3) health behaviors purported to increase the risk of sleep disturbances among post-deployed servicemembers. Appendix B, Table B.3, provides details of the reviewed studies.

Stable Demographic Factors

Research on the demographic characteristics associated with increased risk for sleep problems in the military population has generally focused on gender, age, and ethnicity and has found patterns similar to the epidemiology of sleep problems in the civilian population (Young et al., 1993; Taylor et al., 2005). The research generally suggests that demographic risk factors for sleep disturbances depend somewhat on the nature of the sleep disturbance. For example, female servicemembers are more likely than male servicemembers to be diagnosed with insomnia, to report long sleep duration (nine hours or more on average), and to report dissatisfaction with sleep quality; however, male servicemembers are at greater risk for OSA and report the shortest sleep duration (Capaldi, Guerrero, and Killgore, 2011; Mysliwiec, Gill, et al., 2013; Seelig et al., 2010; Swinkels et al., 2013; Lentino et al., 2013; Plumb, Peachey, and Zelman, 2014). Older servicemembers are at greater risk for OSA and report poorer sleep quality than younger servicemembers, while long sleep duration is more common among younger servicemembers (Capaldi, Guerrero, and Killgore, 2011; Mysliwiec, Gill, et al., 2013; Seelig et al., 2010; Swinkels et al., 2013; Plumb, Peachey, and Zelman, 2014). Con-

sistent with the civilian literature on racial/ethnic differences in sleep patterns (Hale and Do, 2007; Ruiters et al., 2011), servicemembers identifying as non-Hispanic black or African American report shorter sleep duration and more difficulty initiating and maintaining sleep than white servicemembers (Gellis et al., 2010; Seelig et al., 2010). However, in other work, non-Hispanic white servicemembers have been shown to be at risk for short sleep duration and poor sleep quality compared with other ethnicities in a veteran sample (Swinkels et al., 2013).

Some of our interviewees suggested that younger servicemembers are a high-risk population for sleep problems because of attitudes and behaviors that interfere with healthy sleep. For example,

They're in their immortal phase, under 27. [Ages] 18–27 is what the insurance companies call [the] “high risk population.” In the Marine Corps, it's the immortal phase where nothing is ever going to happen to you. You're willing to take risks, not really looking at risk benefit rewards.

This generation of youngsters that we have coming into the service. . . . The way they relax is not the way we relax. . . . They go to an Xbox or some handheld device and they are spinning up their brains, but this is their relaxation, which is cutting into their sleep time, and that clearly is a factor as well. . . . [I] think that is going to be one of the predisposing factors for how we force the rest cycle on these kids.

Operational and Military Support Factors

The research on operational and military support factors includes studies examining general military characteristics (e.g., officer status, Service branch) and unit- and deployment-specific factors (e.g., unit support, location of deployment).

General Military Characteristics

Post-deployment sleep disturbances are associated with several characteristics of military service. For example, those serving in the Army or Marine Corps, those on active-duty (versus Guard/Reserve), and those who are junior enlisted (versus officers, and, similarly, those with less education) are at risk for short sleep duration and global sleep problems post-deployment (Seelig et al., 2010; Swinkels et al., 2013; Lentino et al., 2013; Plumb, Peachey, and Zelman, 2014). Military occupational specialty categories at risk for insomnia, OSA, and poor sleep quality include those deployed in support and sustainment units (e.g., medics) and electronic equipment repair specialists (Armed Forces Health Surveillance Center, 2010b; Brundage, Wertheimer, and Clark, 2010; Seelig et al., 2010), perhaps because of the pressure from these demanding positions and the exposure to traumatic medical emergencies.

Unit- and Deployment-Specific Factors

A greater number of deployments, greater combat exposure while deployed, and deployment to Iraq or Afghanistan versus other locations are additional factors associated with an increased risk of poor sleep quality and short sleep duration post-deployment (Luxton, Greenburg, et al., 2011; Seelig et al., 2010; Swinkels et al., 2013; Wright et al., 2011b; Plumb, Peachey, and Zelman, 2014). For example, both one month and three months after deployment, approximately 40 percent of those deployed to Iraq or Afghanistan reported sleep problems, compared with 20–25 percent of those who had deployed to Kuwait or other places or who were shipboard—locations presumably exposed to less combat than locations in Iraq and Afghanistan (McLay, Klam, and Volkert, 2010). In addition, lower levels of unit support while deployed (i.e., amount of assistance or encouragement from unit members and leaders) and limited exposure to sleep management training in theater are associated with poor sleep quality among OEF/OIF officers and veterans (Miller, Shattuck, and Matsangas, 2011; Pietrzak, Morgan, and Southwick, 2010), while Army personnel who report positive sleep leadership from noncommissioned officers (NCOs) during deployments are less likely to report sleep problems (MHAT 9, 2013).

Health Behaviors

As demonstrated in our conceptual model (Figure 2.1), perpetuating factors, such as the use of alcohol to facilitate sleep onset or the use of caffeine or stimulants to increase wakefulness, can contribute to ongoing sleep problems in the post-deployed environment. Several cross-sectional studies indicate that poor health behaviors are associated with an increased risk of sleep problems among servicemember populations (Seelig et al., 2010; Swinkels et al., 2013; Toblin, Clarke-Walper, et al., 2012). For example, a cross-sectional study of Iraq and Afghanistan veterans indicated that long sleep duration (i.e., sleep lasting nine or more hours) was associated with increased odds of smoking (Swinkels et al., 2013). In addition, a large-scale study of more than 41,000 OEF/OIF active-duty servicemembers also found that problem drinking was correlated with trouble sleeping (Seelig et al., 2010). Given that some servicemembers may use alcohol to cope with sleep disturbances (e.g., nightmares or trouble falling asleep), but that chronic or heavy alcohol use can also lead to sleep disturbances, the directionality of these associations remains unclear.

An emerging area of research also suggests that servicemembers may be increasingly using highly caffeinated products, such as energy drinks or “shots” (e.g., Red Bull, Monster, 5-Hour Energy) to compensate for insufficient sleep duration or fatigue. Use of these products may begin in the deployed setting as a way to increase alertness and reduce sleepiness or fatigue. For instance, data from the 2010 Deployment Well Being Survey (J-MHAT 7, 2011) indicated that, of a sample of 998 deployed Army and Marine Corps servicemembers in Afghanistan, 44.8 percent consumed at least one energy drink per day. The nearly 14 percent who were drinking three or more per day

reported frequent sleep disruption (Toblin, Clarke-Walper, et al., 2012). The majority of soldiers and Marines in the sample who took sleep medications (60 percent) also drank at least one energy drink per day, suggesting that servicemembers with sleep problems are also more likely to engage in compensatory behaviors to offset sleepiness during the day, compared with those without sleep problems.

Our interviewees also discussed the widespread and frequent heavy use of caffeine, particularly in deployed environments and in the form of energy drinks. According to several interviewees, caffeine use may be so ingrained in military work culture and so routine a part of servicemember recreation that intervening or regulating its use may be difficult. For example,

There is nothing that is going to [diminish] my credibility faster than if I go down range and I say, "Hey, you know you shouldn't really drink all those Rock Stars [energy drinks] and smoke all those cigarettes when you are out on patrol. It's really bad for you, and it's interfering with your sleep." I'm going to get told that, "well, you know that nothing is really going to interfere more with my sleep than getting killed."

Following our conceptual model, consuming caffeine and other energy products may become a habit that perpetuates into the post-deployed setting and has a lasting impact on sleep. Yet, research has just begun to focus on the use of energy products in the post-deployed setting specifically, and the reasons for their use are unclear. For example, Adler et al. (2011) found that approximately one-third of active-duty Army personnel returning from deployments reported an increased use of energy drinks and caffeine since prior to deployment. While the reasons (e.g., to combat fatigue) were not confirmed, the use of these caffeinated products was associated with PTSD symptoms. Although experimental studies show that stimulants, such as caffeine, can promote alertness and performance among sleep-deprived individuals for limited periods, they cannot replace the necessary restorative power of sleep on alertness and performance (Bonnet et al., 2005). Moreover, given the known effects of caffeine on sleep, a vicious cycle can ensue, leading to a perpetuation of sleep problems. That is, a servicemember may consume energy drinks to compensate for sleepiness or fatigue, but particularly when taken later in the day, such consumption can interfere with the quality and duration of sleep, leading to daytime sleepiness and fatigue, and so on.

Although there are few studies in this area with post-deployed servicemember samples, our interviewees and working group participants were particularly informative about these perpetuating factors and how the use of caffeine and stimulants while deployed could continue to affect sleep in the long term. Indeed, misuse of caffeine and energy drinks or other stimulants may serve as a barrier to achieving restful sleep once the opportunity is presented. Regarding the use of energy drinks, one interviewee remarked,

The use is heavy and it's a popular thing to do, part of the culture. We try to discourage it because if they knew better about how to manage their fatigue and got away from the caffeine and got adequate sleep and used the caffeine only when they needed it, I think they would have better success with it, and, in general, I think it's a problem for the military as it is for society.

Sleep medications are the most commonly prescribed psychotropic drug used in theater (Parkinson and Silva, 2011), and our interviewees described the difficulty of extending policies on the use of prescription stimulants and sleep medications. A small number of interviewees raised the point that servicemembers in certain occupational groups—for example, aviation or special forces—regularly use prescription stimulants, or “go pills,” to remain alert during long or dangerous missions. However, such use was perceived as a highly regulated practice integral to certain military missions, not as problematic. Some interviewees suggested that the military prescribes the right medications, which produce the desired effect while minimizing the potential for abuse. Still, others discussed the importance of limiting the use of sleeping pills to help with sleep while deployed to ensure that these medications did not impact continuous operations. For example, one interviewee stated,

There are just certain medications we say “no” to because we need you to be alert, or we need you to be at your full mental capabilities almost all the time when you're on the job, and so any prolonged effects from sleeping medications would be inexcusable.

Aside from stimulants, alcohol was perceived to be a notable cause of sleep disturbances, particularly during the post-deployment period, which fits with the research reviewed and the 3P model. Some interviewees highlighted the tendency of certain servicemembers to “self-medicate” with alcohol and to engage in heavy alcohol use after returning from a deployment.

Finally, interviewees also indicated that the overuse of technologies, such as the Internet or video games, which are often used as a means of relaxing and distracting servicemembers from the stress and anxiety of military work, may perpetuate sleep disturbances by increasing arousal right before bedtime. For example, one interviewee noted,

[Servicemembers] have such access now to the Internet, . . . video games, or their music. . . . There's just so many things out there they use to stimulate themselves and try and get their minds off the mission and try and relax. They could do that for hours on end, [and] they end up waking up for the mission exhausted.

Over time, such behaviors may become habitual, which, in turn, can lead to chronic sleep disturbances long after the servicemember has returned from deployment.

Correlates and Consequences of Sleep Problems in the Post-Deployment Period

In this section on the correlates and consequences of sleep disturbances, we review the available literature on mental health problems and physical health problems, noting that evidence suggests that many of these relationships are bidirectional (e.g., sleep problems are a symptom of mental health disorders but also can predict the onset of a mental health disorder). Recognizing the complexity of these relationships and the inability of cross-sectional studies to elucidate their directionality, we highlight findings from longitudinal studies and summarize suggestive cross-sectional data. This section also includes studies of operational readiness, which generally focus on longitudinal experiments or field studies that simulate sleep-deprived environments. Appendix B, Tables B.3 (cross-sectional studies) and B.4 (longitudinal studies), provide details of the reviewed studies.

Mental Health Problems

Sleep disturbances are a core feature of many psychological disorders, including PTSD (Germain, Buysse, et al., 2004), depression (Taylor et al., 2005), and TBI (Lew et al., 2010; Ouellet, Beaulieu-Bonneau, and Morin, 2006), which are the three most prevalent mental health diagnoses among active-duty military and veteran populations following deployments (Hoge, Castro, et al., 2004). Thus, it is not surprising that sleep problems are particularly prevalent among servicemembers with these and other medical or psychological conditions (Goff et al., 2007; Swinkels et al., 2013; Plumb, Peachey, and Zelman, 2014). For instance, sleep disturbances are the most prevalent symptoms of PTSD (Insana, Kolko, and Germain, 2012; Lew et al., 2010; McLay, Klam, and Volkert, 2010; Wallace et al., 2011), and those with PTSD are significantly more likely to report sleep problems and diagnosed insomnia or OSA than are those with other mental health problems or no mental health problems (Capaldi, Guerrero, and Killgore, 2011; Gellis et al., 2010; Hoge, Terhakopian, et al., 2007; Hughes et al., 2013; Picchioni et al., 2010; Seelig et al., 2010; Mysliwiec, Gill, et al., 2013). Sleep disturbances are also among the most prevalent symptoms reported by servicemembers and veterans with TBI (Hoge, McGurk, et al., 2008; Lew et al., 2010; Wallace et al., 2011). For example, in one study, nearly all patients receiving treatment for TBI at Walter Reed Medical Center reported sleep complaints (97.4 percent; Collen et al., 2012). In this patient sample, OSA was associated with blunt injuries, while insomnia was associated with blast injuries. A head injury with a loss of consciousness has also been associated with sleep difficulties among OEF/OIF veterans (Gellis et al., 2010), particularly among those with more-severe symptoms of PTSD (Cooper et al., 2011; Lew et al., 2010). Servicemembers who screen positive for TBI are more likely to report sleep problems than are those who screen negative (Macera et al., 2013).

Beyond these studies demonstrating that sleep problems are a key correlate or symptom of virtually every mental health diagnosis, substantial evidence from both civilian and military studies suggests that *sleep problems can also be a cause of downstream mental health consequences*. For example, multiple longitudinal studies in civilian samples have shown that sleep disturbances are a significant risk factor for developing depression, PTSD, anxiety disorders (e.g., panic disorder, obsessive-compulsive disorder), substance-use disorders, and suicidality (Breslau et al., 1996; Bryant et al., 2010; Buysse, Angst, et al., 2008; Koren et al., 2002; Ohayon and Roth, 2003; Riemann and Voderholzer, 2003; Weissman et al., 1997).

Our review identified 11 longitudinal studies involving military populations that investigated the temporal relationships between sleep and the development of mental health problems, including PTSD, depression, anxiety, and suicidality (Britton et al., 2012; Gehrman et al., 2013; Insana, Kolko, and Germain, 2012; McLay, Klam, and Volkert, 2010; Pigeon et al., 2012; Ribeiro et al., 2012; Seelig et al., 2010; van Liempt et al., 2013; Wright et al., 2011a, 2011b; Macera et al., 2013). We review the longitudinal research in the mental health areas of (1) depression, anxiety, PTSD, and substance-use disorders and (2) suicidality.

Depression, Anxiety, PTSD, and Substance-Use Disorders

Although there are a limited number of rigorous longitudinal studies with military samples, the available longitudinal evidence is strong for sleep problems (e.g., nightmares, insomnia) predicting symptoms and diagnoses of depression, anxiety, and PTSD. For example, in a sample of 15,204 servicemembers from all military branches, pre-deployment insomnia preceded new-onset PTSD, anxiety, and depression diagnosed post-deployment (Gehrman et al., 2013). Pre-deployment short sleep duration (less than six hours) predicted PTSD and anxiety post-deployment. Servicemembers with *both* predeployment insomnia and short sleep duration were at greatest risk for PTSD and anxiety. In addition, those with combat trauma during their most recent deployment and those with pre-deployment insomnia were at greatest risk of new-onset depression. In another recent longitudinal study of Dutch servicemembers deployed to Afghanistan, researchers found that pre-deployment nightmares predicted symptoms of PTSD six months post-deployment (van Liempt et al., 2013). As for PTSD and depression, researchers found that, among 29,640 sailors and Marines, post-deployment sleep problems explained the relationship between potential TBI diagnoses immediately post-deployment and positive PTSD screens three to six months later (Macera et al., 2013). Researchers also found that insomnia at four months post-deployment was a significant predictor of depression and PTSD at 12 months post-deployment. In contrast, depression and PTSD four months post-deployment did not predict insomnia at 12 months post-deployment (Wright et al., 2011a); these findings suggests that sleep may be a stronger predictor of the development of a subsequent mental health condition, rather than the reverse. In a subsequent study by Wright and colleagues (2011b),

combat exposure in Iraq, combined with poor post-deployment sleep, explained a significant portion of the variance in post-deployment PTSD, even after controlling for pre-deployment PTSD symptoms. Furthermore, in this same study, sleep problems, combined with greater levels of combat exposure, predicted alcohol problem severity after controlling for pre-deployment alcohol-use problems (Wright et al., 2011b).

Key informant interviews corroborated these research findings. Those we interviewed were generally attuned to the idea that sleep problems were not a specific or isolated symptom of a larger mental health disorder but, rather, were independent correlates within a larger system of personal mental health problems that warranted further attention.

Suicidality

There is also an established link between sleep problems and suicidality (i.e., suicidal ideation, suicide attempts, completed suicide, self-harm) in civilian studies, along with a growing body of evidence demonstrating similar associations in military populations. Specifically, in civilian studies, the risk of suicidality is associated with short sleep duration, insomnia symptoms (difficulty initiating and maintaining sleep), and nightmares, even after controlling for other known risk factors, including depression (Goodwin and Marusic, 2008; Pigeon et al., 2012; Sjostrom, Waern, and Hetta, 2007; Tanskanen et al., 2001). Similarly, in a large military sample, Ribeiro et al. (2012) found that insomnia predicted future suicidal ideation one month later, even after controlling for baseline suicidal ideation, depression, and hopelessness. Cross-sectional work has also indicated that post-deployed soldiers with very short sleep duration (less than six hours) were over three times more likely to have attempted suicide than those with more adequate sleep (Luxton, Greenburg, et al., 2011). These findings, coupled with the evidence from civilian research, suggest that sleep problems are an independent predictor of suicidality, not merely an epiphenomenon of an established mental health disorder, such as depression.

Retrospective examinations of the VHA medical records of 381 veterans who died by suicide show that veterans with reported poor sleep during their most recent visit to the VHA in the year prior to their death died approximately 100 days sooner than those who did not report sleep problems (Pigeon et al., 2012).

Physical Health Problems

Evidence from epidemiological and experimental studies suggests that sleep problems are both a cause and a correlate of numerous physical health conditions, such as pain, fertility problems, diabetes, hypertension and cardiovascular disease, asthma, weight gain and obesity, cancer, and even mortality (Spaeth, Dinges, and Goel, 2013; Patel and Hu, 2008; Mallon, Broman, and Hetta, 2005; Kripke et al., 2002; Jensen et al., 2013; Gangwisch, Malaspina, et al., 2005; Gangwisch, Heymsfield, et al., 2006, 2007; Gallicchio and Kalesan, 2009). Similarly, in cross-sectional work with military sam-

ples, short sleep duration, nightmares, and sleep disorders (e.g., OSA and insomnia) are common correlates of diagnosed health conditions (e.g., cardiovascular disease, asthma poor health), self-reported poor health, obesity, hypertension, pain symptoms, and respiratory and chest symptoms (Brundage, Wertheimer, and Clark, 2010; Engel et al., 2000; Mysliwiec, McGraw, et al., 2013; Seelig et al., 2010). For example, in one cross-sectional study, 34 percent of Gulf War combat veterans with diagnosed medical conditions (e.g., cardiovascular disease, asthma) reported sleep disturbances (Engel et al., 2000). Sleep problems are also highly comorbid with pain conditions and can also exacerbate pain conditions (Gellis et al., 2010; Lew et al., 2010; Mysliwiec, McGraw, et al., 2013; Wallace et al., 2011).

In a large sample of more than 14,000 active-duty soldiers and Army guardsmen/reservists, researchers found that those reporting symptoms of poor sleep (i.e., dissatisfaction with sleep quality, low energy from poor sleep) were more likely to self-report poor health, have a high body mass index (BMI), have poor nutrition, and fail to meet recommended exercise expectations (Lentino et al., 2013). In one of the few longitudinal studies examining sleep problems as a predictor of physical health problems, researchers found that servicemembers who self-reported trouble sleeping, short sleep duration (five or fewer hours), and OSA were more likely than those without sleep problems to self-report the onset of diabetes three and six years later (Boyko et al., 2013). Findings for diabetes risk predicted by these three sleep problems were not explained by other risk factors for diabetes, such as BMI, mental health diagnoses (e.g., PTSD, depression), and race/ethnicity.

As mentioned previously, the presence of medical comorbidities, including deployment-related injuries, is associated with an increased risk of short sleep duration and poor sleep quality (Hoge, McGurk, et al., 2008; Luxton, Greenburg, et al., 2011). There is also a link between obesity and OSA in both military and civilian samples. For example, active-duty personnel and veterans with higher BMIs and obesity are more likely to be diagnosed with OSA (Kryger et al., 2003; Mysliwiec, McGraw, et al., 2013; Yesavage et al., 2012). Civilian studies have established clear directionality of obesity leading to OSA rather than the reverse (Yu and Berger, 2011), suggesting that obesity is a precipitating factor for sleep problems in military populations as well.

Operational Readiness

Field and experimental studies reveal that short sleep duration has profound effects on cognitive functioning, attention, decisionmaking, and moral reasoning—all of which are directly related to servicemembers' operational readiness and fitness for duty. These consequences are most alarming for those in "high-risk" occupations, such as air traffic controllers and pilots, which require high levels of sustained attention and have small margins of error. In fact, a great deal of media attention has focused on high-profile cases related to poor sleep that have been linked with occupational hazards in the civilian domain, such as the Chernobyl and Three Mile Island nuclear accidents, the Exxon

Valdez oil spill, the Challenger space shuttle explosion, and numerous vehicular crashes (Banks and Dinges, 2007; Drake, Roehrs, et al., 2010; Mitler et al., 1988). Experimental work has also shown that the cognitive and performance effects of sleep deprivation are similar to impairment seen with blood alcohol levels above the legal limit (Dawson and Reid, 1997). For example, an individual continuously awake for 24 hours experiences impairment similar to someone with a blood alcohol level above 0.80—the level at which states legally determine that one is too intoxicated to operate a motor vehicle. Compounding this, sleep-deprived individuals are poor at determining their own level of impairment from lack of sleep (Dorrian et al., 2003), which possibly contributes to fewer requests for shift changes or voluntary breaks during work hours.

Experimental studies with military samples replicating the sleep deprivation states encountered during deployment have primarily found that sleep deprivation can have next-day effects on performance, cognitive tests, flexible decisionmaking, and moral reasoning (Balkin et al., 2004; Belenky et al., 2003; Caldwell et al., 2004; Horne and Moseley, 2011; Lieberman, Bathalon, et al., 2002; Olsen, Pallesen, and Eid, 2010; Previc et al., 2009). In field studies, deployed Army personnel who reported getting less sleep than they needed (about six hours per night) were significantly more likely to report accidents or mistakes on the job, a limited ability to do their jobs, working less carefully, and having supervisors who were concerned about them than were those who reported no sleep deprivation (MHAT V, 2008). Likewise, during deployments, half of OEF Army personnel who reported making a mistake or having an accident while on duty attributed the cause to sleepiness (MHAT 9, 2013). In a simulation combat study in which Army officers received about three hours of sleep during a 53-hour exercise, participants experienced severe impairments in vigilance, reaction time, attention, memory, and reasoning and reported a depressed mood, effects likely compounded by other factors present in the simulation, like extreme heat and undernutrition (Lieberman, Tharion, et al., 2005).

Discussion

Sleep problems are prevalent, debilitating, and persistent in servicemember populations in the post-deployment period. Consistent with evidence from the civilian population, the most prevalent diagnosed sleep disorders among servicemembers seeking evaluation for sleep problems include insomnia and OSA. Servicemembers, in general, and those who have previously deployed, specifically, are at high risk for insufficient sleep duration. Consequently, servicemembers are also at high risk for the daytime consequences associated with insufficient sleep duration and poor sleep quality, including daytime sleepiness and fatigue. Servicemembers who have deployed or who are currently deployed also report fewer hours of sleep per night than those who have not

deployed, and they report numerous symptoms of poor sleep, such as difficulty falling and staying asleep, frequent awakening, daytime sleepiness, and nightmares.

Our review of the demographic literature suggests that risk factors for sleep problems vary with the type of sleep disorder or symptom targeted (e.g., men are at greater risk for OSA, while women are at greater risk for insomnia). Combat exposure, injuries incurred during deployments, occupation while deployed, and location of deployment have also been shown to increase the risk of post-deployment sleep problems. Poor sleep hygiene, which includes the use of alcohol, tobacco products, and energy drinks or caffeine, may also increase the risk of sleep problems in the post-deployment period; however, no research has examined the longitudinal relationship between poor sleep hygiene and the development of sleep problems among servicemembers. These data would help to support the 3P model of insomnia developed by Spielman and expanded upon in our conceptual model (Figure 2.1) and in other work (Spielman, Caruso, and Glovinsky, 1987; Spielman and Glovinsky, 1991; Bramoweth and Germain, 2013).

Consistent with the civilian literature demonstrating that sleep problems are commonly comorbid with other physical or mental health conditions, the prevalence of sleep disorders and symptoms in the post-deployment period is higher among servicemembers with deployment-related injuries or mental health problems than among those without such comorbid conditions. Research with servicemembers further suggests that sleep problems are not only a key symptom of many physical and health conditions, but they can also predict the onset of chronic health conditions, including diabetes, depression, PTSD, and suicidal thoughts and behaviors. Indeed, we examined 11 longitudinal studies that supported the directionality of sleep problems leading to lasting consequences. Veteran research also indicates that, once initiated, sleep disturbances often follow a persistent course, lasting for years after deployment. These findings are important for several reasons, most notably because they highlight that sleep problems are a correlate or associated symptom of a larger mental or physical health problem and that sleep problems actually precede both mental and physical health problems in both civilian and military populations. This suggests that targeting poor sleep patterns early on could help make servicemembers more resilient in avoiding long-term problems in the post-deployed period.

Our review also identified several field and experimental studies that suggest that sleep deprivation can have short-term effects on cognitive functioning and occupational readiness; however, given the epidemic levels of insufficient sleep duration among servicemembers, more research is needed to identify the long-term cognitive and occupational consequences of chronic insufficient sleep duration and other sleep problems and disorders. Together, these findings indicate that sleep problems are prevalent, debilitating, and persistent in servicemember populations in the post-deployment period. The adapted 3P model (Figure 2.1) may be a useful heuristic for identifying and ultimately modifying sleep-related thoughts and behaviors that serve to perpetuate sleep problems long after the servicemember returns from deployment.

Unaddressed Gaps in the Literature

The literature on military sleep has grown considerably in the past 15 years. Still, several gaps remain that limit our understanding of the prevalence, risks and correlates, and consequences of sleep problems in the deployed environment and post-deployment period. The primary limitations of the available studies include the small number of longitudinal studies and the lack of comprehensive, standardized, and valid self-report measures used to assess the diverse types of sleep problems that servicemembers experience. Table 2.1 highlights the major limitations of the studies, which are described in more detail in Appendix B, Tables B.2–B.4, and some ways such limitations can be addressed.

Most studies have used single- or few-item self-report measures of “sleep problems” (a general term that can encompass specific diagnoses or symptoms), or “sleep disturbances,” which may be transient or “acute” sleep problems generally lasting less than three weeks. Such single-item assessments of sleep problems may not generate information on the different subtypes of sleep problems or disorders that could be obtained from longer, validated measurements of sleep disturbances. The studies on mental health are limited primarily because they rely on either single-item measures of symptoms or because they utilize items pulled from established measures of other psychiatric concerns. These items are frequently pulled from the Patient Health Questionnaire–9 (PHQ-9) (Kroenke and Spitzer, 2002), the PHQ-15 (Kroenke, Spitzer, and Williams, 2002), and the PTSD Checklist (PCL; Weathers et al., 1993). The PHQ scales contain two items related to the frequency of trouble sleeping and feeling tired during the day in relation to screening for depression, while the PCL scale includes two items related to nightmares and trouble initiating and maintaining sleep. In these studies, the mental health scales are often used with the sleep items removed, which alters the scales’ psychometric properties. More comprehensive and validated measures of sleep problems exist, such as the PSQI (Buysse, Reynolds, et al., 1989) and the Insomnia Severity Index (ISI; Morin, Belleville, et al., 2011), but they are infrequently used in studies with military samples; thus, further validation of these instruments in military populations is warranted.

Other limitations include the fact that studies typically focus on servicemembers in only one or two Services (the Army primarily), making it impossible to compare findings across the Services. Studies are also often characterized by small sample sizes and regionally restricted samples. Additionally, with few exceptions, studies have not targeted family members and their assessments of servicemembers’ sleep patterns, which may be useful in providing corroborating information on sleep symptoms of which the sleeping individual is unaware (e.g., snoring, sleepwalking, sleepwalking). Also, few studies use objective measures, such as wrist actigraphy or polysomnography (PSG), to provide a more rigorous assessment of sleep timing, duration, efficiency, and architecture (in the case of PSG). Moreover, certain sleep disorders (e.g., OSA, periodic leg movement disorder) can only be evaluated using overnight PSG. More generally,

Table 2.1
Literature Limitations and Ways to Address Them

Domain	Primary Limitations	Ways to Address Limitations
Measures	Studies use subjective and single-item measures, assess symptoms and not diagnoses, and vary widely in terms used to describe sleep problems.	Studies should use comprehensive, standardized, and valid self-report measures to measure clearly defined sleep problems. Valid measures used with civilian samples need to be validated with military samples (e.g., PSQI). Where applicable, objective data (e.g., polysomnography) or collateral information (e.g., bed partner reports) should be collected to validate self-reports.
Samples	Samples are primarily small and do not include representative portions of branch-specific participants.	Studies should include samples of servicemembers from all branches of the military and compare sample demographics to the broader military population to ensure representativeness. Large-scale prevalence studies of diagnosed disorders and symptoms of sleep problems with military samples are needed to better understand the extent and nature of the sleep problems in this population.
Design	Studies are primarily cross-sectional and do not look at deployment as a direct cause of sleep problems post-deployment.	More well-designed longitudinal studies are needed to make inferences about causality of sleep on physical and mental health problems. Studies should follow servicemembers across the deployment cycle to examine deployment as a precipitating factor leading to sleep problems post-deployment.
Analyses and comparisons	Most studies do not control for important demographic factors (e.g., age, gender) between samples, do not account for mental health problems as mediators on poor sleep outcomes, do not differentiate sample findings based on deployment history or other important deployment factors (e.g., extent of combat exposure), and do not permit direct comparisons between civilian and military samples.	Analyses of data collected from military samples should consider demographics unique to this population and control for multiple factors that may explain sleep problems (e.g., preexisting physical health problems). Studies are needed with both civilian and servicemember samples using similar measures and research designs to directly assess whether military populations are at increased risk for sleep problems compared with civilians and whether more targeted prevention and intervention efforts are needed.
Focus	Studies focus only on sleep problems and not healthy sleep.	A focus on sleep health will allow researchers to better understand what factors lead to healthy sleep, how servicemembers can preserve it to prepare for known periods of risk (e.g., deployments), and how healthy sleep patterns can prevent long-term physical and mental health consequences.

as with all self-report instruments, these measures are subject to reporting biases. For example, research with both veterans and civilians suffering from PTSD indicates that subjective reports of insomnia are less reliable than wrist actigraphy reports (Lavie, 2001; Westermeyer et al., 2007). Ambulatory objective assessment of sleep, using wrist

actigraphy, or subjective reports from partners or observers of servicemembers' sleep patterns are cost-effective techniques that can be used in large-scale studies and may help strengthen these findings.

Finally, many of the reviewed studies did not explicitly state that servicemembers or veterans had deployment experience; thus, it is difficult to capture prevalence specifically for the post-deployed population. Likewise, analyses of military sleep data often do not control for important demographic or risk factors that may explain findings indicating poor sleep (e.g., servicemember age, duration or other characteristics of deployments). Furthermore, there have been no within-person military-wide prevalence studies of sleep disorders among servicemembers in the post-deployment period. The absence of longitudinal studies of sleep disturbances across the deployment cycle is a gap in the literature; one cannot definitively state that deployment, itself, served as the precipitating event. In fact, at least with regard to insufficient sleep duration, the available evidence suggests that this may be a problem endemic to military culture rather than specifically related to deployment.

We targeted several of the above-mentioned limitations in this study (see Chapter Three). First, we incorporated a broad assessment of validated sleep measures. We addressed sample and analyses limitations by adding a sleep survey to an existing and ongoing study of a large and representative sample of married, deployable servicemembers from all branches of the military, controlling for a number of demographic factors, providing a rich characterization of deployment history, including number and length of deployments and combat exposure. By targeting these limitations, this study makes several unique contributions to the literature and fills several research gaps, providing a comprehensive review of sleep problems and their associated consequences for servicemembers.

Future Directions for Military Sleep Studies

This literature review shows that sleep research with military populations is important for increasing understanding of the risks and problems associated with poor sleep. However, the majority of the literature reviewed focused on sleep *problems*; little research has focused on the role that healthy sleep can play in promoting physical and mental health, operational readiness, and overall resilience to stress after deployment. Indeed, no available research exists documenting how promoting healthy sleep can have beneficial effects on outcomes of great interest to the military, such as operational readiness and resilience. This tendency to focus on the consequences of sleep problems rather than the benefits of maintaining healthy sleep also extends to the civilian literature (Buysse, 2014). Sleep health is not just the absence of sleep problems; it also includes wellness, performance, and adaptation. Sleep health has been defined as “a multidimensional pattern of sleep-wakefulness, adapted to individual, social, and environmental demands, that promotes physical and mental well-being. Good sleep health is characterized by subjective satisfaction, appropriate timing, adequate dura-

tion, high efficiency, and sustained alertness during waking hours” (Buysse, 2014, p. 12). Though limited, examples from the available civilian literature suggests that sleep extension—sleeping more than eight hours in a night, “banking sleep” by dedicating longer periods to sleep, or napping after periods of sleep deprivation—can decrease daytime sleepiness, improve mood and cognitive functioning, sharpen reaction times, and improve physical performance (Gillberg et al., 1996; Kamdar et al., 2004; Lentino et al., 2013; Mah et al., 2011; Rupp et al., 2009; Waterhouse et al., 2007). Research suggests that “more is better” when it comes to sleep and that getting more sleep in a night establishes a sleep reserve in case sleep is lost one night in the future (Wesensten and Balkin, 2013). Research also shows that preserving healthy sleep patterns by reducing the perpetuating behaviors represents an area of important research for the military.

A focus on defining and measuring sleep health, rather than sleep disorders or deficiency, has several advantages: (1) it provides a positive frame of reference for both patients and providers; (2) it provides concrete and modifiable targets for education, health promotion, and prevention at the individual, group, and population levels; and (3) it provides new opportunities for research that could help identify biomarkers of resilience across the continuum of sleep health (Buysse, 2014). To a certain extent and in certain contexts (e.g., in the combat environment), the unique role and demands of the military will necessarily restrict the opportunity for sufficient sleep duration and quality (Wesensten and Balkin, 2013). However, an agenda that focuses on promoting sleep health offers opportunities to identify what *can* be done to preserve sleep despite military operational demands, what practices and programs can best help servicemembers recover during post-deployment periods from prolonged sleep loss in situations (e.g., combat) when it may be unavoidable, and what leaders and policymakers can do to raise awareness and recognition of the benefits of sleep health for promoting servicemember resilience and population health.

Unfortunately, not enough research has emphasized the programs to promote healthy sleep patterns among post-deployed servicemembers and veterans in the critical days and weeks following a deployment. Research is also needed to evaluate the efficacy of current military policies or programs to promote healthy sleep. There is a critical need for the next generation of military sleep research to focus on “sleep health” (broadly defined) as a pathway to resilience.

Another area of future work involves changing the traditional notion that poor sleep is merely a correlate associated with underlying physical and mental health problems. Research indeed supports that those with underlying physical and mental health problems suffer from poor sleep, but, until recently, less research attention has been focused on examining how poor sleep can lead to lasting physical and mental health consequences. For example, civilian and military research suggests that sleep problems and disorders have both short-term and lasting negative effects on physical health, cognitive functioning, and occupational readiness. Physical health problems, such

as obesity and high BMI, are particularly prevalent among those with sleep-related breathing disorders. In fact, increased BMI is a significant risk factor for developing sleep-related breathing disorders, such as OSA, in civilian populations (Yu and Berger, 2011). PTSD, depression, and TBI are common disorders associated with sleep problems, but longitudinal evidence further demonstrates that sleep problems can presage the onset of these disorders.

In addition to increasing the risk of developing a subsequent mental health condition, sleep problems are known to be among the most intractable symptoms, even with successful treatment for a co-occurring behavioral health condition (e.g., depression), and they can also exacerbate the severity of a co-occurring physical condition (e.g., pain). Still, some preliminary evidence from civilian studies suggests that targeting sleep problems directly in treatment (e.g., through CBT-I) can alleviate symptoms from associated psychological (e.g., PTSD, depression) and physical (e.g., pain) conditions (Ruff, Ruff, and Wang, 2009; Ulmer, Edinger, and Calhoun, 2011; Manber, Bernert, et al., 2011; Manber, Edinger, et al., 2008). Given that there are efficacious treatments for nightmares (Aurora et al., 2010; Nappi, Drummond, and Hall, 2012)—and that, for many, treating nightmares may be more acceptable than treating PTSD (possibly due to less stigma associated with seeking care for sleep problems or because, for some people, exposure-based therapies for PTSD are perceived as aversive)—targeting nightmares may be an important gateway treatment to reduce the consequences of PTSD and increase the acceptability of PTSD-focused treatments. Taken together, these findings highlight a shift toward focusing on sleep specifically as a key indicator of health in its own right that can predict subsequent morbidity, the severity of comorbid conditions, and treatment responses for comorbid conditions (National Institutes of Health, 2005).

Assessing Sleep Disturbances and Consequences Among Post-Deployed Servicemembers

As summarized in Chapter Two, the existing literature provides suggestive evidence that sleep problems are a prevalent and salient issue among servicemembers. Military deployments may be associated with an increased risk of sleep problems, and these problems are associated with numerous downstream consequences. These findings have generally been derived from studies that included single- or few-item assessments of isolated sleep symptoms (e.g., trouble sleeping or sleep duration). However, sleep is a multidimensional state, with both nocturnal characteristics (e.g., quality, duration, nightmares) and associated daytime consequences (e.g., sleepiness, fatigue). No study to date has examined multiple dimensions of sleep and associated daytime impairments in a large sample of servicemembers across all Services and components. Further, few studies have utilized validated sleep measures. In addition, only a handful of studies have examined sleep problems according to deployment history or characteristics of the deployment that may increase the risk of stress-related sleep disturbances (e.g., exposure to combat). Moreover, the existing literature has generally focused on a single Service, which may limit the generalizability of the findings. Finally, given that sleep problems are known to covary with sociodemographic and military characteristics, as well as overall well-being, questions still remain as to whether sleep is merely a proxy for these co-occurring factors or an independent correlate of key indicators of mental and physical health and operational readiness.

We conducted a cross-sectional survey study examining a broad assessment of sleep problems and associated consequences in a large and diverse sample of servicemembers across all four branches of the U.S. armed forces. This study was designed to provide an in-depth analysis of the types of sleep problems and behaviors among servicemembers, specific subgroups of servicemembers who may be at greater risk for sleep problems, and the degree to which sleep problems are independently associated with mental and physical health and operational readiness. In addition to including a broad assessment of servicemembers' self-reported sleep problems, this study is also the first to include spouse/bed partners' reports of sleep symptoms to provide corroborating data on sleeping behaviors of which the sleeping individual may be unaware, such as snoring, which is a primary symptom of OSA.

To accomplish these goals, we partnered with the RAND Deployment Life Study team (see Tanielian et al., 2014) to include a sleep survey in its ongoing large-scale study of married, deployable servicemembers across all Service branches and components. We included the sleep survey in one of the waves of planned data collection in the Deployment Life Study, allowing us to assess both sleep parameters and sleep-related disturbances.

We focused on the association between sleep symptoms and behaviors and several important indicators of servicemember health and readiness. We also included a rich assessment of covariates (e.g., depressive symptoms, presence of TBI, shift work, and a host of deployment and sociodemographic characteristics) that are known to covary with sleep problems, well-being, and readiness. In so doing, we ensured that our analyses would provide a more robust examination of the degree to which sleep problems are independent correlates of health and readiness indicators.

This chapter is divided into three sections. First, we describe the development and administration of the sleep survey to servicemembers enrolled in the ongoing Deployment Life Study. Second, we describe the study's research aims and analytic plan. The third section summarizes the findings from our analyses of the sleep survey data, including findings related to the prevalence of sleep problems in the sample, subgroup differences in sleep problems, and the cross-sectional relationship between sleep problems and indicators of physical and mental health and perceived operational readiness among previously deployed servicemembers.

Sleep Survey Development and Administration to Servicemembers in the Deployment Life Study

This section provides an overview of the RAND Deployment Life Study—including the study's design and measures—and details on how we created and administered the sleep survey for inclusion in the Deployment Life Study.

Deployment Life Study Overview

The Deployment Life Study (see Tanielian et al., 2014) was designed to identify the antecedents, correlates, and consequences of family readiness across the three phases of a deployment cycle: pre-deployment, deployment, and post-deployment. The sample included servicemembers eligible for deployment within the next six to 12 months, their spouses, and children under 18 (if available); for details on the sampling methods, recruiting strategies, and incentives for study participation, see Tanielian et al. (2014). Briefly, rolling recruitment and administration of the baseline assessment began in March 2011 for the Army, Air Force, and Marine Corps samples and in November

2012 for the Navy sample.¹ At baseline, 2,724 married families—including a servicemember, a spouse, and a child between the ages of 11 and 17 (if available)—completed interviews.² Follow-up assessments were conducted using a web-based survey every four months for three years (i.e., for a total of nine assessments).³ Sampling weights were used to ensure that the sample of servicemembers at baseline was representative of married, deployable servicemembers *across and within* the Service branches and components that were actually deployed in the field during the first six months of 2012—an active period of follow-up for the study.

Sleep Survey Added to the Deployment Life Study

At the start of our study in August 2012, the Deployment Life study (which began approximately 18 months earlier) had already collected four waves of data for the Army, Air Force, and Marine Corps and was about to begin baseline data collection on the Navy. Prior to developing and launching our study, we systematically reviewed the literature on sleep metrics and designed a survey that incorporated multiple domains of sleep while minimizing participant burden by keeping the instrument brief. We presented a proposed set of sleep measures to the Deployment Life Study team and received approval to include the sleep survey in the overall Deployment Life Study survey in October 2012. As a result, we were able to administer the sleep survey concurrent with the launch of the baseline assessment for the Navy in November 2012 and with wave 5 data collection in the Army, Air Force, and Marines, beginning in December 2012. Given that the sleep study was a two-year project, we were only able to analyze data from a single wave of data collection from the Deployment Life Study. Therefore, findings presented herein are cross-sectional.

As noted earlier, based on the literature review of existing survey and administrative data, we identified self-report measures that have been used to assess sleep symptoms (e.g., sleep quality, quantity, nightmares) and sleep-related behaviors (e.g., use of sleep medications or stimulants, inconsistent bedtimes, frequent napping) and that specifically focus on conditions relevant to servicemembers (see Chapter Two). Appendix D presents the common sleep metrics used in the literature and describes the measures, psychometric properties, and advantages and disadvantages of each measure. Although that list is not exhaustive—as there are numerous study-specific instruments used in the literature—it includes the most commonly used, validated instruments.

¹ The Navy baseline started one year later.

² If an eligible child was not available or if an eligible child was available but did not participate in the survey, then the servicemember and spouse were considered a household.

³ If participants preferred phone-based surveys, that option was provided. Navy families were interviewed only seven times because this subsample of military families did not enter baseline data collection until one year after Army, Air Force, and Marine Corps families.

For the sleep survey, we selected a set of items and full scales (i.e., the PSQI) that assess important and relevant components of these sleep domains and sleep disorders and that could be completed in five to ten minutes (to reduce participant burden). Most items were self-reported by the servicemembers; however, we also included items requesting the spouse's assessment of the servicemember's sleep behavior. Table 3.1 outlines the domain, number of items (with descriptions for each of the selected measures included in the final analyses of the sleep survey data reported here), and source. Appendix E provides further description of each selected source and the additional items collected in the survey (but not reported here), including psychometric information and support for using these measures with our targeted population.

Outcomes and Covariates

The Deployment Life Study included a rich assessment of sociodemographic and military characteristics, health, and well-being that we used as covariates or outcomes in our current analyses. In addition, the survey for the Navy sample included a measure of perceived unit readiness, which we included as an outcome.

Primary Outcome Measures

We examined four primary outcomes: probable depression, probable PTSD, physical health, and perceived unit readiness (Navy only).

Probable Depression

The PHQ-8 (Kroenke and Spitzer, 2002) asked all participants to indicate the frequency with which they experienced each of eight symptoms of depression (e.g., little interest or pleasure in doing things; feeling down, depressed, or hopeless) in the prior two weeks on a scale from not at all (0) to every day (3). The PHQ-8 is a variant of the full PHQ-9 scale that does not include the self-harm item. It is typically used to assess depression in research studies of non-clinical samples where clinical intervention would be difficult if an individual endorsed self-harm (Kroenke, Strine, et al., 2009), as would be the case in this online survey study. Also, since self-harm is a low base rate behavior in samples assessed outside clinical settings (Huang et al., 2006; Rief et al., 2004), the psychometric impact on scoring the PHQ-8 compared with the PHQ-9 is minimal (Kroenke and Spitzer, 2002). Probable depression was defined by scores of greater than or equal to 10 on the summed PHQ-8 index (Kroenke, Strine, et al., 2009).

Probable PTSD

The PCL (Weathers et al., 1993) was used with participants who endorsed ever experiencing a traumatic event, such as military combat, an auto accident, a physical assault, an unwanted sexual experience, a natural disaster, or witnessing the death or injury of another person. These participants rated how bothered they were by each of 17 items in the prior month, with response options ranging from not at all (1) to extremely (5).

Table 3.1
Summary of Items from the Sleep Survey Used for Analyses

Domain	Measure	Source
Sleep symptoms		
Sleep quality	Global score is a composite of subscales, including sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction. Higher values indicate poorer sleep quality: Scores of >5 validated as clinical cut-point for "clinically significant poor sleep quality."	PSQI (Buysse, Reynolds, et al., 1989)
Sleep onset latency		
Sleep duration		
Sleep efficiency		
General sleep disturbance		
Use of sleep medications		
Daytime dysfunction		
Bed partner–reported loud snoring or long pauses between breaths during sleep	Assessed servicemember sleep symptoms as observed and reported by the servicemember’s bed partner	Modified from PSQI bed partner items (Buysse, Reynolds, et al., 1989)
Daytime dysfunction	<p>“To what extent does a sleep problem interfere with your work or daily chores?”</p> <p>Response options: Not at all interfering A little Somewhat Much Very much interfering</p>	Modified from Insomnia Severity Index (ISI) (Bastien, Vallieres, and Morin, 2001)
Fatigue	<p>“When you are awake, how often do you feel tired, fatigued or not up to par?”</p> <p>Response options: Nearly every day 3–4 times a week 1–2 times a week 12 times a month Never or nearly never</p>	Modified from Berlin Questionnaire (Ahmadi et al., 2008; Netzer et al., 1999)

Table 3.1—Continued

Domain	Measure	Source
PTSD-related disturbed dreams/nightmares	<p>Single item taken from the PCL–Stress-Specific Version (PCL-S), which was already included in the Deployment Life Study survey. PCL-S was assessed of participants who endorsed at least one traumatic event, such as military combat, auto accidents, physical assaults, unwanted sexual experiences, natural disasters, or witnessing the death or injury of another person.</p> <p>How much have you been bothered by this problem in the last 30 days: Repeated, disturbing dreams of a stressful experience from the past?</p> <p>Response options: Not at all A little bit Moderately Quite a bit Extremely</p>	PCL-S (Weathers et al., 1993)
Sleep-related behaviors		
Sleep-related behaviors/ sleep hygiene (regular awakening routine)	<p>“I get out of bed at different times from day to day. Would you say that statement is . . .”</p> <p>Response options: Always true Frequently true Sometimes true Rarely true Never true</p>	Modified Sleep Hygiene Index (Mastin, Bryson, and Corwyn, 2006)
Sleep-related behaviors/ sleep hygiene (use of energy drinks, caffeine, or medications to stay awake)	<p>“Some people may use different things to help them stay awake. For each category, please indicate how often, if at all, you use the following: (a) Energy drinks (for example: Monster, Red Bull, Rock Star, 5-Hour Energy); (b) caffeinated beverages besides energy drinks (for example: coffee, soda, tea); (c) over-the-counter or prescription medication (for example: Adderall, Ritalin, Vivarin, NoDoz)”</p> <p>Response options (for each item): Not during the past month Less than once a week Once or twice a week Three or more times a week Daily</p>	Modified from Fred Hutchinson Center Caffeine Questionnaire items

Probable PTSD was derived using guidelines offered by Weathers et al. (1993). Specifically, scores of 44 or higher were considered evidence of probable PTSD. This scoring has been shown to have high specificity and sensitivity.⁴

Physical Health

For the physical health outcome, we used a single item measuring self-reported health on a five-point scale, which has been validated in prior research (Stewart and Ware, 1992). The item (“In general, how would you rate your physical health?”) included response options from poor (1) to excellent (5). Before conducting our analyses, we fit both linear and ordinal logistic models to this item and found that inferences were highly similar across the two sets of models. Therefore, we report results from the linear model, which allows us to standardize the findings more easily to represent changes in effect sizes.

Perceived Unit Readiness

To measure unit readiness, we took the average of three items designed to measure how well prepared servicemembers felt their unit was for the next deployment.⁵ The questions asked specifically, “How prepared do you believe your unit is to perform its mission on your next deployment with regard to: (a) manning level, (b) training and (c) parts and equipment?” The response options ranged from very poorly prepared (1) to very well prepared (5), with a Cronbach’s alpha of 0.77. As mentioned earlier, this measure was assessed for the Navy sample only.

Covariates

The analyses statistically adjusted for a number of important control measures to examine the independent association between sleep variables and study outcomes. Covariates included demographics and personal history, military characteristics, depressive symptoms (except when depression was the outcome), and probable TBI.

Demographics and Personal History

We assessed sociodemographic factors with single-item open-ended or forced-choice questions. These items included age, gender, education (measured as high school degree or less, some college but no degree, associate or vocational degree, bachelor’s degree, or post-graduate degree), race/ethnicity (white non-Hispanic, black non-Hispanic, Hispanic, Asian, and other), and number of children in the household.

Military Characteristics

We selected military characteristics to include as covariates based on prior literature (reviewed in Chapter Two) on correlates of sleep problems in military populations.

⁴ See Brewin (2005) for a review of different scoring methods.

⁵ Although we have reports of self-rated individual readiness, there was very limited variability in the measure to allow for meaningful analyses; most servicemembers felt that they were ready for combat/deployment.

Specifically, we included binary variables for officer status (i.e., officer versus enlisted) and active-duty status (i.e., active-duty versus reserve or guard personnel). In addition, given the comprehensive assessment of deployment histories in the Deployment Life Study, we further adjusted for the number of prior deployments, duration of the most recent deployment, months home since the most recent deployment, combat exposure, Service branch, and shift-work pattern (day shift only versus night or rotating shifts). Measures of prior deployments (number, duration, and time home since most recent deployment) and combat exposure were measured differently at baseline (Navy) and in wave 5 (all other branches) in the Deployment Life Study. Therefore, we provide specific details about the characterization of deployment history and combat exposure for the Navy and all other branches.

Using information collected at baseline, we defined *deployment* in the Navy as having had at least one deployment outside the continental United States (OCONUS) and having been away from home for at least one month because of military service. The following model covariates were specific to OCONUS deployments: number of deployments (categorized as one, two, three, four, or five or more deployments), length of most recent deployment (categorized as three or fewer months, three to fewer than six months, and six to nine months), and months home since most recent deployment (six or fewer, six to 12, 12–18, and more than 18 months). At baseline, the combat exposure scale included 15 yes/no items asking whether the participant had experienced specific traumatic aspects of combat during a deployment. We dichotomized this scale to 1 if a participant reported experiencing at least one traumatic aspect and to 0 otherwise.

Subsequent waves of the Deployment Life Study collected a more detailed deployment history, and this information was used to define deployment for the Army, Air Force, and Marine Corps. For these branches, the following model covariates were specific to OEF, OIF, and OND deployments: number of deployments (categorized as one, two, three, four, or five or more deployments), length of most recent deployment (categorized as three or fewer months, three to fewer than six months, six to nine months, and nine or more months), and months home since most recent deployment (six or fewer, six to 18, 18–36, and more than 36 months). In follow-up waves, the combat exposure scale included only 11 items, and they were not a subset of items asked at baseline. We dichotomized this scale as with the Navy subsample to 1 if a participant reported experiencing at least one traumatic aspect and to 0 otherwise.

To account for differences in how deployment history and combat exposure were measured at baseline (for the Navy) and follow-up (for the other branches), we included interaction terms in the model between the Navy and each deployment variable, which allowed us to determine whether the effect of these measures varied if the servicemember was in the Navy.

Probable TBI and Depressive Symptoms

The presence of probable TBI (yes/no) was included as a covariate in all models. To identify probable TBI, participants were asked, “Have you ever in your life been hit or injured in a way that caused the following symptoms?” (Schwab et al., 2007). The presence of probable TBI was coded “yes” if servicemembers endorsed any of the eight responses to this question: being dazed, confused, or “seeing stars”; not remembering the injury; losing consciousness (knocked out) for less than a minute; losing consciousness for one to 20 minutes; losing consciousness for longer than 20 minutes; having any symptoms of a concussion afterward; head injury; or lost consciousness with unknown duration, and “no” otherwise.

For all outcomes, except for probable depression, we also included the continuous depressive symptom scores from the PHQ-8 as a covariate (omitting the sleep items to avoid redundancy with the sleep measures), given that depressive symptoms are known to covary with both sleep and the other outcomes (i.e., PTSD and physical health).

Analytic Plan for the Sleep Survey

Based on the review of the literature in Chapter Two, which identified several research gaps regarding the prevalence and correlates of sleep problems and sleep-related behaviors among a broad group of servicemembers, as well as subgroups of servicemembers who may be at greater risk for sleep-related problems and behaviors, our analyses had two primary aims:

- *Aim 1:* To describe sleep symptoms and sleep-related behaviors among servicemembers and determine whether sleep symptoms and behaviors differ based on deployment history (never/prior/currently deployed) or combat exposure.
- *Aim 2:* To determine whether sleep symptoms and behaviors are associated with key post-deployment outcomes, including mental and physical well-being and perceived unit readiness, even after controlling for other known risk factors among servicemembers who have experienced at least one deployment.

Our analyses used the first wave of data collection in which the sleep survey was added to the Deployment Life Study for each Service branch: baseline data from Navy servicemembers and wave 5 data from servicemembers in the Army, Air Force, and Marine Corps. The initial sample consisted of 873 Navy servicemembers, though one participant switched to another Service branch before baseline data collection and participated in the non-Navy data collection schedule. We excluded 47 Navy servicemembers from our analyses because their deployment history could not be determined due to missing data. Additionally, given the extremely low enrollment of only eight Navy reservists, we also excluded these servicemembers from our analyses. Thus, the

Navy sample includes active-duty servicemembers only. A total of 1,851 servicemembers were sampled in the other branches at wave 1 (1,426 Army, 298 Air Force, and 127 Marine Corps), of whom 61.6 percent participated in data collection at wave 5. The final analytic sample included 1,957 servicemembers (870 Army, 817 Navy, 202 Air Force, and 68 Marine Corps), representing 72.8 percent of all sampled servicemembers.

All analyses used the sampling weights from the Deployment Life Study that weighted the sample to be representative of deployable, married servicemembers who were actively in the field during the first six months of 2012. Given the low follow-up rate in the Army, Air Force, and Marine Corps in wave 5, attrition analyses explored whether there were meaningful differences between those servicemembers who did and did not follow up at wave 5. No notable differences were found; thus, we did not include attrition weights in our analyses. The weighted distribution of servicemembers in the sample was 24.9 percent Army, 32.3 percent Navy, 31.2 percent Air Force, and 11.6 percent Marine Corps.

Rates of missing data were very low in the sample (ranging from 0 to 3.4 percent on the measures described above). Thus, our analyses simply excluded individuals with missing data, resulting in a loss of approximately 5–7 percent of the sample in any given set of analyses.

Prevalence of Sleep Symptoms and Sleep-Related Behaviors Overall and by Subgroup

To address aim 1, we computed descriptive statistics on the prevalence of sleep problems and sleep-related behaviors in the full sample of servicemembers from the Deployment Life Study. Then, we examined whether the prevalence of sleep problems and behaviors differed according to deployment history or combat exposure, using multivariate logistic, ordinal, or linear regression models, depending on whether the sleep measure was binary, ordered categorical, or continuous, respectively. These models controlled for such covariates as sociodemographic and military characteristics and depressive symptoms, and they included indicator variables for the primary deployment subgroups of interest (never/currently/prior deployed) or the continuous measure of the combat exposure scale. We used recycled mean predictions to estimate the adjusted means for each sleep measure by subgroup, after adjusting for covariates. For the continuous combat exposure scale, we report predicted means for servicemembers one standard deviation above and below the mean of the scale to illustrate the relationship between the sleep measure and combat exposure in the sample.

For subgroup analyses of deployment history, we compared servicemembers who had never been deployed with those who had one or more prior deployments or those who were currently deployed. Given that relatively few Air Force or Marine Corps servicemembers in the sample were never deployed or currently deployed, we restricted these subgroup analyses to Army and Navy servicemembers. In addition, the sample did not include Navy servicemembers who were deployed at baseline (by study design).

We conducted analyses comparing personnel who had never deployed versus those who were currently deployed or had previously deployed using the Army sample only. Across all Service branches, we assessed whether sleep measures were associated with combat exposure among servicemembers with at least one prior deployment. We used joint F-tests to test statistical significance for personnel who had never deployed versus those who were currently deployed or had previously deployed and standard Wald t-tests to test for the linear trend of the combat exposure scale. Statistical significance was assessed at the 0.01 level to adjust conservatively for the number of hypothesis tests being implemented in these subgroup analyses.

Associations Between Sleep Symptoms and Sleep-Related Behaviors and Outcomes Among Previously Deployed Servicemembers

Given our study's focus on the degree to which sleep problems are independently associated with servicemember health and functioning in the post-deployment period, analyses for aim 2 only included servicemembers with at least one prior deployment (N = 1,596). Specifically, we used multivariate regression models to assess the association between sleep measures and post-deployment outcomes, including probable depression, probable PTSD, perceived unit readiness, and physical health.

Since sleep problems and disturbances may vary as a function of many other known factors that are themselves risk factors for poor mental or physical health or lowered readiness (see Chapter Two), our multivariate regression models adjusted for several key covariates, including sociodemographic and military characteristics, and probable TBI and depressive symptoms (described in detail above), which may account for observed associations between sleep and the outcomes of interest. The models for physical health and unit readiness included all the control covariates listed. For the models with probable PTSD or probable depression as outcomes, we used a reduced set of these controls, given the low rate of occurrence for each outcome in the sample (12.4 percent and 8.7 percent, respectively). Specifically, for these models, we included a subset of sociodemographic (age, gender, race) and military characteristics (branch, officer status, combat exposure, shift work, total number of deployments), as well as TBI and depressive symptoms (except where probable depression was the outcome), as these covariates have shown consistent associations with sleep, as well as with PTSD and depression, in prior literature. We added sleep measures to the multivariate models separately to assess whether there were associations between each of the sleep measures and the outcomes above and beyond the control covariates already in the model.

To be more conservative about the number of hypothesis tests conducted, we assessed statistical significance at the 0.01 level and used joint F-tests to test whether categorical predictors were significantly associated with the outcomes. We fit linear regression models to standardized versions of the self-reported physical health item, and we assessed unit readiness and goodness of fit for these models using QQ plots of the residuals. We standardized these outcomes and the single continuous sleep predic-

tor, total PSQI, by dividing by their standard deviation to obtain regression coefficients that represent the standardized effects of each sleep measure on physical health and unit readiness. As cited in the literature, standardized effects of less than 0.20 are considered small, effects of 0.20–0.50 are considered moderate, and effects greater than 0.50 are considered large (Cohen, 1988). Logistic regression models were fit to probable PTSD and probable depression. To better describe the magnitude of the associations observed in the logistic models, we computed recycled mean predictions using these models to estimate the adjusted means for each binary outcome within each level of the particular sleep measure.

Sample Characteristics

Table 3.2 shows the weighted distributions of characteristics in the analytic sample. The mean age was 34, and 91.6 percent of the servicemembers were male. Approximately one-third of the sample had a bachelor's degree or higher, while the majority (52 percent) had no degree beyond high school. Additionally, approximately three-quarters of the sample was non-Hispanic white. The majority had experienced a previous deployment (83.5 percent), with only 6 percent being currently deployed and 10.5 percent having never experienced a deployment. In terms of shift work, the majority of the sample (74.1 percent) had work patterns involving only day shifts.

Tables 3.3 and 3.4, respectively, show the deployment characteristics for the Navy sample and other Service branches separately (due to differences in the measurement of deployment characteristics for the Navy sample) among servicemembers with a prior deployment. The mean number of deployments in the Navy was 2.9, and the mean number of deployments for the other branches was 2.2. For Navy personnel, the mean length of the most recent deployment was 6.5 months, and the mean length of time home since the most recent deployment was 18.2 months. For non-Navy branches, the mean length of the most recent deployment was 7.5 months, and the mean length of time home since the most recent deployment was 27.6 months.

Prevalence of Sleep Problems in Full Sample

Figure 3.1 shows the distribution of average hours slept per night as reported by servicemembers. The figure shows a high prevalence of insufficient sleep, with only 37.4 percent of the sample reporting getting the recommended “seven hours or more” of sleep. Moreover, 31.4 percent reported sleeping five hours or less, which would be categorized as an “extreme short sleeper”—a category that has previously been linked with significantly increased morbidity and mortality in epidemiologic cohorts (see Chapter Two).

Figure 3.2 shows the distribution of the PSQI, illustrating that the sample also has a high prevalence of poor sleep quality. In fact, as depicted in the figure, 48.6 percent had PSQI scores greater than 5; the threshold value is indicative of clinically significant sleep problems (Buysse, Reynolds, et al., 1989).

Table 3.2
Sample Characteristics

Characteristic	Weighted % or Mean (SD)
Demographics	
Age (years, continuous)	34.0 (7.3)
Male	91.6
Highest education level	
High school or less	23.1
Some college, no degree	28.5
Associates or vocational degree	16.1
Bachelor's degree	21.4
More than a bachelor's degree	10.9
Total number of children living in household	1.3 (1.1)
Race/ethnicity	
White	75.2
Black	6.5
Hispanic	12.0
Asian	1.5
Other/missing	4.8
Service characteristics	
Officer	23.8
Active duty	85.4
Usual work pattern	
Day only, with or without rotating shifts	74.1
Night, with or without rotating shifts or "other"	25.9
History of deployment	
Never deployed	10.5
Currently deployed	6.0
Previously deployed but not currently deployed	83.5

NOTE: N = 1,957. SD = standard deviation.

Table 3.3
Deployment Characteristics, Navy Sample

Characteristic	Weighted % or Mean
Total OCONUS deployments	
1 deployment	25.6
2 deployments	18.4
3 deployments	13.8
4 deployments	13.7
5+ deployments	28.4
Duration of the most recent OCONUS deployment	
3 months or less	12.0
> 3–6 months	40.4
> 6–9 months	47.6
Any combat exposure	
No	47.9
Yes	52.1
Months home since most recent deployment	
6 months or less	32.4
> 6–12 months	27.1
> 12–18 months	14.0
> 18 months	26.6

NOTE: N = 709 for Navy respondents who had experienced at least one prior deployment.

Figure 3.3 shows the frequency of responses on the item pertaining to the experience of trauma-related distressing dreams in the prior 30 days (among the subsample of servicemembers who reported a traumatic or stress event). Thirteen percent of the sample reported that they were “moderately” to “extremely” bothered by disturbing dreams in the prior month.

Figure 3.4 shows the frequency of responses to the sleep-related daytime impairment item (“To what extent does a sleep problem interfere with work or chores?”). Approximately 17 percent of the sample reported that a sleep problem impaired daytime function “somewhat” to “very much.” Figure 3.5 shows the frequency of responses to the item assessing fatigue (“When you are awake, how often do you feel tired, fatigued, or not up to par?”). Thirty-three percent reported feeling fatigued at least three to four times per week.

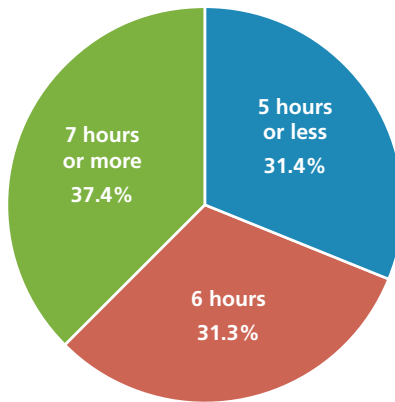
Table 3.4
Deployment Characteristics, Non-Navy Sample

Characteristic	Weighted % or Mean
Total combat deployments	
1 deployment	31.6
2 deployments	30.2
3 deployments	22.3
4 deployments	8.2
5+ deployments	7.7
Duration of the most recent combat deployment	
3 months or less	5.9
> 3–6 months	32.7
> 6–9 months	39.1
> 9 months	22.4
Any combat exposure	
No	11.9
Yes	88.1
Months home since most recent combat deployment	
6 months or less	9.9
> 6–18 months	6.6
> 18–36 months	66.1
> 36 months	17.4

NOTE: N = 887 for non-Navy respondents who had experienced at least one prior deployment.

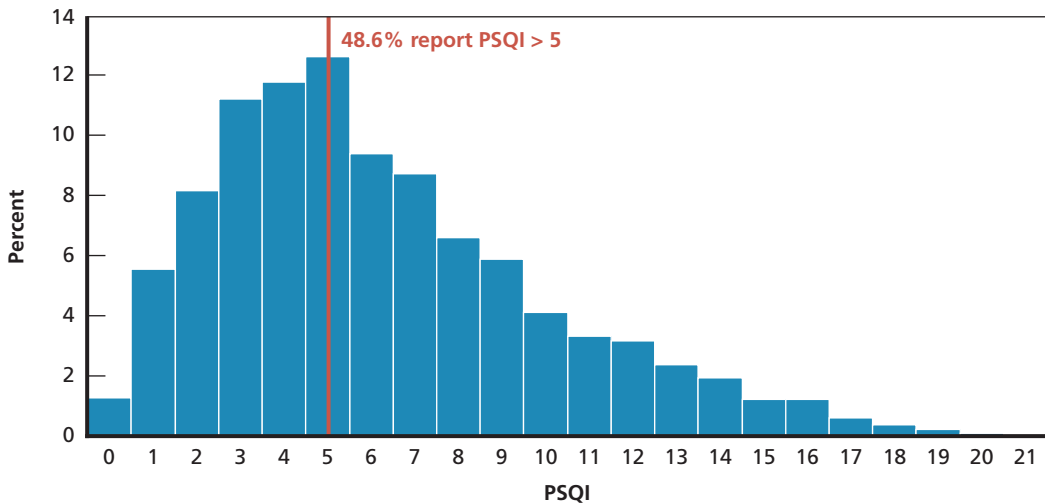
Table 3.5 shows summary measures for sleep-related behaviors that are relevant to sleep hygiene. As shown, 18.4 percent of servicemembers in the sample took medicine during the prior month to help them fall asleep. Almost half drank energy drinks at least once in the prior month, and 80.4 percent drank caffeinated beverages other than energy drinks at least once per week. Only 3.2 percent of servicemembers reported using medications to stay awake during the prior month. Approximately 60 percent of the sample reported getting out of bed at different times on a regular basis (“sometimes” to “always”). To provide a composite indicator of the sample’s overall sleep hygiene behaviors, we also report the total number of sleep-related behaviors that servicemembers engaged in regularly (taking medication to sleep, consuming energy drinks, taking other caffeinated beverages, taking medication to stay awake at least

Figure 3.1
Prevalence of Short Sleep Duration in Deployment Life Study Servicemember Sample



RAND RR739-3.1

Figure 3.2
Distribution of Sleep Quality Scores



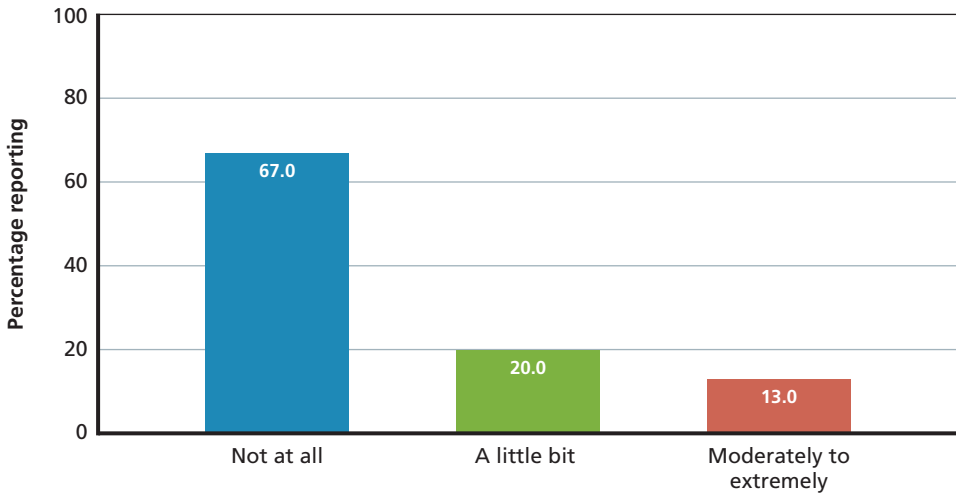
RAND RR739-3.2

once in the prior month, and getting out of bed at different times “always” or “frequently”). As shown, most servicemembers reported engaging in one (33.9 percent) or two (38.0 percent) of these sleep-related behaviors.

Prevalence of Sleep Problems, by Subgroup

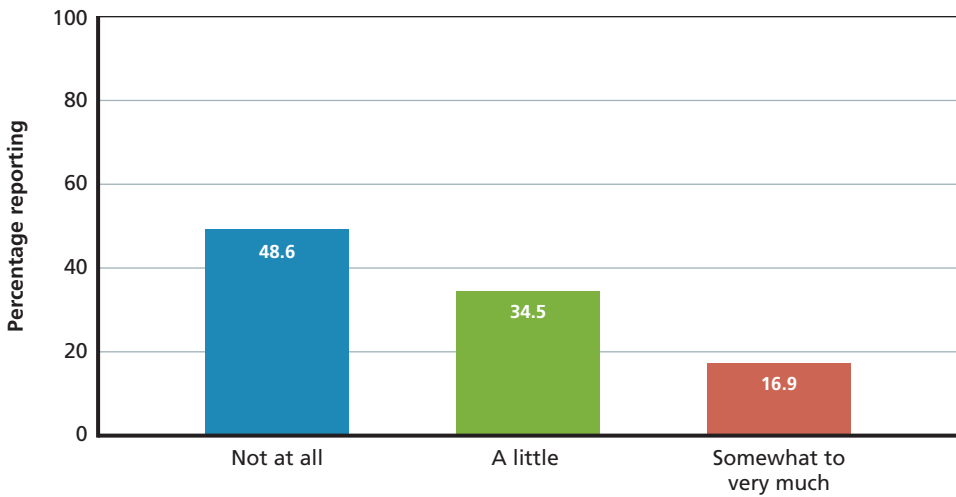
Table 3.6 shows the adjusted sample means for the sleep measures according to deployment history separately for the Army and Navy samples. Across all deployment categories, servicemembers reported clinically significant poor sleep quality, on average

Figure 3.3
Frequency of Repeated, Disturbing Dreams in the Past 30 Days



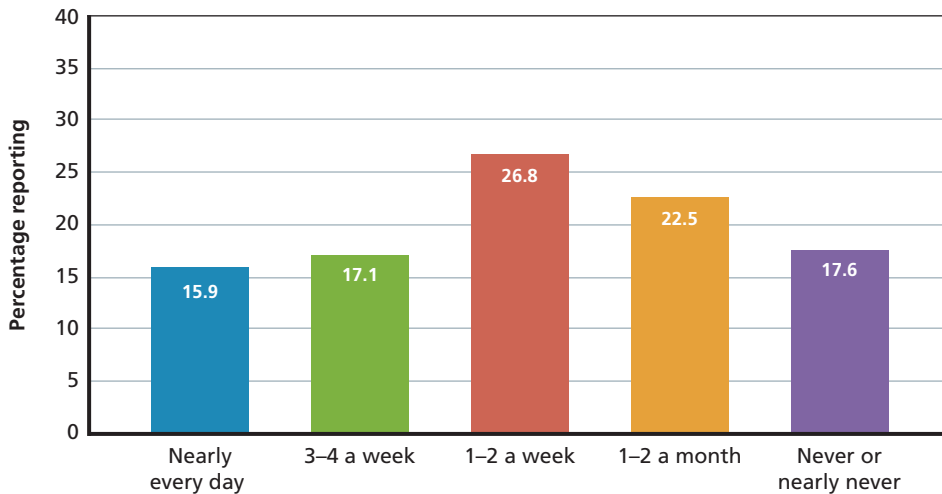
NOTE: Only those who reported a traumatic or stress event responded to this item (N = 950).
RAND RR739-3.3

Figure 3.4
Frequency of Sleep-Related Daytime Impairment (i.e., Sleep Problem Interferes with Work or Daily Chores)



RAND RR739-3.4

Figure 3.5
Frequency of Feeling Tired, Fatigued, or Not Up to Par



RAND RR739-3.5

(i.e., PSQI > 5), and a high prevalence of short sleep duration; however, there were no statistically significant differences according to deployment history for these sleep measures in either the Army or Navy samples. In fact, for the Army, we found no statistically significant differences for any of the sleep measures based on deployment history (i.e., never deployed, currently deployed, or previously deployed). For the Navy, there was one statistically significant subgroup difference: Servicemembers with prior deployments were more likely to report any sleep-related daytime impairment (i.e., sleep problem interferes with work or chores “a little bit” or “somewhat to very much of the time”) compared with servicemembers without a prior deployment (57.8 percent versus 42.8 percent, respectively; $p < 0.01$).

Table 3.7 shows the predicted sample means for previously deployed servicemembers at one standard deviation above and one standard deviation below the mean levels of combat exposure. Servicemembers with higher levels of combat exposure had poorer sleep quality than those with lower levels of combat exposure ($p < 0.001$; effect size = 0.39, which corresponds to a moderate difference). In addition, among those who experienced a traumatic event, higher combat exposure was associated with more-frequent distress related to repeated or disturbing dreams, compared with those with lower levels of combat exposure (32.7 percent versus 23.7 percent, respectively; $p < 0.001$).

Table 3.5
Frequency of Sleep-Related Behaviors

Sleep Variable	Weighted % or mean
During the past month, how often have you . . .	
Taken medicine (prescribed or over the counter) to help you sleep?	
Not during the past month	81.6
< 1 time a week to 3+ times a week	18.4
Taken energy drinks (for example: Monster, Red Bull, Rockstar, 5-Hour Energy)?	
Not during the past month	55.4
< 1 time a week to 3+ times a week	36.1
Daily	8.6
Taken caffeinated beverages besides energy drinks (for example: coffee, soda, tea)?	
Not during the past month	19.6
< 1 time a week to 3+ times a week	31.7
Daily	48.7
Taken medication to stay awake?	
Not during the past month	96.8
< 1 time a week to daily	3.2
"I get out of bed at different times from day to day." Would you say that statement is . . .	
Always true	12.5
Frequently true	16.3
Sometimes true	29.3
Rarely true	37.9
Never or nearly never true	24.0
Number of the above sleep-related behaviors engaged in regularly	
0	11.2
1	33.9
2	38.0
3	14.0
4	2.7
5	0.2

Table 3.6
Adjusted Distributions of Sleep Symptoms and Sleep-Related Behaviors, by Deployment History in the Army and Navy

Variable	Army			Navy	
	Never Deployed	Currently Deployed	Previously Deployed	Never Deployed	Previously Deployed
N (unweighted sample size)	101	115	654	108	709
Hours of sleep per night					
5 hours or less	28.0	36.0	37.9	32.7	40.8
6 hours	28.0	28.8	28.8	34.9	34.1
7 hours or more	44.0	35.2	33.3	32.4	25.1
PSQI (continuous)	6.3 (2.7)	7.5 (2.7)	7.3 (2.7)	5.9 (1.5)	6.3 (1.5)
Bothered by repeated, disturbing dreams of traumatic or stressful experience					
Not at all	72.5	61.6	59.2	86.4	81.8
A little bit	18.1	23.6	24.7	8.5	11.1
Moderately to extremely	9.4	14.8	16.1	5.1	7.1
To what extent does a sleep problem interfere with your work or daily chores?					
Somewhat to very much	21.0	25.8	22.5	12.5	20.6
A little	29.7	32.5	30.7	30.3	37.2
Not at all	49.3	41.8	46.8	57.2	42.2
When you are awake, how often do you feel tired, fatigued, or not up to par?					
Nearly every day	17.1	15.3	15.9	15.1	16.7
3–4 times a week	20.0	18.7	19.2	17.0	18.1
1–2 times a week	26.5	26.2	26.4	32.3	32.4
1–2 times a month	20.5	21.7	21.3	20.5	19.2
Never or nearly never	15.9	18.1	17.2	15.2	13.5
Spouse reports loud snoring or long pauses between breaths					
Not during the past month to 3 times a week	82.2	N/A	76.4	80.3	69.6
3+ times a week	17.8	N/A	23.6	19.7	30.4
During the past month, how often have you . . .					
Taken medicine [prescribed or over the counter] to help you sleep?					
Not during the past month	68.6	76.1	74.6	88.8	84.1
< 1 time a week to 3+ times a week	31.4	23.9	25.4	11.2	15.9

Table 3.6—Continued

Variable	Army			Navy	
	Never Deployed	Currently Deployed	Previously Deployed	Never Deployed	Previously Deployed
During the past month, how often have you . . . (cont.)					
Taken energy drinks (for example: Monster, Red Bull, Rockstar, 5-Hour Energy)?					
Not during the past month	58.0	56.4	56.2	52.6	48.4
< 1 time a week to 3+ times a week	33.8	34.8	35.0	38.8	41.4
Daily	8.2	8.8	8.8	8.6	10.2
Taken caffeinated beverages besides energy drinks (for example: coffee, soda, tea)?					
Not during the past month	25.1	20.5	16.5	19.1	18.6
< 1 time a week to 3+ times a week	34.9	33.2	30.6	29.4	29.1
Daily	40.0	46.4	52.9	51.5	52.3
"I get out of bed at different times from day to day." Would you say that statement is . . .					
Always true	6.9	7.6	6.6	9.4	8.4
Frequently true	13.3	14.2	12.8	15.2	14.0
Sometimes true	25.6	26.4	25.1	21.9	21.2
Rarely true	39.3	38.1	39.9	32.9	33.8
Never or nearly never true	14.9	13.7	15.7	20.5	22.6

NOTE: Shading indicates a statistically significant difference (at $p < 0.01$) for the Navy subsample. Analyses were adjusted for age, gender, education, number of children in household, race/ethnicity, officer or enlisted, active-duty or guard/reserve service, shiftwork pattern, and depressive symptoms.

Table 3.7
Adjusted Distributions of Sleep Symptoms and Sleep-Related Behaviors, by Combat Exposure, Among Those with a Prior Deployment

Variable	Among All with a Prior Deployment, Weighted % or Mean (SD)	Predicted Mean, Combat Exposure Scale 1 SD Below the Mean, Weighted % or Mean (SD)	Predicted Mean, Combat Exposure Scale 1 SD Above the Mean, Weighted % or Mean (SD)
N (unweighted sample size)	1,596		
Hours of sleep per night			
5 hours or less	32.5	30.4	38.1
6 hours	31.3	31.8	32.2
7 hours or more	36.2	37.8	29.7

Table 3.7—Continued

Variable	Among All with a Prior Deployment, Weighted % or Mean (SD)	Predicted Mean, Combat Exposure Scale 1 SD Below the Mean, Weighted % or Mean (SD)	Predicted Mean, Combat Exposure Scale 1 SD Above the Mean, Weighted % or Mean (SD)
PSQI (continuous)	6.2 (3.9)	6.0 (2.3)	6.9 (2.3)
Bothered by repeated, disturbing dreams of traumatic or stressful experience			
Not at all	66.0	76.3	67.3
A little bit	20.4	15.6	20.9
Moderately to extremely	13.6	8.1	11.8
To what extent does a sleep problem interfere with your work or daily chores?			
Somewhat to very much	17.5	16.9	18.4
A little	35.4	34.7	36.2
Not at all	47.1	48.5	45.4
When you are awake, how often do you feel tired, fatigued, or not up to par?			
Nearly everyday	16.5	17.3	16.3
3–4 times a week	17.5	17.2	16.5
1–2 times a week	26.9	27.3	27.0
1–2 times a month	21.1	21.2	21.8
Never or nearly never	18.0	17.2	18.4
Spouse reports loud snoring or long pauses between breaths			
Not during the past month to 3 times/week	75.9	79.1	74.1
3+ times a week	24.1	20.9	25.9
During the past month, how often have you taken medicine (prescribed or over the counter) to help you sleep?			
Not during the past month	81.4	83.5	78.3
< 1 time a week to 3+ times a week	18.6	16.5	21.7

NOTE: Shading indicates a joint p-value < 0.01 for adjusted test of difference by combat exposure scale. Analyses adjusted for age, gender, education, number of children in household, race/ethnicity, officer or enlisted, active-duty or guard/reserve service, work pattern, depressive symptoms, Service branch, total number of deployments, length of last deployment, and time since last deployment.

Associations Between Sleep Measures and Outcomes Among Previously Deployed Servicemembers

In this subsection, we discuss findings for each outcome separately. Tables 3.8 and 3.9 show the multivariate regression results examining the association between our sleep measure and the outcomes for the linear and logistic models, respectively, based on the distributions of the outcomes.

Table 3.8
Summary of Linear Regression Model Results for Self-Rated Physical Health and Unit Readiness

Outcome	Self-Rated Physical Health (single item)	Unit Readiness
Model type	Linear	Linear
Set of predictors	Full	Full
Hours of sleep per night		
5 hours or less	-0.33 [-0.49, -0.16]***	-0.40 [-0.64, -0.16]**
6 hours	-0.16 [-0.31, -0.00]*	-0.18 [-0.40, 0.05]
7 hours or more (reference)	0.00	0.00
Sleep quality (PSQI continuous, standardized)		
	-0.23 [-0.31, -0.15]***	-0.23 [-0.37, -0.09]**
Bothered by repeated, disturbing dreams of traumatic or stressful experience		
Not at all (reference)	0.00	0.00
A little bit	0.30 [0.08, 0.51]	0.23 [-0.69, 0.24]
Moderately to extremely	-0.07 [-0.40, 0.26]	0.59 [0.08, 1.10]
To what extent does a sleep problem interfere with your work or daily chores?		
Somewhat to very much	-0.62 [-0.81, -0.44]***	-0.37 [-0.63, -0.10]**
A little	-0.29 [-0.44, -0.15]***	-0.31 [-0.52, -0.11]**
Not at all (reference)	0.00	0.00
When you are awake, how often do you feel tired, fatigued, or not up to par?		
Nearly every day	-0.70 [-0.95, -0.46]***	-0.42 [-0.80, -0.05]
3-4 times a week	-0.73 [-0.93, -0.53]***	-0.36 [-0.68, -0.05]
1-2 times a week	-0.61 [-0.78, -0.45]***	-0.35 [-0.64, -0.06]
1-2 times a month	-0.26 [-0.44, -0.07]**	-0.12 [-0.43, 0.19]
Never or nearly never (reference)	0.00	0.00

Table 3.8—Continued

Outcome	Self-Rated Physical Health (single item)	Unit Readiness
Spouse reports loud snoring or long pauses between breaths		
Not during the past month to 3 times a week (reference)	0.00	0.00
3+ times a week	-0.30 [-0.45, -0.16]***	0.13 [-0.08, 0.34]
During the past month, how often have you . . .		
Taken medicine [prescribed or over the counter] to help you sleep?		
Not during the past month (reference)	0.00	0.00
< 1 times a week to 3+ times a week	-0.15 [-0.34, 0.04]	-0.10 [-0.37, 0.16]
Taken energy drinks (for example: Monster, Red Bull, Rockstar, 5-Hour Energy)?		
Not during the past month (reference)	0.00	0.00
< 1 times a week to 3+ times a week	-0.13 [-0.27, 0.02]	-0.18 [-0.39, 0.02]
Daily	0.16 [-0.14, 0.45]	0.17 [-0.13, 0.47]
Taken caffeinated beverages besides energy drinks (for example: coffee, soda, tea)?		
Not during the past month (reference)	0.00	0.00
< 1 times a week to 3+ times a week	-0.18 [-0.37, 0.00]	-0.24 [-0.53, 0.06]
Daily	-0.24 [-0.43, -0.06]	-0.31 [-0.59, -0.04]
Taken medication to stay awake?		
Not during the past month (reference)	0.00	0.00
< 1 times a week to daily	-0.31 [-0.73, 0.10]	0.13 [-0.35, 0.61]
"I get out of bed at different times from day to day." Would you say that statement is . . .		
Always true	-0.12 [-0.41, 0.16]	-0.26 [-0.62, 0.10]
Frequently true	-0.26 [-0.48, -0.03]	-0.45 [-0.78, -0.12]
Sometimes true	-0.31 [-0.52, -0.10]	-0.33 [-0.60, -0.07]
Rarely true	-0.13 [-0.31, 0.04]	-0.21 [-0.45, 0.03]
Never or nearly never true (reference)	0.00	0.00

NOTE: Shading indicates joint p-value < 0.01.

* p < 0.05, ** p < 0.01, *** p < 0.001, where joint p-value < 0.01.

Table 3.9
Summary of Logistic Regression Model Results for Probable Depression and Probable PTSD

Outcome	Probable Depression	Probable PTSD
Hours of sleep per night		
5 hours or less	4.33 [2.08, 9.00]***	5.60 [1.24, 25.16]
6 hours	1.23 [0.49, 3.08]	1.67 [0.34, 8.09]
7 hours or more (reference)	1.00	1.00
Sleep quality (PSQI continuous, standardized)	4.33 [3.20, 5.87]***	5.00 [2.97, 8.43]***
Bothered by repeated, disturbing dreams of traumatic or stressful experience ^a		
Not at all (reference)	1.00	N/A
A little bit	2.49 [1.11, 5.56]*	N/A
Moderately to extremely	10.41 [4.40, 24.59]***	N/A
To what extent does a sleep problem interfere with your work or daily chores?		
Somewhat to very much	56.53 [22.37, 142.87]***	5.05 [1.83, 13.98]**
A little	7.31 [2.80, 19.06]***	2.11 [0.75, 6.00]
Not at all (reference)	1.00	1.00
How often do you feel tired, fatigued, or not up to par?		
Nearly every day	71.58 [17.55, 292.03]***	1.15 [0.22, 6.14]
3–4 times a week	20.72 [4.97, 86.40]***	4.15 [1.05, 16.37]
1–2 times a week	6.18 [1.44, 26.62]*	1.61 [0.36, 7.15]
1–2 times a month	1.66 [0.32, 8.62]	2.48 [0.52, 11.88]
Never or nearly never (reference)	1.00	1.00
Spouse reports loud snoring or long pauses between breaths		
Not during the past month to 3 times a week (reference)	1.00	1.00
3+ times a week	1.80 [0.89, 3.64]	1.51 [0.61, 3.72]
During the past month, how often have you . . .		
Taken medicine [prescribed or over the counter] to help you sleep?		
Not during the past month (reference)	1.00	1.00
< 1 time a week to 3+ times a week	2.00 [1.16, 3.45]	1.58 [0.68, 3.69]

Table 3.9—Continued

Outcome	Probable Depression	Probable PTSD
During the past month, how often have you . . . (cont.)		
Taken energy drinks (for example: Monster, Red Bull, Rockstar, 5-Hour Energy)?		
Not during the past month (reference)	1.00	1.00
< 1 time a week to 3+ times a week	1.40 [0.79, 2.47]	0.93 [0.40, 2.19]
Daily	1.72 [0.72, 4.13]	1.74 [0.32, 9.43]
Taken caffeinated beverages besides energy drinks (for example: coffee, soda, tea)?		
Not during the past month (reference)	1.00	1.00
< 1 times a week to 3+ times a week	1.82 [0.77, 4.30]	3.67 [0.68, 19.92]
Daily	1.72 [0.73, 4.01]	5.08 [1.08, 23.81]
Taken medication to stay awake?		
Not during the past month (reference)	1.00	1.00
< 1 time a week to daily	3.84 [1.19, 12.38]	1.38 [0.30, 6.29]
"I get out of bed at different times from day to day." Would you say that statement is . . .		
Always true	5.46 [1.85, 16.10]**	0.25 [0.03, 1.95]
Frequently true	3.14 [1.21, 8.17]*	1.14 [0.34, 3.85]
Sometimes true	1.31 [0.50, 3.43]	1.13 [0.39, 3.26]
Rarely true	1.00 [0.41, 2.45]	0.61 [0.19, 1.97]
Never or nearly never true (reference)	1.00	1.00

NOTE: Shading indicates joint p-value < 0.01.

^a The item assessing distressing dreams/nightmares was drawn from the PTSD measure and thus was not included as a predictor of probable PTSD.

* p < 0.05, ** p < 0.01, *** p < 0.001, where joint test < 0.01 only.

Physical Health

Overall, most of the sample reported that their physical health was "very good" or "excellent" (mean for the physical health item = 3.8; range of 1–5). As shown in the first column of Table 3.8, five different measures of sleep problems were associated with poorer physical health after adjusting for the sociodemographic and military characteristics, depressive symptoms, and presence of TBI. Specifically, there was a significant association between sleep duration and physical health ($F = 7.32$, standardized beta = -0.33 , corresponding to a moderate effect size; $p < 0.001$), such that those sleep-

ing five hours or less per night reported significantly poorer physical health compared with those sleeping seven hours or more per night. Additionally, poorer sleep quality was associated with poorer health, such that a one standard deviation increase in the PSQI was associated with a 0.23 decrease in mean physical health ($p < 0.001$). Sleep-related daytime impairment was also significantly associated with poorer physical health ($F = 22.86$, $p < 0.001$), such that servicemembers reporting more frequent impairment had significantly poorer physical health than those who reported no impairment, with effect sizes in the moderate to large range for increasing frequency of daytime impairment. Similarly, greater frequency of fatigue was associated with poorer physical health ($F = 20.35$, $p < 0.001$), which corresponded to a large effect size based on the standardized beta coefficients reported in Table 3.8. Finally, having a spouse report loud snoring or long pauses for servicemember was associated with lower mean physical health (standardized difference = -0.30 ; $p < 0.001$). Across all these sleep measures, the associations were generally of moderate to large magnitude, based on the standardized coefficients, shown in Table 3.8. The largest effect sizes were observed for fatigue and sleep-related daytime impairment; in each case, effect sizes were greater than 0.6, which corresponds to a large effect.

Perceived Unit Readiness

As shown in the second column of Table 3.8, we found three sleep measures that were significantly associated with perceived unit-level readiness with moderate effect sizes. Specifically, there was a significant association between sleep duration and unit readiness ($F = 6.77$, standardized beta = -0.40 ; $p < 0.01$), such that those sleeping five hours or less per night reported significantly lower mean unit readiness than those sleeping seven hours or more per night. Additionally, poorer sleep quality was associated with lower reported unit readiness, such that a one-standard-deviation change in the PSQI (i.e., increase in sleep complaints) was associated with a 0.23 decrease in perceived unit readiness ($p < 0.001$). Finally, reporting that sleep interferes with work or chores was also significantly associated with unit readiness ($F = 6.05$, $p < 0.01$); servicemembers reporting that sleep interfered with work or chores “a little” or “somewhat to very much” reported significantly lower unit readiness than those who reported that sleep did not interfere with chores at all; effect sizes were moderate. No specific sleep measure was notably stronger or weaker than any of the others for this outcome.

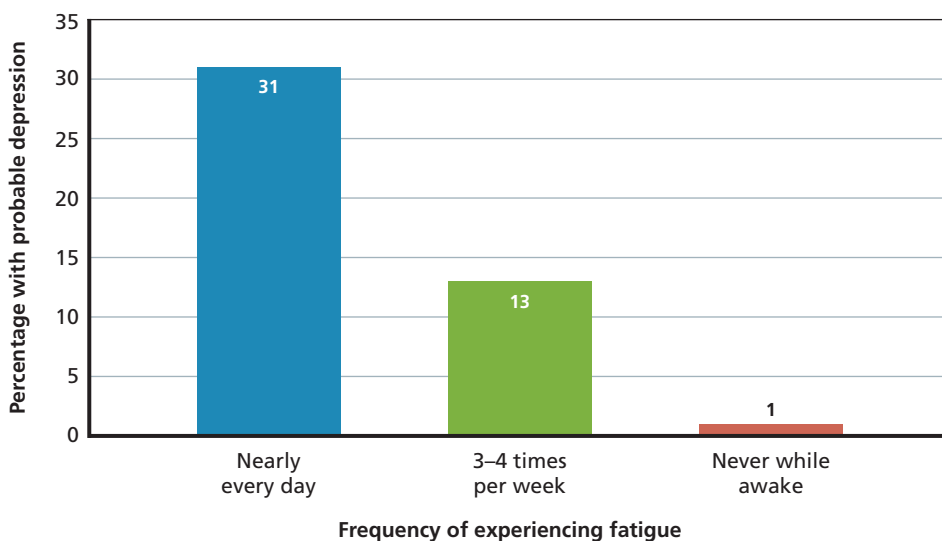
Probable Depression

8.7 percent of the sample was classified as having probable clinical depression. As shown in the first column of Table 3.9, six different measures of sleep were associated with a higher risk of probable depression, after adjusting for sociodemographic and military characteristics and TBI. Specifically, there was a significant association between sleep duration and probable depression ($X^2 = 20.96$, $p < 0.001$), such that those sleeping five hours or less per night had significantly higher odds of having probable depression. Based on predicted means for this outcome, those sleeping five hours or less per

night were approximately three times more likely to have probable depression than those sleeping seven hours or more per night (17 percent versus 5 percent). Additionally, poorer sleep quality (higher PSQI scores) was associated with significantly higher odds of having probable depression (OR = 4.33; $p < 0.001$). Greater frequency of sleep-related daytime impairment was also significantly associated with a greater likelihood of probable depression ($X^2 = 90.72$, $p < 0.001$). We note here that the odds ratio comparing those reporting “somewhat to very much” is extremely large because probable depression occurred so rarely among the group of servicemembers reporting “never” having sleep-related daytime impairment. Specifically, the adjusted rates of probable depression for the groups reporting “never” having sleep-related daytime impairment versus those reporting “somewhat to very much” were 1 percent and 35 percent, respectively, though caution is warranted in interpreting these results, given the small sample sizes for those reporting that they never experienced sleep-related daytime impairment.

Greater frequency of fatigue was also associated with a greater likelihood of probable depression ($X^2 = 84.30$, $p < 0.001$; see Figure 3.6 for the predicted mean percentages based on differing levels of fatigue). These odds ratios for fatigue are also very large because the rate of probable depression in the reference group (those who “never or nearly never” experience fatigue) is so small compared with the rates in the other groups. Getting out of bed at different times of the day was also associated with a greater likelihood of probable depression ($X^2 = 17.77$, $p < 0.01$), such that 25 percent of those who “always” get out of bed at different times have probable depression versus 7 percent of those who “never or nearly never” get out of bed at different times. Finally, among those servicemembers who had experienced a traumatic event, greater

Figure 3.6
Percentage with Probable Depression, According to Frequency of Experiencing Fatigue



frequency of distress related to disturbing dreams was significantly associated with a higher likelihood of having probable depression—39 percent versus 8 percent with probable depression for those reporting being “moderately to extremely” bothered by disturbing dreams or “not at all” bothered, respectively ($X^2 = 28.68$, $p < 0.001$).

Probable PTSD

Slightly more than 12 percent (12.4) of the sample was classified as having probable clinical PTSD. As shown in the second column of Table 3.9, poorer sleep quality and greater sleep-related daytime impairment were associated with higher odds of probable PTSD. Specifically, poorer sleep quality (higher PSQI scores) was associated with a higher likelihood of having probable PTSD (OR = 5.00; $p < 0.001$, for a one-standard-deviation increase in the PSQI). Additionally, greater sleep-related daytime impairment was also significantly associated with probable PTSD ($X^2 = 90.72$, $p < 0.001$), such that 18 percent of servicemembers reporting “somewhat to very much” impairment had probable PTSD versus only 7 percent of those who reported no daytime impairment.

Discussion

The current analyses make several important contributions to the study of sleep problems among servicemembers. First, this study is among the only ones to use a large and diverse representative sample of married and deployable servicemembers across all four branches of the U.S. armed forces. Second, we used validated measures to more broadly assess sleep symptoms and sleep-related behaviors, including both nighttime symptoms and resulting impairments in daytime functioning. In addition, we focused on a number of diverse outcomes important for the military population, including mental health, physical health, and operational readiness. Finally, we used robust analytic approaches to control for a large number of associated factors that could explain the relationships between poor sleep and targeted outcomes. The methodological strengths of this study and robust analytic approach build upon the extant literature and provide a more comprehensive, multi-informant perspective on sleep problems experienced by servicemembers in the post-deployment period.

Consistent with the extant literature, we found a high prevalence of insufficient sleep duration and poor sleep quality in this sample (see, e.g., Luxton, Greenburg, et al., 2011; Seelig et al., 2010; Mysliwiec, Gill, et al., 2013; Mysliwiec, McGraw, et al., 2013). Notably, nearly half of the sample exceeded the established threshold for clinically significant sleep disturbances, and more than one-third of the population would be categorized as extreme “short sleepers.” This is concerning, given the well-evidenced prospective associations between short sleep duration and morbidity and mortality (Grandner, Hale, et al., 2010). Further, few studies have specifically focused on sleep-related daytime impairment and fatigue in servicemember populations. We found that more than one-third of the sample reported daytime impairment three or more times

per week, and nearly 17 percent reported experienced fatigue on a daily basis. In light of the operational demands and inherent hazards associated with military occupations, these findings highlight the importance of considering not only the prevalence of insufficient sleep duration and other sleep problems but also the potential impacts on daytime functioning. As discussed in Chapter Five, there is scant evidence to support the use of pharmacologic agents to treat sleep disturbances in servicemember populations specifically. Nevertheless, 18 percent of the population reported using sleep medications; however, the survey did not specify which types of medications were used. Clearly, there is a need for further research on the prevalence of sleep and stimulant medication use in servicemember populations, as well as physician prescribing practices, given safety concerns related to such use.

This study is also among the first to systematically examine a host of sleep-related behaviors (i.e., sleep hygiene behaviors) that may contribute to the onset or perpetuation of sleep problems. Overall, the results showed that the majority of servicemembers engaged in one or two sleep-related behaviors, with regular caffeine consumption being the most frequently reported behavior. Notably, however, caffeine consumption that is appropriately dosed and timed (i.e., several hours before bedtime) is an appropriate counter-measure for reducing fatigue, without necessarily compromising sleep quality or quantity. Although there have been recent media reports and concerns raised about the high prevalence of stimulants and, in particular, the use of energy drinks in servicemember populations, less than 10 percent of our sample used energy drinks on a daily basis. However, it should be noted that the relatively low prevalence of daily energy drink use may reflect specific demographic characteristics of the Deployment Life Study sample (i.e., they are married and tend to be older than respondents in other surveys of servicemembers). For instance, in the J-MHAT 7 survey, in which more than half the sample was unmarried, with the majority between the ages of 18 and 24 (the highest risk demographic for using energy products overall), 44.8 percent of servicemembers reported daily energy drink use. In contrast, in our study, only 8–10 percent of servicemembers reported daily use (Toblin, Clarke-Walper, et al., 2012). These findings bear further replication to identify the risk factors for using energy drinks and other stimulants to promote wakefulness.

Our findings build upon previous work by highlighting these problems across the Service branches. Moreover, the findings extend the prior work by demonstrating a high prevalence of poor sleep and associated daytime impairment as measured by a multi-item, validated scale (the PSQI). Prior research has tended to focus primarily on short sleep duration or on an isolated symptom of insomnia using single-item measures, rather than on more comprehensive and well-validated measures such as the PSQI. The frequency of fatigue and sleepiness interfering with work or chores is also concerning, given occupational demands and the consequences of fatigue for high-risk occupations. Experimental research has shown that poor sleep can have negative impli-

cations on performance and cognitive abilities, thus interfering with operational readiness in the field (Wesensten and Balkin, 2013; Wesensten, Belenky, and Balkin, 2006).

We found some evidence of differences in sleep based on combat experience but very little evidence demonstrating differences based on deployment history. For instance, we found no evidence of differences between our deployment subgroups in the Army, though this may be due to the small sample sizes in the “never” and “currently” deployed subgroups. In the Navy sample, we found that servicemembers with prior deployments had greater sleep-related daytime impairment than those without a prior deployment. For combat exposure, the results were consistent with the previous literature: Higher levels of exposure to combat were associated with poorer sleep quality and greater frequency of reporting repeated, disturbing dreams among those who had experienced a traumatic event (Plumb, Peachey, and Zelman, 2014; Luxton, Greenburg, et al., 2011; Wright et al., 2011b). Consistent with the conceptual model presented in Chapter Two, these findings may reflect conditioned or “learned” hyperarousal (e.g., after deployment, being extra alert or on guard even when there is no real threat present), which manifests in sleep disturbances that can persist long after deployments have ended.

As for the analyses of outcomes associated with poor sleep, we found that poor sleep quality and sleep-related daytime impairment were associated with poor physical health, probable depression, probable PTSD, and lower perceived unit readiness, with effect sizes in the moderate-to-large range.

These findings are consistent with previous military sleep studies that have documented the association between sleep problems and mental health problems, like depression and PTSD (Wright et al., 2011a, 2011b; Gehrman et al., 2013; Ribeiro et al., 2012; van Liempt et al., 2013). Our findings also extend this work by highlighting the robust associations between sleep quality and health outcomes; previous research has focused primarily on short sleep duration. Other military and civilian studies show sleep problems’ effects on physical health, such as risk for diabetes and obesity (Boyko et al., 2013; Gangwisch, Heymsfield, et al., 2007; Gangwisch, Malaspina, et al., 2005; Yu and Berger, 2011). Our models also showed evidence that fatigue and daytime impairment are independent correlates of probable depression and poorer physical health. Importantly, because our analyses incorporated cross-sectional data, it may be that individuals with depression or poor physical health are more likely to endorse daytime impairments, including fatigue or sleepiness, given the high comorbidity between these symptoms and depression and poor physical health, as found in other work (see Chapter Two).

Strengths and Limitations

Findings from the current study must be tempered by a discussion of several limitations. In particular, because of the design of the Deployment Life Study, our sample was restricted to married, deployable servicemembers. Thus, the findings may not

generalize to unmarried servicemembers or those not eligible for deployment. Importantly, those groups may be at even greater risk for sleep problems and associated consequences than their married counterparts, given the epidemiologic evidence showing that unmarried individuals have higher rates of sleep disturbances (Hale, 2005). We were also unable to conduct subgroup analyses for deployment history for Air Force and Marine Corps servicemembers because of small sample sizes. Finally, the findings are cross-sectional; therefore, causal relationships cannot be determined based on the current data. In particular, although we found few differences in sleep patterns based on deployment history, these analyses are between-person and cross-sectional rather than within-person and longitudinal (i.e., we did not follow individual servicemembers' sleep patterns across the deployment cycle). Thus, we cannot make any causal interpretations regarding the impact of deployments on sleep disturbances. Moreover, given known bidirectional associations between sleep and associated daytime impairments with each of the self-reported outcomes, we cannot make inferences about causality or the directionality of the associations.

These limitations notwithstanding, we used a conservative modeling approach, which included using a host of sociodemographic, military, and psychological (depressive symptoms) and physical health (probable TBI) covariates; this conservative approach lends support to the existing evidence suggesting that sleep problems are independent correlates of mental and physical health outcomes and perceived unit readiness. Although previous studies have included control variables, only a few of these studies have included such a comprehensive assessment and multiple potential confounding factors. This indicates that our study provides a more robust analysis of the degree to which sleep problems are independently associated with key outcomes of mental health, physical health, and operational readiness. Nevertheless, there may be other unmeasured variables that could have accounted for observed associations. We also recognize inherent limitations in the measurement of some of our covariates, such as the measure of probable TBI. This measure has been validated as a useful screening tool but may lack sensitivity and specificity for diagnosing TBI (Schwab et al., 2007).

Clearly, more longitudinal research is needed to examine the extent to which sleep problems predict downstream health consequences and operational readiness in servicemember populations, whether deployments precipitate the onset of sleep problems, or whether sleep problems precede deployments in some individuals. In summary, our comprehensive assessment of sleep problems and sleep-related behaviors and associated consequences in a nationally representative sample of married and deployable servicemembers across all Service branches highlights the prevalence of a wide range of sleep problems among servicemembers and suggests a continued need to focus on the role of sleep in contributing to servicemember health, well-being, and operational readiness.

Review of Sleep Policies and Programs

In Chapters Two and Three, we examined the prevalence of sleep disturbances, including insomnia, insufficient sleep duration, and nightmares, in servicemember populations, as well as their association with a host of adverse mental and physical health outcomes.

In this chapter, we seek to answer the third research question: What are the current sleep policies and programs in the military? Sleep-related *policies* in the military context can generally be thought of as instructions that dictate how sleep-related behaviors and sleep disorders among servicemembers are identified and treated. Policies can also serve as guidelines on and, in some cases, requirements for sleep duration and work/rest cycles. Ideally, these policies would be enforced by line leaders and medical professionals and would influence the development of related doctrines, protocols, and standard operating procedures with the ultimate goal of optimizing health and performance. We define sleep programs, on the other hand, as efforts and actions to address sleep problems. Sleep *programs* may be the translation of a policy, but a program's existence or implementation may not necessarily be dictated or mandated by a policy.

To date, no literature review has identified or synthesized sleep-related policies across DoD or within each military branch. This chapter provides a comprehensive review of formal sleep-related policies and programs that apply to servicemembers in the training, operational, and clinical (which includes medical and prevention) domains. We first discuss our approach, followed by a summary of policies and programs in four categories—prevention, medical, training, and operational—both across DoD and within the individual Services.

Approach

To better understand what policies may be in place to support healthy sleep behaviors, we conducted a policy review that entailed a literature search for publicly available and written Service-specific and DoD policies and procedures related to sleep. These policies sought to contribute to better operational performance, post-deployment sleep, and

resilience among servicemembers. In addition, programs to address sleep problems surfaced in our searches. Sleep *programs* may be a translation of a policy, but a program's existence or implementation may not necessarily be dictated or mandated by a policy.

To this end, we first developed a list of key questions to guide our policy analysis:

- What policies or programs seek to prevent sleep problems or promote healthy sleep among servicemembers?
- What policies or programs support healthy sleep behaviors in training or operational environments?
- What medical policies inform readiness standards for servicemembers?
- What policies inform clinical practice for diagnosing sleep disorders or ensuring continuity of care for servicemembers for the entirety of a servicemember's training and operational cycles?

Starting with these key questions, we conducted custom searches for existing policies and programs using online search engines and targeted DoD, VA, and Service-specific repositories to identify existing publications, issuances, and directives (see Table 4.1). We used search terms that would be applicable to the military context, such as *instruction, policy, program, directive, sleep, clinical, prevention, operational, training, fatigue, crew rest, and shift work*. Exclusion criteria included policies published before 1995 or those currently under review. Sources below the Service or branch level, such as theater-specific policies, installation-specific policies, and unit-specific standard operating procedures, are likely to be unique to each individual command or unit; thus, we excluded these sources because it can reasonably be inferred that such subor-

Table 4.1
Types of Policy and Program Publications Reviewed

Type of Publication	Example Website Queried
U.S. Department of Defense instructions (DoDIs), U.S. Department of Defense directives (DoDDs), and manuals	http://www.dtic.mil
VA Clinical Practice Guidelines (CPGs)	http://www.healthquality.va.gov
TRICARE manuals	http://www.tricare.mil
Army regulations (ARs), Department of the Army pamphlets, and field manuals (FMs)	http://armypubs.army.mil
Secretary of the Navy instructions (SECNAVINSTs); Navy tactics, techniques, and procedures (NTTP); and Chief of Naval Operations instructions (OPNAVISTs)	http://doni.daps.dla.mil/default.aspx
Air Force instructions (AFIs); Air Force tactics, techniques, and procedures, and Air Force guidance memorandums (AFGMs)	http://www.e-publishing.af.mil
Marine Corps orders (MCOs) and Marine Corps reference publications (MCRPs)	http://www.marines.mil

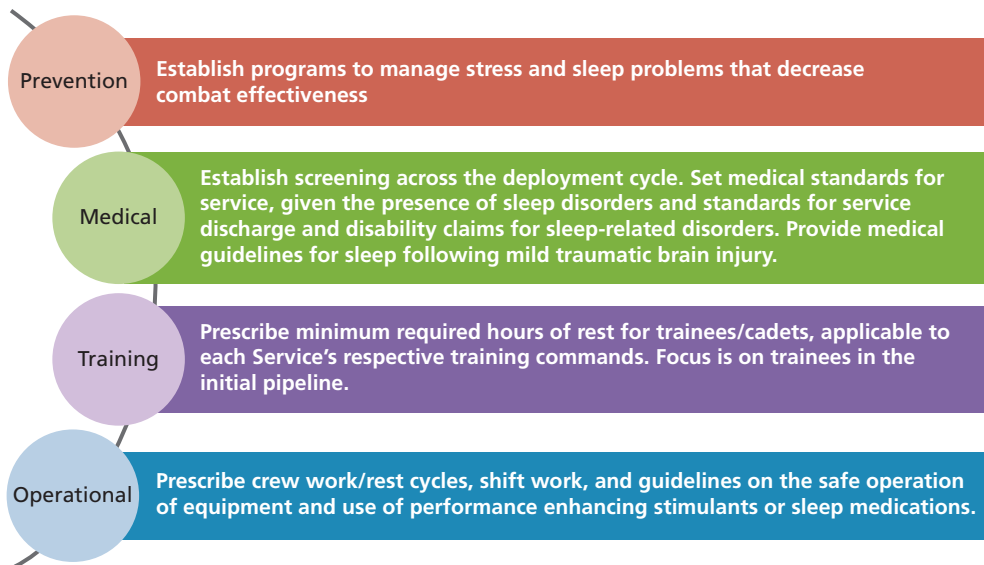
dinate policies, at least in writing, would be consistent with higher-echelon guidance. We did not specifically target a review of programs or policies for the National Guard or reserve components of any Service; however, many of these programs and policies are likely applicable to all Service components. We did not have access to classified policies. However, if any of these policies are related to sleep, it is probable that they are specific to smaller units and therefore unlikely to be amenable to implementation across an entire Service, occupation category, or DoD.

We also conducted an iterative search using the reference lists from the policies retrieved to identify policies that may have been missed. After removing duplicates and identifying the most recent versions of policies related to sleep, we applied exclusion criteria to guide the decision to include the policy in our review.

Codified policies across DoD, VA, and the Service branches are summarized in Appendix F and included instructions, issuances, and regulations related to medical policies, prevention programs, operational and training policies, safety policies, and stress management publications or leader guides. We defined operational policies as those related to sleep during combat operations or exercises. These operational policies typically prescribed shift work cycles and the duration of rest periods.

Our search also yielded prevention strategies that were included in programs that may or may not be required by codified policies. Thus, this review includes four broad categories, as depicted in Figure 4.1.

Figure 4.1
Four Categories of Military Sleep Policies and Programs



The categories of policies are not mutually exclusive and may overlap. For example, many of the operational policies serve the dual purpose of promoting stress management and prevention efforts. Below, we summarize the key points of all relevant policies related to sleep in each category, DoD-wide, if applicable, and then by Service component. These descriptions are not meant to be a comprehensive list of all Service-specific resiliency efforts; rather, they highlight some of the most important policies and programs that may serve as a vehicle to promoting healthy sleep. In Appendix F, we provide a list of these relevant policies at the DoD and Service levels.

To augment the policy review, we conducted key informant interviews and held an expert working group meeting to ensure that our policy review was comprehensive, to provide context for the policies and programs, and to identify gaps in the policies and programs. The methods for these interviews and for the working group meeting are described in Appendixes G and H.

Sleep-Related Prevention Policies/Programs

Because sleep disturbances have strong implications for concurrent and future psychological, physical, and operational consequences, the converse may also be true: Promoting healthy sleep and preventing sleep disorders may have implications for enhancing resilience to current and future stressors and adversities, which is of utmost importance to the military and servicemembers returning from deployments. However, trade-offs must be considered in terms of the costs of proactively administering prevention efforts for sleep disorders for all servicemembers versus the costs of treatment after problems have been individually diagnosed. In Chapters Two and Three, we identified the high prevalence of sleep disorders and many mental and physical health consequences of sleep disorders. As such, employing a prevention-focused sleep strategy may provide efficiencies in avoiding the societal and medical costs that result as a consequence of sleep disorders. In this section, we examine DoD-wide prevention strategies before turning to Service-specific strategies.

DoD Prevention Policies/Programs

Resilience is defined operationally as the ability to withstand, recover, and grow in the face of stressors and changing demands and as the process of coping with or overcoming exposure to adversity or stress (Meredith et al., 2011). In this context of resilience, across DoD and within each of the Service branches, efforts are under way to prioritize sleep, promote sleep health, and prevent chronic and debilitating sleep disorders. Among the most well-known of these programs is the DoD-issued instruction (DoDI 6490.05, 2013) to establish and maintain combat and operational stress control (COSC) programs in each of the military branches. Specifically, each branch must train and employ COSC personnel who are able to “consult with units/individuals on

psychological principles that enhance combat effectiveness and to evaluate, identify, and differentiate combat stress reactions from diagnosable mental health conditions and concerns.” Part of this duty is determining whether individuals are sleep-deprived or suffering from other sleep problems that significantly decrease their combat effectiveness or place anyone at added risk of harm. In such cases, COSC personnel have the discretion and authority to intervene and bring such individuals to mental health care providers for evaluation and treatment.

In addition to training and employing COSC personnel, the Service branches are responsible for educating leaders and servicemembers on combat and operational stress reactions. This involves educating servicemembers on the causes and how to deal with them. The Army and Navy both have guidebooks that contain sections on the impact of sleep management on readiness. This literature explains sleep hygiene practices in the context of military operations, with the goal of preventing chronic and debilitating sleep disturbances that could compromise readiness. However, empirical evidence suggests that this guidance may go unheeded. For example, in one study of Army officers, 80 percent reported not receiving sleep management briefings during deployments (Miller, Shattuck, and Matsangas, 2011). The majority of the officers (74 percent) reported that their unit never or rarely encouraged or monitored naps, and most (67 percent) reported that their unit never or rarely designated dark or quiet areas for rest. Given the inherent qualities of deployments that make sleep difficult, encouraging somewhat regular sleep schedules, designating dark areas for rest, encouraging naps, and providing designated time off for rest may be helpful in attempting to avoid continued sleep difficulties post-deployment (Wesensten and Balkin, 2013).

Several other DoD publications identify sleep as an important factor in the context of stress resilience for military personnel. These resources are not necessarily formal policies, but they include information for servicemembers in the form of “how-to” suggestions or tips for the best ways to manage sleep and/or stress in the post-deployment period. For instance, the Army’s *Guide to Coping with Deployment and Combat Stress* (U.S. Army, 2008) advises sleeping at least seven to eight hours in each 24-hour period to prevent combat stress and describes poor sleep as a warning sign for suicide and one to be aware of when servicemembers use the “battle buddy” method of accountability.¹ However, according to experts involved in our working group meeting, these resources are decentralized and there is no oversight to ensure the accuracy of the recommendations. Moreover, interviewees and the experts who attended the working group meeting noted the importance of leadership in emphasizing the importance of these messages.

While neither a policy nor a program, J-MHAT 7’s report offers recommendations related to servicemember sleep-related behaviors and other positive health behav-

¹ The battle buddy method is commonly used in military training and operations. It involves pairing two servicemembers in the same unit, often bunkmates, who are then responsible for each other’s conduct and well-being. This method encourages teamwork and motivates servicemembers to maintain high standards in many areas, including sleep hygiene.

iors, for the U.S. Army and U.S. Marine Corps in particular (J-MHAT 7, 2011). The 2011 J-MHAT 7 report makes a joint recommendation to incorporate sleep hygiene and discipline into pre-deployment training, to have small-unit leaders enforce sleep plans, and to mitigate environmental factors that lead to poor sleep environments.

Service-Specific Prevention Policies/Programs

Each military Service has at least one program or campaign to promote resiliency among its servicemembers, including the Comprehensive Soldier and Family Fitness Program (Army), the Comprehensive Airman Fitness Program (Air Force), the Marine Total Fitness Program (Marine Corps), and the Operational Stress Control Program (Navy). Across these resilience initiatives, healthy sleep is identified as an important component of resilience; however, according to our working group members, these guidelines fall short of providing evidence-based strategies to promote sleep health.

One of the most concerted and systematic efforts to promote sleep health as a critical component of resilience is the Army's Performance Triad initiative. Specifically, the model highlights nutrition, exercise, and sleep as critical factors that influence the resilience and readiness of servicemembers. By identifying sleep as a major component of healthy living, the Army has made a major step toward advocating for good sleep habits in the military. The Army continues to fund research into how poor sleep quality and quantity can affect the performance of soldiers. So far, however, the effects of this research and program on Army policies and health outcomes are limited, so the efficacy of such programs for improving sleep has yet to be demonstrated.

Many other, less formalized messaging efforts are under way within each Service branch to educate servicemembers on the importance of sleep and to promote healthy sleep behaviors. These instructions generally come in the form of *sleep hygiene instructions*, which refer to such behaviors as limiting the use of caffeine and alcohol, exercising regularly, and eliminating light and noise during sleep. Although sleep hygiene may be useful in conjunction with other therapies, there is insufficient evidence to suggest that sleep hygiene is an effective stand-alone treatment for people suffering from sleep disorders (Moss, Lachowski, and Carney, 2013).

Additionally, many aspects of good sleep hygiene (such as a dark, quiet, comfortable sleep environment) are infeasible in many military occupational settings. According to comments from key informants and working group attendees, these sleep hygiene recommendations are often ineffective because they fail to recognize the environmental constraints imposed on servicemembers, particularly in deployed settings. In contrast, other practical solutions, such as sending "sleep kits" containing an eye mask or earplugs and other supplies to servicemembers in deployed settings may represent more practical and feasible strategies to encourage healthy sleep behaviors.

Sleep-Related Medical Policies/Programs

U.S. Department of Defense Medical Policies/Programs

Overarching DoD policies related to sleep exist primarily to set medical standards and qualifications for initial military service or referral to a medical evaluation board (DoDI 6130.03, 2011). We also identified subordinate policies that set medical standards for each Service (see Appendix F). Each of these policies lists which sleep-related disorders affect Service eligibility or medical care options for sleep disorders for servicemembers. Additionally, DoDI 6490.11 (2012) prescribes guidelines for commands in managing concussion injuries. This instruction states that servicemembers with a recurrent concussion within a 12-month period will be afforded recovery care, which includes uninterrupted sleep and pain management. However, the policy does not refer to, or provide specific guidelines about, what the sleep or pain management plan should include, nor does it provide referral guidelines for care. Related policies on concussion management were also identified at the Service level.²

In addition to medical standards, medical policies include screening for sleep disorders. Self-report assessments are the most commonly used tools to identify sleep problems among servicemembers. In 2005, in response to high numbers of physical and psychological casualties from the wars in Iraq and Afghanistan, DoD ordered the establishment of the Post-Deployment Health Assessment (PDHA) and the Post-Deployment Health Reassessment (PDHRA) programs through DoDI 6490.03 (2011; see McCarthy, Thompson, and Knox, 2012). They are used to screen for physical and mental health problems, including PTSD and troubled sleep. If servicemembers screen positive for any disorder, they are evaluated by a physician and enter treatment if necessary. The PDHA is administered immediately after leaving a deployed area of operations, and the PDHRA is completed three to six months after returning home.

While these broad screening tools may be useful for identifying sleep problems, the timing of the PDHA administration (i.e., between the end of a servicemember's deployment and his or her return home) may lead to underreporting of symptoms, as servicemembers may believe that reporting symptoms on the PDHA will result in further medical examinations that will delay their return. The advantage of the PDHRA is that its timing (six months after the servicemember has returned home) may avoid the risk of underreporting. Nevertheless, given that the six months following return from deployment is a dynamic period of adjustment for both the servicemember and

² Researchers identified one Air Force policy that prescribes standards for servicemembers injured in the line of duty and that is being classified as a medical policy related to sleep. Air Force Guidance Memorandum (AFGM) 44-01.2, *Deployment Related Concussion Management*, dated February 15, 2012, prescribes medical recovery standards for those diagnosed with a concussion injury. This policy memorandum states that airmen who have had a first concussion will be allowed a recovery period of eight hours of uninterrupted sleep. This policy also uses a couple of questions on sleep as part of a battery of tests (neurobehavioral symptom inventory and acute stress response).

his or her family, sleep problems may be less apparent or less salient in this more immediate reintegration period (Pincus et al., 2001).

Perceived stigma may also deter servicemembers from reporting symptoms of sleep disorders because the PDHA and PDHRA are official documents maintained in each servicemember's military record. A study by Hourani et al. (2012) found that problems sleeping and feeling tired were reported over twice as often on an anonymous survey (48-percent prevalence) than on the PDHRA (21-percent prevalence).

The surveys are compiled of items from existing health screeners, such as the PHQ and PCL. The limited number of sleep-related items on the PDHA and PDHRA raises questions about whether these screeners accurately identify individuals with insomnia or nightmares. Although one study has shown the diagnostic validity of the PDHRA in identifying PTSD, there have not been similar efforts to validate the PDHA or PDHRA when examining insomnia or nightmares (Skopp et al., 2012).

U.S. Department of Veterans Affairs Medical Policies/Programs

Relevant policies or guidelines related to sleep under the VA consist primarily of Clinical Practice Guidelines (CPGs), which are statements to assist practitioner and patient decisions about appropriate health care services. However, none of the CPGs are tailored specifically to sleep. Rather, sleep is mentioned as a symptom of, or diagnostic criteria for, another mental or physical problem in a CPG addressing a mental health condition, which could lead to the underdiagnosis of sleep disorders and insufficient treatment. The four most relevant CPGs include those for bipolar disorder, depression, post-deployment health, and PTSD. These four CPGs are cited as joint VA/DoD publications. The VA pharmacy benefits guide for the treatment of insomnia in veterans in the primary care setting (VA, 2007) provides a decision tool for treating acute or chronic insomnia, but it is available only in this guide format.

The CPG on post-deployment health states that servicemembers' sleep habits should be assessed during reviews of routine medical history. If a servicemember presents with complaints of chronic fatigue, medical professionals should consider a PSG, multiple sleep latency test, referral to a sleep specialist consult, or referral to a psychology or psychiatry consult. In addition to these diagnostic tests, standard health assessment tools for the VA and DoD that include questions related to sleep behaviors are the PHQ-Brief, PHQ C-3, PCL-Military Version (PCL-M), and the PCL-Stress Specific Version (PCL-S; VA and DoD, 2001).

Department of the Air Force Medical Policies/Programs

Air Force medical policies typically provide general guidance on sleep-related behaviors to enhance resilience and operational performance through a suggested seven or eight hours sleep every 24 hours if the mission permits (AFI 44-153, 2014; AFI 44-172, 2011).

Department of the Army Medical Policies/Programs

AR 40-501, *Standards for Medical Fitness* (2011), outlines the medical standards for enlistment, retention, and retirement. This may be applicable to soldiers in the post-deployment period because it describes the sleep disorders that may prevent a soldier from remaining eligible for service or redeploying in the future.

Department of the Navy/Marine Corps Medical Policies/Programs

The Navy's *Manual of the Medical Department*, NAVMED P-117 (2014), specifies what medical conditions sailors and Marines must obtain waivers for to join the Navy or Marine Corps. Sleep disorders, including apnea, are disqualifying, as are altered sleep patterns exceeding one month as a result of posttraumatic stress.

The Chief of Naval Operations' policy for conducting human health risk assessments under the Environmental Restoration Program seeks to identify lifestyle choices that impact health (Chief of Naval Operations Policy Letter Series N453/1U595168, 2001). This health risk assessment provides immediate feedback about a servicemember's sleep and a link to online resources at the Navy and Marine Corps Public Health Center for improving sleep and recognizing when a referral is needed (Navy and Marine Corps Public Health Center, undated[a]).

SECNAVINST 5510.35B defines the Personnel Reliability Program (PRP) for personnel working with nuclear weapons. The PRP instruction is quite broad and assesses such domains as servicemembers' physical competence and physical ability and the mental suitability and reliability of individuals who are working on or have access to certain programs and materials. The PRP is quite restrictive in terms of what medical conditions or over-the-counter medications are acceptable for someone to have or to use and still work within the program.³

Sleep-Related Policies/Programs in Training Environments

Although there are no DoD-wide training policies related to sleep, across the Services, we observed consistency across policies specifically in terms of the initial entry training pipeline of servicemembers, whereby the policy is to afford seven to eight hours of uninterrupted sleep per night for trainees. However, there are exceptions for such activities as final culminating exercises or standing guard duty, as noted in the sections dedicated to each Service.

Department of the Air Force Training Policies/Programs

The Air Force has Air Education and Training Command Instruction (AETCI) guidelines for eight hours of uninterrupted sleep for students in the training environment

³ See, in particular, SECNAVINST 5510.35B, 2011, Enclosure 7.

(see Appendix F). AFI 11-202, Vol. 3 (2010), also requires a 12-hour nonduty period before the assumption of duty. In addition, this policy takes care to identify what qualifies as suitable sleeping provisions (i.e., crew bunks or other major command–defined rest facilities, privacy, and noise levels).

Another example is AETCI 36-2205, Vol. 11 (2010), which prescribes training schedule standards for survival, evasion, resistance, and escape students and states that the operational schedule for students must last no longer than 16 hours per day, except during operational evasion and resistance training. Other Air Force publications for trainees or cadets, such as United States Air Force Academy Instruction (USAFAI) 36-2014, *Allocation of Cadet Time* (2008), do not include any guidance on sleep, but that instruction’s subordinate publication, USAFAI 36-3518, *Intercollegiate Athletic Programs* (2012), prescribes a policy on “sleep-throughs” for Air Force cadets, allowing them seven and a half hours.

Department of the Army Training Policies/Programs

At least two Army training policies (U.S. Army Training and Doctrine Command [TRADOC] Regulation 350-6, 2007, and TRADOC Pamphlet 600-4, 2008) are applicable only to soldiers in a training environment and state that in garrison, trainees will be given the opportunity for seven hours of continuous sleep per night, excluding scheduled guard duties. They also offer trainees tips about how to manage their sleep and how to recognize sleep problems as a symptom of stress or other mental health problems.

Department of the Navy/Marine Corps Training Policies/Programs

The Marine Corps has issued its sleep-related policy guidance primarily through MCOs: MCO 1510.32E, *Recruit Training*; MCO 5530.15, *Interior Guard Manual*; MCO 1553.2B, *The Management of Marine Corps Formal Schools and Training Detachments*; and Navy Marine Corps [NAVMC] 3500.18B, *Marine Corps Common Skills (MCCS) Training and Readiness (T&R) Manual*. These orders give recruits “rights” in terms of sleep, stating that they will normally be permitted eight hours of uninterrupted sleep per night, except when assigned to certain guard duties, such as fire/security watch duties, or when the program of instruction includes night training (MCO 1510.32E, 2007). The eight-hour rule may be reduced to four hours per night during the culminating training exercise (MCO 1510.32E, 2007). This policy for Marines in training is consistent with the Army’s training policy for soldiers in initial-entry training (TRADOC Regulation 350-6, 2007). One policy (NAVMC 3500.18B, 2012) lists “maintain sleep hygiene” as a training task; to demonstrate proficiency in this task, trainees must be able to do the following:

- Describe the effects of sleep loss and fatigue on performance.
- Assess individual sleep hygiene.

- Employ fatigue countermeasures (i.e., strategic napping, caffeine).
- Assess results.

In the Navy, local commanders dictate specific policies related to sleep. However, Navy leadership's views on sleep align with those of the other Services (Naval Service Training Command M-1533.2, 2012).

Sleep-Related Policies/Programs in Operational Environments

U.S. Department of Defense Operational Policies/Programs

Our DoD-level review of policies revealed an instruction for operators of government-owned vehicles. The instruction specified a 12-hour period prior to a prolonged work period that is as free of duties as possible and, ideally, for those hours to be spent sleeping (DoDI 6055.04, 2013).

The aviation communities of each Service have advanced fatigue monitoring and safety planning software programs that can be used to help manage sleep and rest cycles. These serve the goal of managing sleep during operations, but they also aim to prevent sleep problems from developing. Some of the most common programs are the Fatigue Avoidance Scheduling Tool (FAST), FlyAwake, and Alertness Management and Military Operations (Fatigue Science, undated; Beshany, 2009; Concurrent Technologies Corporation, 2010). The FAST tool may be required post-mission to analyze how sleep and rest impacted an operation. It compares servicemembers' future and past activity pattern with their sleep and circadian rhythm. It also includes a graphical interface to show how servicemembers' performance reactions and accuracy decline as they become more sleep-deprived.

Department of the Air Force Operational Policies/Programs

The majority of applicable Air Force policies are related to operational flight standards for pilots and aircrews (AFI 11-2 series; AFI 11-401; AFI 16-1202; AFMAN 31-201, Vol. 3; AFI 11-2AE, Vol. 3; ATTP 3-42.2; AFI 21-101; AFI 21-202, Vol. 1; AFI 48-149; AFI 91-202; AFI 91-203; AFI 91-204; and AFI 91-207).

Air Force policies prescribe crew rest; fatigue management, including sleeping provisions; and flight duty limitations. The guidance given for crew rest in AFI 11-202, Vol. 3 (2010), and the 11-2 series publications that follow, all require at least ten continuous hours of rest, including an opportunity for at least eight hours of uninterrupted sleep during the 12 hours immediately prior to duty. This instruction serves as a good model in distinguishing between rest and sleep, because it ensures enough time to get eight continuous hours of sleep during rest periods. It also gives guidance on when exceptions to the policy can be made and how to mitigate fatigue during extended operations.

The Air Force also has Counter-Fatigue Management Program policies to minimize conflict with crew circadian rhythms and opportunities for eight hours of sleep in each 24-hour period (AFI 11-2B-1, Vol. 1, 2011). The policies advise that the appropriate management of sleep/rest cycles should be the primary counter-fatigue management effort. Secondary efforts include scheduling procedures aimed at managing those cycles, strategic napping techniques, and proper diet and exercise (AFI 11-2C-130, 2012). The policies also dictate the readjustment time following worldwide missions before requiring personnel to perform normal home station duties.

Maintenance publications, such as AFI 21-202, Vol. 1, specify an uninterrupted 12-hour rest period upon completion of an off-base dispatch and an opportunity for a minimum of eight hours of sleep prior to beginning the next scheduled duty period (AFI 21-202, Vol. 1, 2013; AFI 21-101, 2011).

At least one publication gives guidance to flight surgeons to issue flight medications as a way to optimize alertness during planned missions and facilitate sleep during the alert portion of one's circadian rhythm (AFI 48-149, 2012). These medications are often referred to as go/no-go pills, prescription stimulants to help servicemembers stay awake during fatigue-inducing flight missions or prescription sedatives to aid sleep and help pilots rest after missions.

There are also Air Force policies related to safety stating that unit commanders establish and enforce duty hour limits for operators of motor vehicles (AFI 91-202, AFI 91-203, AFI 91-204, AFI 91-207). In addition to safety policies, there are also safety programs in place (such as Air Mobility Command's Operational Risk Assessment and Management system). In addition to broader Air Force policies, each combatant command or theater of operations may have its own policies related to sleep/crew rest or shift work.⁴

Department of the Army Operational Policies/Programs

We identified operational policies related to sleep management in the Army that provide comprehensive sleep guidelines for leaders and soldiers. Army Field Manual (FM) 6-22.5 provides a basic framework for leaders and soldiers to understand the implications and ways to mitigate the negative consequences of sleep deprivation in the operational environment (Headquarters, U.S. Department of the Army, 2009). It is applicable to both the tactical and training environments and includes pre-deployment, deployment, pre-combat, combat, and post-combat timeframes and is not specific to a certain occupational field. This manual states that seven to eight hours of quality sleep is required in every 24-hour period and debunks the myth that four hours

⁴ One such example is Pacific Air Forces Instruction 24-101, *PACAF Combat Mobility Flights* (2012). This policy prescribes standards for personnel utilization for shift work. It states that work schedules for deployed aerial port operations are based on individuals working 12-hour shifts. After completion of a continuous-duty period, commanders and supervisors will ensure that personnel are provided a rest period of sufficient duration to allow a minimum of eight hours of uninterrupted sleep.

of sleep is sufficient for soldiers, or that there is even a minimum level of sleep that is acceptable below the prescribed seven to eight hours. The manual describes the operational effects of sleep deprivation and lists some of the indications of sleep deprivation that a leader may be able to recognize in soldiers or in him- or herself. If an individual or unit cannot achieve seven to eight hours of sleep because of operational constraints, the manual offers strategies to recover sleep, such as a series of naps. The manual also provides tips for leaders on how to plan and manage sleep schedules and offers recommendations for managing sleep debt for short durations, including the limited use of caffeine stimulants, if required.

The *Leader's Guide to Crew Endurance*, published by the U.S. Army's Aeromedical Research Laboratory, offers very useful information that is similar to what is found in FM 6-22.5 (Headquarters, U.S. Department of the Army, 2009). However, it is dated (1997), and the information provided about acceptable sleep hours is somewhat inconsistent with what is provided in FM 6-22.5. Although the *Leader's Guide to Crew Endurance* does state that optimal sleep for adults is seven to nine hours per night, it also indicates that as little as four hours of sleep per night may be acceptable for short durations up to one week without major performance degradation (U.S. Army Aeromedical Research Laboratory and U.S. Army Safety Center, 1997). Rest or sleep plans may be part of an operational risk matrix, which is used when conducting most operations or field training.

Department of the Navy/Marine Corps Operational Policies/Programs

Since the Marine Corps is a component of the Department of the Navy, many of the Navy's instructions may also be applicable to the Marine Corps. The Navy and Marine Corps have a joint manual for managing stress, which includes information on sleep deprivation as a potential stressor. NTTP 1-15M/MCRP 6-11C, *Combat and Operational Stress Control* (NTTP, 2010), is similar to the Army's *Combat and Operational Stress Control Manual*, FM 6-22.5 (Headquarters, U.S. Department of the Army, 2009; see Schmitz, Browning, and Webb-Murphy, 2009).

In the most recent version of the Navy and Marine Corps joint manual, sleep is cited in relation to stress as a necessary component that leaders should manage. NTTP 1-15M/MCRP 6-11C is a guide for Navy and Marine Corps leaders and personnel to ensure awareness of problems in the combat and operational environment that can lead to poor sleep habits, poor sleep discipline, and sleep deprivation. It explicitly addresses the need for Navy/Marine Corps leadership to value sleep and to challenge existing cultural norms that accept sleep debt. The manual encourages leaders to set a good example for "sleep discipline" and to reward sailors and Marines who excel at their jobs while achieving six to eight hours of sleep per night. Guidance is given to leaders that they should make appropriate efforts to ensure that sleep recovery opportunities are offered when sleep loss is unavoidable. The manual also describes the effects on sailor/

Marine performance when they are sleep-deprived and lists the signs and stressors that leaders should look for in evaluating sleep behaviors.

Two primary Navy policies relevant to operational sleep practices provide a framework for managing crew rest and sleep—OPNAVINST 3710.7U, *NATOPS General Flight Operating Instructions*, and Navy Medical Publication [NAVMED] P-6410, *Performance Maintenance During Continuous Flight Operations*. They highlight the importance of an adequately rested crew, whether deployed or not, and educate readers about circadian rhythm considerations, non-medication counter-fatigue options, and the use of anti-fatigue medications, when necessary. Crew rest must include an opportunity for eight hours of uninterrupted sleep time in every 24-hour period (OPNAVINST 3710.7U, 2004).

Other operational policies that give guidance on shift or work hours provide information about assessing the risks associated with sleep deprivation using fatigue modeling software, such as FAST or FlyAwake (OPNAVINST 3750.6R, *Naval Aviation Safety Program*, and OPNAVINST 1000.16K, *Navy Total Force Manpower Policies and Procedures*).

Additional Navy policies, not necessarily related to flight operation, include instructions related to shift work (a suggested minimum of six hours sleep per 24-hour period), safety, and occupational health (SECNAVINST 5100.10J, 2005; OPNAVINST 5100.19E, 2007; OPNAVINST 5100.23G, 2011; OPNAVINST 5102.1D/MCO P5102.1B, 2005).

The Navy recently issued guidance to commanders to allow them to change operational strategies to promote healthy sleep among submariners by shifting from an 18-hour day (six hours on duty, six hours off duty, six hours rest) to a 24-hour day with eight-hour time blocks. Such operational strategies do not amount to a direct order mandating that all personnel across the force will achieve a certain number of hours of sleep; rather, they authorize individual submarine commanders to make the change if desired.

In addition to these policies, the Marine Corps has programs, such as the forward-deployed COSC joint teams and the Operational Stress Control and Readiness (OSCAR) program, which is a tiered program. The mission of the COSC teams is to inform a commander about the best ways to use staff while considering the impact of circadian rhythms. The OSCAR program is geared toward the ground combat element and includes a training program, particularly for NCOs in small units, to teach awareness of combat and operational stress; an extender program consisting of medical personnel and then chaplains who are given more medical- or counseling-oriented training about how to recognize and counsel servicemembers on how to deal with combat and operational stress; and OSCAR providers who spend part of their time providing mental health care and part of their time out with the operational unit in the operational/occupational setting.

Discussion

In our policy review, we identified several training, operational, and medical policies and programs related to sleep. We found that policies about sleep are mostly Service-specific, emphasized more in certain occupational specialties, and not specifically tied to the post-deployed context. Rather, they are primarily focused on operational contexts or training.

DoD recognizes sleep as an important contributor to physical and mental health and operational readiness, and it has established several programs and policies to treat and prevent sleep disorders and promote healthy sleep practices. The review of the literature and findings from our interviews and working group meeting identified several promising strategies that are being used to promote sleep health, particularly with regard to intervention strategies. However, there are also several notable gaps, including a lack of evidence-based prevention programs and validated self-identification tools to assess the broad spectrum of sleep disturbances experienced by servicemembers. Evidence-based identification and prevention programs can help promote sleep health and provide opportunities for intervention before acute sleep disturbances become chronic and debilitating.

In terms of *prevention programs*, the Army Performance Triad is perhaps the most comprehensive effort to date to promote sleep health. However, the efficacy of this program has not been evaluated, though research efforts are under way. The Performance Triad may be a useful platform for other Service branches to develop similarly comprehensive sleep health programs.

In terms of *training policies*, the only place in which we found relative consistency across policies and across all Service branches was the initial-entry training of servicemembers. In these policies, servicemembers in the initial pipeline as part of their entry into military service are all afforded the opportunity for at least seven hours of uninterrupted sleep per night. However, we did not find that all subsequent training schools had policies related to sleep. Services agree on the need for eight hours of sleep in basic training, but policies are not always in place for personnel receiving more advanced or specialized training. For example, the Army's Ranger school places a high degree of emphasis on training in an extremely sleep-deprived state (Brown, Caldwell, and Chandler, 2013). It is considered an elite training course, and soldiers in this environment are trained, in part, to be able to operate under severe sleep deprivation. This same standard for eight hours may not be appropriate for training environments of this nature. In addition, while opportunities for rest are given, there may be other tasks that compete with sleep during these periods of rest, such as written assignments, uniform preparation, or studying for exams. Thus, mandated periods of rest may not translate to achieving seven or eight hours of sleep.

We found that *operational policies* were the most common, and we often identified multiple policies for each Service. The vast majority of publications cited eight

hours as the appropriate number of hours of rest that servicemembers should receive, and the Army's FM 6-22.5 was the strictest (Headquarters, U.S. Department of the Army, 2009). However, some occupational fields in the Services do not have guidelines regarding sleep in their occupational or branch-specific operating manuals. In contrast, aviation policies in all the Services are much more codified and are included in a number of combat arms branch-specific operational field manuals related to managing flight schedules and crew endurance (see AR 95-3, 1990).⁵ This is likely because military aviation policies must also comply with, or may have been modeled after, similar Federal Aviation Administration regulations. Few other branches embed guidelines in their doctrinal field manuals that discuss sleep or fatigue management other than brief references to establishing work/rest plans, and they do not give leaders any further guidance on how many hours of sleep are needed for normal operations or tips for how to structure these rest plans.

Our review did not return any operational policies specifically for the management of sleep, but we did identify policies on the management of resilience and stress for soldiers, sailors, airmen, and Marines. While the majority of policies are fairly recent, they may not reflect current research or clinical practice in terms of sleep. For example, some manuals, such as the U.S. Army Aeromedical Research Laboratory's *Leader's Guide to Crew Endurance*, still document that the minimal amount of sleep is four hours and that sustaining four hours of sleep for as long as a week will not affect performance; this documented information may lead to a misunderstanding on the part of servicemembers or line leaders in terms of what is the minimal acceptable amount of sleep. While both Marine Corps and Navy policies emphasize sleep as a necessary component for operational effectiveness, they advise less than the eight hours of sleep recommended to support optimal performance and functioning (Marine Corps Community Services, 2009; NAVMED P-6410, 2000). Although the vast majority of publications did cite eight hours as the appropriate number of hours that servicemembers should receive, the policies provided little guidance on how to achieve that via structuring sleep plans and work/rest cycles that support circadian rhythm considerations (e.g., changing watch bills or coordinating sleep schedules in joint environments).

Many operational policies focused on providing rest periods, but similar to training policies, they do not necessarily translate to sufficient sleep for servicemembers because of various factors at the individual (e.g., sleep-related behaviors that do not facilitate sleep, heightened state of alertness), environmental (e.g. noise, light) and operational levels (e.g., duties that must be executed during "rest periods" while in training, operational demands that cut into rest periods). Chapter Six focuses on these barriers to achieving healthy sleep and to implementing sleep policies.

⁵ Examples of other Army aviation manuals that discuss the use of sleep plans and maintaining crew rest include FM 3-04.120 (Headquarters, U.S. Department of the Army, 2007a).

As for *medical policies*, medical publications primarily mention sleep as a symptom of other conditions, mainly mental disorders, and there are no policies specifically related to sleep that address continuity of care from deployment to the post-deployment period. Although policies are in place to screen for sleep problems, these instruments are short, global tools, and servicemembers may not respond accurately because of stigma, perceived impact on their career, or potential incentives for endorsing symptoms.

In general, the programs we identified may promote healthy sleep related to resiliency and stress management but not specifically to sleep. In other words, these programs are directed at the whole individual from a broader wellness perspective but are inconsistent in specifically addressing how to help servicemembers achieve a sufficient amount of quality sleep, which is different from guidance on how to manage one's stress reactions. Therefore, sleep disorder prevention through the promotion of healthy sleep receives, at best, indirect treatment in the germane policy literature.

We did not find documents outside of the larger reintegration or stress management guides that specifically referenced policies related to sleep in the post-deployment period. Our finding that sleep is considered primarily in the larger context of individual wellness should not necessarily be viewed in a negative light; this broader approach may, in fact, ultimately be more effective in preventing sleep problems than only targeting sleep-specific issues, such as hygiene, duration, and environment. Concern should be raised, however, that we found no evidence of healthy sleep enforcement mechanisms in our policy review. As discussed previously in this chapter, military leadership can provide the opportunity and conditions to help servicemembers get the proper amount of healthy sleep. Despite the existence of codified policies, at both the DoD and Service levels, implementation often falls short on guidance to line leaders in terms of how to effectively track and enforce local sleep programs.

Evidence-Based Interventions to Treat Sleep Disturbances Among Servicemembers

As discussed in the prior chapters, sleep disturbances—including insomnia, insufficient sleep duration, and nightmares—are highly prevalent among servicemembers both during and after deployments, are associated with a host of adverse mental and physical health outcomes, and can compromise operational readiness by diminishing attention, emotion regulation, and concentration. In fact, sleep disturbances are the most commonly reported symptoms among servicemembers returning from deployments. Sleep disturbances are also highly comorbid with several of the signature “wounds” servicemembers have experienced in OEF/OIF combat operations, including PTSD, depression, TBI, and chronic pain conditions. Even with effective treatments for these co-occurring conditions, sleep disturbances remain among the most intractable symptoms.

Given this, there is increasing recognition of the need for empirically supported treatments that target sleep disturbances in servicemember populations, regardless of whether such disturbances are the primary disorder or comorbid with other conditions. Fortunately, several cognitive-behavioral interventions and some pharmacologic approaches have demonstrated efficacy in treating sleep problems in civilian and servicemember populations. However, the most robust clinical trials on sleep interventions have been conducted in civilian populations. Given that servicemember populations may have unique characteristics (e.g., younger age, predominantly male, high consumption of caffeinated products to sustain operational demands) and that the precipitating factors that may initiate the onset of sleep disturbances (e.g., sustained conditions of hyperarousal in deployed settings) may differ between servicemember and civilian populations, it is not clear whether the efficacy data on civilian populations can be extended to servicemember populations or settings. By way of example, selective serotonin reuptake inhibitors (SSRIs) have been shown to be effective in treating PTSD in civilians (predominantly women exposed to sexual trauma); however, SSRIs have not consistently demonstrated efficacy in treating combat-related PTSD in veteran populations (Alexander, 2012).

Thus, this chapter reviews the extant literature on evidence-based interventions to treat combat-related sleep problems among servicemember populations. In particular, it examines evidence-based behavioral interventions to treat insomnia and

nightmares and technological developments in treatment delivery. With few exceptions, there is scant evidence to support the use of pharmacologic strategies specifically within servicemember populations or military contexts, though there is considerable literature on the civilian population. Medications to treat insomnia in servicemembers are generally the same as those used in civilian populations and include antidepressants, sedatives/hypnotics, and adrenergic antagonists/anticonvulsants. Comprehensively reviewing this literature was beyond the scope of this study, but this literature has recently been reviewed elsewhere (Brown, Berry, and Schmidt, 2013; DCoE, 2012). Given this, and to provide context for evaluating behavioral interventions, we briefly summarize current pharmacologic strategies for treating sleep disturbances. We also note that a review of wake-promoting agents (i.e., stimulants) in servicemember populations was beyond the scope of this review and refer the reader to existing review articles (Caldwell and Caldwell, 2005; DCoE, 2012).

Approach

We examined the academic literature on treating sleep disturbances and disorders from studies that used military or veteran samples (as described in detail in Appendix C). Findings from the literature review were corroborated by discussions with key informants and expert panelists with knowledge of interventions currently being used to treat sleep disturbances in military populations. (Methods are described further in Appendixes G and H). The vast majority of the studies included in the literature review were conducted after 2001, a fact that reflects the large growth of interest in mental health care for servicemembers and veterans after the start of the wars in Iraq and Afghanistan. Literature was identified through online database searches with various combinations of the following terms: *sleep disorders, military, veterans, sleep hygiene, imagery rehearsal therapy, cognitive-behavioral therapy, pharmacotherapy, medication, insomnia, nightmares, treatment, intervention, identification, self-identification, assessment, teletherapy, sleep apnea, sleep deprivation, complementary, alternative medicine, yoga, acupuncture, meditation, relaxation, Internet, technology, smartphone, and pain*. We targeted seven databases for published peer-reviewed literature: PsycInfo, PsycArticles, PubMed, ProQuest, Google Scholar, EBSCO Academic Search Complete, and DTIC.

Pharmacotherapy to Treat Sleep Disturbances

The most commonly used medications to treat sleep disturbances in both civilian and servicemember populations are over-the-counter medications (primarily antihistamines) and prescribed medications, including antidepressants, sedatives/

hypnotics, and adrenergic antagonists/anticonvulsants. Although all these medications have known side effects, they remain the front-line therapies to treat sleep disturbances in both civilian and servicemember populations. Such medications can induce drowsiness to help patients fall asleep, decrease anxiety that may be the source of their insomnia, or limit nightmares that disturb sleep. Unfortunately, unlike behavioral treatments, medication relieves sleep-related symptoms only while the patient takes the drug and does not have lasting effects after treatment is terminated. Therefore, experts recommend that medications be prescribed for sleep disorders in conjunction with behavioral treatments rather than as stand-alone primary treatments (National Institutes of Health, 2005).

Pharmacologic Interventions to Treat Insomnia

The most commonly used classes of drugs to treat insomnia are traditional benzodiazepines (e.g., alprazolam, diazepam, and temazepam) and the newer class of nonbenzodiazepines (e.g., zolpidem, zopiclone, zaleplon, and eszopiclone). Although each type of medication is chemically distinct, they all act as agonists at the benzodiazepine receptor component of the gamma-aminobutyric acid receptor chloride channel complex and preferentially bind to the alpha 1 receptor subunit, which is thought to contribute to their sedating and anticonvulsant properties. The newer class of “non-benzos” has the strongest evidence base for the treatment of insomnia in civilian populations, and these medications are generally preferred clinically because they have a more selective hypnotic effect than traditional benzodiazepines. This means that they are less likely to produce residual “hangovers” the next day, are considered safer than traditional benzodiazepines in terms of their risk for abuse and overdose, have a lower risk of withdrawal issues (though “rebound insomnia” is quite common when patients stop using the drug), and have minimal physiological tolerance issues.

Common side effects of these medications include dizziness, anxiety, drowsiness, depression, and disinhibition (Van Camp, 2009). These potential side effects warrant particular caution in operational contexts that involve using heavy or lethal machinery, complex decisionmaking, and sustained attention and vigilance. In addition to these more common side effects, other reports have documented increased rates of a range of nocturnal behaviors (ranging from “sleep sex” to “sleep driving”) with potentially lethal or litigious consequences. The risk of these nocturnal behaviors appears to increase among individuals who use higher doses of the medications than recommended, who combine them with other sedating substances (such as alcohol), or who are sleep-deprived. Thus, these rarer but potentially dangerous side effects are of particular concern in servicemember populations, in which there are also high rates of alcohol use and abuse and high rates of sleep insufficiency (as described in Chapters Two and Three).

Nevertheless, evidence from civilian studies suggests that these classes of drugs are efficacious in improving insomnia symptoms, with generally moderate to large

effect sizes for improving sleep quality and sleep continuity (i.e., number of awakenings and sleep latency; Benca, 2005). However, our review did not reveal any specific evidence on how efficacious these medications are in treating combat-related sleep disturbances—a notable limitation, particularly given that they remain the front-line treatments for servicemembers. Other, newer classes of drugs, including those that target the melatonin receptor agonist (i.e., Ramelteon) may hold promise for treating insomnia in servicemember populations because they tend to have an even more benign side effect profile than the non-benzodiazepines and are less likely to produce tolerance, rebound insomnia, or morning sedation. Still, to date, there is no systematic empirical evidence to support their use as front-line treatments for insomnia in servicemember populations.

Pharmacologic Interventions to Treat Nightmares

In contrast to the general lack of support for other medication classes to treat insomnia, nightmares, or PTSD-related sleep disturbances in servicemember populations, multiple studies have shown the efficacy of the alpha 1-adrenergic antagonist (alpha-blocker) prazosin in treating combat veterans for nightmares associated with PTSD (Raskind, Thompson, et al., 2002; Raskind, Peskind, Kanter, et al., 2003; Raskind, Peskind, Hoff, et al., 2007). In this group of studies, the researchers observed that veterans who were given prazosin experienced reductions in nightmare frequency and in the severity of PTSD symptoms. They also had less difficulty falling and staying asleep than patients in the control conditions. Additionally, the patients given prazosin commonly reported that the content of their dreams shifted from trauma-related to normal after beginning use of the drug. The results of a study by Calohan and colleagues (2010) suggest that prazosin may also be useful in reducing acute sleep disturbances among active servicemembers recently exposed to traumatic events while deployed.

Summary and Limitations of Pharmacologic Interventions

Except for the studies of the use of prazosin in military populations, there is little systematic research on the efficacy of pharmacologic interventions for treating other sleep disorders, such as insomnia, in military populations. Nevertheless, many physicians continue to rely on medications to treat military members and veterans with sleep problems (Schmitz, Browning, and Webb-Murphy, 2009). A particular concern in using pharmacotherapy as a first-line treatment is that some medications can have serious side effects. Although prazosin shows promise for treating nightmares, it is clearly contraindicated for individuals with low blood pressure because it can further lower blood pressure to dangerous levels. Given that all these medication approaches have some side effects that make them less than ideal or contraindicated in certain operational contexts or certain individuals, there has been increasing interest and a growing evidence base supporting the use of non-pharmacologic (i.e., behavioral) interventions to treat sleep disturbances in servicemember populations.

Evidence-Based Behavioral Treatments for Sleep Disorders Among Servicemembers

The following sections review the current empirical literature on evidence-based treatments for sleep disorders using samples of active-duty servicemembers or veterans. We focused our review on the treatment of insomnia and nightmares because these are the most common sleep disturbances among servicemembers. Also, unlike other sleep disorders, such as OSA, narcolepsy, or parasomnia, the causes of insomnia and nightmares in a military population are commonly related to military service or combat trauma and may require tailored treatments (Center for Integrated Healthcare, 2009).

Cognitive-Behavioral Therapy for Insomnia

CBT is often used by mental health clinicians to treat a range of mental health disorders. CBT techniques have been the subject of many research studies, and the empirical evidence base on CBT efficacy and effectiveness is quite robust (Butler et al., 2006). CBT for insomnia (CBT-I) has been shown to be a highly effective treatment for insomnia and for some other sleep-related symptoms (Mitchell et al., 2012). A course of CBT-I comprises multiple cognitive and behavioral techniques, most often including stimulus control, sleep restriction, and cognitive restructuring. Numerous meta-analyses of CBT-I and pharmacologic interventions show that CBT-I is just as effective, and often more enduring (in terms of the stability of treatment gains after active treatment has terminated), than medications for treating insomnia (Morin, Culbert, and Schwartz, 1994; Irwin, Cole, and Nicassio, 2006; Mitchell et al., 2012; National Institutes of Health, 2005).

In 2005, the National Institutes of Health published a conference statement on chronic insomnia, in which they recommended CBT-I as a highly efficacious treatment for insomnia. Unlike treatment with medication, CBT-I has been shown to produce beneficial effects that persist even after active treatment is discontinued, perhaps because the patient learns new skills that can be used long after direction from a therapist is removed.

The VA's Center for Integrated Healthcare, which serves to integrate primary care and mental health services, has advocated using cognitive and behavioral therapies in treating military members and veterans with sleep problems related to combat trauma. In its report summarizing recommendations from an expert panel held on this subject in 2009, the Center for Integrated Healthcare endorsed CBT-I and IRT (described below) as empirically supported treatments for insomnia and recurrent nightmares, respectively, within military and veteran populations (Center for Integrated Healthcare, 2009). This being said, most CBT-I studies have been conducted with civilian samples, which means less is known about the efficacy of CBT-I for servicemembers and veterans. The unique experiences of servicemembers and veterans may necessitate adaptations to CBT-I treatment protocols. In particular, although side effects are

less common with behavioral approaches than with pharmacologic approaches, both stimulus control and sleep restriction therapies (two integral components of CBT-I) often result in at least temporary increases in daytime sleepiness, which could be problematic in operational settings. Furthermore, the dissemination of CBT-I to patients in the military health system and VHA has been slow. Nevertheless, CBT-I has shown promise in effectively treating military populations.

CBT-I Application to Military Populations and Evidence of Effectiveness

Our review identified five studies that assessed the use of CBT-I in veteran populations, all of which demonstrated its efficacy in reducing insomnia symptoms. Appendix C, Table C.1, describes these studies and their results. Overall, the results from these efforts show that when used to treat servicemembers and veterans, CBT-I reduces insomnia symptoms and core PTSD and depressive symptoms, with moderate to large effect sizes. Specifically, effect sizes reported for changes in the ISI ranged from 1.08 to 3.2, while those for sleep efficiency ranged from 1.4 to 1.57 (Talbot et al., 2014; Margo- lies, 2011; Gellis and Gehrman, 2011; Koffel and Farrell-Carnahan, 2014; Perlman et al., 2008). One study observed a 41-percent remission rate for insomnia among CBT-I patients, compared with a 0-percent remission rate among control group patients (Talbot et al., 2014). This is an important finding, because insomnia and PTSD are commonly comorbid in combat veterans. In fact, one study showed that insomnia was the most frequently reported symptom of PTSD in a sample of post-deployed service- members (McLay, Klam, and Volkert, 2010). To enhance dissemination, several studies tested different treatment modalities of CBT-I, including group settings (Perlman et al., 2008; Koffel and Farrell-Carnahan, 2014). These studies also showed positive results for reducing insomnia symptoms and may provide a useful strategy for enhancing dissemination.

Summary and Limitations of CBT-I

Overall, the studies on CBT-I in military populations show highly promising results, with similar effect sizes (i.e., in the moderate to large range) in terms of reducing insomnia symptoms and improving sleep continuity compared with the robust civilian literature on CBT-I treatment efficacy. The magnitude of these results is also comparable to reported effect sizes in studies of pharmacologic interventions, which have, to date, been only systematically studied in civilian populations. However, given the relatively small number of studies and the small sample sizes ($N = 8-45$), larger studies, including more randomized controlled trials (RCTs), are needed to identify the effectiveness of CBT-I in treating servicemembers and veterans with insomnia. Furthermore, many of the participants in these studies suffered from multiple conditions or used other treatments during the trials (e.g., medications). Therefore, it is difficult to estimate the true efficacy of the CBT-I interventions used. Then again, positive results from these real-world samples may demonstrate the effectiveness of CBT-I. Moreover, given the finding from one study that showed that treating insomnia with CBT-I

also reduced core PTSD and depressive symptoms, more research is needed to examine the efficacy of combined treatment strategies in commonly comorbid conditions (e.g., insomnia, PTSD, depression, and TBI; Margolies, 2011). Finally, even though CBT-I may be effective in treating insomnia in military populations, the dissemination of this treatment option has proven difficult, partly because there is a critical shortage of trained providers and partly because of a lack of provider knowledge about the existence of these treatments and a lack of availability at the traditional point of contact (i.e., primary care settings).

To address some of the dissemination challenges, the VHA began a national dissemination program to train mental health providers to deliver CBT-I to patients. This program involved a three-day CBT-I training workshop for clinicians (Manber, Carney, et al., 2012). Karlin and colleagues (2013) evaluated the effects of this dissemination program on clinician competency and patient health outcomes. After collecting data from 102 VHA clinicians and 182 veteran patients diagnosed with insomnia, the researchers found that clinician competency increased and patient insomnia symptom severity decreased significantly over the CBT-I training period. The study did not involve a control group, and the clinicians understood that their CBT-I competence was being observed and measured, so the results may not generalize to “real-life” clinical settings. However, the results show promise that the VHA’s CBT-I dissemination program is having positive effects and may be a model for future large-scale dissemination efforts.

The Center for Deployment Psychology has also established workshops to train DoD behavioral health professionals on CBT-I techniques. In addition to in-person workshops, the center offers virtual CBT-I workshops and remote courses. Since the program started in October 2010, it has trained more than 1,400 providers and continues to provide consultation after workshop completion (Brim, 2013). However, evaluation of the efficacy of these programs in terms of provider knowledge, competence, adherence, and patient outcomes has yet to be conducted.

CBT-I remains one of the most efficacious treatment modalities for insomnia. The efficacy of CBT-I has been shown in military and veteran populations, and a study of the feasibility of its widespread implementation in the VHA has shown encouraging results. Treatment with CBT-I has the benefit of addressing the behaviors that perpetuate insomnia and producing lasting effects after the treatment stops. This benefit is not seen with pharmacotherapy, which is a very common front-line treatment modality prescribed to military members and veterans suffering from sleep problems (Schmitz, Browning, and Webb-Murphy, 2009). Policy changes are needed within the military health system and VHA to address this inconsistency between health care practice and the empirical evidence. Continued dissemination efforts, greater education about CBT-I for primary care providers, and more training for mental health care providers are needed in both the military health system and VHA to make CBT a front-line treatment for insomnia.

Imagery Rehearsal Therapy for Nightmares

Nightmares are a cardinal symptom of PTSD and can also manifest as an isolated symptom or disorder, even in the absence of PTSD. Nightmares can significantly impair sleep quality and quantity and lead to daytime distress and impaired functioning (Harb, Phelps, et al., 2013). These impairments can exacerbate the problems of patients suffering from PTSD, such as depleted physical health, employment and relationship problems, poor adherence to treatment, and substance abuse. Disrupted sleep is also linked to the development and maintenance of PTSD, often creating a feedback loop between nightmares and PTSD (Nappi, Drummond, and Hall, 2012). IRT—a cognitive-behavioral treatment—has garnered significant interest among clinicians and researchers because of its ability to reduce nightmare frequency and intensity (Harb, Phelps, et al., 2013).

Treatment of nightmares with IRT involves having the patient describe a distressing dream and then repeatedly (over the course of treatment) rehearse a new dream with more desirable and less distressing content (Krakow et al., 1995). For example, a war veteran could alter a nightmare involving a firefight by “rehearsing” a new dream in which the enemy soldiers have harmless toy guns or creating an entirely new dream that has little, if any, resemblance to the original nightmare content. The process of rehearsing the new dream is believed to help patients assert control over their dreams and create a new association between sleep and pleasant or non-distressing dreams versus nightmares. This new association often reduces the frequency of nightmares, as well as the distress and arousal associated with them (Forbes, Phelps, and McHugh, 2001).

IRT Application to Military Populations and Evidence of Effectiveness

The use of IRT has been shown to be effective in seven studies with U.S. servicemembers and veterans (Cook et al., 2010; Forbes, Phelps, and McHugh, 2001; Harb, Thompson, et al., 2012; Lu et al., 2009; Nappi et al., 2010; Moore and Krakow, 2007; Long et al., 2011). Appendix C, Table C.2, describes these studies and their results. Overall, the results from these efforts show that IRT can be effective in reducing nightmare frequency and intensity among veterans with combat-related PTSD and recurring nightmares. Effect sizes for changes in nightmare frequency in these studies ranged from 0.45 to 1.37. One study showed that IRT was effective when patients’ symptoms were resistant to previous inpatient treatment programs (Forbes, Phelps, and McHugh, 2001). Additionally, Harb, Thompson, et al. (2012) showed that excluding violent details from a revised nightmare and incorporating a positive resolution tended to improve treatment outcomes in terms of nightmare frequency and sleep quality ($B = 5.69$ [$SE = 1.14$]).

The efficacy of IRT may not be limited to individual treatment delivery settings, as demonstrated by multiple studies that found significant positive results from IRT interventions in group settings (Long et al., 2011; Lu et al., 2009). However, Nappi et al.

(2010) have shown that individual treatment delivery may foster greater effects than group delivery in terms of symptom severity reductions. Veterans in that study who were treated with individual IRT experienced significantly larger mean decreases in ISI scores (9.08) than those treated with group IRT (1.58). In addition to reducing nightmares, IRT may be effective in reducing other symptoms of PTSD and comorbid conditions, such as depression and insomnia (Forbes, Phelps, and McHugh, 2001; Nappi et al., 2010). One study observed effect sizes from IRT of 0.72 and 1.03 for ISI and PCL scores, respectively (Nappi et al., 2010). Additionally, the effects of IRT in reducing nightmares appear to be enduring. One study showed that nightmare frequency decreased from baseline by 40 percent and 37 percent at three- and six-month follow-ups after treatment, respectively (Lu et al., 2009). Finally, IRT may be useful in treating servicemembers with acute combat-related nightmares (Moore and Krakow, 2007).

Summary and Limitations of IRT

Several of the studies on IRT in servicemember populations show promising results; however, as with CBT-I studies, the current evidence base is limited by small sample sizes and a lack of control groups. With two exceptions (Cook et al., 2010, and Nappi et al., 2010), IRT studies had sample sizes of less than 50 and did not use control conditions. Additionally, the majority of the studies focused primarily on Vietnam veteran samples, with current servicemembers used in only one pilot study (Moore and Krakow, 2007). Given the differences in combat experiences and the generation gap between Vietnam and OEF/OIF veterans, clinicians may need to modify IRT procedures when working with veterans of a specific conflict to achieve better outcomes. Veterans may also feel uncomfortable participating in group therapy with veterans from eras other than their own, making mixed-generation treatment groups inappropriate and less effective. Clearly, there is a need for more research on the use of IRT in treating recent veterans and current servicemembers to identify treatment protocol modifications for this younger generation. Despite these limitations, the body of research involving IRT and veteran populations shows promising results. Overall, further research on IRT in the military health system and VHA is needed to develop best-practice guidelines for treating military members and veterans with recurrent traumatic nightmares.

Complementary and Alternative Medicine

Interest in CAM has grown in recent years among military and veteran populations. Reasons for the growing interest in CAM may include perceived limitations of conventional medicine, poor appointment availability, greater public acceptance of CAM and concerns about the effectiveness and side effects of medications (Kroesen et al., 2002). CAM is a broad category, but, in general, treatments not commonly used in traditional medicine fall under CAM. CAM methods have sometimes been viewed as unscientific and ineffective by Western medicine, but research efforts of recent decades have shown the usefulness of specific CAM modalities in treating mental health disorders, such as

depression, anxiety, PTSD, and various sleep disorders. The effectiveness of treatments, such as yoga and meditation, have been shown in empirical research and shared anecdotally. Meditation involves the quiet focus of thought to induce relaxation and is a key part of yoga, a Hindu spiritual discipline that combines controlled breathing and bodily postures with meditation to promote physical and mental health. Because of the perceived effectiveness and growing popularity of CAM, military patients may seek CAM treatments in lieu of traditional medicine for their various mental and physical health conditions, a decision that often leads them outside of the military and veteran health systems and results in greater personal expenditure.

Among military populations, interest in CAM has increased markedly in recent years. For instance, in a study conducted by Micek and colleagues (2007) on the treatment-seeking behaviors of more than 16,000 patients in the VHA system, 27 percent reported using CAM treatments within a year of the study's survey. The researchers also observed that factors associated with CAM use were patients' beliefs in non-scientific treatments, concerns about the harmful effects of conventional medicine, adherence to a natural diet, and the use of health information not provided by a health care professional. They also found that higher use of CAM was negatively associated with overall satisfaction with VHA primary care and the belief that physicians control patient health.

CAM Application to Military Populations and Evidence of Effectiveness

The use of CAM in military settings may be particularly useful in reducing hyperarousal, a symptom often inherent to military life, particularly in deployed settings; hyperarousal can become a conditioned response that perpetuates into the sleep environment. CAM strategies, such as yoga and meditation, may be particularly helpful for servicemembers who struggle to reduce their arousal to sleep efficiently. Meditation and yoga are also relatively inexpensive and can be offered in group settings by instructors who do not require medical training or psychology degrees. As such, a significant benefit of CAM treatments is that they may reduce the demands placed on mental health care providers to interact with each patient individually and provide effective treatment for sleep disorders. Moreover, they are also consistent with the patient-centered care models that the DoD and VA are currently advocating (Veterans Health Administration, 2013). Additionally, because CAM modalities are often used to promote wellness, they may prevent sleep disturbances and disorders from developing, thus leading to cost savings for DoD and improved quality of life for servicemembers and veterans. However, it is difficult to show this empirically, because demonstrating prevention capability requires large samples of individuals who must be followed over long periods of time.

But there is limited evidence of the efficacy of CAM modalities in treating servicemembers and veterans with sleep disorders. Our review identified six studies on the subject, which are summarized in Appendix C, Table C.3. Overall, the results

demonstrate that meditation and yoga interventions improve multiple aspects of sleep quality and reduce symptoms of insomnia and PTSD. In one study, 54 percent of participants who received yoga instruction reported improvements in their sleep (Stoller et al, 2012). However, the small sample sizes, lack of adequate control groups, and limited number of studies on the efficacy of these approaches preclude recommending them as a front-line treatment until their efficacy is more systematically evaluated.

Summary and Limitations of CAM

Like the studies listed in previous sections, several of the CAM studies in our review were limited by methodological factors. Five out of the six studies lacked control conditions and had relatively small sample sizes ($N < 53$). Because of the limitations in the current evidence base, CAM approaches are not recommended as front-line treatments for insomnia or nightmares. However, given the growing interest in CAM treatments and the fact that relaxation techniques, in particular, may be useful for reducing hyperarousal, which is a predominant feature of servicemember sleep disturbances, further research using more robust methodologies is warranted to evaluate their efficacy.

Combined Treatment Modalities

Mental health clinicians often use multiple treatment options when treating particular patients, especially if their conditions are relatively severe or treatment-resistant. The appropriate combination of treatments for an individual patient depends greatly on the specific disorder(s), the severity of the disorder(s), and such factors as the patient's willingness to get treatment and the patient's family and social life. Comorbidities create additional challenges in selecting a course of treatment, because insomnia can be both a symptom and a cause of other disorders. To address these issues, clinicians may choose to provide multiple forms of therapy or prescribe a medication in conjunction with therapy. This latter technique allows the clinician to provide patients with immediate relief of symptoms while addressing the underlying causes of their disease and creating positive impacts that last beyond the course of treatment. There are many different combinations of treatment types available, and there have been several studies on specific treatment combinations for sleep disorders among veterans.

Applications of Combined Treatment Modalities to Military Populations and Evidence of Effectiveness

Our review identified five studies showing that veterans suffering from insomnia and PTSD-related nightmares can be treated effectively with a combination of CBT-I and another behavioral treatment (Harb, Cook, et al., 2009; Ulmer, Edinger, and Calhoun, 2011; Margolies et al., 2013; Swanson et al., 2009; Nakamura et al., 2011). Appendix C, Table C.4, provides details of these studies. Although most of the studies used small sample sizes or lacked control conditions, they demonstrate that combined treatment modalities may be able to effectively improve sleep quality and duration and

reduce nightmares and symptoms of insomnia and PTSD. Effect sizes observed in these studies ranged from 0.24 to 2.05 for the PSQI, 1.7 to 2.17 for the ISI, and 0.4 to 1.85 for PTSD symptom severity scales.

For instance, Germain, Richardson, and colleagues (2012) compared the effects of treating veterans with chronic sleep disturbances using a combined behavioral treatment that included components of CBT-I and IRT versus a pharmacologic agent, prazosin, or a placebo. They found that both prazosin and CBT-I were significantly better than the placebo at improving sleep quality and quantity and reducing PTSD symptom severity, but there were no significant differences in outcomes between the two treatment groups. Specifically, 62 percent of participants randomized to one of the treatment conditions experienced sleep improvements, whereas only 25 percent of those in the placebo group improved.

Unfortunately, the authors did not evaluate the effects of an intervention combining prazosin and CBT-I. This is a critical issue, and further study to examine the effects of a combined prazosin/CBT-I intervention is warranted to determine the value of prescribing prazosin in conjunction with CBT-I when treating chronic sleep disturbances among veterans, as opposed to either treatment in isolation. The potential benefit of combined behavioral and pharmacologic approaches is that they can provide patients with both rapid symptom relief (through pharmacologic agents) and more-enduring symptom relief (through behavioral strategies). However, combining behavioral treatments with pharmacologic therapy may diminish enduring treatment effects by reducing the patient's self-efficacy, particularly if they attribute positive effects to the medication rather than to behavioral changes.

Summary and Limitations of Combined Treatment Modalities

The generalizability of the findings from some of the studies described here is limited by small sample sizes (all but Germain, Richardson, et al., 2012, and Nakamura et al., 2011) and a lack of control groups (Harb, Cook, et al., 2009; Swanson et al., 2009; Ulmer, Edinger, and Calhoun, 2011). These limitations emphasize the need for more robust research in this field. The studies of multiple treatments described here do not include all treatment options, but they do illustrate the point that multiple treatment modalities can be paired to successfully treat servicemembers and veterans with sleep problems. This research serves as a guide for military health system and VHA providers, who must find adaptive and creative ways of treating their patients successfully.

Technological Developments in Treatment Delivery

A significant challenge in treatment delivery is overcoming barriers to dissemination. Servicemembers are often hard to reach because of their training, deployment, and relocation schedules. Additionally, the small number of qualified behavioral health specialists limits the availability of CBT-I (Siebern and Manber, 2011). Technologies

that enable patients to obtain treatment without coming face to face with providers can dramatically improve dissemination. Several mental health–related smartphone and Internet applications have become available in recent years, and their creators claim that they can improve dissemination and treatment outcomes. Since these applications are still relatively new, there is little empirical evidence to support these claims of their efficacy as treatment modalities and tools. Telehealth (i.e., the use of electronic information and telecommunications technologies, including telephone, Internet, and video conferencing, to support clinical care) has been used for a longer period and has shown efficacy in some studies, but the use of telehealth in treating servicemembers and veterans with sleep disturbances is a relatively unexplored area of research. Only one recent study has examined the efficacy of telephone-delivered CBT-I involving sleep restriction, stimulus control, sleep hygiene, cognitive therapy, and relapse prevention. The researchers observed that the patients receiving the treatment experienced greater improvements in sleep-related cognition and daytime insomnia symptoms than those in the control group (Arnedt et al., 2013). The interest in and market for these technological health care applications are growing rapidly, so further research into their use and efficacy is greatly needed.

The study described above used participants in the civilian population, but a similar study of servicemembers or veterans has not been conducted. However, Luxton, Mishkind, and colleagues (2012) examined the feasibility of using the two-way video functions of smartphones to conduct video chat therapy sessions between servicemembers and providers. The authors found that the barriers to successful implementation mainly included connection limitations, such as a lack of reliable wireless Internet or cellular service in certain areas. However, when a strong connection was established, the servicemembers were generally very comfortable using this platform to communicate. This research effort demonstrates the feasibility of using video chat and smartphones to conduct therapy sessions between providers and servicemembers, which may be a more effective method than simple telephone communication. However, these findings need to be replicated to measure the added value of video interaction during teletherapy.

Several mental health treatment programs have also been developed for use over the Internet through designated websites. Such treatments have the advantages of convenience for patients, low costs, and high accessibility (Siebern and Manber, 2011). Evaluations of some of these programs have shown evidence of efficacy in reducing symptoms of insomnia and comorbid disorders (Espie et al., 2012; Thorndike, Ritterband, Gonder-Frederick, et al., 2013; Ritterband et al., 2009). A web-based CBT-I course delivered by a virtual therapist was used in an RCT to treat adults with chronic insomnia. Compared with treatment as usual and a placebo condition, this intervention was associated with significant improvements in sleep efficiency and sleep-wake functioning (Espie et al., 2012). Another online CBT-I program, called SHUTi (Sleep Healthy Using the Internet), was associated with significant improve-

ments in insomnia severity scores, wake after sleep onset, sleep efficiency, fatigue, and mental health quality of life (Ritterband et al., 2009; Thorndike, Ritterband, Gonder-Frederick, et al., 2013). Because these studies included civilian participants, research on the use of online interventions with military populations is warranted. The Center for Deployment Psychology also has an online CBT-I program (Brim, 2013), but the efficacy of this program has not been systematically evaluated.

Recent efforts have promoted the use of smartphone applications as tools to aid in treatment delivery to servicemembers and veterans suffering from sleep disturbances and disorders. Unfortunately, the empirical evidence base for using smartphone applications in this manner is limited because they were developed only recently. One application, called PTSD Coach, was evaluated with veterans receiving treatment for PTSD at a VHA residential treatment program. The researchers noted that the participants generally felt very satisfied with PTSD Coach and perceived it to be helpful in managing their PTSD symptoms. The participants primarily used the application to manage acute distress and to help with sleep onset (Kuhn et al., 2014). However, quantitative data to measure symptom severity changes were not collected. Another application to aid in prolonged exposure (PE) therapy, PE Coach, contains tools designed to help therapists and patients improve implementation, fidelity, and homework adherence during treatment for PTSD. These tools are purported to help reduce PTSD symptoms, including sleep disturbances (Reger et al., 2013). However, no scientific evaluations have provided evidence in support of the claims made by PE Coach's developers. Additionally, this application targets sleep disturbances as symptoms of PTSD, not insomnia specifically.

Because the U.S. population uses smartphones extensively, these devices offer a highly accessible platform for delivering tools to aid in treatment to servicemembers and veterans. The two-way video capabilities of smartphones allow for face-to-face interaction between patients and providers who cannot meet for treatment in person. This method may bolster the effectiveness of CBT-I interventions delivered by telephone. Smartphone applications also provide easy ways to deliver tools to patients, which may complement treatments and improve adherence and outcomes. The highly customizable nature of these applications allows software developers to create a wide range of tools that may be useful to clinicians and patients. The use of wearable electronic devices (i.e., actigraphs and accelerometers) to measure sleep and activity may also help the military monitor the sleep habits of servicemembers (van Wouwe, Valk, and Veenstra, 2011). In fact, in our working group meeting, participants recommended increasing the use of technology for monitoring sleep and alertness as a primary strategy; however, the group also noted that these instruments must be validated before broader dissemination can be recommended.

More research is needed to identify the added value of smartphone applications and wearable devices, as well as the efficacy of treatments delivered by technological platforms to servicemembers and veterans. This research should drive the future devel-

opment of technologies aimed at treating this population, because there may be clear benefits in reducing the stigma associated with visiting a behavioral health clinic. These technologies could also increase access for servicemembers living in remote locations and enhance the dissemination of evidence-based treatments.

Discussion

The review of the literature and perspectives of our interviewees and working group attendees identified several promising strategies that are being used to promote sleep health, particularly with regard to intervention strategies. However, there are also several notable gaps, including a lack of evidence-based prevention programs and validated self-identification tools.

Our literature review was limited by the relative scarcity of studies on treatments for sleep disorders in military and veteran populations compared with those focusing on civilian samples. Of the studies that were included in our review, many had small sample sizes or did not use control groups, limiting the generalizability of the results. Additionally, some treatment modalities, such as meditation and video teletherapy, remain relatively unexplored for treating post-deployed servicemembers with sleep disorders.

However, several treatments have demonstrated efficacy in military samples. In particular, CBT-I and IRT therapy have been shown to be efficacious treatments for insomnia and nightmares, respectively, two of the most common types of sleep disturbances that servicemembers experience in the post-deployment period. Unfortunately, to date, there have been no large-scale RCTs of these treatment modalities in military populations. There are also significant gaps between guidelines from scientific studies and current practices in DoD. In particular, pharmacologic therapies (e.g., sleep medications) continue to be the front-line treatment prescribed by many providers (Schmitz, Browning, and Webb-Murphy, 2009), though there is scant evidence on the efficacy of these treatments in treating servicemember sleep disturbances. Furthermore, there are known side effects to these medications, including daytime fatigue, which is particularly concerning in operational contexts and certain occupations that require sustained attention and cognitive vigilance.

The dissemination of efficacious cognitive-behavioral therapies to servicemembers is also lacking, largely as a result of a critical shortage of trained providers in behavioral sleep medicine techniques and relatively low provider awareness of the efficacy of these programs. These are critical issues that should be addressed. Hiring a greater number of qualified behavioral health specialists, creating more clinical training opportunities, and expanding treatment delivery options beyond specialty health care clinics, including primary care settings (Goodie et al., 2009), could help decrease this short-

age and enhance dissemination (Troxel, Germain, and Buysse, 2012), as we discuss in Chapter Six.

Further research using robust RCTs and participants from military populations is also greatly needed to establish best-practice guidelines for treating servicemembers and veterans specifically. There is also a need for further research to evaluate the efficacy of innovative and promising treatment techniques that may fill treatment delivery gaps and be preferred by servicemembers, such as video teletherapy, therapies delivered through mobile technology, and CAM techniques (e.g., meditation).

Providing training for clinicians to effectively treat servicemembers and veterans with sleep disorders is an important and complex undertaking for policymakers. Facilitating the broader dissemination of evidence-based treatments for sleep problems and systematically evaluating promising, novel interventions will entail costs and resources, but the benefits accrued in improving sleep health and associated downstream consequences in servicemembers will likely outweigh those costs.

Barriers to Achieving Healthy Sleep Among Servicemembers

Even the best evidence-based practices, programs, and policies to prevent and treat sleep problems among servicemembers may not mitigate barriers to achieving healthy sleep. In the military context, such barriers can be cultural, operational, or individual (knowledge-related); they can also include medical and treatment system barriers. Understanding these barriers—and their interactions with one another—is critical to implementing policy changes to address key sleep-related challenges that servicemembers face.

One of the most robust ways to systematically assess the gaps between policies and their actual implementation and adherence is by soliciting the perspectives of representatives across DoD. In our case, we conducted key informant interviews with clinical practitioners, researchers, and line leaders in both the military health system and the military departments knowledgeable about the clinical and operational implications of military sleep policies. This qualitative method allowed us to capture in-depth views of how DoD and Service-level sleep policies have been implemented and barriers to achieving healthy sleep in the military context. Quantitative analyses might include a comprehensive survey of a sample of servicemembers that is representative of the entire military. In lieu of conducting that kind of time-intensive, burdensome, and cost-prohibitive survey, qualitative data analyses are a robust way to obtain preliminary data to motivate future research directions.

We begin with an overview of our approach to identifying the barriers to healthy sleep. We then review each type of barrier identified and explore the implications of these findings.

Approach

Participants

The findings in this chapter are derived from interviews with 40 key informants in DoD and input from our expert working group meeting. Our final interview sample included 30 personnel working in military medical settings across DoD (including medical professionals and sleep experts, as well as health policymakers at multiple

levels), nine personnel working in military operational environments (ranging from pilots to brigade commanders and naval ship commanding officers), and one with military training responsibilities. Appendix G provides more detail on our interview recruitment strategy, along with our interview guide and interview protocols. We recorded each 30- to 60-minute phone interview, then transcribed and analyzed the responses. Each interview included questions about the process and barriers to preventing, identifying, and treating sleep problems. Questions then asked about perceived barriers to implementing and enforcing sleep-related policies.

In addition to our phone interviews with key informants, we held a daylong in-person meeting of a broad group of experts. This working group included 31 researchers, uniformed personnel, and clinicians from both the civilian and military sectors. Those invited to participate represented a range of clinical, operational, and policy backgrounds related to sleep. In consultation with DCoE, the research team identified four topics of focus for the meeting and asked each of four groups of experts to share their perspectives on the current practices and barriers and to provide recommendations related to each of the following topics: (1) self-identification of sleep problems, (2) prevention of sleep disorders, (3) best sleep practices and programs in operational or training contexts, and (4) best sleep practices and programs in clinical or medical contexts. The research team took notes during the breakout sessions and then the group reconvened to present their views on each domain's barriers. The large group then discussed recommendations to address those gaps together. Further details about the meeting logistics and the summaries provided are included in Appendix H.

Qualitative Data Analysis

We coded transcripts from our key informant interviews according to the methods of applied thematic analysis (Guest, MacQueen, and Namey, 2011). Two coders extracted data from the notes and transcripts and binned responses into thematic categories. Both coded 10 percent of interviews to check for consistency in coding practices. After any inconsistencies were discussed and resolved, the remaining interviews were coded according to the mutually agreed-upon set of thematic categories. These categories represented consistent and repeated messages from more than one key informant. In many cases, these messages were conveyed by interviewees across multiple Services and job functions (e.g., medical and operational) and at various levels within DoD (e.g., unit commanders, senior leaders). As such, quotes from interviewees represent consistent viewpoints from at least two informants. The overarching thematic categories correspond to the various levels of influence on sleep behaviors:

- military culture
- operational environment
- servicemember and leadership knowledge
- medical and treatment systems.

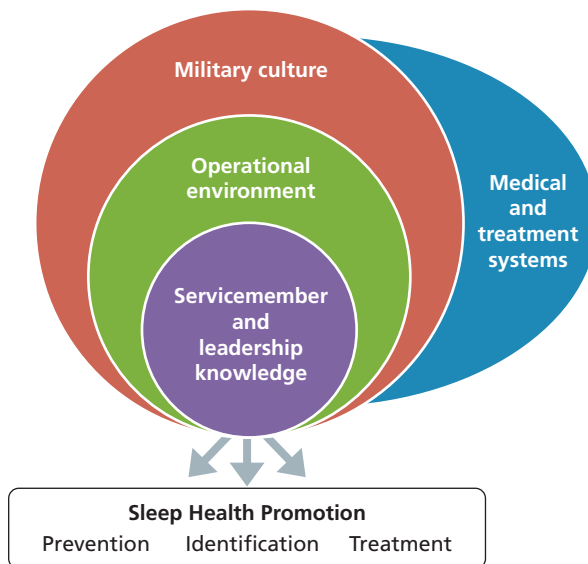
Figure 6.1 illustrates how these levels of influence relate to one another to affect sleep outcomes. Cultural, operational, and individual factors (servicemember and leadership knowledge of sleep-related issues) all have an impact on the continuum of sleep health—whether sleep problems are prevented and whether they are identified and subsequently treated. These categories, or levels of influence, also interact with medical and treatment systems. We also supplemented these qualitative data analyses with notes from the expert working group meeting.

Within these thematic categories are the specific barriers to healthy sleep practices described by our key informants and working group participants. In the following discussions of each thematic barrier, we provide representative quotes highlighting the perspectives of interviewees and working group participants.

Cultural Barriers to Sleep Health

Numerous studies have identified military cultural attitudes and beliefs about sleep as a critical barrier to implementing and enforcing healthy sleep practices (Kennedy, 2009; Miller and Shattuck, 2005; Mysliwiec, McGraw, et al., 2013; Brown, Caldwell, and Chandler, 2013). For example, Brown, Caldwell, and Chandler (2013) noted that “the operational community treats the need for sleep as a resource to be rationed in the best times, and as a sign of weakness in the worst.” The perspectives of our inter-

Figure 6.1
Barriers to Promoting Healthy Sleep Among Servicemembers



viewees and the expert working group participants supported this finding, suggesting that cultural attitudes about sleep can serve as significant barriers to promoting sleep health (through prevention, treatment, and identification, as shown at the bottom of Figure 6.1). Both groups indicated that a servicemember's ability to perform with little or no sleep has traditionally been viewed as a "badge of honor" within the military rather than a risk or a problem. They also pointed to potential stigma associated with expressing a need for more sleep, which may deter servicemembers from self-identifying or seeking help before a sleep problem becomes chronic and debilitating. At the operational level, the military culture emphasizes mission first, and a need for sleep is perceived as secondary to that goal or, perhaps, even a sign of weakness.

Sleep May Be Viewed as a Luxury Rather Than a Biological Need

Interviewees and working group participants across all the Services, particularly those who engaged in military operations, indicated that resistance to recognizing the importance of sleep is deeply embedded in military culture. They noted that prioritizing sleep can be met with such sentiments as "You're not being macho enough," "Toughen up," "Suck it up," or "Sleep is for the weak." In essence, sleep is considered a "luxury" that generally falls low on the list of servicemembers' priorities, especially in a high-OPTEMPO setting. Further, some noted that these attitudes and beliefs are difficult to modify because of institutional resistance to change. These perspectives suggest that cultural attitudes toward sleep may compound or exacerbate other, more tangible—and often unavoidable—operational or environmental barriers to servicemember sleep, as discussed later in this chapter.

While the cultural attitudes surrounding sleep in the military generally seemed less than positive, these attitudes tended to vary by military branch or occupational field and rank. For example, some interviewees and working group participants felt that aviators tend to be more rigid about how much rest and sleep they get during their crew days and that this was less common in the ground or surface fleet forces. One Marine Corps operational staff member stated,

In a perfect world we'd follow the model that's done by the air side. There's not anything that's even kind of close, even halfway . . . for the ground or the shore.

Expectations regarding sleep also seemed to vary by rank. Some interviewees and working group participants suggested that senior military personnel or leadership may have an exceedingly difficult time prioritizing sleep:

As a senior person, I wasn't going to be the first person to go to bed. You want to be at the table, you want to be part of the discussion, and a lot of these discussions are happening well into the evening.

These perspectives are supported in the literature, which suggests that leadership is often required to work extended hours (Harrison and Horne, 2000). A survey of Army infantry officers found that “an overwhelming majority of respondents reported that their superior slept significantly less than needed” (Miller, Shattuck, and Matsangas, 2011). Indeed, many in our sample described the pressures on commanders to avoid sleep and suggested that commanders may be the most sleep-deprived servicemembers.¹

Many interviewees and working group participants were hopeful that increasing recognition of the value of sleep, in both society as a whole and in the military, would lead to a cultural shift in how sleep is prioritized. Specifically, some felt that military attitudes toward sleep are improving, partly because of increasing media attention on the consequences of insufficient or poor sleep and greater public awareness of the importance of sleep for optimal health and functioning.

Cultural Attitudes Toward Sleep Appear to Vary Across Occupational Specialties and Settings

Sleep policies and practices in the aviation community are better developed than in other career fields, partly because of broader federal aviation regulations that mandate these policies (as discussed in Chapter Five). In addition, many interviewees, including those in the Air Force, suggested that Air Force policies are more codified because the consequences are more severe: When a plane crashes due to pilot fatigue, it costs a lot of money, there is high visibility via the media, and it triggers many evaluations of the mishap. When we asked key informants whether policies or practices similar to those in aviation could be extended to other career fields, the responses were mixed. Some viewed it as a practical and logical extension:

None of the pilots flying off the carrier are sleep-deprived. That’s something that the aviation community said—“This is our rule.” [Aviators] take it very seriously. There are not a lot of operational communities that do that. . . . There are probably lots of places where we would benefit from that.

However, others perceived the cultural differences between career fields as notable impediments to such adaptations. For example, when asked about barriers to the extension of the aviation policies supporting ample sleep, one Air Force medical staff member stated,

This is the way that we’ve done it forever, and when you have that ingrained in someone for so many generations, it’s a hard ship to steer.

¹ See Shay (1998) for a detailed discussion of the challenges facing military leadership not only in encouraging others to prioritize sleep but also in allocating sufficient time for sleep for themselves.

Two key informants, doctors by training, drew parallels between the armed forces and the medical training environment, suggesting that the medical profession has made positive changes. One Navy medical staff member described this shift:

[I] went through [medical] training when there were no restrictions on number of hours worked per week. . . . I think the medical community finally came around and recognized that that's just not safe . . . for patient care. . . . It was decided that there had to be some restrictions placed on the number of hours per day [or] number of hours per week that young doctors in training could do.

These responses imply that certain military career fields are slower to adopt sleep policies and practices and could perhaps learn from other professions. However, it is not fully clear whether those career fields could feasibly adopt sleep best practices from outside of the military (e.g., from the medical profession more generally) or even from within the military (e.g., from the aviation community). In the absence of a broad-based study of the topic, it is not possible to capture the full extent to which cultural attitudes toward sleep vary across occupational settings or by specialty.

Operational Barriers to Sleep Health

“Mission first” is the creed of every servicemember, regardless of job title or duty description. Repeated and prolonged deployments and increased operational demands during combat create a clear conflict for commanders and other leaders when prioritizing mission needs and training requirements. Many interviewees and working group participants pointed to tension between awareness of the operational benefits of healthy sleep and a desire to achieve healthy sleep, on the one hand, and competing demands that inhibit proper sleep practices, on the other. For example, one Marine Corps operational staff member acknowledged the importance of sleep (“Well-rested [servicemembers] going into the mission . . . have the best judgment and the best reflexes and the best reactions when they come into contact with the enemy”) but added that personnel may not be afforded sufficient time to rest because “[they’re] trying to plan to perfection in everything that [they] do, from the generals all the way down through the lieutenants and the sergeants and the corporals.”

Manpower Limitations

Manpower limitations can compound the operational demands faced by military leaders and servicemembers. Interviewees and working group participants noted that even where sleep policies are in place, leaders may not have sufficient manpower to provide all servicemembers with adequate time to sleep. For example, according to one Marine Corps operational staff member,

It keeps always coming back to manpower. Even if we have this perfect tool in a perfect world where you [conduct] this test on me and say, “You’re fatigued,” but if you look to your left or to your right but there’s nobody else there to [take your place], guess what, I’m going on anyway.

These personnel noted that the threat to manpower has been particularly salient in recent years, given the high OPTEMPO many units face.

Interviewees and working group participants offered suggestions for improving watch bills and shift-work schedules by emphasizing the importance of circadian rhythms, equity in responsibilities, and access to amenities, with particular attention to those with exceptional shift-work duties.² One interviewee described how commanders proactively took it upon themselves to address shift work and sleep issues within their units, demonstrating the positive effects of reducing fatigue.

Balancing Sleep Policies with Operational Demands

Even where codified sleep policies are in place, as in the aviation community, they may be interpreted as guidance rather than a set of mandates. Units often need to reconcile sleep policies with their operational requirements. Thus, it is not clear whether these decisions simply do not account for the negative effects of sleep deprivation or whether sleep policy is followed to the fullest extent possible within operational limitations. Moreover, it appears that some servicemembers may resist widespread or restrictive sleep policies, either because of operational requirements or because such policies do not coincide with military culture. In the words of one interviewee, sleep policies and guidance are perceived as “important and necessary [but] not the primary ingredients that create or maintain the warrior spirit.”

Generally, the ability to deviate from sleep policy guidance was deemed quite important, particularly in deployed environments:

We want to be as prepared [as we can be] so that we can be successful in the mission and bring everybody home, and that tends to run into planning and preparation that eats into that rest and sleep time that we need.

Indeed, certain training activities may even require periods of sleep deprivation:

It may be necessary to shortcut policies. . . . It may be beneficial to maximize certain training opportunities, such as those that exist during “High-Light Level” time periods. . . . [These] windows may only exist for five working days per month, so capitalizing on these training periods, for the aviation community, is a must.

² For another example of successfully overcoming manpower barriers, see McMichael (2010).

Although the ability to deviate from sleep policy was viewed as important, it creates an inherent barrier to encouraging or ensuring appropriate sleep across the military. For this reason, efforts to improve or enforce healthy sleep behaviors must be carefully balanced against the realities of the dynamic military environment and critical operational demands. In fact, successful efforts to change watchbill schedules on Navy ships and submarines have demonstrated that such changes must occur within the context of a comprehensive plan that takes into account the other exigencies of shipboard living and mission requirements, such as mealtimes and evening prayer, the timing of collateral-duty meetings and other administrative events, and the need for some divisions (i.e., deck) to deviate from the new schedule to satisfy mission requirements (Cordle and Shattuck, 2013).

Environmental Barriers

The operational environment itself can be an impediment to sleep health promotion. A consistent theme described some of the uncomfortable, noisy, and otherwise challenging environments in which servicemembers must try to get quality rest:

We have environments in the Navy and the Marine Corps that aren't conducive to sleep, watch rotations that aren't conducive to sleep, and people don't always pay a whole lot of attention to that.

There were also suggestions from multiple informants on how to reduce the environmental barriers to sleep, for example:

What we found is on the six [hours] on/six [hours] off [schedule], the six hours they were off, they only had the opportunity to lay down for four and a half hours, and out of that four and a half hours they were maybe lucky to get two to three hours of sleep because the environment is not conducive to that, and that's why we jumped up and down on the warfighter sleep kits—because it gave them the earplugs and the masks, [which] made it dark, made it easier for them to fall asleep.

Knowledge Barriers to Sleep Health

Successful identification of sleep disturbances in a military context depends on a number of factors, including the knowledge level or help-seeking disposition of the person suffering from the problem, the awareness of people living and working in proximity to the sufferer, and screening efforts in place to detect sleep problems. Our interviewees and working group participants suggested that the individual servicemember is largely responsible for recognizing his or her own sleep problems because screening is not universal. They also stressed that increased education and awareness about sleep

health and the existence of sleep policies for both servicemembers and line leaders are paramount.

Lack of Servicemember and Unit Leader Knowledge About Sleep Health

A theme that arose in interviews was that individual perceptions about what is (or is not) healthy sleep can vary greatly. Without a baseline level of knowledge or common understanding about what is (and is not) healthy sleep, servicemembers or unit leaders may not view sleep disturbances or deficits as problematic. According to one Army operational staff member,

Guys like me get six hours now. And if it just kept getting worse and I got five, I wouldn't think anything of it.

Working group participants cited the lack of clear evidence linking fatigue to sub-optimal mission performance—and a lack of awareness of this link—as a knowledge-related barrier to healthy sleep. Thus, while some policies do emphasize awareness of the importance of sleep to mission readiness (see Chapter Four), this information is not reaching servicemembers.

Lack of a Centralized Resource on Sleep Health

Several interviewees and working group participants mentioned education about sleep issues as a possible solution to the knowledge-related barriers they identified. However, working group experts were not aware of a DoD-wide centralized resource that provides servicemembers with education about healthy sleep practices, and in some cases, they were unaware of the existence of sleep policies across the DoD or service-specific policies.

In particular, the common theme was that military leaders were not sufficiently educated about circadian rhythms to develop sleep plans or may resist changes that decrease their flexibility in tasking personnel in a high-OPTEMPO environment.³ A sleep plan is part of the process of establishing operational plans and associated risk assessments. When a leader is establishing priorities in a combat setting or planning shift work for continuous operations, a sleep plan indicates, for example, how to rotate people on and off of watches. As one military medical staff member stated, “A major gap is leaders not valuing sleep in the execution of training and operational plans.” Another military sleep expert referenced a survey of recently redeployed soldiers who were asked whether they complied with sleep plans or were aware of them:

An alarmingly high number of people had never even heard of sleep plans. Not only didn't they comply, they didn't know what one was. They had never heard

³ In a recent study of 49 Army officers, nearly 80 percent reported receiving no briefing on a sleep management plan during their most recent deployment (Miller, Shattuck, and Matsangas, 2011).

of it [and] had never been briefed on it. A real indication that there is a policy, all units must comply with this policy, but there [is] not compliance.

Lack of Knowledge About the Risks of Sleep Medication Use

Interviewees and working group participants perceived sleep medication use to be high among servicemembers and suggested that servicemembers and leaders may not know the risks associated with the chronic use of these medications. Some viewed their use as a matter of routine practice in deployed units. As one Navy medical staff member recounted,

[During] my first time overseas with them, I was surprised and amazed at the ease and the frequency of Ambien use. . . . The teams would deploy with [sleep medications]—quite a bit of them. . . . People almost expected that, “yeah, that’s just the way I’m going to sleep.”

We also heard concerns that servicemembers may seek sleep medication from different providers without the other provider(s) knowing. (We address this concern in greater detail in the section “Continuity of Care Challenges,” later in this chapter.)

Another common theme suggested that high levels of sleep medication use alongside frequent stimulant use is common and that servicemembers and unit leaders may not be educated about the risks of these behaviors. Key informants perceived that some servicemembers are caught in a “vicious cycle” of stimulant and sleep medication use. One Navy medical staff member stated,

Prior to going out at night, they are going to take, I think, caffeinated substances—Monster drinks, Rip-Its, [or] coffee drinks—to make sure they are up. Then they operate, they come back, and during the day they are sleeping. And how do many of them sleep during the day? With Ambien. So that’s a vicious cycle. It may work . . . for short bursts . . . but when you multiply that by, say, six to eight months, I think most reasonable clinicians will say, “Holy cow!” . . . We are starting perhaps to alter some brain chemistry and circadian functioning in a way that it is concerning.

Despite concerns about sleep medications their use in conjunction with stimulants, some interviewees felt that sleep medications were an important tool to support servicemembers during deployments. In particular, they perceived high levels of sleep medication use in such highly regulated occupational fields as aviation. More generally, our interviewees and working group participants suggested that the prevalence of sleep medication use, the subsequent effect on functioning, and risks of sleep medication use and abuse in the military context was not fully understood.

Medical and Treatment Systems Barriers to Promoting Sleep Health

Resistance to Treatment Seeking

A common theme in interviews and the expert working group suggested that negative attitudes toward sleep in the military may contribute to servicemembers' reluctance to admit or seek treatment for sleep problems. This unwillingness could be associated with a fear of negative career consequences, particularly in the case of serious sleep problems requiring intensive treatment. According to one medical staff member,

If [a servicemember] is identified with a sleep disorder of some type, they may be concerned that it may interfere with their career and their ability to stay in the [Service] if they have sleep apnea or narcolepsy.

More generally, stigma associated with help-seeking for mental health problems that are frequently comorbid with sleep problems (Ramchand, Acosta, et al., 2011) may serve as a barrier to identifying and treating sleep problems. Servicemember concerns may include the implications for his or her career or a perceived change in respect from peers. Clinical screening forms are often oriented around mental health disorders. For this reason, a sleep-related diagnosis could be considered as solely a mental health diagnosis and perhaps carry an equivalent amount of stigma from the servicemember's perspective.

Nevertheless, the level of stigma characteristic of sleep problems, alone, appears to be lower than that associated with depression, PTSD, or other mental health issues. Thus, servicemembers may be more likely to seek help for sleep problems than for these mental health disorders:

I don't get the sense that there's a stigma involved with being referred for sleep, similar to what there would be for a PTSD. . . . It may be that they get sent for evaluation for primary sleep disorder, but the real issue is their PTSD, and they just get referred under the guise of the sleep disorder, but the heart of the problem could be the mood disorder [sic].

Lack of Emphasis on Sleep Screening

As mentioned earlier, there have been various initiatives to screen for sleep disturbances in the military across the deployment cycle. However, sleep was generally perceived to be a low institutional priority in military communities, or it simply fell "behind other areas" of war-related health issues. One interviewee suggested that the military inherently has little incentive to identify sleep problems among its forces and thereby disqualify personnel from certain critical jobs or activities, particularly when there is not always a clear treatment path.

Others indicated that servicemembers rarely come forward with only a sleep problem; rather, they tended to present with another health or mental health condition that was induced or exacerbated by a sleep problem. They noted that the resulting condition could be more severe—or perceived as more severe—than the underlying sleep disturbance and, thus, act as a catalyst to treatment-seeking or other means of detection. Similarly, our interviewees suggested that sleep problems are often identified only after accidents and subsequent investigations. Although screening was perceived as an important tool for detecting sleep problems, it is worth noting that line leader and servicemember self-identification was also considered a critical method for identifying these problems.

Continuity of Care Challenges

Our interviews addressed continuity of care in terms of sleep problems. Specifically, servicemembers can experience a “gap” during the post-deployment transition period wherein sleep issues may not be detected or treated. According to an Army medical staff member,

[The] general gap is the health care in that transition period. Whatever the health care needs are, it’s hard to make it a clean transition. Post-Deployment Health Assessment is a self-report. What’s done in theater may or may not transition over. [A] health care provider may not catch it right away.

A common theme described the concerns about continuity of care for certain veterans. VA treatment providers are a likely means for detecting sleep issues, either through primary care visits or through other treatment or screening encounters. However, after a servicemember’s separation from the military, he or she may either choose not to or be unable to use VA services due to limited access, long wait times, or a lack of awareness about eligibility for services.

As for concerns about continuity of care for the treatment of sleep problems, the military’s electronic medical records system, the Armed Forces Health Longitudinal Technology Application, may address gaps by making diagnosis and treatment information available to a range of providers across the deployment cycle. However, some of our interviewees stressed that even with this system in place, prescriptions for sleep medications and other treatments can be handwritten or otherwise not recorded in the electronic medical record.

A lack of universal documentation of prescriptions presents challenges for health care providers who may be unaware of the full range of medications a servicemember is taking or whether he or she has been prescribed a given medication by another provider.

Sleep Clinic and Provider Shortages

Another theme mentioned a different type of treatment concern: a shortage of specialized providers at sleep clinics and a shortage of sleep clinics themselves.

In terms of specialists that deal with sleep issues, those people certainly have a backlog for people to access them, so you're talking, often, 30 days from referral to a specialty service.

Numerous examples in the sleep medicine literature corroborate this issue and emphasize that the shortage of trained providers in evidence-based interventions for treating sleep disorders is a critical issue in the civilian health care system, as well as in the military health care system (Manber, Carney, et al., 2012; Troxel, Germain, and Buysse, 2012). According to a previously published report by a leader in academic sleep medicine,

[I]n an ideal health care system, one would expect behavioral treatment for insomnia to be widely disseminated because of the data showing efficacy, the cost savings that would accrue from reduced pharmacy costs, and reduced morbidity from sedative hypnotic-related falls and injuries. The message repeatedly finds its way into the scientific literature but not into practice settings. (Neylan, 2011)

Amidst these reported shortages, we also heard about recent efforts to bolster the number of sleep providers and clinics in the military, including the VHA CBT-I clinician training program (discussed in greater detail in Chapter Four).

Discussion

Even with the best evidenced-based practices and programs to prevent and treat sleep problems among servicemembers and with codified policies related to sleep in place, cultural, operational, and individual (knowledge-related) barriers may impede efforts to promote sleep health in servicemember populations. Barriers associated with military medical and treatment systems also pose a potential challenge to identifying and treating servicemembers experiencing sleep problems.

Military cultural attitudes have historically tended to prioritize mission requirements over healthy sleep practices, particularly in deployed settings. Furthermore, the stigma associated with expressing a greater need for sleep may deter servicemembers from self-identifying or seeking help before a sleep problem becomes chronic and debilitating. Screening for sleep disturbances is limited, but it is difficult to determine the respective extent to which military culture, gaps during the transition period following a deployment, and a shortage of sleep specialists contribute to this trend.

In operational contexts, the military emphasizes mission first, with the need for sleep perceived as a sign of weakness. Manpower limitations can compound the operational demands faced by military leaders and servicemembers; even where sleep policies are in place, leaders may not have sufficient manpower to accommodate the guidance for proper sleep—a consideration that is particularly salient given the high OPTEMPO of recent years. Above and beyond these operational barriers, operational settings are often uncomfortable, noisy, and otherwise challenging environments. Although the ability to deviate from a sleep policy may be extremely important for a unit's operational effectiveness, doing so produces an inherent tension or trade-off: Efforts to improve or enforce healthy sleep behaviors must be carefully balanced against the realities of the military environment. However, our interviews and working group discussions indicated that recent initiatives to promote healthy sleep by optimizing crew shift schedules have been largely successful. Thus, perceived trade-offs may be balanced by improvements in servicemember performance and overall satisfaction. New policies must account for servicemembers' need to prioritize among multiple responsibilities and a fear of punitive consequences (for servicemembers or commanders), however.

We asked our interviewees and expert working group participants whether new sleep-related policies were needed. In general, they felt that introducing new policies would create a confusing exercise in prioritization for servicemembers and expressed concern that new sleep policies could be established independent of—or perhaps even in competition with—other, more operationally focused policies or guidance. Such a change could require servicemembers to decide which policies and regulations to follow and could raise concerns about the punitive consequences of not following a new policy that conflicts with an existing policy or mission requirements. Instead, interviewees suggested that better enforcement of existing policies and more education to address knowledge barriers would be more welcome than new policies.

A lack of knowledge about the importance of sleep behaviors may also act as a barrier to recognizing and addressing sleep problems. Our interviews and working group discussions suggested that this lack of knowledge or awareness is due, at least in part, to limited education and training among leadership about the importance of sleep and a lack of a centralized DoD-wide resource on how to identify or manage sleep problems or develop and implement a sleep plan, though some Service-specific websites do provide sleep resources and tips on sleep promotion and disturbances.⁴ One particular area in which interviewees and working group participants noted a possible deficit was knowledge of the risks of chronic sleep medication use.

Finally, medical and treatment system challenges also pose barriers. A common theme pointed to a lack of adequate screening tools, procedures, and systems for the detection of sleep problems in military contexts. In addition, both continuity of care

⁴ For example, see Navy and Marine Corps Public Health Center (undated[a]).

and sleep provider and clinic shortages were noted as barriers to promoting sleep health in servicemember populations.

Understanding these barriers is critical to making well-informed and robust policy recommendations related to the prevention, identification, and clinical management of sleep problems and to promoting sleep health in both operational and training settings.

Conclusions and Recommendations

In this chapter, we summarize key conclusions from the study and then provide some recommendations drawn from those conclusions.

Conclusions

As we noted in Chapter One, this study was guided by five research questions:

1. What are the correlates and consequences of sleep problems among servicemembers in the post-deployment period?
2. What are the current programs and policies related to sleep in the military?
3. What are the evidence-based interventions to treat sleep disorders among servicemembers?
4. What are the barriers to achieving healthy sleep for servicemembers?
5. What actions can be taken to promote sleep health among servicemembers?

In this section, we summarize our findings and conclusions as they relate to each of our first four research questions. We then turn to our recommendations for steps DoD could take to promote sleep health among servicemembers, which addresses the fifth research question.

What Are the Correlates and Consequences of Sleep Problems Among Servicemembers in the Post-Deployment Period?

The findings from our literature review, presented in Chapter Two, show that sleep problems are prevalent, debilitating, and persistent in servicemember populations in the post-deployment period. Consistent with the civilian population, the most prevalent diagnosed sleep disorders among servicemembers who seek evaluation for sleep problems include insomnia and OSA. Servicemembers, in general, and those who have previously deployed, specifically, are at high risk for insufficient sleep duration, even more so than civilians. Consequently, servicemembers are also at high risk for the daytime consequences of insufficient sleep duration and poor sleep quality, including

daytime sleepiness and fatigue. Consistent with the civilian literature that shows that sleep problems are commonly comorbid with other medical or psychological conditions, the prevalence of sleep disorders and symptoms in the post-deployment period is higher among servicemembers with deployment-related injuries or mental health problems than among those without such comorbid conditions. Once initiated, sleep disturbances often follow a persistent course, lasting for years after the servicemember returns from a deployment.

There were several methodological limitations in the studies on the prevalence and consequences of sleep in the military. Notably, most studies relied on single-item measures; they often focused on servicemembers within only one or two Service branches, and sample sizes were typically small and regionally restricted; and the studies did not include corroborating reports from family members or bed partners, which may contribute unique information (e.g., on snoring, a primary symptom of OSA) and help improve the field's understanding of the sleep behaviors of military servicemembers.

Thus, to better address our first research question and build upon the current literature on the prevalence and consequences of sleep problems in servicemember populations, we administered a sleep survey to participants in an existing study of a large and diverse sample of servicemembers across all four branches and all components of the U.S. armed forces (The Deployment Life Study; Tanielian, et al., 2014), as discussed in Chapter Three.

In this large sample, we found a high prevalence of insufficient sleep duration and poor sleep quality, as well as notable sleep-related daytime impairments, including daily experience of fatigue, which can compromise operational readiness and overall functioning. Use of sleep medications was also relatively high (i.e., 18 percent), despite limited empirical support for the efficacy and safety of such medications in servicemember populations specifically.

Somewhat surprisingly, we found few significant differences in sleep based on deployment history; however, we did find differences in sleep based on exposure to combat. In particular, in the Army sample, we found no significant differences in sleep among the deployment subgroups (never deployed, currently deployed, and previously deployed), but this may be because of the small sample sizes in the “never deployed” and “currently deployed” subgroups. Among our Navy sample, we found that Navy servicemembers with prior deployments had greater sleep-related daytime impairment than Navy servicemembers without a prior deployment. For combat exposure, our results were consistent with the previous literature: Higher levels of exposure to combat were associated with poorer sleep quality and greater frequency of reporting repeated, disturbing dreams among those who experienced a traumatic event.

In analyzing the outcomes associated with poor sleep, we found that both poor sleep quality and sleep-related daytime impairment were associated with poor physical health, probable depression, probable PTSD, and lower perceived unit readiness. Short sleep duration was associated with all the outcomes except an increased risk of prob-

able PTSD. Daytime fatigue was also associated with a greater risk of probable depression and poor physical health. Such associations were generally moderate in magnitude (in terms of effect sizes) and demonstrate the independent association between sleep problems and these outcomes, even after controlling for a host of covariates that may explain the associations.

Despite these suggestive findings, there are still notable limitations in our analyses and in the extant literature that should be addressed in future studies of sleep in the military. In particular, the field still lacks rigorous longitudinal studies that track servicemembers pre-deployment to post-deployment and that would provide evidence of the role of deployment as a *causal* contributor to developing sleep problems post-deployment. Findings from such studies would also provide evidence to support decisions about which policy efforts and resources should be devoted to programs and practices that seek to prevent and treat lasting sleep problems after the inevitable poor sleeping conditions during deployment. There is also a need for studies involving objective measures of sleep, as well as objective indicators of fatigue, to provide more conclusive demonstrations of the impact of sleep problems and associated daytime consequences on key indicators of operational readiness and servicemember mental and physical health. These and other suggestions for the continued systematic study of sleep in the military are included in the recommendations that follow.

What Are the Current Policies and Programs Related to Sleep in the Military?

In Chapter Four, we identified four types of policies or programs related to sleep—prevention, medical, training, and operational. Policies on the minimum number of hours of sleep required are not necessarily up to date with current research and clinical recommendations and are often embedded in broad policies on general resilience, stress management, or other mental health topics rather than focused on sleep-related behaviors.

While training policies were the most uniform in terms of the duration of sleep recommended (seven to eight hours), they focused on the initial training pipeline; subsequent training schools did not necessarily have policies related to sleep. Operational policies, the most common type of policies identified, focused on prescribing shift-work cycles and duration of rest periods. Operational policies mandate sleep plans, but they do not give leaders further guidance on how to structure sleep plans. Further, there was inconsistency in how much emphasis was placed on sleep in each occupational area within the Services. This inconsistency may create conflict for leaders trying to integrate work schedules or manage shift work in a joint environment.

Overarching DoD medical policies related to sleep primarily set medical standards and qualifications for initial military service or referral to a medical evaluation board. Service-specific and VA medical policies on treating sleep disorders primarily mention sleep as a symptom of other conditions; no policies address continuity of care from deployment to the post-deployment period. No policies were found outside of

larger reintegration or stress management guides that specifically referenced policies related to sleep in the post-deployment period. The Army Performance Triad program is perhaps the most comprehensive effort to date to promote sleep health from a prevention perspective. Although the efficacy of this program has not yet been evaluated, research efforts are under way. The program may be a useful platform for the other Services to develop similarly comprehensive sleep health promotion programs.

What Are the Evidence-Based Interventions to Treat Sleep Disorders Among Servicemembers?

The review of evidence-based interventions for sleep disturbances in servicemembers identified several promising non-pharmacologic (i.e., behavioral or cognitive-behavioral) interventions. In particular, CBT-I and IRT have been shown to be efficacious treatments for insomnia and nightmares, respectively, which are two of the most common types of sleep disturbances experienced by servicemembers in the post-deployment period. Unfortunately, there are significant gaps between guidelines from scientific studies and current practices within DoD. In particular, pharmacologic therapies (e.g., sleep medications) continue to be the front-line treatment prescribed by many providers (Schmitz, Browning, and Webb-Murphy, 2009), though there is scant evidence on the efficacy of these treatments in treating servicemember sleep disturbances and known side effects to these medications, including daytime fatigue; such side effects are particularly concerning in operational contexts and in certain occupations, which require sustained attention and cognitive vigilance. A lack of dissemination of efficacious cognitive-behavioral therapies to servicemembers—which is partly the result of a critical shortage of trained providers in behavioral sleep medicine techniques and a lack of provider awareness of the efficacy of these programs—are critical issues that should be addressed. Hiring a greater number of qualified behavioral health specialists and creating more clinical training opportunities could help decrease this shortage. However, further research using robust RCTs and participants from military populations is also greatly needed to establish best-practice guidelines for treating servicemembers and veterans specifically.

What Are the Barriers to Achieving Healthy Sleep for Servicemembers?

As noted in Chapter Six, even with the best evidenced-based best practices and programs to prevent and treat sleep problems in servicemembers and codified policies related to sleep, cultural, environmental and operational, and individual (knowledge-related) barriers across the military context may impede efforts to promote sleep health in servicemember populations; medical and treatment systems barriers may also impede such efforts.

An ongoing challenge is that military cultural attitudes have historically tended to discount the importance of sleep. These cultural attitudes can serve as significant barriers to implementing healthy sleep practices across the continuum of sleep health,

including prevention, identification, and clinical management, and across operational and medical system contexts. For instance, stigma associated with expressing a greater need for sleep may deter servicemembers from self-identifying or seeking help before a sleep problem becomes chronic and debilitating. In operational contexts, the military emphasizes mission first, and the need for sleep may be perceived as a sign of weakness. Manpower limitations can also compound the operational demands faced by military leaders and servicemembers; even where sleep policies are in place, leaders may not have sufficient manpower to allow for proper sleep—an issue that is particularly salient, given the high OPTEMPO of recent years. Above and beyond operational barriers, operational settings are barriers themselves because they are often uncomfortable, noisy, and otherwise challenging environments. And sleep policies, even when implemented, may be interpreted as guidance secondary to operational demands.

Our research suggested that a lack of knowledge about the importance of sleep behaviors was a barrier to recognizing and addressing sleep problems. Such lack of knowledge or awareness is partly the result of limited education and training among leadership about the importance of sleep and the lack of a centralized, DoD-wide resource on how to identify and manage sleep problems, as well as how to develop and implement a sleep plan.

Finally, the military medical and treatment systems experience challenges because of a lack of adequate screening tools, procedures, and systems for detecting sleep problems in military contexts. In addition, both continuity of care and sleep provider and clinic shortages were noted as barriers to promoting sleep health in servicemember populations.

Understanding these barriers is critical to making well-informed and robust policy recommendations related to the prevention, identification, and clinical management of sleep problems and the promotion of sleep health in both operational and training settings.

Recommendations

In this section, we offer recommendations for filling gaps and overcoming barriers to achieving healthy sleep among servicemembers. Recommendations are organized to reflect opportunities for programs and policies to promote sleep health in multiple contexts, including both operational and medical or clinical settings, and across a continuum of care from prevention to identification and intervention. Table 7.1 summarizes the recommendations discussed below in more detail. These recommendations should be addressed collectively by individual servicemembers, unit leaders, the military health system, training and operational commands, military health researchers, and DoD at large.

Table 7.1
Recommendations to Promote Sleep Health

Prevent Sleep Problems
<ol style="list-style-type: none"> 1. Increase servicemember and line leader education about healthy sleep behaviors to increase self-awareness and knowledge about the factors that inhibit or promote adequate, restful sleep. 2. Fund or conduct research to perform longitudinal studies on sleep and effects on operational readiness and resilience.
Increase Identification and Diagnosis of Sleep Problems
<ol style="list-style-type: none"> 3. Educate families on signs and symptoms of sleep disturbances as a way to bolster sleep detection efforts. 4. Improve screening for sleep disturbances in primary care settings, including the routine use of validated screening tools to identify those at high risk for the broad range of sleep disorders.
Clinically Manage Sleep Disorders and Promote Sleep Health
<ol style="list-style-type: none"> 5. Develop provider education programs on preventing, identifying, and treating sleep disorders, with a focus on giving providers the latest findings in the field of sleep science to effectively advise patients on sleep issues and a focus on <i>prevention</i> as well as <i>treatment</i>. 6. Develop a clinical practice guideline for sleep disorders that specifically addresses sleep and discusses prevention, identification, and treatment of sleep disorders. 7. Increase the use of mobile technology for assessing and clinically managing sleep disorders, in particular to monitor sleep and alertness and to identify and manage sleep disorders before they become chronic or debilitating. 8. Continue to research evidenced-based practices for advancing healthy sleep in military populations (e.g., mindfulness, teletherapy) and establish guidelines for treating servicemembers and veterans. 9. Enhance dissemination of evidence-based sleep treatments (e.g., CBT-I, IRT) by training providers in primary care settings as well as behavioral health clinics. 10. Improve continuity of care of sleep disorder treatments, such as through the use of electronic medical records that link records across the deployment cycle.
Improve Sleep in Training and Operational Contexts
<ol style="list-style-type: none"> 11. Make appropriate revisions to existing training and operational policies to minimize inconsistencies and align with current clinical guidelines about optimal sleep duration that recommend that the amount of sleep required among civilians is eight hours. 12. Educate line leaders on creating sleep plans that align with current research on circadian rhythms, consider the physical sleeping environment, and factor in shift schedules of roommates or tent-mates when assigning duty. 13. Create standardized operational and training policies across DoD to increase sleep duration and quality and reduce fatigue-related impairment. 14. Link sleep-related surveillance data on mishaps to evaluate the role of sleep and fatigue. 15. Prioritize sleep in re-integration policies to offer servicemembers a period of recuperation during which they might be able to begin to return to normal sleep habits and potentially prevent the onset of chronic sleep problems that develop well after the initial re-integration period. 16. Disseminate positive messaging about sleep as an operational imperative (a vital sign, such as blood pressure) to increase awareness and reduce cultural barriers.

Recommendations to Prevent Sleep Problems

Our review of the literature and sleep policies and practices in the military, discussions with key informants, and working group proceedings found no evidence-based practices to prevent sleep disorders in military or civilian populations, except possibly for weight loss and management strategies that also reduce the risk of OSA. This lack of prevention efforts is consistent with the history of sleep medicine and medicine in general, which has tended to focus on the treatment of manifest physical illnesses or disorders rather than on promoting health—a differing view that has just recently been suggested (Buysse, 2014). However, just as overall health is not merely the absence of disease, sleep health is not merely the absence of sleep disorders. Prevention efforts also have the advantage of reaching a broader audience than what we see in the context of a medical or clinical setting. Changing the military culture’s perception of sleep needs is the first step toward developing best practices for sleep prevention. At the individual level, limited understanding or awareness of the effects of sleep deprivation or disturbances on performance may also serve as barriers. Finally, the lack of evidence linking fatigue to suboptimal mission performance is a barrier to demonstrating the importance of sleep and contributes to poor messaging about the importance of sleep. Thus, we provide several recommendations to support prevention efforts, with the ultimate goal of promoting sleep health.

Increase Servicemember and Line Leader Education About Healthy Sleep Behaviors

A key to prevention is self-awareness and knowledge about the factors that inhibit or promote adequate, restful sleep. Many servicemembers are in a high-risk period in life (i.e., ages 18–35) for engaging in a number of behaviors that are counterproductive for achieving high-quality sleep or sufficient sleep duration, including the use of highly caffeinated energy drinks or products, the use of alcohol or other substances, irregular sleep schedules and daily routines, and frequent use of highly stimulating video games. Thus, providing education on factors that facilitate or interfere with healthy sleep is critical. Educational efforts to promote sleep hygiene are necessary, but not sufficient, for treating sleep problems, however. For example, evidence suggests that sleep hygiene treatment alone is not efficacious for insomnia (Moss, Lachowski, and Carney, 2013). Nevertheless, providing sleep hygiene education is a key step to promoting sleep health and preventing sleep disorders from a public health perspective.

There are at least two venues within which to disseminate these educational programs. The first is in operational and training settings. Existing operational and training policies provide guidance to line leaders on what is the sufficient amount of sleep required for servicemembers. However, these policies focus on prescribing rest periods, which do not necessarily translate to adequate, high-quality sleep. As such, these operational and training policies related to sleep must be accompanied by educational programs that remove barriers to achieving sufficient and high-quality sleep. These include programs that increase awareness among line leaders and servicemembers of the need

to remove environmental barriers (noise, light) and behavioral barriers (refraining from use of electronics and caffeinated beverages near sleep times) to achieve quality sleep. While sleep hygiene briefings are available for military personnel, few may actually receive these skill-focused briefs. In one study of Army officers, 80 percent reported not receiving sleep management briefings during deployments (Miller, Shattuck, and Matsangas, 2011). Expert working group attendees and key informants suggested that the most effective way to disseminate this information is to provide it throughout training and in different operational contexts.

The Army Performance Triad model provides a useful model for incorporating education about healthy sleep in the context of other key health behaviors, such as physical activity and nutrition. Many of our interviewees also stressed that senior leader buy-in is essential to encouraging healthy sleep behaviors and that responsibility should be instilled for enforcing good sleep behavior at all levels, from command down to squad and team leaders and, ultimately, to individual servicemembers. Without leadership education and buy-in, efforts to emphasize the value-added of sleep would be unsuccessful. Leaders are in a unique position to promote sleep health efforts. This can be achieved by modeling healthy sleep behaviors for others, modifying schedules to provide more opportunities for adequate sleep environments without disruption, promoting and encouraging the use of programs for those needing help with sleep problems (either alone or as a symptom of a mental health concern), and counteracting messages that “sticking it out” despite feeling tired is a sign of mental toughness.

The second node to promote and disseminate educational materials is through a centralized repository at the DoD level or, at the very least, the Service-specific level, as some Services have done (Navy and Marine Corps Public Health Center, undated[b]). This repository would store regularly updated and expert-vetted educational materials and resources about sleep and would serve as a readily identifiable source if a servicemember has questions about sleep needs, wants tips on how to achieve better sleep in operational or post-deployment settings, or needs guidance on where to go if he or she is experiencing sleep problems.

Ultimately, however, the onus is on the servicemember to ensure the proper amount of sleep when given the opportunity to do so in an appropriate environment and to engage in behaviors that are conducive to healthy sleep. Providing adequate opportunities to sleep, evidence-based prevention and intervention programs, and education on healthy sleep behaviors and having leaders emphasize that sleep health is a priority for one’s health and military readiness can help establish the importance of sleep for servicemembers at all phases of the deployment cycle.

Fund/Conduct Longitudinal Research on Sleep and Downstream Effects on Operational Readiness and Resilience

Our literature review (Chapter Two) and primary data collection (Chapter Three) on the correlates and consequences of sleep problems indicated that there is (1) a lack

of longitudinal research on precipitating factors that precludes identifying prevention targets and (2) an inability to clarify whether sleep problems exist prior to deployment because within-person studies have not tracked sleep across the deployment cycle. Based on cross-sectional findings reported in Chapter Three that sleep quality and sleep-related daytime impairments, as well as sleep duration, are important correlates of servicemember mental and physical health and perceived readiness, longitudinal studies should incorporate broader assessments of sleep (rather than focusing on sleep duration, solely) and their linkages with resilience. Future studies that contribute to prevention efforts should track sleep across the deployment cycle and should also augment current survey approaches with the use of objective measures as well as validated measures of sleep, rather than relying on single- or few-item assessments that cannot capture the multidimensional nature of sleep. Longitudinal studies with military samples are needed to understand how preserving healthy sleep patterns (e.g., by banking sleep or establishing healthy patterns pre-deployment) can effectively help reduce sleep problems after deployment and strengthen resilience to sleep and mental health problems. Indeed, the civilian longitudinal literature reveals that sleep problems can lead to further mental health problems; research establishing how healthy sleep can protect against development of mental health problems in military populations is an area ripe for future work.

Finally, more research is needed to determine how perpetuating factors (e.g., use of caffeine to combat daytime fatigue), adopted either during deployment or after deployment, contribute to long-term sleep problems in the post-deployment period, as these may be targets for subsequent intervention efforts.

Recommendations to Increase the Identification and Diagnosis of Sleep Problems

We identified several factors that may facilitate the detection of sleep disturbances, including the family as a key mechanism for detection, primary care as a key setting for detection, and the use of objective assessments to quantify insufficient sleep and fatigue.

Educate Families on Signs and Symptoms of Sleep Disturbances

Servicemembers' families are particularly important in detecting sleep disturbances, especially during the post-deployment period; thus, targeting them for education before servicemembers return home may be promising. Literature supports bed partners' prominent role in diagnosing sleep disorders, including OSA, which has been referred to as "a disease of listeners" (Brin et al., 2005; Schmaling and Afari, 2000). Such a label connotes not only the importance of including the bed partner as an important source of corroborating data in the initial sleep evaluation, but it also suggests that OSA is a disease that exacts a toll on the dyad, not just the patient (Bonekat and Krumpke, 1990; Troxel, Robles, et al., 2007). In analyses reported in Chapter Three, we showed that bed partner-reported loud snoring was associated with poorer physical health among

servicemembers. Thus, educating spouses or close family members on sleep problems is an effective means for bolstering sleep detection efforts. At the same time, sleep disturbances may simply not be detected or acknowledged by servicemembers who are single or living alone, which highlights the need for comprehensive sleep assessments that can capture symptoms the individual is aware of (e.g., daytime sleepiness) and symptoms that can be assessed by a clinician and that are known risk factors for sleep disorders (e.g., BMI).

Improve Screening for Sleep Disturbances in Primary Care Settings

Most patients with sleep problems initially present in primary care settings. Thus, primary care visits represent a critical opportunity for the early identification and detection of sleep disturbances, as well as for their treatment. Lack of time in traditional primary care visits and lack of provider knowledge of sleep disorders were identified (in Chapter Six) as critical barriers to the early identification of sleep problems by providers. Thus, the use of brief, validated screeners in the primary care setting may facilitate identification efforts, even in the context of constrained clinical settings. There are no standardized assessment tools specific to the military, and no tools that can risk-stratify servicemembers with various sleep issues—from short sleep duration to clinically significant sleep disorders. A new, standardized, DoD-wide brief intake questionnaire with standardized cut-points indicating clinically meaningful sleep problems would help inform servicemembers whether their current sleep habits fall below the cut-point and whether further medical evaluation is needed. In addition to broad primary prevention efforts, clinical screening should also be targeted to those with high-risk military operational skills, including those in high-combat-exposed occupations and shift workers.

Given the high prevalence of insomnia in servicemember populations and comorbidity with other mental health conditions or TBI, many providers ascribe sleep disturbances solely to insomnia or a comorbid mental health condition or TBI. Therefore, providers may delay or forgo recommending a full diagnostic PSG because it is not routinely recommended in diagnosing insomnia except to rule out other sleep disorders, such as OSA. However, recent research in military populations suggests that the incidence of OSA is increasing and that approximately 38 percent of servicemembers diagnosed with OSA also have comorbid insomnia (Brundage, Wertheimer, and Clark, 2010; Mysliwiec, Gill, et al., 2013). Such delays in screening for the broader spectrum of sleep disorders may serve to exacerbate other comorbid conditions and may result in less-than-optimal treatment responses. Thus, validated screening tools should be routinely used to identify those at high risk for the broad range of sleep disorders.

Recommendations for Clinical Management of Sleep Disorders and Promotion of Sleep Health

Our study also suggests a need to improve the education of health providers in diagnosing and treating sleep and fatigue problems to better disseminate evidence-based practices; to improve education to help servicemembers engage in healthy sleep-related behaviors, including the appropriate use of stimulants and sleep medications; and to systematically evaluate promising programs and intervention approaches, including the use of technology to monitor and treat sleep disturbances. Policies that support provider training and that provide incentives for specialized sleep medicine training are needed to fill gaps in provider capabilities and to ensure that there are a sufficient number of trained providers who are able to confidently deliver care related to the prevention, identification, and treatment of sleep disorders among military populations. We offer a series of recommendations in line with these findings.

Develop Provider Education Programs on Preventing, Identifying, and Treating Sleep Disorders

Proper education of military health care providers and allied professionals, such as chaplains, occupational therapists, nurses, and paraprofessionals, is essential to prevent, identify, and clinically manage sleep disturbances. Military health and mental health care providers reportedly occupy a key role in educating servicemembers and may benefit from knowledge of the latest findings in the field of sleep science to effectively advise patients on sleep issues. Some informants reported that physicians do not receive in-depth training on sleep or sleep disorders while in medical school or that the training they do receive is brief and hard to remember. Moreover, informants highlighted training courses that focus on treatment, but very few, if any, of these programs focus on prevention. Our study suggests a need to improve the education of health providers in diagnosing and treating sleep and fatigue problems and to improve education to help servicemembers engage in healthy sleep-related behaviors, including the appropriate use of stimulants and sleep medications.

Develop a Clinical Practice Guideline for Sleep Disorders

Medical publications related to sleep primarily mention sleep as a symptom of other conditions, mainly mental disorders. This structure does not account for a large and growing body of research summarized in Chapter Two that sleep may be a *precipitating factor* for mental disorders and that treatment of sleep problems may actually also improve symptoms of mental disorders, such as PTSD. New medical policies are needed, such as a clinical practice guideline that specifically addresses sleep and discusses preventing, identifying, and treating sleep disorders. These medical policies for military populations should build on existing American Academy of Sleep Medicine (AASM) practice guidelines provided for the general population. Medical policies should also address the use of stimulants and sleep medications with consistent guidance.

Key informants expressed fear of negative career consequences if they self-identified as having a mental disorder. Thus, new medical policies that focus on sleep may be a way to combat stigma associated with treatment-seeking, which may be lower for sleep than for mental disorders, which may, in turn, have downstream benefits for other co-occurring conditions. Indeed, research with both civilians and veterans suggests that targeting sleep disorders, such as insomnia or nightmares, may also have effects on reducing mental health problems that servicemembers may be more resistant to seek help for, such as PTSD and depression (Manber, Edinger, et al., 2008; Nappi, Drummond, and Hall, 2010; Ulmer, Edinger, and Calhoun, 2011). The role of sleep may not only be a prodromal symptom that can herald the onset of other mental health disorders; it may also be a possible entry point to enhance treatment-seeking for populations in need, who may otherwise be resistant to treatment.

Increase the Use of Technology for Assessing and Clinically Managing Sleep Disorders

Subjective self-identification of sleepiness and sleep disorders through brief screening surveys may not provide a useful index of a servicemember's ability to perform effectively or safely. A more promising approach than simply asking individuals about their sleep disturbances would be to use objective techniques to monitor sleep. This could be accomplished through the use of technology for monitoring sleep and alertness to help individuals monitor sleep behaviors and detect sleep problems early, before they become chronic or debilitating. There are numerous commercial off-the-shelf tools, such as wristwatches, wristbands, and other devices, that military personnel could use to monitor their sleep/rest cycles; however, these instruments need to be validated before broader dissemination is recommended. The use of telehealth strategies may also facilitate dissemination efforts; again, more research is needed on their efficacy and safety, particularly for individuals with comorbid conditions. Developing and validating assessment tools to facilitate self-identification of sleep problems could also facilitate self-monitoring of healthy sleep behaviors and could identify sleep problems in the early stages, when they may be more amenable to treatment. Recognizing behaviors through self-assessment and education may help both servicemembers and military leadership initiate healthier sleep practices and reduce maladaptive behaviors, such as the use of alcohol or sedatives, prior to the onset of long-term sleep problems.

Continue to Research Evidenced-Based Practices for Advancing Healthy Sleep in Military Settings

We recommend creating a dedicated research agenda aimed at improving the evidence base for advancing best practices and for evaluating existing programs and validating current and emerging technologies for assessing, treating, and monitoring sleep issues, specifically in military populations, because operational constraints may limit the efficacy or feasibility of strategies developed for civilian populations. Robust RCTs within military settings are also greatly needed to establish best-practice guidelines

for treating servicemembers and veterans specifically. There is also a need for further research to evaluate the efficacy of innovative and promising treatment techniques that may fill treatment delivery gaps and be preferred by servicemembers, such as video teletherapy, therapies delivered through mobile technology, and CAM techniques (e.g., meditation).

Enhance Dissemination of Evidence-Based Treatments

One potential model for DoD to employ is to integrate sleep providers into primary care so that the nature of sleep problems can be thoroughly evaluated and a range of treatments, including evidence-based behavioral treatments, can be provided in the primary care setting, where patients are most likely to present with sleep disturbances. The challenge, however, is that traditional CBT for insomnia is conducted over six to eight sessions by a specially trained provider, which may not be feasible in the primary care setting. The military may wish to pursue brief behavioral treatments (i.e., one to two sessions) designed to be delivered in primary care settings by nurses or other health care professionals with limited training in sleep medicine—treatments that have shown promising efficacy in civilian populations with chronic insomnia (Troxel, Germain, and Buysse, 2012; Buysse, Germain, et al., 2011).

There is an additional need for further research on the dissemination of brief behavioral treatments in military primary care clinics, such as that described by Goodie and colleagues (2009). Behavioral health clinicians already assigned to larger clinics may be well-suited to deliver brief interventions for insomnia in addition to their existing assessment and intervention duties. However, additional training for these clinicians will be necessary, as well as further evaluation of the efficacy of this approach. Providing these additional services in the primary care setting will help offset the shortage of specialty sleep clinics and the difficulty of accessing specialty treatment, but will also increase costs. However, these costs will likely be outweighed in the long term by the savings from recovered health and productivity of individuals who suffer from insomnia. In the general population, the direct and indirect costs of untreated sleep disorders are estimated in the billions of dollars (Institute of Medicine Committee on Sleep Medicine and Research, 2006). Direct costs stem from increased healthcare utilization, prescriptions, and over-the-counter medications. Indirect costs may be caused by increased absenteeism, disability, work-related accidents and injuries, motor vehicle accidents, decreased productivity and operational effectiveness, and illness-related morbidity and mortality. Further research is needed to quantify the costs and benefits of brief behavioral treatments for insomnia in servicemember and veteran populations.

Improve Continuity of Care of Sleep Disorder Treatments

A main finding in our policy review was a lack of policies specifically related to sleep that address continuity of care of sleep problems from deployment to the post-deployment period. Electronic medical records, like the Armed Forces Health Longi-

tudinal Technology Application system, that link records across the deployment cycle may be able to address this continuity of care barrier.

Recommendations to Improve Sleep in Training and Operational Contexts

Operational missions are often viewed as being at odds with sleep, but in reality, they are mutually supportive efforts. As noted in Chapter Four, in general, the policies related to sleep are Service-specific, sometimes inconsistent, and not specifically tied to the post-deployment setting. However, there are clearly unique challenges to sleep in the post-deployed setting, and it is in this context that chronic and debilitating sleep disorders are likely to manifest. Even codified sleep policies at the DoD and Service levels may not be properly communicated or enforced uniformly. Key informants suggested that where guidance does exist, clinical sleep terms are often difficult to translate into understandable and relevant operational language. Thus, efforts need to be made to communicate guidance related to sleep in terms that are actionable and consistent with, and coherent within, an operational framework.

While careful review and revision of existing policies and the development of new policies may be warranted, our key informants expressed concern that if new policies are developed, they should not be overly prescriptive nor punitive and should be consistent with operational policies and any older policies that may take precedent over new guidance that competes with legacy policies. As such, we provide recommendations that minimize the necessity for new policies; when new policies are recommended, they are not intended to be punitive. These new policies should be carefully considered to ensure consistency with existing operational policies. In some cases, new policies cannot be undertaken in isolation from others and may require grouping with complementary policies to ensure maximum impact.

Revise Existing Training and Operational Policies to Align with Current Clinical Guidelines About Optimal Sleep Duration

Operational policies that dictate four hours of sleep are not in line with current research on circadian rhythms and clinical recommendations and should be modified to concur with policies that recommend eight hours of sleep for civilians (DHHS, 2005). In addition, while entry-level training policies in each of the Services had the most consistent guidance on sleep duration, we found that not all subsequent training schools had policies related to sleep. As such, training policies should outline guidance on sleep for training throughout the military training and education establishment.

Educate Line Leaders on Creating Sleep Plans

While some operational and training policies do provide specific guidance on the minimum number of hours of sleep, the policies do not say how to achieve that goal. Programs are needed to educate line leaders about how to create and implement sleep plans that align with current research on circadian rhythms, consider the physical sleeping environment, and factor in the shift schedules of roommates or tent-mates

when assigning duty. These programs are needed not only at the Service level and for various occupation types but also DoD-wide to ensure consistency in sleep duration recommendations, shift work, and sleep plans to facilitate smooth operations in a joint environment.

Create Standardized Operational and Training Policies Across DoD to Increase Sleep Duration and Quality and Reduce Fatigue-Related Impairment

Our policy analysis, key informant interviews, and expert working group collectively suggested that there is a need for standardized policies across the Services on sleep, such as what we see in Service-specific operational stress manuals. Specifically, operational and training policies may be implemented most efficiently if DoD created overarching, less prescriptive operational sleep guidance that allowed the Services to tailor the overarching policies to meet their needs with more restrictive and occupation-specific guidelines.

While creating new policies in general were not widely supported by our qualitative data analyses, one new policy that was suggested was to create strategies to mitigate sleep debt when high operational demands may preclude opportunities for sleep. For instance, when operational demands interfere with opportunities for sufficient sleep, policies that support purposeful efforts to make up “sleep debt” as soon as possible after a prolonged mission may be one way to help balance operational demands with priorities for sleep. Field work has also indicated that frequent and opportunistic naps may help mitigate the possible effects of fatigue during the day (Ferguson et al., 2008), while “banking sleep” prior to a period of sleep deprivation can assist in performance during that period of limited sleep (Wesensten and Balkin, 2013). Encouraging work that has been done with Army recruits and shipboard Navy sailors suggests that changing operational schedules to align with circadian rhythms and increase sleep opportunity can have positive effects on self-reported sleep quality and duration (Miller, Matsangas, and Kenney, 2012; Miller, Tvaryanas, and Shattuck, 2012) and operational performance (Cordle and Shattuck, 2013). Policies that incorporate these research findings should explicitly highlight the inherent challenges in obtaining sufficient sleep in the deployed setting but should also stress the critical need to optimize adequate sleep in the post-deployed setting to mitigate fatigue-related operational impairment.

Link Sleep-Related Information to Data on Mishaps

One of the main barriers to prioritizing sleep in the military is the inability to prove the value-added of getting sufficient sleep. The use of technology to quantify sleep and vigilance in real-time, real-life contexts can help demonstrate that adequate sleep is required to perform optimally and would be a key step toward changing cultural attitudes and individual beliefs about sleep. Conversely, proving the negative impacts of insufficient sleep may also change cultural attitudes. For better or worse, economics often drive policy development; thus, when accidents occur, costs to human life and equipment may spur policy changes. Our study suggested that one way to overcome

this barrier is to collect more comprehensive data about the role of fatigue in accidents. DoD currently has a mishap investigation and analysis tool known as the Human Factors Analysis and Classification System. However, information on the possible role of sleep deprivation is not routinely collected when mishap data are gathered. By linking these data, the military could assess whether sleep factors were involved by logging the time of day when the incident occurred, examining the 72-hour sleep histories of the individuals involved, and then making a determination about the likely role played by insufficient sleep. This policy should be supplemented by data dissemination (e.g., via briefings) to top commanders and operational leadership to demonstrate the impacts of sleepiness and fatigue on performance and to encourage their support and advocacy of these recommendations.

Prioritize Sleep in Reintegration Policies

Existing policies that impact sleep in the post-deployment period are issued in the immediate post-deployment reset period and are general resilience initiatives or time-off policies. These policies are localized at the tactical and operational command levels and dictate time off that servicemembers may be allotted immediately following their return from a deployment or extended training period. In theory, the policies were not necessarily designed with sleep benefits in mind, but modifying them to incorporate more specific guidance on sleep may help servicemembers achieve healthy sleep in the post-deployment period. Aspects that could be incorporated into these reset policies include guidance on engaging in healthy sleep-related behaviors during reintegration through educational programs and more integrated medical and psychological health services and resilience programs. The intention in modifying these policies would be to offer servicemembers a period of recuperation during which they might be able to begin to return to normal sleep habits and potentially stave off the onset of chronic sleep problems that develop well after the initial reintegration period.

Disseminate Positive Messaging About Sleep as an Operational Imperative to Increase Awareness and Reduce Cultural Barriers

One potential way to change how sleep is viewed is to change the terminology used to discuss it. Using the analogy of “heat casualties” that result from insufficient hydration in the presence of high temperatures, the military can refer to individuals whose performance suffers from insufficient sleep as “sleep casualties.” This use of terminology emphasizes the point that sleep-related performance decline does not reflect weakness or a lack of discipline but, rather, a failure to meet a basic biological need. When sleep is viewed as an imperative and not as a deterrent through educational campaigns and broader public awareness, cultural and stigma barriers may slowly disintegrate. These messages about the value of sleep as a component of readiness (e.g., “operational sleep”) should be incorporated into all levels of Professional Military Education curriculums to present the ideas early and often in servicemembers’ careers. In addition, key informants suggested referring to sleep as another vital sign, just as blood pressure, pulse

and respiratory rates, and body temperature are vital signs. The VA has used “Pain as the 5th Vital Sign” in its toolkit for conducting pain assessments, and the same could be applied to sleep (VA, 2000).

Table 7.2 shows where the recommendations discussed above fit within the continuum of sleep health promotion that runs from prevention to identification, clinical management, training, and operations. As the table shows, most of the recommendations are specific to one of the four categories. However, two of them—disseminate positive messaging about sleep and increase servicemember and line leader education about health—cut across all four categories, while one of them—develop provider education programs—cuts across the first three categories.

Final Words

Given the recent drawdown from combat operations in Iraq and Afghanistan, increasing attention has focused on factors that promote or hinder servicemembers’ ability to reintegrate and rebuild their lives post-deployment. This study indicates that insufficient sleep duration, poor sleep quality, and sleep-related daytime impairment are pervasive problems in the military, even more so than they are in society as a whole. These findings are critical for DoD to consider in light of the solid scientific evidence that shows that sufficient, high-quality sleep is critical for mission readiness and that the lack thereof increases risk for adverse mental and physical health consequences, including depression, PTSD, obesity, diabetes, cardiovascular disease, accidents, and injuries.

Table 7.2
Recommendations to Promote Sleep Health

Prevention	Identification	Clinical Management	Training and Operations
Disseminate positive messaging about sleep			
Increase servicemember and line leader education about sleep health			
Develop provider education programs			
Fund/conduct longitudinal studies on sleep and health/operational readiness	Improve screening in primary care Educate families on signs and symptoms	Develop CPGs Increase the use of technology Continue to research evidence-based practices Enhance dissemination of evidence-based treatments Improve continuity of care	Revise existing training and operational policies Create standardized operational and training policies Link sleep-related information to data on mishaps Prioritize sleep in reintegration policies Educate line leaders on creating sleep plans

Historically, sleep problems have been viewed merely as a symptom, secondary to other co-occurring mental health conditions. However, sleep problems are both a symptom of virtually every mental health diagnosis of most concern to DoD, including depression, PTSD, and TBI, and can also presage the development of psychological disorders and suicidality. Left untreated, sleep problems are among the most intractable symptoms in the context of other co-occurring mental health conditions and can predict poorer treatment outcomes and increased risk of relapse in depression. Yet evidence-based practices to treat and prevent sleep problems among servicemembers are limited in their demonstrated efficacy and accessibility. Unfortunately, sleep is traditionally viewed as a luxury by military populations—which can undermine efforts related to the prevention, identification, and treatment of sleep problems.

This report presents 16 overarching policy recommendations to improve the prevention, identification, and treatment of sleep problems in servicemembers. Individual servicemembers, unit leaders, the military health system, training and operational commands, and DoD at large are encouraged to undertake these policy recommendations collectively. Implementing these recommendations must go hand in hand with better messaging about the biological and operational necessity of sleep to overcome knowledge-related, cultural, medical, and operational barriers to ensuring that servicemembers achieve healthy sleep. Such an integrated approach will be critical to targeting one of the most important factors contributing to the resilience and operational readiness of the U.S. military.

Sleep Terminology

In our report, we use common terminology used to describe sleep parameters and sleep disturbances. The definitions commonly used in the sleep literature are included below to help guide the readers through the report. This appendix does not contain an exhaustive inclusion of all sleep parameters and disturbances; rather, it is a description of the sleep terms used within this report. For example, we focus on the sleep disorders typically studied and diagnosed within the military population. There are more than 80 clinical sleep disorders recognized in the International Classification of Sleep Disorders (American Academy of Sleep Medicine, 2005) diagnostic manual for sleep disorders. Readers are referred to this manual for further reading about sleep disorders and sleep parameters outside the scope of this report.

In addition to defining the terms, we include common measures used in the military sleep literature to assess the sleep parameters and disturbances relevant to post-deployed servicemembers as part of our literature review to inform the creation of the sleep survey and subsequent analyses (see Chapter Five). A more detailed description of these measures, including psychometric properties, is found in Appendix D.

Diagnosed Sleep Disorders

The two most commonly diagnosed sleep conditions in the military population are insomnia and OSA. Medical record review and clinician interview are the standard for assessing diagnosed condition, but these are not typically available outside clinical samples.

Obstructive Sleep Apnea

OSA is defined as the cessation of airflow during sleep preventing air from entering the lungs caused by an obstruction. OSA only happens during sleep, as it is a lack of muscle tone in your upper airway that causes the airway to collapse. During the day, individuals have sufficient muscle tone to keep the airway open, allowing for normal breathing. When one experiences an episode of apnea during sleep, the brain will automatically wake one up, usually with a very loud snore or snort, in order to breathe again. People

with OSA will experience these awakening episodes many times during the night and consequently feel very sleepy during the day and they have an airway that is more likely to collapse than normal. In military studies, OSA is generally measured with polysomnography activity in a controlled sleep laboratory or with the self-report Berlin Questionnaire and the STOP-BANG questionnaire (Ahmadi et al., 2008; Chung et al., 2008). One of the difficulties related to the self-reported assessment of OSA, however, is that individuals are often unaware of their symptoms (e.g., snoring and breathing patterns, unusual sleep motor activity and daytime consequences from sleep deprivation). Roommates or bed partners, however, can provide objective information with regard to the frequency and severity of the patient's condition (Morgan, Kucharczyk, and Gregory, 2011; Falloon et al., 2011; Sivertsen et al., 2010).

Insomnia

The term *insomnia* is used in the research literature to refer both to the diagnosable condition itself and the symptoms manifested by the disorder. Symptoms of insomnia include difficulty falling asleep, frequent or prolonged awakenings, inadequate sleep quality, or short overall sleep duration in an individual who has adequate time available for sleep. In contrast, an *insomnia disorder* is a syndrome consisting of the insomnia complaint combined with significant daytime impairment or distress, and the exclusion of other causes. Commonly reported daytime impairments associated with insomnia include complaints of mood disturbances (e.g., irritability, mild dysphoria, or difficulty tolerating stress), impaired cognitive function, and daytime fatigue (Moul et al., 2002). Importantly, insomnia patients commonly report feeling fatigued or exhausted during the day, but rarely report daytime sleepiness. Another important distinction is that insomnia symptoms are present despite adequate opportunity for sleep. That is, in insomnia, the opportunity for sleep is adequate, but the ability to sleep is compromised. In contrast, sleep deprivation (often used in the literature interchangeably with insomnia) is characterized by a restricted opportunity to sleep (for example, due to lifestyle or shift work) with adequate ability. Insomnia is assessed with the self-report ISI (Bastien, Vallieres, and Morin, 2001) in studies with military samples. In many studies, however, single item measures removed from validated scales of depression (PHQ-9: "trouble falling or staying asleep, or sleeping too much"; Kroenke and Spitzer, 2002; MacGregor et al., 2012) or PTSD (PCL: "trouble falling or staying asleep"; Weathers et al., 1993) are used to assess insomnia symptoms, though these items do not specifically capture a diagnosed condition or the extent of symptoms commonly observed in the condition.

Symptoms of Sleep Disturbances and Other Sleep Parameters

Sleep Duration (Sleep Quantity)

Sleep duration, or *sleep quantity*, refers to the total sleep time during a night. It is commonly assessed with a single item to assess habitual sleep duration in one-hour increments (e.g., “On average, how many hours of sleep do you usually get in a night?”). Sleep duration is the most commonly used metric in epidemiologic studies, and a great deal of research and media attention has focused on the reported links between both short and long sleep durations and a host of adverse health outcomes, including obesity, cardiometabolic consequences, and mortality (Gangwisch, Heymsfield, et al., 2006, 2007; Gangwisch, Malaspina, et al., 2005; Kripke et al., 2002; Gallicchio and Kalesan, 2009; Knutson, 2010; Grandner, Chakravorty, et al., 2014). As reviewed in Chapter Two, short sleep duration is particularly prevalent among servicemember populations. However, despite the growing public interest and awareness of the connections between self-reported sleep duration and health outcomes, there is still considerable debate among the scientific community regarding the validity of these assessments (Lavie, 2009). In fact, it is common to find discrepancies between the objective number of hours slept (as assessed via polysomnography) and individuals’ subjective report (Kronholm et al., 2009; Girschik et al., 2012). These inconsistencies can be problematic if the objective is to document sleep duration accurately. However, if the goal is to appraise the impact of sleep on individuals’ functioning, the subjective perception of sleep quantity may be a better predictor of sleepiness and morbidity than objective sleep duration (Pilcher, Ginter, and Sadowsky, 1997; Sateia and Nowell, 2004; Sateia and Pigeon, 2004).

Sleep Quality

Sleep quality refers to individuals’ subjective reports of how well they are sleeping (e.g., frequently waking up, feeling tired in the morning despite spending an adequate number of hours in bed), in terms of the degree to which it was experienced as deep, refreshing, or restorative. For instance, there is often a discrepancy between the objective number of hours slept (as assessed in sleep studies) and individuals’ subjective report. This is consistent with studies indicating that average sleep quality is a better predictor of sleepiness than sleep quantity (Pilcher, Ginter, and Sadowsky, 1997). Sleep quality will influence individuals’ perception of the quantity of sleep they get. The most widely used and well-validated measure of sleep quality is the PSQI (Buysse, Reynolds, et al., 1989). However, few studies in military populations have used the full, validated instrument. Rather, sleep quality (or lack thereof) has most often been assessed in military populations using single or few-item assessments of sleep quality or insomnia-related symptoms (i.e., “trouble sleeping”), typically drawn from the PSQI or from depressive symptom questionnaires, which include items on trouble sleeping, such as the PHQ-9 (MacGregor et al., 2012; Kroenke and Spitzer, 2002).

PTSD-Related Sleep Disturbances and Nightmares

In some contexts, PTSD-related sleep disturbances are referred to as a diagnosed sleep disorder due to the prevalence of PTSD in the military population. However, PTSD-related sleep disorders are not a specifically diagnosed condition. Yet there is a substantial overlap between PTSD and such sleep disturbances as nightmares, poor sleep quality, OSA, and diagnosed insomnia (see Chapter Two). An addendum to the PSQI (PSQI-Addendum for PTSD) (Farrahi et al., 2009; Germain, Hall, et al., 2005; Insana, Hall, et al., 2013) assesses PTSD-related sleep disturbances and has been validated specifically within the military population. Nightmares, which are a specific symptom of PTSD but can also be independent of the disorder, have only been assessed in the context of PTSD from the PCL (Weathers et al., 1993), with the item regarding distress from “repeated, disturbing dreams of a stressful experience from the past” assessed as a single item measure of nightmares. Nightmare disorder, which is a diagnosable sleep disorder, is less frequently studied in the military and we did not find any validated measures available for use with this population.

Sleep Efficiency (Hours of Sleep/Number of Hours in Bed)

Sleep efficiency is the ratio of time spent asleep (total sleep time) to the amount of time spent in bed. Sleep efficiency greater than 85 percent is generally indicative of normal sleep.

Daytime Sleepiness and Fatigue

Sleepiness and fatigue are similar but distinct sleep parameters. The two sometimes, but not always, correlate. For instance, insomnia patients commonly report feeling fatigued or exhausted during the day, but rarely report daytime sleepiness. Excessive sleepiness and extreme fatigue both impact individuals’ cognitive and physical performance and may threaten the safety of others as well. We define and discuss the differences below.

Sleepiness

Sleepiness is the subjective feeling of having to sleep, or the tendency to doze off or to fall asleep, known as sleep propensity (Johns, 1998; Carskadon, 1993). It is considered to reflect the physiological need for sleep. Sleepiness is also associated with sleep disorders such as sleep apnea (Dement, Carskadon, and Richardson, 1978) and narcolepsy (Dement, 1976), as well as some medical and psychiatric disorders (Guilleminault et al., 1975). Excessive sleepiness and impaired alertness during wakefulness have been associated with increased morbidity for the individual and may threaten the safety of others as well. Daytime sleepiness is a primary complaint among individuals with OSA (Slater and Steier, 2012). The “gold-standard” measure of excessive sleepiness is a laboratory multiple sleep latency test, which is a laboratory-based procedure that consists of a series of napping opportunities, and measures the propensity to nap at any given

nap opportunity and the time it takes to fall asleep. In military studies, daytime sleepiness has been assessed primarily with self-report instruments, including the Epworth Sleepiness Scale (ESS; Johns, 1992) or the Stanford Sleepiness Scale (SSS; Hoddes et al., 1973).

Fatigue

Fatigue, on the other hand, refers to the subjective experience of feeling weary or exhausted. There is no clear gold standard measure of fatigue, although several performance-based metrics, including reaction time tasks, have been used as objective measures of fatigue. Sleepiness and fatigue are often used interchangeably throughout the military sleep literature; thus, fatigue is primarily measured with the sleepiness scales indicated above (e.g., ESS, SSS). However, in some military studies, the Fatigue Severity Scale (FSS; Krupp et al., 1989) has been used to more formally measure the concept of fatigue. Others use single-item fatigue measures, such as “To what extent do you feel tired during the day?”

Other Specific Symptoms and Consequences of Sleep Disturbances

We refer to two other specific symptoms of sleep disturbances in this report: sleep onset latency and early morning awakening. Sleep onset latency refers to the length of time that it takes to accomplish the transition from full wakefulness to sleep. Early awakening or premature morning awakening refers to the early termination of the sleep period due to inability to return to sleep. Early awakening can be a sign of mood disorders (e.g., depression) or can be a sign of a sleep disorder affecting the initiation or maintenance of sleep such as insomnia. Both disturbances are generally measured in a sleep laboratory with polysomnography data or with at-home objective sleep measures like wrist actigraphy. The PSQI includes self-report items about sleep onset latency, and early awakening has been assessed with subjective single-item measures. Daytime dysfunction refers to one of the many consequences from lengthy sleep onset latency and early awakening without adequate sleep (see Chapter Two for a description of the consequences associated with sleep disturbances). It is measured in military samples with items from the PSQI or the ISI.

Sleep-Related Behaviors/Sleep Hygiene

Good sleep hygiene can be defined as practices that may help one to have normal, quality nighttime sleep and full daytime alertness. Sleep disturbances and daytime sleepiness are the most telling signs of poor sleep hygiene. Individuals are often unaware of the behaviors and habits that are maintaining their sleep disturbances, and sleep hygiene education can help correct misperceptions and provide useful strategies to regulate the sleep-wake cycle. However, it is important to note that although sleep hygiene is oftentimes a necessary condition for adequate sleep, it is generally not sufficient to correct maladaptive sleep-wake patterns. Indeed, there is limited evidence to suggest

that promotion of sleep hygiene alone is a sufficient intervention for sleep problems (Stepanski and Wyatt, 2003; Moss, Lachowski and Carney, 2013). Another important behavioral contributor to poor sleep hygiene is caffeine consumption. There is evidence that servicemembers use caffeinated beverages and medication to combat fatigue and increase alertness. Although caffeine may temporarily alleviate feeling of tiredness, it also contributes to maintain sleep disturbances in disrupting the sleep-wake cycle (Bonnet and Arand, 1992; Lieberman, Tharion, et al., 2002; McLellan et al., 2007). Caffeine use is typically assessed with single item measures—for example, “How many energy drinks (e.g., Monster, Red Bull, 5-Hour Energy) do you use per day?” (Toblin, Clarke-Walper, et al., 2012). Assessments of other sleep behaviors/sleep hygiene are typically single item response questions or checklists assessing healthy sleep behaviors (e.g., avoiding stimulants, such as caffeine, nicotine, and alcohol, too close to bedtime; ensuring adequate exposure to natural light; maintaining a healthy diet; associating bed with sleep and avoiding performing alternative activities; ensuring a pleasant and relaxing sleep environment; establishing a regular relaxing bedtime routine). The Sleep Hygiene Index (Mastin, Bryson, and Corwyn, 2006) has also been used in civilian studies to assess sleep hygiene behaviors.

Methods and Review of Published Studies on Sleep in the Military

The first section of this appendix outlines the methods employed in our literature review strategy for studies included in Chapter Two, “Epidemiology of Sleep Problems in the Military.” The second section details the studies included in our literature review on post-deployment problems in military samples.

Methods for Literature Review

For the literature presented in Chapter Two, we targeted two databases for searches of peer-reviewed journal articles: PubMed and PsycInfo. We also searched for “gray literature” using the WorldCat database, which indexes books, reports, and other non-peer-reviewed journal literature, and DTIC. The search terms we used are listed in Table B.1. We also conducted an Internet search in Google Scholar using the search terms in Table B.1 to locate reports of sleep difficulties in military populations published by such agencies as DCoE, the NATO Research and Technology Organization, and the Naval Center for Combat and Operational Stress Control (DCoE, 2012; Young-McCaughan, Peterson, and Bingham, 2011; Schmitz, Browning, and Webb-Murphy, 2009). We next performed an iterative search using the reference lists from the publications retrieved from the initial search results to identify articles that may have been missed. We also located the sleep-related publications of known experts in the field of military health and consulted with these experts to verify that we did not miss any relevant publications.

Searches yielded 633 unique articles, reports, and reviews. We double-checked the titles and abstracts from these sources with inclusion and exclusion criteria to narrow down the number of sources. We included studies that measured sleep disorders or symptoms in military populations (i.e., active-duty, veteran, retired, reserve) that served post-September 11, 2001 (OEF/OIF/OND). We also included studies of servicemembers in non-U.S. countries where appropriate. We cited some high-impact articles published prior to 2001 of servicemembers from combat and non-combat eras in the Gulf War and Vietnam War, though these are not included in our comprehensive review or referred to in our tables. These articles were judged by our team to be high-impact, given

Table B.1
Databases and Search Terms for Literature Review on Post-Deployment Sleep Problems

Database	Sleep Terms	Risk and Protective Factors/ Consequences	Population Terms
PubMed N = 30 peer-reviewed articles	"Sleep Disorders"[Mesh] OR "Sleep Initiation and Maintenance Disorders" OR sleep* OR insomnia OR nightmare*	"Mental health, operational readiness, consequences, vulnerabilities, risk, PTSD, depression, psychiatric, disorder, pain, physical, health"	military OR veteran* OR soldier* OR army OR armed services OR combat AND postdeploy* OR post-deploy* OR after deploy* OR return from deploy* OR returning from deploy* or returning combat veteran*
PsycInfo N = 301 peer-reviewed articles	DE "Sleep Disorders" OR DE "Hypersomnia" OR DE "Insomnia" OR DE "Kleine Levin Syndrome" OR DE "Parasomnias" OR DE "Sleepwalking" OR DE "Sleep" OR DE "Sleep Deprivation" OR nightmare*	"Mental health, operational readiness, consequences, vulnerabilities, risk, PTSD, depression, psychiatric, disorder, pain, physical, health"	DE "Military Personnel" OR DE "Air Force Personnel" OR DE "Army Personnel" OR DE "Coast Guard Personnel" OR DE "Commissioned Officers" OR DE "Enlisted Military Personnel" OR DE "Marine Personnel" OR DE "Military Medical Personnel" OR DE "Military Psychologists" OR DE "National Guard Personnel" OR DE "Navy Personnel" OR DE "ROTC Students" OR DE "Volunteer Military Personnel" OR DE "Air Force Personnel" OR DE "Army Personnel" OR DE "Coast Guard Personnel" OR DE "Commissioned Officers" OR DE "Enlisted Military Personnel" OR DE "Draftees" OR DE "Noncommissioned Officers" OR DE "Military Medical Personnel" OR DE "Volunteer Military Personnel" OR DE "Military Veterans" OR combat OR soldier*
WorldCat and DTIC N = 56 books, reports, and other non-journal	(su: sleep and su: disorder*) OR su: insomnia AND (ti: sleep and ti: disorder*) OR ti: insomnia	"Mental health, operational readiness, consequences, vulnerabilities, risk, PTSD, depression, psychiatric, disorder, pain, physical, health"	(kw: military OR kw: veteran* OR kw: soldier* OR kw: army OR (kw: armed and kw: services) OR kw: combat) NOT kw: poetry OR kw: poem* NOT fiction or juvenile literature

the number of articles post-publication that cited the article. Reviews and high-impact civilian studies are also cited throughout to support and compare the studies with military samples. Exclusion criteria included studies of veterans using pre-Gulf War samples (e.g., Vietnam veterans) in which it was unknown whether participants experienced deployments during their service. We retained veteran studies in which assessments of sleep were conducted within ten years of deployments. We also excluded dissertations, unpublished studies, and book chapters that did not include original data. The majority of studies generated from our search terms were dropped because they did not meet our inclusion criteria for military populations.

Reviewed Military Sleep Studies: Methods and Findings

The following tables detail the studies included in our review of the literature review conducted in Chapter Two on epidemiology of sleep in the military. In total, we included 49 peer-reviewed articles and three reports in our review. These 49 published articles are summarized in Tables B.2–B.4. Seventeen prevalence studies are listed in Table B.2, 20 studies on purported risk factors for sleep disturbances and cross-sectional studies of correlates of sleep problems are listed in Table B.3, and 19 longitudinal studies of sleep disturbances and mental and physical health and operational readiness are listed in Table B.4. Studies with content that met more than one of these descriptions are summarized in all the tables that apply.

A few items are important to note. In the “Measures Related to Sleep” column, we include the specific terms for sleep problems as indicated in the article. This is important as definitions and measures of sleep parameters and disorders vary widely across the military sleep literature. The period of assessment in relation to deployment (e.g., post-deployment, deployment status unknown) is indicated in the column “Study/Design.” Also, in these tables, a “veteran sample” is noted as a limitation, as these studies may not apply to active-duty servicemembers, which was the population of focus of the present report. Still, these veteran studies provide important information about post-deployed problems as many studies include veterans with deployment experiences. However, in many of these studies on veteran samples, time since deployment was generally unknown or may have been several years, limiting our ability to suggest that sleep problems are related to deployments.

Table B.2
Studies on Prevalence of Sleep Problems in the Post-Deployment Period

Study/Design	Sample Characteristics	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
Armed Forces Health Surveillance Center, 2010b Longitudinal examination of incidence rates (unknown deployment status)	All individuals who served in the active component of the Army, Navy, Air Force, Marine Corps, or Coast Guard at any time between January 1, 2000, and December 31, 2009; actual number not reported Demographics not reported	OSA: incidence rates of diagnosed OSA (hospitalized for OSA or at least 2 ambulatory visits for OSA) in medical records of active-duty military	Incidence rate for primary OSA was 69.1 cases per 10,000 person-years, with six-fold increases in rates between 2000 (25.6 per 10,000 person-years) and 2009 (145.3 per 10,000 person-years). Incidence rates were highest among those > age 40 and lowest among Marines, females, and youngest servicemembers (< age 30). Non-specific respiratory/chest symptoms and hypertension/elevated blood pressure were most frequent diagnoses comorbid with OSA.	Incidence rates can include same individual multiple times (e.g., if they presented for more than one incident in that calendar year); higher rate among age > 40 may reflect diagnoses obtained during mandatory medical examinations prior to retirement; deployment status unknown
Armed Forces Health Surveillance Center; 2010a Longitudinal examination of incidence rates (unknown deployment status)	All individuals who served in the active component of the Army, Navy, Air Force, Marine Corps or Coast Guard at any time between January 1, 2000, and December 31, 2009; actual number not reported Demographics not reported	Insomnia: incidence rates of diagnosed insomnia (hospitalized for insomnia or at least 2 ambulatory visits for insomnia) in medical records of active-duty military	Incidence rates of primary insomnia diagnoses increased over time between 2000 and 2009 among active-duty servicemembers (48.4 rate per 10,000 person-years in 2000 to 135.8 rate per 10,000 person-years in 2009). Rates increased most dramatically for the Army, those in combat-specific operations, and those over age 25. "Adjustment reactions" (PTSD primary within this category) were the other conditions most commonly diagnosed during hospital and ambulatory visits when insomnia was diagnosed.	Incidence rates can include same individual multiple times (e.g., if they presented for more than one incident in that calendar year); only looked at primary insomnia diagnoses; deployment status unknown

Table B.2—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
Capaldi et al., 2011 Cross-sectional chart review of polysomnography data (“recently deployed” personnel)	69 active-duty Army soldiers referred for polysomnography evaluation at Walter Reed Army Medical Center due to sleep-disordered breathing Age: 37.9 (9.7) Gender: 87% male Ethnicity: not reported	Sleep-disordered breathing; polysomnography data including apneas per hour, total sleep time, sleep efficiency, sleep latency, REM, sleep stages Sleepiness: ESS	76.8% were diagnosed with OSA. Most frequent problems were excessive awakenings (95.7% of the sample), hypoxia (76.8%), and excessive daytime sleepiness (65.3%).	Small clinical sample already seeking care for sleep problems limits generalizability; veteran sample; PTSD severity of symptoms unknown; no measure of combat exposure, which may have exacerbated PTSD symptoms; reliance on retrospective chart review
Gellis et al., 2010 Cross-sectional post-deployment survey (unreported time since deployment)	201 OEF/OIF trauma-exposed veterans referred to VHA for a behavioral health assessment Age: mean 34.2 (10.1) Gender: 88.1% male Ethnicity: 58.2% white	Sleep disturbances: two items from the PCL for nightmares and insomnia	51% reported moderate or severe nightmares.	Self-report; veteran sample; single-item measures of nightmares and insomnia removed from validated scales; trauma unreported; small specialized patient sample referred for behavioral health assessment limits generalizability
Hoge, McGurk, et al., 2008 Cross-sectional post-deployment survey (3–4 months post-deployment)	2,525 U.S. Army infantry soldiers surveyed 3–4 months after yearlong deployments to Iraq Age: 55.5% under 30 Gender: 95.5% male Ethnicity: not reported, though “demographics were similar to those of infantry soldiers deployed to Iraq”	Sleep disturbances: single item from PHQ-15 Fatigue: single item from PHQ-15	For those with TBI (loss of consciousness), rates of sleep disturbances and fatigue were 53.8% and 53.2%, respectively. For reported TBI (altered mental state), 44.9% reported sleep disturbances and 39.7% reported fatigue.	Self-report; only Army represented limits generalizability; use of single items for sleep disturbances and fatigue removed from validated scale

Table B.2—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
Kryger et al., 2003 Cross-sectional physician interview and overnight polysomnography (deployment status unknown)	70 Canadian military personnel and 70 civilian controls (matched for age and gender; both groups obese) Age: ~ 40 years old Gender: 87% male Ethnicity: not reported	Sleep disorders: compared Canadian military personnel to civilian controls on reasons for referral to sleep clinic Excessive daytime sleepiness: ESS	More military than civilians were referred for “movement disorders” (e.g., restless leg syndrome; 17% vs. 0%). Fewer military than civilian referred for insomnia of excessive daytime sleepiness (7% vs. 20%). More military than civilian were diagnosed with sleep-disordered breathing and periodic limb movements (30% vs. 18%) or isolated periodic limb movements (16% vs. 0%).	Small Canadian patient sample; sample was obese, limiting generalizability; reason for most sleep problems was obesity in the sample.
Luxton, Greenburg, et al., 2011 Cross-sectional post-deployment survey (3–6 months post-deployment)	2,717 Army soldiers from OIF assessed as part of the Health Risk Assessment II Age: mean 25.5 (5.6) Gender: 72% male Ethnicity: not reported	Sleep duration: hours of sleep per night Short sleep duration: sleeping < 7 hours on average Very short sleep duration: sleeping < 6 hours Insufficient sleep: sleep duration < 7 hours; reported naps or poor job performance due to lack of sleep	Mean sleep duration of 5.8 hours (SD = 1.2). Most (72%) soldiers reported short (43%) or very short (29%) sleep duration. 16% reported symptoms of insufficient sleep. Insufficient more likely among those with combat exposure and among enlisted soldiers.	Self-report data, single-item measure of sleep duration; cross sectional; sample from one Army installation; included only soldiers who were already screened as fit for duty

Table B.2—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
<p>Miller, Shattuck, and Matsangas, 2011</p> <p>Cross-sectional post-deployment survey (unknown time since deployment)</p>	<p>49 active-duty U.S. Army officers returned from deployments</p> <p>Age: mean 29.4 (4.4)</p> <p>Gender: 100% male</p> <p>Ethnicity: not reported</p>	<p>Sleep and napping patterns during deployment: 13 items included being briefed on sleep management plan, fatigue, average sleep duration, napping, sleep deprivation</p>	<p>Approximately 80% reported they had not been briefed on a sleep management plan during their most recent deployment. More than 55% reported that fatigue was a problem in their units.</p> <p>During high OPTEMPO periods, participants report receiving only 4 hours of sleep daily. Approximately 83% reported feeling sleep-deprived at least occasionally while at high OPTEMPO.</p>	<p>Retrospective self-report of sleep issues from “most recent deployment;” small sample of only male Army officers limits generalizability; unknown unit and mission assignment of participants surveyed</p>
<p>Mysliwiec, Gill, et al., 2013</p> <p>Cross-sectional with post-deployment clinical evaluation and polysomnogram within 18 months of return from deployment</p>	<p>110 military personnel undergoing sleep evaluations at one center</p> <p>Age: 33.6 ± 8.0</p> <p>Gender: 97.3% male</p> <p>Ethnicity: not reported</p>	<p>Comprehensive sleep evaluation with OSA and insomnia diagnoses and polysomnogram</p>	<p>88.2% of the sample was diagnosed with a sleep disorder. 62.7% met diagnostic criteria for OSA and 63.6% met criteria for diagnosed insomnia.</p> <p>38.2% of the sample met criteria for comorbid insomnia and OSA. Those with both diagnoses were more likely to also meet criteria for depression and PTSD.</p>	<p>Clinical sample limits generalizability to population; self-report and no clinician-administered interview</p>

Table B.2—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
Mysliwiec, McGraw, et al., 2013 Cross-sectional survey and polysomnography data (unknown time since deployment)	725 active-duty military personnel with primary sleep diagnoses from the Army, Air Force, and Navy at one installation Age: mean 35.5 (8.6) Gender: 93.2% men Ethnicity: not reported	Sleep disorders: OSA, insomnia, paradoxical insomnia, snoring, behaviorally induced insufficient sleep syndrome (BISS), and “other disorders.” Sleep duration and sleepiness: duration in hours and ESS Polysomnography data: objective assessment of period of 8 hours of sleep including sleep onset latency, wakefulness, REM and other sleep stages	Participants self-reported a mean of 5.74 (SD = 1.54) hours of sleep per night. Medical records revealed most prevalent sleep disorders were mild OSA (27.2%), insomnia (24.7%), and moderate to severe OSA (24.0%). Those with insomnia had more severe objective sleep problem indexes.	Clinical sample limits generalizability to population; self-report; retrospective chart review of diagnoses; sample from 1 installation; Marine Corps not represented
Okpala et al., 2011 Cross-sectional survey (deployment status unknown)	1,300 active-duty British military from 3 military bases in the UK Age: 95% under 39 Gender: 89% male Ethnicity: not reported	Snoring and sleep-disordered breathing: researcher-generated items (number unknown) such as breathing pauses during sleeping, sleeping arrangement, snoring habits.	19.5% reported snoring regularly and 2.9% reporting sleep symptoms consistent with sleep-disordered breathing or OSA. 13.6% reported snoring so loudly it disturbed others during a past deployment. 29.1% reported near accidents at work or while driving because of sleepiness or poor concentration.	Self-report; unknown quantity and quality of items used in assessing sleep outcomes

Table B.2—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
Peterson et al., 2008 Cross-sectional survey of present sleep while deployed and of retrospective pre-deployment sleep	156 active-duty U.S. Air Force deployed to a remote Southwest Asia location in support of OEF Age: mean 29.2 (7.7) Gender: 83% male, Ethnicity: not reported	Researcher-generated sleep scale: 21-item Military Deployment Survey of Sleep included self-report items related to total sleep time, time needed to fall to sleep, sleep efficiency, sleep onset latency, waking after sleep onset, and daytime naps	During deployment, average total sleep time was about 6.5 hours. Mean sleep efficiency (83%) and mean sleep onset latency (32 minutes) were at comparable threshold for criteria for insomnia. Night-shift workers had worse sleep efficiency and reported more sleep problems. Approximately 75% rated their sleep as worse during deployment as compared with retrospective reports of pre-deployment sleep.	Self-report data; cross-sectional comparisons of retrospective reported pre-deployment sleep with current sleep; specific sample deployed to one environment; all one branch (Army) may not be generalizable; no assessment of continued disturbance post-deployment
Plumb et al., 2014 Cross-sectional post-deployment survey (~25 months since last deployment)	375 OEF/OIF servicemembers and veterans Age: mean 34.5. (8.9) Gender: 87% male Ethnicity: 84% white	Global sleep problems: 19-item PSQI PTSD-related sleep problems: 7-item PSQI-PTSD symptom addendum	89.1% met criteria for sleep disturbances using the global PSQI score. 21.4% reported duration < 4.5 hours and 45.4% reported sleep latency > 30 minutes. The majority of participants reported poor sleep efficiency, "bad sleep," and disrupted sleep due to PTSD symptoms.	Convenience sample of those receiving email from a state Transition Assistance Advisor; self-report data; primarily Army and Army National Guard represented in sample limits generalizability
Seelig et al., 2010 Longitudinal cohort survey of 3 groups of servicemembers assessed before, after, and during deployment	41,225 servicemembers from Millennium Cohort Study Age: ~34 Gender: 80% male Ethnicity: 70% white, 11% African-American/black	Sleep duration: past month hours of sleep in average 24-hour period Trouble sleeping: 2 insomnia items combined from the PCL–Civilian Version (PCL-C) and anxiety scale of the PHQ	Deployed and post-deployed servicemembers had significantly shorter sleep duration and increased odds of reporting trouble sleeping than those who never deployed. Associations between deployment and sleep duration and trouble sleeping were mediated by the effects of combat exposure and mental health symptoms.	Self-report data; single-item measure of sleep duration; trouble sleeping items taken from validated scales; validated mental health scale composite scores do not contain sleep items

Table B.2—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
Toblin, Rivieri, et al., 2012 Cross-sectional post-deployment survey (6 months post-deployment)	1,532 U.S. Army soldiers with deployment experience in Iraq or Afghanistan for at least one month Age: 73% under age 30 Gender: 92% male Ethnicity: not reported	Sleep problems: 1 item from the PHQ-15 Fatigue: 1 item from the PHQ-15	Sleep problems were the most commonly endorsed of 15 physical health concerns. 33% of soldiers reported sleep problems; 32% reported fatigue. Soldiers reporting difficulty coping with grief were more likely to report fatigue or sleep problems.	Self-report data, single-item measures of sleep problems and fatigue from validated scales; Army infantry sample limits generalizability
Wallace et al., 2011 Cross-sectional clinical interview, polysomnography and sleep diaries (~30 months post-deployment)	30 male OEF/OIF veterans seeking care at 1 VA (healthy sleepers and patients with mTBI and/or PTSD presenting for insomnia-related concerns) Age: mean 31 (7) Gender: 100% male Ethnicity: 63% Hispanic, 23% white	Insomnia and other sleep disorders: Diagnosed insomnia from Duke Interview for Sleep Disorders; self-report from ISI Daytime sleepiness: ESS Fatigue: FSS Polysomnography: Sleep efficiency, sleep-disordered breathing, sleep stages, sleep onset latency, awakenings, REM	Compared to healthy sleepers, patients with PTSD and PTSD + mTBI presenting for insomnia concerns reported greater fatigue, pain, PTSD, depression, and health-related quality of life. PTSD + mTBI patients (60%) reported more daytime sleepiness than PTSD alone (33%) and healthy sleepers (0%). Few self-report and meaningful polysomnography differences between PTSD + mTBI patients and PTSD only patients.	Small all-male clinical sample from one site; those with history of pre-deployment sleep disorders excluded from study; self-report of mTBI not through structured interview; all patients had comorbid conditions limit ability to differentiate insomnia symptoms independent from PTSD or mTBI symptoms
Yesavage et al., 2012 Cross-sectional with overnight polysomnography data (unknown time since deployment)	105 Vietnam-era veterans with PTSD diagnoses from one VA Age: mean 59.9 (3.1) Gender: 100% male Ethnicity: 70% white	Sleep disordered breathing: overnight polysomnography data with the Apnea-Hypopnea Index (AHI)	69% of the sample had AHI scores meeting criteria for significant sleep disordered breathing. BMI was associated with more sleep-disordered breathing. No significant effects of sleep-disordered breathing were found on an extensive battery of cognitive tests.	Older (age > 55) and obese small sample limits generalizability; veteran sample

Table B.3
Studies on Purported Risk Factors for Sleep Disturbances and Cross-Sectional Studies of Correlates of Sleep Problems

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Alfred and Rice, 2011 Cross-sectional surveys during military training (non-deployed sample)	153 servicemembers attending health care specialist Army advanced individual training Age: mean 21.7 (5.4) Gender: 55.6% male Ethnicity: not reported	Hours of sleep and feelings of tiredness: 2 sleep questions regarding weekend and weekday hours of sleep; 1 item regarding frequency of feeling tired	Academic performance among servicemembers in training as indicated by course pass/fail status and grade point average	Better academic performance associated with more hours of weekend sleep. Those with fewer hours of weekend sleep were more likely to fail than those with more hours of weekend sleep. Adequate weekend sleep, rather than weekday sleep, was more strongly associated with better academic performance and feeling tired less often.	Self-report; cross-sectional; forced choice options for sleep duration and single item of feeling tired; no control group; participants given feedback based on their reported sleep durations may have influenced results
Capaldi et al., 2011 Cross-sectional chart review of polysomnography data ("recently deployed" assessment not defined)	69 active-duty Army soldiers referred for polysomnography evaluation at Walter Reed Army Medical Center due to sleep-disordered breathing Age: 37.9 (9.7) Gender: 87% male Ethnicity: not reported	Sleep disordered breathing: polysomnography data including apneas per hour, total sleep, time, sleep efficiency, sleep latency, REM, sleep stages Sleepiness: ESS	Comparison of OSA rates between those with PTSD, TBI, major depression, and non-PTSD anxiety	In general, male, older age, and higher BMI were more likely to be diagnosed. Rates of OSA diagnoses did not differ across diagnostic groups. However, subtle differences as measured by polysomnography evaluation were noted, such as on severity of apnea frequency in a night (PTSD > TBI) and the percent of time spent in slow wave sleep (TBI > "other").	Small clinical sample already seeking care for sleep problems limits generalizability; veteran sample; PTSD severity of symptoms unknown; no measure of combat exposure, which may have exacerbated PTSD symptoms; reliance on retrospective chart review

Table B.3—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Collen et al., 2012 Cross-sectional chart review of post-deployment sleep disorder symptoms and polysomnography data (~16 months post-deployment)	116 consecutive OEF/OIF servicemember patients receiving care for TBI at one facility Age: mean 31.1 (9.8) Gender: 96.6% male Ethnicity: not reported	Sleep complaints: ESS, subjective sleep complaints in chart OSA and insomnia: diagnostic criteria based on symptom reports	Documentation of sleep complaints among TBI patients; type of injury (blast vs. blunt) used to predict sleep complaints	Nearly all TBI patients reported sleep complaints (97.4%). Most frequently reported sleep complaints were hypersomnia (85.2%) and sleep fragmentation (54.3%). Symptoms consistent with OSA reported by 34.5% and symptoms consistent with insomnia reported by 55.2%. Patients with blast injuries were more likely to report insomnia than those with blunt injuries, who were more likely to report OSA.	Small clinical sample; cross-sectional; reliance on retrospective chart review
Cooper et al., 2010 Cross-sectional post-deployment survey (unreported time since deployment)	472 OEF/OIF recently deployed servicemembers who screened positive for possible TBI Age: ~26-28 Gender: 97% male Ethnicity: not reported	Sleep problems: 1 item from the 22-item Neurobehavioural Symptom Inventory	PTSD groups created from PCL scores; "high combat stress" group (PCL scores > 60) and "low combat stress" group (PCL scores < 30)	Servicemembers classified as "high combat stress" reported more sleep problems than those in "low combat stress" group. Those in the "low combat stress" group reported sleep disturbances as their most severe problem of all symptoms of TBI assessed (rated with mild severity).	Self-report; single item assessing sleep disturbances embedded in a larger 22-item scale; primarily Army sample from one site limits generalizability

Table B.3—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Gellis et al., 2010 Cross-sectional post-deployment survey (unreported time since deployment)	201 OEF/OIF trauma-exposed veterans referred to VA for a behavioral health assessment Age: mean 34.2 (10.1) Gender: 88.1% male Ethnicity: 58.2% white	Sleep disturbances: 2 items from the PCL for nightmares and insomnia	Descriptive comparisons of demographics and mental health symptoms on sleep disturbances	African Americans were more likely than whites to report difficulties initiating and maintaining sleep. PTSD and depression severity, diagnosed panic disorder and bipolar disorder, and pain interferences with work were associated with difficulties initiating and maintaining sleep (i.e., insomnia and nightmares).	Self-report; cross-sectional; veteran sample; single-item measures of nightmares and insomnia removed from validated scale of PTSD; trauma unreported; small specialized sample referred for behavioral health assessment limits generalizability
Goff et al., 2007 Cross-sectional survey (~5 months post-deployment)	45 male soldiers recently returning from deployment to Iraq or Afghanistan and their female civilian partners Age: 31.2 (6.9) soldiers; 29.4 (6.3) spouses Gender: 100% male soldier; 100% female spouses Ethnicity: 82.2% and 77.8% white for soldiers and spouses, respectively	Sleep disturbances: 6 items from the Trauma Symptom Checklist–40 item	Personal relationship satisfaction reported by soldiers and their spouses	Sleep disturbances (along with sexual problems) were associated with soldier’s own perceived relationship dissatisfaction over and above anxiety and depression symptoms. Sleep disturbances did not associate with partner’s perceived relationship satisfaction.	Self-report; cross-sectional; small Army sample limits generalizability; diagnoses of anxiety and depression not collected; sample overall satisfied with their relationship

Table B.3—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Hoge, Terhakopian, et al., 2007 Cross-sectional survey (1 year post-deployment)	2,863 Army soldiers with combat experience in Iraq Age: 80.5% less than 30 Gender: 97.2% male Ethnicity: not reported	Sleep disturbances and fatigue: 2 sleep items from the PHQ-15	Compared those screening positive for PTSD and those screening negative for PTSD on physical health problems	Those with PTSD were more likely to report sleep disturbances (71.1%) and fatigue (74.9%) compared with non-PTSD group (26.1% and 28.3%, respectively). The PTSD group was 6–7 times more likely to report sleep problems or fatigue, respectively.	Self-report; cross sectional; “positive or negative” for PTSD based on 17-item symptom scale and not interview/chart review; Army only sample limits generalizability
Hoge, McGurk, et al., 2008 Cross-sectional survey (3–4 months post-deployment)	2,525 U.S. Army infantry soldiers surveyed 3 to 4 months after year-long deployments to Iraq Age: 55.5% under 30 Gender: 95.5% male Ethnicity: not reported; “demographics were similar to those of infantry soldiers deployed to Iraq”	Sleep disturbances: single item from PHQ-15 Fatigue: single item from PHQ-15	Prevalence of physical complaints (including sleep disturbances and fatigue) based on injury status	TBI (loss of consciousness and altered mental state) was associated with sleep disturbances and fatigue. Effect was reduced to non-significance when adjusting for PTSD diagnoses. Sleep disturbance and fatigue rates among those with TBI were significantly different from soldiers who reported non-TBI “other injuries” or no injuries.	Self-report; cross-sectional; only Army represented limits generalizability; use of single items for sleep disturbances and fatigue from validated scale
Hughes et al., 2012 Cross-sectional post-deployment survey (unknown time since deployment)	107 female veterans with insomnia complaints who had received care at one VA Age: mean 49 (16.1) Gender: 100% female Ethnicity: 44% non-Hispanic white	Sleep quality: PSQI Insomnia severity: ISI	Retrospective report of events experienced during first experience of insomnia complaints	75% of participants with insomnia complaints reported a specific stressful event occurred at time of onset of sleep complaints. One-third reported that this event was military-related (e.g., deployment, basic training). PTSD symptoms were associated with insomnia severity.	Small female sample; veteran sample; cross-sectional; few recruited veterans participated; self-report of PTSD

Table B.3—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Lentino et al., 2013 Cross-sectional survey (deployment status unknown)	14,148 active-duty Army (52.6%) and civilian Guardsmen/Reservists Age: mean 27.7 (8.3) Gender: 83.4% male Ethnicity: not reported	Poor sleep: categorized as poor, fair, or good sleepers from two responses to the Pittsburgh Insomnia Rating Scale (lack of energy due to poor sleep, satisfaction with sleep quality)	Self-reports of health behaviors (e.g., eating breakfast, exercise) and reports from most recent Army Physical Fitness Test	Women, active-duty personnel, and enlisted personnel were more likely than men, Guard personnel/reservists, and officers to be categorized as poor sleepers. Compared with good sleepers, poor sleepers were more likely to report poor health, have a higher BMI, and have a larger waistline and less likely to eat healthy, exercise regularly, and pass the Army Physical Fitness Test in the top quartile.	Cross-sectional; self-report of health behaviors (e.g., BMI); sample categorized as “poor” to “good” sleepers based on two items of self-reported poor sleep
Lew et al., 2010 Cross-sectional review of post-deployment assessment and diagnostic interview (unknown time since deployment)	200 OEF/OIF veterans evaluated at one VA outpatient polytrauma clinic Age: 32.1 (9.5) Gender: 94% male Ethnicity: not reported	Sleep disturbances: 2 items assessing post-concussion symptoms reported by polytrauma patients	Comparison of sleep disturbances and other physical complaints (e.g., pain) between those with PTSD and TBI	Most patients reported PTSD, TBI, pain, or comorbidity (94.5%). 93.5% of patients reported mild to moderate sleep disturbances. Patients with pain or PTSD reported more sleep disturbances than those without either. No differences between those with and without TBI. Sleep disturbances were most prevalent for those with TBI + PTSD diagnoses and those with PTSD and pain.	Small clinical sample evaluated for TBI limits generalizability; TBI diagnosis determined through self-report; sleep disturbance assessed with 2 items of difficulty falling asleep or staying asleep; data extracted from medical records and were lacking in other important issues, such as substance use and other medical or psychiatric problems

Table B.3—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Lewis et al., 2009 Cross-sectional post-deployment survey (unknown time since deployment)	152 Australian Vietnam combat veterans Age: mean 51 (4.4) Gender: 100% male Ethnicity: not reported	Sleep disturbances: 19-item PSQI	Compared sleep disturbances between veterans with and without PTSD	94% reported sleep problems at a clinical level. PTSD veterans reported poorer sleep quality, longer sleep latency, longer sleep duration, more sleep disturbances, use of more sleep medications, and more daytime dysfunction. Compared with control participants from other studies and from the Australian population, veterans reported poorer sleep on all dimensions of the PSQI.	Self-report; cross-sectional; PTSD assessed with the PCL and not diagnostic interview; low response rate among those recruited; small male veteran sample
Luxton, Greenburg, et al., 2011 Cross-sectional post-deployment survey (3–6 months post-deployment)	2,717 Army soldiers from OIF assessed as part of the Health Risk Assessment II Age: mean 25.5 (5.6) Gender: 72% male Ethnicity: not reported	Sleep duration: hours of sleep per night Short sleep duration (SSD): sleeping < 7 hours on average Very short sleep duration (VSSD): sleeping < 6 hours Insufficient sleep: sleep duration < 7 hours; reported naps or poor job performance due to lack of sleep.	Sleep duration, insufficient sleep, and mental health outcomes (e.g., PTSD, mTBI, depression, panic)	VSSD and insufficient sleep were associated with PTSD, depression, mTBI, panic, and suicide risk. VSSD was associated with obesity and tobacco/alcohol abuse.	Self-report data, single item measure of sleep duration; cross sectional; sample from one Army installation; included only soldiers who were already screened as fit for duty

Table B.3—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
<p>Mysliwicz, McGraw, et al., 2013</p> <p>Cross-sectional survey and polysomnography data (unknown time since deployment)</p>	<p>725 active-duty military personnel with primary sleep diagnoses from the Army, Air Force, and Navy at one installation</p> <p>Age: mean 35.5 (8.6)</p> <p>Gender: 93.2% men</p> <p>Ethnicity: not reported</p>	<p>Sleep disorders: OSA, insomnia, paradoxical insomnia, snoring, BISS, and “other disorders”</p> <p>Sleep duration and sleepiness: duration in hours and ESS</p>	<p>Sleep diagnoses from review of medical records</p>	<p>Women, those with pain syndrome, those with low BMI, and those with diagnoses of anxiety, PTSD, and/or depression were more likely to have insomnia diagnoses.</p> <p>Male gender, older age, and elevated BMI were associated with risk for OSA.</p>	<p>Clinical sample limits generalizability; cross-sectional; Marines not represented; retrospective chart review of diagnoses</p>
<p>Picchioni et al., 2010</p> <p>Cross sectional survey post-deployment (3 months post 15-month deployment)</p>	<p>576 Army veterans of the Iraq War</p> <p>Age: 55% > age 24</p> <p>Gender: 83% male</p> <p>Ethnicity: 58% White, 21% African-American, 11% Hispanic</p>	<p>Nightmares: single item from PCL</p> <p>Insomnia: first three items from the ISI</p>	<p>Mental health symptoms related to PTSD and depression</p>	<p>Nightmares partially mediated the relationship between combat stressors and other PTSD symptoms. Full mediation was evident for those meeting criteria for PTSD.</p> <p>Insomnia partially mediated the relationship between combat stressors and other depression symptoms. Full mediation was evident for those meeting criteria for depression.</p>	<p>Self-report; cross-sectional; 1 sleep item removed validated scale of PTSD; incomplete data for approximately 200 participants (original sample N = 787)</p>

Table B.3—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Pietrzak et al., 2010 Cross-sectional post-deployment survey (within 1 year post-deployment)	159 OEF/OIF veterans (60.5% on active duty) from mental health and primary care clinics at 1 VA Age: mean 29.4 (7.3) Gender: 95.8% male Ethnicity: 63.5% White, 21%Hispanic	Sleep quality and disturbance: 19-item PSQI Nightmare severity: 1 PSQI item and 1 item from PCL	Association between PTSD symptoms, social support, alcohol use problems, combat exposure, and cognitive coping strategies on sleep quality	PTSD symptoms, worry, fear of loss of vigilance, and less unit support (i.e., amount of assistance/encouragement from unit members and leaders while deployed) associated with sleep difficulties. Those with PTSD reported more-severe sleep difficulties than those without PTSD. In the PTSD sample, fear of loss of vigilance, less ability to cope with cognitive distraction when having negative thoughts, and less unit support were associated with poor sleep.	Self-report; cross-sectional; 2 items assessing nightmares with 1 from a validated scale for PTSD; measures to capture underlying cognitive constructs not related to sleep management cognitions
Plumb et al., 2014 Cross-sectional post-deployment survey (~25 months since last deployment)	375 OEF/OIF servicemembers and veterans Age: mean 34.5. (8.9) Gender: 87% male Ethnicity: 84% white	Global sleep problems: 19-item PSQI PTSD-related sleep problems: 7-item PSQI-PTSD symptom addendum	Association between sleep problems and demographics, number of deployments, combat exposure, and mental health symptoms	Female gender, older age, less education, increased combat exposure, and symptoms of depression and PTSD were associated with sleep problems. Controlling for covariates, only PTSD and depression symptoms were associated with sleep problems. 8 of 9 specific sleep complaints assessed were reported more frequently among those above clinical cutoff scores for depression, PTSD, and/or anxiety.	Convenience sample of those receiving email from a state Transition Assistance Advisor; self-report data; cross-sectional; primarily Army and Army National Guard represented in sample

Table B.3—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Schmidt et al., 2008 Cross-sectional survey (deployment status unknown)	377 active-duty servicemembers in the U.S. Air Force Age: mean 29.5 Gender: 82.8% male Ethnicity: not reported	Sleep problems: 2 items for trouble sleeping and trouble staying awake as a result of consuming energy drinks	Energy drink usage prevalence among active-duty Air Force and sleep-related results from use	61.0% reported energy drink usage, with 30.5% reporting usage at least once per week. Rates of usage were higher than comparative college and adolescent samples. 30.9% reported trouble falling asleep as a negative side effect, with 10.9% reporting trouble staying asleep. Trouble staying asleep associated with higher levels of usage.	Self-report; cross-sectional; Air Force only sample limits generalizability; limited options for reasons to use; no descriptive information regarding write-in responses related to combating sleepiness and fatigue; descriptive data only, with no comparisons between energy drink users and non-users
Swinkels et al., 2013 Cross-sectional post-deployment survey (unknown time since deployment)	1,640 OEF/OIF veterans at 4 VA medical centers in North Carolina and Virginia Age: mean 37 (10) Gender: 80% male Ethnicity: 56% white	Sleep quality: 19-item PSQI-Addendum Very short sleep duration (VSSD): sleeping < 5 hours/night Short sleep duration (SSD): > 5 but sleeping < 7 hours/night Average sleep duration (ASD): between 7 and 8 hours/night Long sleep duration (LSD): > 9 hours/night	Comparisons between VVSD, SSD, ASD, and LSD on demographics and risky drinking and drug use, suicidal ideation, and structured clinical interview for diagnosis of mental health disorders	SSD was associated with number of deployments, white ethnicity, junior enlisted status, PTSD, panic disorder, major depression, alcohol use, drug use, and smoking. LSD was associated with younger age, junior enlisted status, and female gender. VSSD and SSD were associated with PTSD and major depression diagnoses after controlling for other factors in analyses. LSD (> 9 hours) was associated with smoking.	Self-report; cross-sectional; assessed symptoms of poor sleep and not diagnosed insomnia

Table B.3—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Toblin, Clarke-Walper, et al., 2012 Cross-sectional survey during deployment (no post-deployment assessment)	998 Army and Marine Corps servicemembers deployed to Afghanistan completed the 2010 Deployment Well Being Survey Age: not reported Gender: 100% male Ethnicity: not reported	Sleep health: items assessed hours of sleep per day, concern about lack of sleep, falling asleep during work activities, and sleep environment	Energy drink usage prevalence among active-duty Air Force and sleep-related results from use	44.8% consumed at least one energy drink per day and 13.9% drank three or more per day. Consumption of three or more energy drinks per day was associated with sleepiness on the job and sleeping \leq 4 hours per night.	Self-report; cross-sectional; male Army- and Marine Corps-only sample limits generalizability; descriptive data only

Table B.4
Longitudinal Studies of Sleep Disturbances and Mental and Physical Health and Operational Readiness

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Studies on mental and physical health					
Britton et al., 2012 Retrospective chart review (unknown deployment status)	VHA service record review of 381 veterans from the Northeast and Midwest Age: 77% over the age of 54 Gender: 97% male Ethnicity: 81% white	Presence of reported sleep disturbances discussed in VHA chart (e.g., trouble falling asleep, staying awake, sleeping too much), plus sleep diagnosis or prescribed sleep medications	Presence of diagnosis or symptoms of depression, mania, anxiety, psychosis, or alcohol/drug abuse	Veterans with psychiatric symptoms (80%) were more likely to have reported sleep disturbances in the past year than those who denied psychiatric symptoms. 60.2% of those with psychiatric symptoms reported sleep disturbances compared with 13.3% of those without psychiatric symptoms.	Unknown information regarding reliability, validity, and completeness of chart data; TBI and other mental disorders not controlled for in analyses; limited generalizability of sample; no strict measure of sleep disturbances; no control group; no information about health care sought outside the VHA
Boyko et al., 2013 Longitudinal cohort study with baseline, 3-year, and 6-year follow-up surveys (unknown time since deployment for those whom deployed)	47,093 servicemembers from Army, Navy, Marine Corps, and Air Force as part of Millennium Cohort Study. Most (74%) never deployed. Age: ~40 Gender: ~75% male Ethnicity: ~70% white; 11% black	Trouble sleeping: 2 items from PHQ and PCL-C Sleep duration: whole number of hours slept on an average night in the past month Sleep apnea: self-report of diagnosis	Self-report of new diabetes diagnosis	Participants with new self-reported diabetes diagnosed were more likely than those without diabetes to report trouble sleeping, < 5 hours sleep duration, and self-reported sleep apnea diagnoses. After adjusting for multiple covariates (e.g., BMI, PTSD, depression, demographics), trouble sleep and sleep apnea were associated with new diagnoses of diabetes.	Excluded patient with diabetes at baseline; self-report of new diabetes diagnosis (i.e., no medical record review), mental health diagnoses, and sleep apnea; trouble sleep items taken from validated mental health scales

Table B.4—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Gehrman et al., 2013 Longitudinal cohort study with pre- and post-deployment assessment points (unknown time since deployment)	15,204 OEF/OIF servicemembers from the Army, Navy, Marine Corps, and Air Force as part of Millennium Cohort Study Age: ~32–33 Gender: ~80% male Ethnicity: ~70% white, and 11% black	Sleep duration: past month hours of sleep in average 24-hour period Insomnia: 2 insomnia items combined from PCL-C and anxiety scale of the PHQ	New onset of post-deployment PTSD, depression, and generalized anxiety using measures of symptom severity	Those with insomnia symptoms and short sleep duration at pre-deployment had the greatest odds of new onset PTSD or new onset anxiety post-deployment. Those with combat trauma during the deployment and insomnia pre-deployment had the greatest odds for new onset depression.	Self-report; insomnia items taken from validated mental health scales; mental health scale composite scores do not contain sleep items; no examination of sleep changes from pre- to post-deployment; new onset of mental health conditions assessed with symptom scales and not diagnostic interviews
Insana, Kolko, and Germain, 2012 Cross-sectional survey and longitudinal polysomnography over two consecutive nights (unknown time since deployment)	63 military veterans with significant combat experience recruited from the community Age: mean 39.2 (13.09) Gender: 90% male Ethnicity: 84% white, 14% African American	Sleep quality: 19-item PSQI PTSD-associated disruptive sleep behaviors: PSQI-Addendum for PTSD Sleep disturbances: overnight polysomnography (REM sleep)	Impact of early life trauma (e.g., before age 18) on sleep disturbances later in life (self-report and REM sleep measured by polysomnography)	Early life trauma was associated with later life trauma and with REM sleep fragmentation, though not with self-reported sleep disturbances. Current PTSD symptoms associated with lower sleep quality and greater PTSD-associated disruptive sleep behaviors.	Small convenience sample; veteran sample; age of early trauma not indicated

Table B.4—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
<p>Macera et al., 2013</p> <p>Longitudinal cohort study with two post-deployment surveys (at deployment end and at 3–6 months post-deployment)</p>	<p>29,640 active-duty Navy (27%) and Marine Corps (73%) servicemembers returning from an OIF/OEF deployment in 2008/2009</p> <p>Age: ~55% under age 25</p> <p>Gender: 100% male</p> <p>Ethnicity: not reported</p>	<p>Sleep problems: single item on the PDHA of “problems sleeping or still feeling tired after sleeping” (yes/no response)</p>	<p>Depression screen using the PHQ-2 item at 3–6 months post-deployment</p> <p>PTSD screen using the 4-item Primary Care PTSD Screen at 36 months post-deployment</p>	<p>Those with positive depression and PTSD screens at post-deployment were more likely to report sleep problems at baseline.</p> <p>Sleep problems assessed at baseline fully mediated the relationship between baseline self-report TBI screen and new reports of depression and PTSD at 3–6 months post-deployment.</p>	<p>Self-report; single item assessing sleep problems; screening surveys used for TBI, PTSD, and depression and thus no confirmed diagnoses; severity of sleep symptoms not accessed; generalized to Navy and Marine Corps only</p>
<p>McLay et al., 2010</p> <p>Longitudinal cohort study with two post-deployment surveys (1 and 3 months post-deployment)</p>	<p>1,887 active-duty servicemembers at Navy Medical Center San Diego</p> <p>Age: 29.1</p> <p>Gender: 76% male</p> <p>Ethnicity: not reported</p>	<p>Insomnia: 1 item from PCL</p>	<p>Review of individual medical records for PTSD symptoms</p>	<p>Insomnia was the most highly endorsed symptom of PTSD among all patients. 33% and 37% reported difficulty with insomnia at 1 and 3 months post-deployment, respectively.</p> <p>No changes in insomnia symptom severity between assessments.</p> <p>Those deployed to Iraq or Afghanistan were more likely to report insomnia. Higher reported insomnia at 1 month post-deployment associated with higher PTSD symptom severity at 3 months post-deployment</p>	<p>Self-report; single item assessing insomnia from validated scale; primarily Navy sample limits generalizability; women and medical personnel overrepresented;; retrospective review of medical records</p>

Table B.4—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Pigeon et al., 2012 Retrospective chart review (unknown time since deployment)	VHA service record review of 381 veterans from the Northeast and Midwest Age: 77% over the age of 54 Gender: 97% male Ethnicity: 81% white	Presence of reported sleep disturbances discussed in VHA chart (e.g., trouble falling asleep, staying awake, sleeping too much) + sleep diagnosis or prescribed sleep medications	Death by suicide	After controlling for psychiatric symptoms (e.g., depression, mania, anxiety, psychosis) and substance abuse, veterans with sleep problems died by suicide 174 days after their last VHA visit, while those without sleep problems died 75 days after their last VHA visit.	Unknown information regarding reliability, validity, and completeness of chart data; TBI and other mental disorders not controlled for in analyses; limited generalizability of sample; no strict measure of sleep disturbances; no control group (i.e., those with sleep disturbances who did not die by suicide); unknown information about health care sought outside the VHA
Ribeiro et al., 2012 Longitudinal cohort study with two post-deployment surveys (included longitudinal and cross-sectional analyses; unknown time since deployment)	311 active-duty servicemembers referred for suicidality Age: mean 22.19 (2.77) Gender: 82% male	Insomnia symptoms: 2 items from the Beck Depression Inventory (BDI) (sleeplessness and fatigue) and 1 item from the Suicide Probability Scale (fatigue and listlessness)	Suicide risk (suicide ideation, behavior, and death by suicide)	Insomnia at baseline predicted suicidal ideation one month later. Hopelessness, depression, PTSD, anxiety, drug abuse, and alcohol abuse did not predict suicidal ideation. Reciprocal relationship (suicide risk predicting insomnia) was not supported (longitudinal). Insomnia was associated with suicidal ideation after controlling for hopelessness, depression, anxiety, PTSD, alcohol and drug abuse, and hopelessness (cross-sectional).	Self-report; patient sample already at-risk for severe suicidal ideation limits generalizability to non-clinical population; insomnia symptom items taken from validated mental health scales and generally assess fatigue rather than insomnia symptoms (e.g., difficulty falling asleep)

Table B.4—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Seelig et al., 2010 Longitudinal cohort study with 3 groups of servicemembers assessed before, after, and during deployment	41,225 servicemembers from the Millennium Cohort Study Age: ~34 Gender: 80% male Ethnicity: 70% white, 11% African-American/black	Sleep duration: past month hours of sleep in average 24-hour period Trouble sleeping: 2 insomnia items combined from PCL-C and anxiety scale of the PHQ	Sleep duration and trouble sleeping at post-deployment examined by demographic factors and cross-sectional characteristics	Risk factors related to shorter sleep duration and trouble sleeping included male gender, younger age, black non-Hispanic ethnicity, service in the Army or Marine Corps, active-duty status, occupation, smoking, and having low overall health, being overweight, or having mental health symptoms.	Self-report data; single-item measure of sleep duration; trouble sleeping items taken from mental health scales; mental health scale composite scores do not contain sleep items
Van Liempt et al., 2013 Longitudinal cohort study with pre-deployment and 6 months post-deployment assessment points	453 Dutch servicemembers deployed to Afghanistan Age: mean 28.8 (9.1) Gender: 93% male Ethnicity: not reported	Insomnia: 2 sleep items from the Self-Rating Inventory for Posttraumatic Stress Disorder (SRIP) and 3 sleep items Symptom Checklist-90 item Nightmares: 1 item from SRIP	PTSD, depression, and anxiety symptoms at 6 months post-deployment using measures of symptom severity	PTSD symptoms, insomnia, and nightmares increased significantly from pre-deployment to post-deployment. Depression and anxiety did not change. Pre-deployment nightmares, not insomnia, increased the risk of more-severe PTSD symptoms at post-deployment.	Self-report data; single-item measure of nightmares; insomnia items taken from validated mental health scales; no qualitative information about nightmare content (e.g., PTSD-related); high attrition; PTSD could have developed post-measurement (i.e., a trauma occurred after 6 months post-deployment)

Table B.4—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Wright et al., 2011a Longitudinal cohort study with pre-deployment and 3-month post-deployment surveys	522 OIF active-duty Army soldiers Age: mean 26 (5.8) Gender: 98% male Ethnicity: 66% white, 16% African American, 12% Hispanic	Insomnia: 7-item ISI for the past two weeks assessed at 3 months post-deployment	PTSD and alcohol problems assessed at 3 months post-deployment	Significant associations between insomnia, PTSD, and alcohol problems assessed at post-deployment were correlated. After controlling for pre-deployment PTSD and alcohol problems, those with greater combat exposure and high insomnia severity reported the most severe PTSD symptoms and alcohol problems.	Self-report; small sample of one branch only; sleep item not removed from PTSD in outcome analyses; insomnia not examined as an outcome in longitudinal analyses
Wright et al., 2011b Longitudinal cohort study with two post-deployment surveys (4 and 12 months post-deployment)	659 OIF active-duty Army soldiers Age: mean 25 Gender: 96% male Ethnicity: 67% white, 13% Hispanic, 10% African-American/black	Insomnia: 4 of the 7 items from the ISI for the past two weeks assessed 4 and 12 months after deployment	Psychological symptoms (e.g., PTSD, depression) 4 and 12 months after deployment	Insomnia at 4 months post-deployment predicted depression and PTSD (specifically, intrusion symptoms) at 12 months post-deployment; depression and PTSD at 4 months post-deployment did not predict insomnia at 12 months post-deployment.	Self-report; full ISI scale not used; small effects; elimination of data due to some high levels of skewness
Studies on operational readiness					
Caldwell et al., 2004 Longitudinal experiment (deployment status unknown)	10 experienced Air Force pilots Age: mean 35.7 Gender: 100% male Ethnicity: not reported	Fatigue: 37 hours of continuous wakefulness	Physiological arousal, cognitive performance, mood, and flight simulator performance after 37 hours of continuous wakefulness	Decreased reaction time, mood, and cognitive abilities beginning at the 26th hour of wakefulness. Worst flight performance was seen between 27 and 33 hours of wakefulness.	Small sample for Air Force pilots limits generalizability; flight simulation shorter than typical flight times; artificial environment provided opportunities for alertness (e.g., walk around, talk with others)

Table B.4—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Ferguson et al., 2008 Longitudinal experiment with sleep/wake performance data and sleep diary (unknown deployment status)	17 Australian marine pilots Age: mean 55.9 (8.0) Gender: 100% male Ethnicity: not reported	Sleep/wake and performance data: 28 days of palm Psychomotor Vigilance Task and sleep/nap diary	Impact of brief, unscheduled naps during work periods on alertness and vigilance	Frequent, opportunistic naps appeared to provide adequate recovery and slowed the accumulation of sleep debt for pilots during wake periods of > 24 hours.	Small sample of Australian marine pilots limits generalizability; Psychomotor Vigilance Task is generally sensitive to short naps
Horne and Moseley, 2011 Cross-sectional field experiment (unknown deployment status)	20 healthy junior officer reservists in the UK Age: 20 to 22 Gender: 100% male Ethnicity: not reported	Sudden early morning awakening: experimental group 3 hours of sleep; control group up to 7.5 hours of sleep	Pen and paper exercise involving decisions regarding rapid response to an enemy attack (test of operational readiness and decisionmaking)	Participants receiving more sleep performed better overall on the simulation exercise. 8/10 experimental participants and 3/10 control participants failed the task.	Small sample with limited military experience; cross-sectional; simulation exercise on paper and not indicative of real-life conditions
Lieberman, Bathalon, et al., 2005 Longitudinal field experiment with pre-, during-, and post-simulation cognitive and mood tests (unknown deployment status)	31 Army officers Age: mean 31.6 (0.4) Gender: 100% male Ethnicity: not reported	Sleep deprivation: mean of 3 hours (0.3) hours of sleep over 53 hours of a combat simulation	Mood and cognitive tests of attention, pattern recognition, memory, and reasoning at three time points during simulation; tests of body composition, hydration, cortisol, and testosterone levels	Participants performed significantly worse on cognitive tests from pre- to post-simulation. Reports of poor mood (e.g., depression, tension) increased over the experiment. Cortisol and testosterone levels decreased.	Small sample of Army officers limits generalizability; simulation experience; other factors besides sleep deprivation present (e.g., high temperatures, limited food/water)

Table B.4—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Lieberman, Tharion, et al., 2002 Longitudinal experiment with cognitive tests delivered pre-sleep deprivation and post-72 hours sleep deprivation (unknown deployment status)	68 Navy SEAL trainees taking part in “Hell Week” with 72 hours of sleep deprivation Age: mean 23.9 (3.0) Gender: 100% male	Sleep deprivation: period of 72 hours of almost total sleep deprivation Sleepiness: 7-item SSS	Effects of caffeine on cognitive performance when delivered after a period of sleep deprivation	After being deprived of sleep, participants performed significantly worse from pre-sleep deprivation levels on nearly all cognitive tests (e.g., visual vigilance, reaction time, visual reaction time, false alarms).	Small sample of Navy SEALs limits generalizability; inability to tease apart sleep deprivation effects from other stressors present during Hell Week
Olsen et al., 2010 Longitudinal field experiment (unknown deployment status)	92 first-year officer cadets at the Royal Norwegian Naval Academy and the Norwegian Army Academy Age: 24.2 (4.2) Gender: 92% male Ethnicity: not reported	Sleep deprivation: rested group 8 hours/day prior to study; sleep-deprived group had 2.5 hours/day past 5 days Sleepiness: SSS	Moral reasoning decisions in hypothetical situations between partial sleep deprivation group and rested group	Compared with moral decisions made during restful states, participants showed more impairment in moral reasoning that related to observing, assessing, and inferring potential moral principles from a situation. Participants lost some capacity for complex justice judgments after being sleep deprived.	Small sample with limited military experience; theoretically-contrived moral reasoning outcomes; did not assess moral decisions related to decisions in combat operations)

Table B.4—Continued

Study/Design	Sample Characteristics	Measures Related to Sleep	Outcomes	Main Findings Related to Sleep	Limitations
Previc et al., 2009 Longitudinal experiment with flight simulation (deployment status unknown)	10 U.S. Air Force pilots with an average of 2,806 hours of flight experience Age: mean 34.2 Gender: 100% male Ethnicity: not reported	Sleep deprivation: objective eye movement, EEG recordings; subjective ratings of fatigue on fatigue-inertia scale of the Profile of Mood States and the sleepiness scale of the Visual Analog Scale	Performance on flight simulation experiment during 34 hours of continuous wakefulness	Sleep deprivation increased subjective fatigue and fatigue-related changes in EEG activity over time, as well as decreased vigilance and cognitive capability. Performance deficits were more pronounced in the early morning hours of the second day of continued wakefulness. Instrument scanning was minimally affected.	Small sample; large variation among outcome measures between participants makes findings difficult to generalize

Methods and Review of Published Studies on Interventions for Sleep Disorders in the Military

The first section of this appendix outlines the methods used in reviewing the literature of interventions for sleep disorders used in Chapter Four, “Evidence-Based Programs to Prevent and Treat Sleep Problems.” The second section includes four tables detailing the studies included in our review of interventions for sleep disorders among military and veteran populations.

Methods for Literature Review

Peer-reviewed journal articles were identified through searches of literature databases: PsycInfo, PubMed, Google Scholar, DTIC, PsycArticles, EBSCO Academic Search Complete, and ProQuest Military Collection. The search terms used are listed in Table C.1. The table includes only the databases from which we obtained articles that matched our inclusion criteria. We also scanned the references from the articles we retrieved from the initial database searches to identify additional sources.

The database searches and subsequent reference list searches yielded a total of 122 sources that met our inclusion criteria based on a title and abstract review. After closer examination of the sources, 59 were included in our review and cited in Chapter Four. We included studies that used samples of military and/or veteran participants and utilized interventions aimed to treat sleep disorders or sleep disturbances. We also included several reviews and meta-analyses of sleep disorder intervention methods and expert panel recommendations for the treatment of servicemembers with sleep disorders. With the exception of two pertinent cases, all of the articles included in our review were published after 2001 to reflect the needs of recent post-deployed servicemembers and veterans.

Table C.1
Databases and Search Terms for Literature Review of Interventions for Sleep Disorders in the Military

Database	Sleep Terms	Intervention Terms	Population Terms
PsycInfo N = 47 peer-reviewed articles	Sleep disorders, sleepy hygiene, sleep, insomnia, sleep apnea, sleep deprivation, pain	Treatment, intervention, imagery rehearsal therapy, cognitive-behavioral therapy, teletherapy, telephone therapy, smartphone applications, smartphone, self-identification, alternative, alternative medicine, yoga, acupuncture, assessment, identification, meditation, relaxation, biofeedback, chiropractic, osteopathic, internet, technology	Military
Google Scholar N = 13 peer-reviewed articles	Sleep disorders, sleep hygiene, insomnia, sleep	Treatment, intervention, imagery rehearsal therapy, cognitive-behavioral therapy, teletherapy, telephone therapy, smartphone applications, smartphone, self-identification, alternative treatment, yoga, acupuncture, complementary treatment	Military
PubMed N = 6 peer-reviewed articles	Sleep disorders, sleep hygiene, sleep, insomnia	Treatment, intervention, imagery rehearsal therapy, cognitive-behavioral therapy, teletherapy, telephone therapy, smartphone applications, smartphone, self-identification	Military
DTIC N = 1 peer-reviewed article	Sleep disorders, sleep hygiene, insomnia	Treatment, intervention, imagery rehearsal therapy, cognitive-behavioral therapy	Military

Reviewed Studies of Interventions for Sleep Disorders in the Military: Methods and Findings

The following tables detail the studies included in our literature review in Chapter Four on evidence-based practices for treating sleep disorders in military and veteran populations. In total, we included 22 peer-reviewed articles on interventions in our review, which are summarized in Tables C.2–C.5. Five references were included in Table C.2 as CBT-I studies, seven in Table C.3 as IRT studies, five in Table C.4 as CAM studies, and five in Table C.5 as combined methods studies.

Table C.2
Studies of Cognitive-Behavioral Therapy for Insomnia with Servicemember and Veteran Samples

Study/Sample Characteristics	Intervention	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
<p>Gellis and Gehrman, 2011</p> <p>Sample: 8 male veterans with combat-related PTSD and insomnia (7 Vietnam, 1 Gulf War)</p> <p>Setting: VA Medical Center</p>	<p>Uncontrolled pilot study to examine the effects of five weeks of individual CBT-I treatments on veterans with long-standing PTSD and insomnia</p> <p>Treatment included: stimulus control, sleep hygiene, sleep compression, and relaxation training.</p>	<p>Sleep diaries</p> <p>Insomnia severity index</p> <p>Actigraphy</p> <p>Clinician-Administered PTSD Scale (CAPS)</p> <p>PCL-M</p> <p>ESS</p> <p>Nightmare Effects Survey</p> <p>FSS</p> <p>SF-12</p>	<p>Subjective assessments of sleep patterns (diaries and ISI) demonstrated improvements in sleep. No significant changes in functioning, nightmares, or PTSD severity were observed.</p>	<p>Lack of a control condition and small sample size.</p>
<p>Perlman et al., 2008</p> <p>Sample: 20 veterans (5 women) with chronic insomnia (patients who had PTSD with recurrent combat-related nightmares were excluded)</p> <p>Setting: VA Mental Health Clinic</p>	<p>Group-administered CBT-I treatment for veterans with chronic insomnia.</p> <p>Treatment included: sleep restriction, stimulus control, sleep hygiene, and cognitive therapy.</p>	<p>Sleep diaries</p> <p>PSQI</p> <p>ISI</p> <p>Dysfunctional Beliefs and Attitudes About Sleep–Short Form (DBAS-SF)</p>	<p>There were improvements in frequency of nighttime awakenings, sleep quality, restedness, and daytime functioning. PSQI, ISI, and DBAS-SF scores decreased significantly.</p>	<p>Lack of a control condition and small sample size. Patients were referred by their primary clinicians, which may have produced selection bias.</p>
<p>Margolies, 2011</p> <p>Sample: 40 OEF/OIF veterans (4 women) with PTSD and sleep disturbance</p> <p>Setting: VA Medical Center</p>	<p>RCT to compare treatment of veterans with PTSD and insomnia with CBT-I versus a waitlist control group. Selected patients received four individual sessions of CBT-I over six weeks.</p> <p>Treatment included sleep restriction, stimulus control, cognitive restructuring, sleep education, sleep hygiene, and imagery rehearsal therapy.</p>	<p>Sleep diary</p> <p>Actigraphy</p> <p>PTSD Symptom Scale–Self-Report</p> <p>PSQI (w/ PTSD addendum)</p> <p>ISI</p> <p>DBAS</p> <p>Insomnia Treatment Evaluation Questionnaire</p> <p>Patient Health Questionnaire</p> <p>Profile of Mood States</p>	<p>Compared with the control group, patients who were treated with CBT-I reported significantly improved sleep quality and duration, as well as decreases in PTSD symptom severity, PTSD-related nightmares, depression, and distressed mood.</p>	<p>Small starting sample size and a low response rate for follow-up data.</p> <p>Only one provider conducted intervention treatment and assessment and did not control for medication usage.</p>

Table C.2—Continued

Study/Sample Characteristics	Intervention	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
<p>Talbot et al., 2014</p> <p>Sample: 45 Adults with PTSD and insomnia currently in treatment (31 women; 9 veterans)</p> <p>Setting: VA Medical Center</p>	<p>RCT design, administered individual CBT-I treatments weekly to 29 of the participants over an eight-week period. The waitlist control group did not receive treatment.</p> <p>Treatment included: stimulus control, sleep restriction, sleep hygiene, cognitive intervention focused on catastrophic beliefs and attitudes related to sleep, and relapse prevention.</p>	<p>Polysomnography</p> <p>Sleep diary</p> <p>Actigraphy</p> <p>CAPS</p> <p>ISI</p> <p>PSQI/PSQI-Addendum</p> <p>ESS</p> <p>PCL</p> <p>BDI</p> <p>Work and Social Adjustment Scale</p>	<p>CBT-I was shown to be more effective than a waitlist control condition at reducing insomnia symptoms in patients with PTSD and diagnosable insomnia. This was shown by test-retest sleep diary measures, total sleep times from polysomnography, ISI total scores, PSQI scores, and ESS scores.</p>	<p>Only a small number of veterans were included in the sample (3 veterans in CBT-I group and 6 in waitlist control group). The specific traumas experienced by the participants were not documented, but the high percentage of women (69%) and high mean duration of PTSD (18.5 years) in this relatively young sample (mean age = 37 years) suggest that many patients suffered trauma of a sexual or intimate abusive nature.</p>
<p>Koffel, 2014</p> <p>Sample: 21 veterans (3 women; 11 Vietnam; 7 Gulf War) diagnosed with insomnia and at least one other psychiatric disorder</p> <p>Setting: VA Medical Center</p>	<p>Uncontrolled group CBT-I sessions (90 minutes each) were administered to patients weekly for 6 weeks.</p> <p>Treatment included: stimulus control, sleep restriction, cognitive restructuring.</p>	<p>Sleep diary</p> <p>ISI</p> <p>DBAS</p> <p>BDI</p> <p>PCL-C</p>	<p>Following treatment, participants demonstrated significant improvements in sleep onset latency, sleep efficiency, nighttime awakenings, ISI scores, DBAS scores.</p>	<p>Lack of a control group and small sample size.</p> <p>Comorbid diagnoses were obtained through chart review rather than diagnostic interviews.</p>

Table C.3
Studies of Imagery Rehearsal Therapy with Servicemember and Veteran Samples

Study/Sample Characteristics	Intervention	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
<p>Cook et al., 2010</p> <p>Sample: 124 male Vietnam veterans with PTSD from combat</p> <p>61 in IRT, 63 in control</p> <p>Setting: VA Medical Center</p>	<p>RCT using IRT as the intervention, and sleep and nightmare management as the control condition. Treatment was delivered over six sessions (90 minutes each) in a group format.</p> <p>Intervention included additional treatment: psychoeducation and elements of standard CBT-I.</p>	<p>Nightmare Frequency Questionnaire</p> <p>PSQI (with PTSD addendum)</p> <p>CAPS</p> <p>Nightmare Effects Survey</p>	<p>No significant differences in outcomes of sleep quality, nightmare frequency, or PTSD symptoms between intervention and control groups.</p>	<p>Control group also received psychoeducation and elements of CBT-I, and the 2 therapists administered both treatments. Therefore, both treatments may have improved symptoms in the two groups equally.</p>
<p>Forbes, Phelps, and McHugh, 2001</p> <p>Sample: 12 male Vietnam veterans with PTSD and trauma-related recurrent nightmares. Participants had completed inpatient treatment programs in the last 6 months, with limited results.</p> <p>Setting: Unspecified</p>	<p>Pilot study to examine the effects of using IRT to reduce combat-related nightmares.</p> <p>Treatment was delivered over six sessions (90 minutes each) in groups of 4 participants.</p>	<p>Nightmare diaries</p> <p>CAPS</p> <p>Impact of Events Scale</p> <p>Symptom Checklist-90</p> <p>BDI</p> <p>Beck Anxiety Inventory</p>	<p>Significant reductions in nightmares and improvements in PTSD and comorbid symptomatology.</p>	<p>Lack of a control condition and small sample size.</p>
<p>Harb, Thompson, et al., 2012</p> <p>Sample: 48 male Vietnam veterans who completed IRT treatment</p> <p>Setting: VA Medical Center</p>	<p>Researchers examined relationships between nightmare characteristics, revised dream scripts, and IRT treatment outcomes from the RCT conducted by Cook et al., 2010.</p>	<p>Nightmare Frequency Questionnaire</p> <p>PSQI</p> <p>CAPS</p> <p>PCL-M</p>	<p>Incorporating resolution of a nightmare theme and excluding violent details from a revised nightmare tend to improve treatment outcomes in terms of nightmare frequency and sleep quality.</p>	<p>The participants chose which dreams to target, and the revised dream scripts used by clinicians were not controlled in the study.</p>

Table C.3—Continued

Study/Sample Characteristics	Intervention	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
<p>Lu et al., 2009</p> <p>Sample: 15 male veterans with combat-related PTSD</p> <p>Completed PTSD psychoeducation group and were referred by providers</p> <p>Setting: VA PTSD clinic</p>	<p>Researchers used multiple measures to examine sleep and nightmare outcomes immediately following treatment and at 3- and 6-month follow-ups.</p> <p>Treatment consisted of 6 groups sessions (90 minutes each) of IRT.</p>	<p>Self-reported: frequency of trauma-related and non-trauma-related nightmares, average number of nightmares per night, severity of nightmares</p> <p>Nightmare Effects Survey</p> <p>PTSD Dream Rating Scale</p> <p>PCL (sleep quality)</p> <p>PSQI</p> <p>BDI</p>	<p>There were significant improvements in trauma-related nightmare frequency long-term, but not immediately following treatment. No effects were found on measures of the impact of nightmares or sleep quality.</p>	<p>Lack of a control condition and small sample size.</p> <p>Several of the measures used were self-reported and may not have been accurate or reliable.</p>
<p>Nappi et al., 2010</p> <p>Sample: 91 veterans referred, 58 received at least one IRT treatment (49 men, 9 women; 22 received group IRT, 36 individual IRT).</p> <p>Setting: VA Healthcare System</p>	<p>Researchers reviewed medical history charts of outpatient veterans with trauma-related nightmares to examine outcomes associated with treatment with IRT.</p>	<p>Nightmare frequency</p> <p>Nightmare intensity</p> <p>ISI</p> <p>PSQI</p> <p>PCL</p>	<p>Those who had prior PTSD treatment were more likely to accept IRT when offered. Completion of IRT was unrelated to previous treatment, demographics, or nightmare severity. IRT completers experienced reductions in nightmare frequency and severity, insomnia severity, and daytime PTSD symptoms.</p> <p>Participants treated in individual settings had greater reduction in ISI scores than those in group settings, despite lower dosage.</p>	<p>Participants were referred to treatment by their providers. The lack of a control condition, attrition between IRT sessions, and the use of self-report measures may reduce the validity of the study's findings.</p>

Table C.3—Continued

Study/Sample Characteristics	Intervention	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
<p>Moore and Krakow, 2007</p> <p>Sample: 11 soldiers with complaint of acute nightmares after experiencing traumatic event</p> <p>Setting: Deployment in Iraq</p>	<p>IRT administered to soldiers with acute nightmares within 30 days after experiencing a traumatic event.</p> <p>Treatment: 4 weekly one-hour sessions</p>	<p>Nightmare frequency</p> <p>PTSD symptoms</p> <p>Insomnia severity (unspecified scales)</p>	<p>Nightmare frequency, PTSD symptom severity, and insomnia severity were reduced post-treatment and at 1-month follow-up.</p>	<p>Lack of a control condition and small sample size.</p> <p>Participants did not have clinical diagnoses. The dissipation of symptoms could have occurred naturally.</p>
<p>Long et al., 2011</p> <p>Sample: 37 male veterans (35 Vietnam, 2 Gulf War) with PTSD and nightmares</p> <p>Setting: VA specialty mental health program for PTSD</p>	<p>Trial of group imagery rescripting and exposure therapy for treating posttraumatic nightmares in veterans with PTSD.</p> <p>Treatment: 6 weekly group IRET sessions (90 minutes each)</p>	<p>PCL-M</p> <p>Daily sleep activity log</p>	<p>Significant reductions in frequency of nightmares and PTSD severity, as well as increased sleep duration.</p>	<p>The lack of a control condition and the fact that participants were allowed to continue other treatments make the true effects of the intervention unclear. Participants were referred by their providers.</p>

Table C.4
Studies of Complementary and Alternative Medicine with Servicemember and Veteran Samples

Study/Sample Characteristics	Intervention	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
Brooks and Scarano, 1985 Sample: 18 male Vietnam veterans with PTSD from combat Setting: Vet Center	Compared use of transcendental meditation to psychotherapy in treating PTSD and insomnia. Treatment was weekly sessions for 3 months.	Insomnia questionnaire Post-Vietnam adjustment questionnaire	There was a significant positive effect of the meditation treatment on self-reported insomnia among participants.	Small sample size; study lacked validated measures and rigorous diagnoses for participants
J. Rosenthal et al., 2011 Sample: 5 OEF/OIF veterans Setting: VA Medical Center	Twice-daily 20-minute sessions of transcendental meditation for 3 months	CAPS PCL-M Quality of Life Enjoyment and Satisfaction Questionnaire	Participants showed significant improvement in PTSD symptom severity and reported sleeping better, feeling happier, and being less anxious.	Lack of a control condition and small sample size; sleep scales such as the ISI and PSQI were not used
Grossl et al., 2012 Sample: 53 veterans (13 women) with chronic lower back pain Setting: VA Medical Center	At least 8 weekly yoga sessions to reduce chronic lower back pain and symptoms of comorbid disorders	Fatigue and energy measures from the Medical Outcomes Study for use with chronic illness populations	Female patients experienced significantly larger improvements in pain, depression, sleep quality, and energy than male patients.	No control condition; sleep scales such as the ISI and PSQI were not used
Staples, Hamilton, and Uddo, 2013 Sample: 12 (2 women) veterans with service-connected PTSD Setting: VA Medical Center	Bi-weekly 1-hour sessions of yoga intervention for 6 weeks	PCL-M PSQI	There was significant improvements in hyperarousal, sleep quality, and daytime dysfunction related to sleep.	Lack of a control condition and small sample size
Stoller et al., 2012 Sample: 70 personnel deployed to Iraq Setting: Deployed military base in Iraq	Participants in intervention group attended at least nine 75-minute sessions of sensory-enhanced hatha yoga over three weeks	Adolescent/Adult Sensory Profile State-Trait Anxiety Inventory Quality of Life Survey	Patients given intervention experienced significant reductions in anxiety and self-reported sleep difficulties, compared with control group.	Participants did not have clinical diagnoses; researchers collected little data on combat experiences and symptom severity; no sleep-specific measures

Table C.5
Studies of CBT Combinations with Servicemember and Veteran Samples

Study/Sample Characteristics	Intervention	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
<p>Harb, Cook, et al., 2009</p> <p>Sample: 11 male veterans of OIF diagnosed with PTSD and insomnia</p> <p>Setting: VA medical center</p>	<p>7–8 individual sessions of combined IRT/CBT-I</p>	<p>CAPS</p> <p>Nightmare Frequency Questionnaire</p> <p>PCL-M</p>	<p>There were reductions in nightmare frequency and PTSD symptom severity, as well as improved sleep quality.</p>	<p>Lack of a control group and small sample size</p>
<p>Ulmer, Edinger, and Calhoun, 2011</p> <p>Sample: 22 veterans (9 female) with PTSD, insomnia, and nightmares</p> <p>Setting: VA hospital</p>	<p>6 biweekly 1-hour individual sessions of intervention (3 sessions of CBT-I and 3 sessions of IRT). Control group received usual care</p>	<p>Duke Structured Interview for Sleep Disorders</p> <p>Folstein Mini-Mental Status Exam</p> <p>ISI</p> <p>Electronic sleep diary</p> <p>PSQI</p> <p>PCL-M</p> <p>PHQ</p>	<p>Compared with the control group, patients given intervention experienced significant reductions in insomnia and PTSD symptom severity, as well as improvements in sleep quality.</p>	<p>Small sample size</p>
<p>Margolies et al., 2013</p> <p>Sample: 40 OEF/OIF combat veterans (4 female) with PTSD and insomnia</p> <p>Setting: VA medical center</p>	<p>4 individual sessions of CBT-I with adjunctive IRT or waitlist control</p>	<p>Sleep diary</p> <p>Actigraphy</p> <p>PSQI</p> <p>ISI</p> <p>DBAS</p> <p>PTSD Symptom Scale-Self Report</p> <p>PHQ</p> <p>Profile of Mood States</p>	<p>Patients in the intervention group reported significantly improved sleep and reductions in PTSD and depression symptom severity.</p>	<p>The IRT component was optional in the intervention</p>

Table C.5—Continued

Study/Sample Characteristics	Intervention	Measures Related to Sleep	Main Findings Related to Sleep	Limitations
Swanson et al., 2009 Sample: 10 male combat veterans (9 Vietnam, 1 Gulf War) with PTSD, insomnia, and recurrent nightmares Setting: VA PTSD Clinic	Ten 90-minute group sessions of treatment combining CBT-I with exposure, rescripting, and relaxation therapy	Sleep and dream diaries ISI PSQI Post-traumatic Diagnostic Scale	Researchers observed improvements in sleep quality, sleep duration, and nightmare frequency among the patients following treatment.	Lack of a control group and small sample size
Nakamura, 2011 Sample: 63 veterans with sleep disturbance Setting: VA Medical Center	Two weekly 90-minute sessions of sleep-focused mind-body bridging, which combines CBT-I with mindfulness-based training	Medical Outcomes Study-Sleep Scale PCL-M	Compared with the control group, patients in the intervention group showed significant improvements in frequency and intensity of sleep disturbances, as well as PTSD symptom severity.	Small treatment dosage. Control group received sleep hygiene education.

Review of Sleep Metrics

Tables D.1 and D.2 provide details on instruments for assessing sleep parameters and sleep disturbances that commonly occur among military personnel.

Table D.1
Summary of Validity Studies on Sleep Metrics

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/ Disadvantages
Sleep duration (sleep quantity)					
Single question embedded in clinical interviews or self-report questionnaires	Epidemiologic studies commonly use a single item to assess habitual sleep duration (e.g., On average, how many hours of sleep do you usually get in a night?)	One item	Epidemiologic studies show a relationship between sleep and morbidity	NA	<p>Advantage: Short and easily administered in large survey studies.</p> <p>Disadvantage: Assesses perceived sleep duration rather than the objective number of hours slept.</p>
Sleep quality					
Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, et al., 1989)	<p>Self-report instrument assessing sleep quality and sleep disturbance over a 1-month period</p> <p>Subscales: Seven clinically derived domains of sleep difficulties: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction</p> <p>Scoring: Scores range from 0 to 21 A global score ≥ 5 is indicative of poor sleep quality among younger adults</p>	19 items	<p>PSQI administered to three groups of respondents over an 18-month period.</p> <p>“Good sleepers”: 52 healthy individuals without sleep complaints</p> <p>“Poor sleepers”: 34 patients with major depressive disorder (24 outpatients and 10 inpatients)</p> <p>“Poor sleepers referred”: 62 outpatients with disorder of initiating and maintaining sleep (N = 45) and disorders of excessive somnolence (N = 17)</p>	<p>Reliability: Test-retest: $r = 0.85$</p> <p>Internal consistency: Cronbach’s $\alpha = 0.83$</p> <p>Validity: Correlations between polysomnography and global score weakly correlated only with objective sleep latency ($r = 0.20$).</p>	<p>Advantages: Well-recognized with robust psychometric properties. Allows more detailed analysis of sleep disturbance</p> <p>Disadvantages: Fairly long Complicated scoring algorithm</p>

Table D.1—Continued

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/ Disadvantages
Patient-Reported Outcomes Measurement Information System (PROMIS) (Pilkonis et al., 2011; Buysse, Yu, et al., 2010; Choi et al., 2010) and PROMIS short forms (Yu and Berger, 2011)	The PROMIS sleep disturbance and SRI item banks were developed to improve self-report instrumentation of sleep-wake function	SD = 27 items SRI = 16 items Short forms (4, 6, and 8 items)	1,993 adults recruited from an Internet polling sample and 259 adults recruited from medical, psychiatric, and sleep clinics.	Reliability: Test-retest: $r = 0.90$ Validity: SD-PSQI: $r = 0.85$ SRI, PSQI: $r = 0.70$ SD, ESS: $r = 0.25$ SRI, ESS: $r = 0.45$ Short form: Comparable psychometrics	Advantages: Short form (4–8 items) can be created by the administrator Web version available Disadvantages: Newer instrument lacking cross-validation in samples other than the original validation sample Generic rather than disease-specific: Does not focus on symptoms of specific sleep disorders, nor does it provide subjective estimates of sleep quantities
Medical Outcomes Study (MOS)–Sleep Scale (Allen et al., 2009; Hays et al., 2005)	Sleep problem index indicative of sleep disturbances or disorders	12 items	551 male and female subjects (ages 18–79) with primary restless legs syndrome. Longitudinal data were available on all patients to assess predictive validity of the scale.	Internal consistency: Cronbach's $\alpha = r \geq 0.73$ Validity: Daytime somnolence scale $r = 0.63$	Advantages: Can be used with other scales of the MOS for comparisons Sensitive to changes over course of treatment Disadvantage: Lacks cross-validation

Table D.1—Continued

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/ Disadvantages
PHQ-9 (Item 3 Screens for Sleep Disturbance) (MacGregor et al., 2012)	<p>Single item (item 3) aiming at screening sleep disturbances in primary care. Patient asked to rate how often he/she has had “trouble falling or staying asleep, or sleeping too much,” assessing the frequency of both insomnia and hypersomnia</p> <p>A cutoff score of 1 on the PHQ-9 item 3 is indicative of sleep disturbance at least several days in the last two weeks</p>	One item	N = 111 male participants (age > 18) in VA primary care (no neurological impairment) completed the PHQ-9 and the Insomnia Severity Index	<p>Validity: Relationship between the ISI and the PHQ-9 item: $r = 0.75$</p> <p>Cutoff score of 1 showed the best balance of sensitivity (82.5%) and specificity (84.5%), as well as positive (78.4%) and negative (91%) predictive value</p>	<p>Advantages: Very brief PHQ can be used to simultaneously assess depression</p> <p>Disadvantages: Lacks cross-validation in samples other than the original validation sample Does not focus on symptoms of specific sleep disorders, nor does it provide subjective estimates of sleep quantities</p>
Sleepiness (feelings or symptoms)					
Stanford Sleepiness Scale (Hoddes et al., 1973)	<p>Subjective perceptions of daytime sleepiness.</p> <p>Seven-point Guttman scaled item ranging from 1 (feeling active and vital; alert; wide awake) to 7 (lost struggle to remain awake)</p> <p>Respondents select the one option that best describes how sleepy they feel at the moment of testing</p>	One item	Five healthy male college students (ages 18–22) were given the SSS, as well as a brief test of memory, the Wilkinson Addition Test, and the Wilkinson Vigilance Test over 6 days	<p>Reliability: Test-retest: $r = 0.88$</p> <p>Validity: Mean scores correlate with Wilkinson addition and vigilance tests: $r = 0.68$</p>	<p>Advantages: Can be administered many times per day Correlates with measures of performance Reflects the effects of sleep loss</p> <p>Disadvantages: Questionable reliability for chronic sleep deprivation, cumulative partial sleep deprivation and narcolepsy Does not distinguish general level of daytime sleepiness from situational sleepiness</p>

Table D.1—Continued

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/ Disadvantages
Karolinska Sleepiness Scale (KSS) (Kaida et al., 2006)	Participants evaluate their subjective level of subjective sleepiness	1 item	16 healthy females (ages 33–43). Eight measures per day over 3 days.	Validity: Electroencephalogram significantly correlated with KSS (mean $r = 0.56$)	Advantage: Very brief Disadvantage: Does not measure the general level of daytime sleepiness, as distinct from feeling of sleepiness at a particular time
Epworth Sleepiness Scale (ESS) (Johns, 1992)	Self-report questionnaire Scoring: scores from 0 to 24 Scores > 10 = significant daytime sleepiness	8 items	180 subjects (ages 18–78), including 30 control participants with no history of sleeping disorders, and 150 patients with various sleep disorders completed the questionnaire; 138 patients completed polysomnography	Reliability: Test-retest: $r = 0.82$ Internal consistency: Cronbach's $\alpha = 0.88 - 0.74$. Correlates with objective measures of sleepiness (Chervin et al., 1997)	Advantages: Well-recognized instrument with robust psychometric properties Fairly brief Differentiate between individuals who are sleep deprived and those who are not (Johns, 1991; Johns, 1994) Disadvantage: Studies that examined the reproducibility of the original structure of the ESS are limited to normal subjects.

Table D.1—Continued

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/ Disadvantages
Sleep/Wake Activity Inventory (SWAI) (Rosenthal, Roehrs, and Roth, 1993)	Participants rate how frequently they experienced sleepiness over the prior 7 days Scoring: Score ≤ 40 = excessive sleepiness 40 to 50 = possible sleepiness ≥ 50 = normal	Long form: 59 items Short form: 12 items	N = 554 male and female respondents	Validity: Good discriminant validity: distinguish between different levels of sleepiness	Advantages: Differentiate pathological levels of sleepiness from normal levels of sleepiness. Sensitive to changes in sleep physiology as improved scores followed normalization of sleep-disordered breathing. Disadvantage: Very long
Healthy sleep/sleep hygiene					
Sleep Hygiene Index (Mastin, Bryson, and Corwyn, 2006)	Self-administered index assessing the presence and frequency of sleep hygiene behaviors (see narrative) and a global assessment of sleep hygiene. Scoring: Higher scores are indicative of more maladaptive sleep hygiene status.	13 items	632 volunteering psychology university students (404 female respondents; mean age = 21.6)	Reliability: Test-retest: $r = 0.71$ Internal consistency: Cronbach's $\alpha = 0.66$ Validity: Correlations with other instruments: ESS: $r = 0.244$ PSQI total score: $r = 0.48$ Inadequate sleep hygiene: $r = 0.371-0.458$	Advantage: Well-recognized instrument with robust psychometric properties Disadvantage: Fairly long

Table D.1—Continued

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/ Disadvantages
Sleep Hygiene Awareness and Practice Scale (Lacks and Rotert, 1986)	Evaluated sleep hygiene awareness/ knowledge	13 items	44 sleep-onset insomniacs, 49 sleep-maintenance insomniacs, and 50 good sleepers	Internal consistency: Cronbach's $\alpha = 0.47$	<p>Advantage: Can distinguish whether deficits in sleep hygiene are due to lack of knowledge or from alternate factors.</p> <p>Disadvantage: Does not measure actual sleep hygiene behaviors</p>
Sleep Hygiene Self-Test (Blake and Gomez, 1998)	Assessed activities influencing sleep quality and quantity or level of sleep hygiene	30 items	52 combat veterans, patients in a treatment program for PTSD, completed the test prior to and after their participation in 5 weeks of group therapy for sleep hygiene	<p>Internal consistency: Cronbach's $\alpha = 0.54$</p> <p>Sensitive to changes pre- post-treatment.</p>	<p>Advantages: Validated in military personnel with PTSD Reliably measures activities that may directly influence sleep quality and quantity</p> <p>Disadvantages: Fairly long Lacks cross-validation</p>

Table D.2
Summary of Validity Studies on Sleep Disorders

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/ Disadvantages
Insomnia					
Insomnia Severity Index (ISI) (Bastien, Vallieres, and Morin, 2001)	<p>Assessed severity of problems with sleep over the past 2 weeks</p> <p>Scoring: < 8 = no insomnia, 8–14 = sub-threshold insomnia 15–21 = clinical insomnia of moderate severity 22–28 = severe clinical insomnia</p>	7 items	<p>Two samples of insomnia patients: 145 patients evaluated for insomnia at a sleep disorder clinic completed the ISI and sleep diaries.</p> <p>78 older patients who participated in an RCT of behavioral and pharmacological therapies for insomnia. Change scores on the ISI over time were compared with those obtained from sleep diaries and polysomnography. Comparisons were also made between ISI scores obtained from patients, significant others, and clinicians.</p>	<p>Reliability: Item-total correlations = 0.36–0.67</p> <p>Internal consistency: Cronbach's α = 0.90 and 0.91</p> <p>Validity: Correlated with sleep diaries, polysomnography, and interviews ($r \geq 0.74$)</p> <p>Cutoff score of 10 had 86.1% sensitivity and 87.7% specificity for detecting insomnia in the community sample.</p>	<p>Advantage: Military and web versions available</p> <p>Disadvantage: Only assessed insomnia severity</p>

Table D.2—Continued

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/ Disadvantages
Insomnia Severity Index for Military Population (Ployhart, 2005)	<p>Assessment of post-deployment sleep problems.</p> <p>Cut-off values: Items 1 and 2 = at risk if soldiers provided responses of “moderate,” “severe,” or “very severe”</p> <p>Item 3 coded = at risk if endorsed with “dissatisfied” or “very dissatisfied”</p> <p>Item 4 = at risk with responses of “somewhat,” “much,” or “very much interfering”</p>	4 items	<p>Ployhart (2005) conducted a complete psychometric analysis of Morin’s seven sleep items that included estimating polytomous Item Response Theory models.</p> <p>From these analyses, four items were identified and kept for use in the military population.</p>	<p>Sensitivity and specificity values associated with scoring positive on two of the four items are adequate (0.74 and 0.76, respectively)</p>	<p>Advantages: Brief Validated in military personnel</p> <p>Disadvantages: Only assesses insomnia severity, not other sleep disturbances common in military personnel The coding system tends to produce a high number of false positives</p>
Web version of the ISI (Thorndike, Ritterband, Saylor, et al., 2011)		7 items	<p>43 adults with insomnia (ages 18–65) enrolled in an online intervention completed both ISI versions during pre-(assessment 1) and post-intervention (assessment 2).</p>	<p>Reliability: Correlations between total scores in the two formats (paper vs. web) $\alpha = 0.98-0.99$</p> <p>Internal consistency: Cronbach’s $\alpha = 0.61-0.89$</p>	<p>Advantage: Web version</p> <p>Disadvantage: Only assess insomnia severity</p>

Table D.2—Continued

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/Disadvantages
Obstructive sleep apnea					
STOP and STOP-BANG (Chung et al., 2008)	<p>STOP: Screening instrument to detect sleep apnea in surgical population.</p> <p>Yes/no answers to questions about snoring, tiredness/sleepiness, observed apneas, hypertension, BMI > 35 kg/m², age > 50 years, neck circumference > 40 cm, and male gender; a score of any 3 affirmative responses was used to dichotomize the population.</p> <p>STOP-BANG: alternative scoring model that incorporates BMI, age, neck circumference, and gender</p>	<p>STOP: 4 items</p> <p>STOP-BANG: 8 items</p>	<p>Validation study: 1,875 patients who were undergoing surgery completed the STOP and underwent an overnight polysomnographic study</p> <p>The STOP and STOP-BANG were originally developed and validated to prevent pre-surgical patients with undiagnosed severe sleep apnea from going to the operating room</p>	<p>Sensitivities measured 83.6%, 92.9%, and 100%, respectively, for patients with at least mild (AHI > 5/h), moderate (AHI > 15/h), and severe (AHI > 30/h) sleep apnea.</p> <p>Predictive validity increases with number of items (0.36–0.60 as scores increase from 3 to 7/8).</p>	<p>Advantages:</p> <p>Simple and brief screening tool</p> <p>Useful for identifying and stratifying risk of suspected or known sleep apnea patients</p> <p>Most commonly used screening tool for sleep apnea in surgical populations.</p> <p>Disadvantage:</p> <p>Dearth of validation studies with non-surgical patients</p>
Berlin Questionnaire (Ahmadi et al., 2008; Netzer et al., 1999)	Most widely tested screening tool to identify the risk (low to high) of sleep-disordered breathing.	10 items	<p>744 adults (ages 45–64) completed the Berlin Questionnaires.</p> <p>100 participants also underwent sleep studies.</p>	Cronbach's α = 0.86–0.92	<p>Advantage:</p> <p>Most widely used and tested screening tool for sleep apnea</p> <p>Disadvantage:</p> <p>Predictive parameters largely vary in different populations</p>

Table D.2—Continued

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/ Disadvantages
Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, et al., 1989), bed partner items	Bed partners rated the frequency of their partners' snoring, breathing interruptions, legs twitching, disorientation or confusion, and other restlessness	6 items			<p>Advantage:</p> <p>Provides an objective assessment of symptoms that the patients may not be able to report.</p> <p>Disadvantage:</p> <p>Dearth of validation studies specifically focusing on the validity of these items to detect obstructive sleep apnea</p>
Sleep disturbance in PTSD					
Pittsburgh Sleep Quality Index Addendum for PTSD (PSQI-A) (Farrahi et al., 2009; Germain et al., 2005; Insana et al., 2013)	<p>Self-report focusing on disruptive nocturnal behaviors during month preceding completion of questionnaire</p> <p>Frequency of disruptive nocturnal behaviors reported by PTSD patients (7 items)</p> <p>Frequency of anxiety and anger accompanying disruptive nocturnal behaviors and the timing of these events during the night (3 items)</p> <p>Scoring 0 = not in past month 1 = < 1 time/week 2 = 1–2 times/week 3 = ≥ 3 times/week</p>	7 items	<p>First sample: 163 women, diagnosed with PTSD and with disruptive nocturnal behaviors, who were enrolled in a clinical trial on nightmare treatment in sexual assault survivors (mean age = 37)</p> <p>Second sample: 40 caregivers and 20 non-caregiving women (mean age = 37). Caregivers were either caring for an immediate family member following recent liver transplantation or with Alzheimer's</p>	<p>Cronbach's α = 0.85</p> <p>Mean PSQI-A item-total correlation: $r = 0.47$ (all individual items significantly correlated to total score, $P_s < 0.01$)</p> <p>Sensitivity = 94% Specificity = 82% Positive predictive value = 93%</p> <p>Validity: Global PSQI-A scores positively correlated with measures of PTSD</p> <p>CAPS: $r = 0.53$, $P < 0.07$ Posttraumatic Symptom Scale–Interview Version: $r = 0.56$, $P < 0.01$</p>	<p>Advantages:</p> <p>Only questionnaire specifically assessing sleep disturbances specific to PTSD</p> <p>Adequately discriminates participants with and without PTSD</p> <p>Validated in military personnel</p> <p>Disadvantages:</p> <p>Initial validation study only in women</p> <p>Military version exclusively validated in men</p>

Table D.2—Continued

Name	Description	Number of Items	Validation Sample	Reliability and Validity	Advantages/Disadvantages
Pittsburgh Sleep Quality Index Addendum for PTSD (PSQI-A) (Farrahi et al., 2009; Germain et al., 2005; Insana et al., 2013) (cont.)			Military validation study: 119 male veterans who were recruited from the community (age ≥ 18). Participants had to be medically stable and free from current (past 3 months) substance abuse, free from lifetime psychotic or bipolar disorder, and free from sleep-disordered breathing—as determined by a sleep disorder screening study	Sensitive to treatment: Decreased scores post-intervention in the PTSD sample, but no change from baseline to follow-up in the healthy group.	
Sleep disorders (others)					
The Sleep Disorders Questionnaire (Douglass et al., 1994)	Evaluate common sleep disorders in physiological sleep (e.g., periodic limb movement), depression, insomnia, narcolepsy, and sleep apnea. SA = sleep apnea NAR = narcolepsy PSY = psychiatric sleep disorder PLM = periodic limb movement disorder	Original version = 165 items Dutch version = 34 items	519 persons: 435 were clinical sleep-disorder patients: 1. Sleep apnea 2. Narcolepsy 3. Inpatient psychiatric 4. Nocturnal myoclonus/PLM 5. Normal (control)	Test-retest reliability: SA: $r = 0.842$ NAR: $r = 0.753$ PSY: $r = 0.848$ PLM: $r = 0.817$. Intercorrelations: SA-NAR: $r = 0.14$ SA-PSY: $r = -0.20$ SA-PLM: $r = 0.34$ NAR-PSY: $r = 0.27$ NAR-PLM: $r = 0.38$ PSY-PLM: $r = 0.48$ Weak relationships between the scales except for the PSY and PLM scales.	Advantage: Allows more detailed analysis of sleep disturbance Disadvantages: PLM shows poor sensitivity and specificity Very long PLM scale shows highest correlation with other scales, suggesting that it might reflect a general condition, such as “results of sleep interruption,” rather than being specific to PLM.

Description of Source Measures Included in the Sleep Survey

This appendix provides a detailed description of the source measures in the 31-item sleep survey we included in the Deployment Life Study. With the exception of the Pittsburgh Sleep Quality Index (PSQI), which we included in its entirety and validated form, items from the below described measures were modified or select items were chosen to fit the needs of the current project without adding burden to the assessments that the Deployment Life Study participants were already completing.

Pittsburgh Sleep Quality Index

The PSQI (Buysse, Reynolds, et al., 1989) is a self-rated questionnaire that assesses key characteristics of sleep, including sleep quality and quantity. The PSQI has 19 self-rated questions and five additional questions for a bed partner or roommate (discussed below). The instrument assesses sleep parameters across seven domains: subjective sleep quality, sleep duration (quantity), sleep latency, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction over the past month. Results from the initial validation study demonstrate that scores ≥ 5 discriminate “good” from poor sleepers. Scoring of the answers is based on a 0–3 scale, in which “3” reflects the negative extreme on the Likert scale. Scores range from 0 to 21, and a global sum of “5” or greater indicates a “poor” sleeper. The PSQI is the most frequently used instrument to measure sleep-wake functions. Numerous studies support the validity and reliability of the PSQI in diverse populations (Aloba et al., 2007; Beaudreau et al., 2012; Beck et al., 2004; Bush et al., 2012; Cai et al., 2006; Carpenter and Andrykowski, 1998; Chan et al., 2012; Farrahi et al., 2012; Fictenberg et al., 2001; Kotronoulas et al., 2011; Shochat, Tzischinsky, et al., 2007; Sohn et al., 2011; Suleiman et al., 2010; Sun, Chiou, and Lin, 2011; Tzeng, Fu, and Lin, 2012).

Pittsburgh Sleep Quality Index (Bed Partner/Roommate Items)

The PSQI contains five additional questions for a *bed partner or roommate*. Bed partners are asked to rate the frequency of the patient's snoring, breathing interruptions, legs twitching, disorientation or confusion, and other restlessness. These items provide an objective assessment of symptoms that the patients may not be able to report otherwise. However, there is a dearth of validation studies specifically focusing on the validity of these items to detect OSA.

Insomnia Severity Index

The ISI (Bastien, Vallieres, and Morin, 2001) is a seven-item self-report questionnaire designed to assess the severity of both nighttime and daytime components of insomnia. The scale content measures the subject's current (within the past two weeks) perception of symptom severity, distress, and daytime impairment. Items include: the severity of sleep onset and maintenance (middle and early morning awakening) difficulties, satisfaction with current sleep pattern, interference with daily functioning, appearance of impairment attributed to the sleep problem, and the degree of concern caused by insomnia. Scores range from 0 to 28. Scores below 8 denote no insomnia, whereas scores ≥ 15 are indicative of moderate to severe clinical insomnia. The ISI has been validated in several languages, and it is increasingly used as a metric of treatment response in clinical research because of the instrument sensitivity to treatment effects (Bastien, Vallieres, and Morin, 2001; Morin, Belleville, et al., 2011; Thorndike, Ritterband, Saylor, et al., 2011).

Berlin Questionnaire

The Berlin Questionnaire (Ahmadi et al., 2008; Netzer et al., 1999) is a ten-item screening tool to assess the risk (low to high) of sleep-disordered breathing. Respondents are asked to rate the severity/frequency of their snoring, their level of excessive daytime sleepiness, and their history of high blood pressure and/or obesity. Patients can be classified into high-risk or low-risk based on their responses to the individual items and their overall scores in the symptom categories. The Berlin Questionnaire is one of the most widely used and validated screening tools to identify the risk of sleep-disordered breathing. We modified the questionnaire to include a single item to assess the fatigue domain.

Sleep Hygiene Index

The Sleep Hygiene Index (Mastin, Bryson, and Corwyn, 2006) is a 13-item self-rated questionnaire used to assess environmental and behavioral variables that are known to lead to inadequate sleep. Participants indicate how frequently they engage in specific behaviors and indicate the frequency (always, frequently, sometimes, rarely, or never). Each item is coded with scores ranging from 5 (always) to 1 (never). Higher scores are indicative of more maladaptive sleep habits. The Sleep Hygiene Index shows positive correlations with all of the associated features of inadequate sleep hygiene as determined by the American Sleep Disorders Association (Mastin, Bryson, and Corwyn, 2006; Yang et al., 2010; Morgenthaler et al., 2006).

Fred Hutchinson Cancer Research Center Caffeine Questionnaire

The Fred Hutchinson Cancer Research Center Caffeine Questionnaire is a supplement form of a general food frequency questionnaire. Food frequency questionnaires are the most common self-administered dietary assessment tools used in large epidemiologic studies of diet and health. The Caffeine Questionnaire asks participants to report the frequency of caffeine consumption and the amount or size of the caffeinated beverages consumed. The caffeine questionnaire can be used independently of the general food frequency questionnaire.

PTSD Checklist

The PCL (Weathers et al., 1993) is a 17-item self-report measure of the 17 symptoms of PTSD in the *Diagnostic and Statistical Manual of Mental Disorders*. The PCL has a variety of purposes, including the screening, diagnosis, and monitoring of symptom changes during and after treatment. Respondents rate each item from 1 (“not at all”) to 5 (“extremely”) to indicate the degree to which they have been bothered by that particular symptom over the past month. The PCL has demonstrated strong psychometric properties (Blanchard et al., 1996; Ruggiero, Rheingold, et al., 2006; Ruggiero, Del Ben, et al., 2003). The PCL-S (specific) asks about symptoms in relation to an identified “stressful experience” (i.e., the symptoms endorsed are directly linked to a specified event). The total symptom severity score (range = 17–85) is obtained by summing the scores from each of the 17 items. Though the full PCL-S was included in the Deployment Life Study, we included only the item on nightmares for our purposes.

Researcher-Generated Shift-Work Item

Though not specifically included as a sleep outcome item, we included a researcher-generated shift-work item for inclusion in the sleep survey as a covariate in analyses. The limited studies assessing shift work in military samples use an examination of a worker's shift schedule or single self-item measure tailored toward the unique environment of the assessed sample (Miller, Matsangas, and Kenney, 2012; Miller and Shattuck, 2005; Miller, Tvaryanas, and Shattuck, 2012). Thus, for the purposes of the current study, we developed and included a multiple-choice, single item on work schedules during the past month (daytime with no shifts, rotating shifts with nights, rotating shifts without nights, permanent nights, other). No psychometric data on this item were available prior to this study.

Other Outcomes and Covariates Available in the Deployment Life Study

In addition to the items for sleep survey that we added, the Deployment Life Study measures already included in the surveys provided a rich characterization of potential confounding factors, as well as outcomes that are used in the sleep survey we developed. These included measures of depressive symptoms, PTSD symptoms, perceived individual and unit readiness, and physical health, as well as information regarding demographics (i.e., age, gender, education, race/ethnicity, number of children in the household) and military characteristics (i.e., officer or enlisted, number of prior OCONUS deployments, duration of most recent deployment, months home since most recent deployment, combat exposure, service branch, shift-work schedule).

U.S. Department of Defense Policies Related to Sleep

This appendix includes a list of training, operational, and medical policies related to sleep, by policy number and title (Tables F.1–F.3).

Table F.1
Sleep-Related Training Policies, by Service

Policy Number	Policy Title
Air Force	
Air Education and Training Command Instruction (AETCI) 11-202, Vol. 3	Flying Operations—General Flight Rules
Air Education and Training Command Air Force Manual (AFMAN) 31-201, Vol. 3	Flight Operations
Air Education and Training Command Instruction (AETCI) 11-2C130J, Vol. 3	C-130J Operations Procedures
Air Education and Training Command Instruction (AETCI) 11-2C130, Vol. 3	C-130 Operations Procedures
Air Education and Training Command Instruction (AETCI) 11-2C-17, Vol. 3	C-17 Operations Procedures
Air Education and Training Command Instruction (AETCI) 11-2HC-130JV3	HC-130J Operations Procedures
Air Education and Training Command Instruction (AETCI) 11-2KC-135V3	KC-135 Operations Procedures
Air Education and Training Command Instruction (AETCI) 11-418	Operations Supervision
Air Education and Training Command Instruction (AETCI) 36-2205V11	Formal Flying Training Administration and Management—Survival, Evasion, Resistance, and Escape (SERE)
Air Education and Training Command Instruction (AETCI) 36-2216	Administration of Military Standards and Discipline Training
Air Education and Training Command Instruction (AETCI) 36-2225	Security Forces Training and Standardization Evaluation Programs

Table F.1—Continued

Policy Number	Policy Title
Air Education and Training Command Instruction (AETCI) 91-202	The U.S. Air Force Mishap Prevention Program
Air Education and Training Command Instruction (AETCI) 91-204	Safety Investigations and Reports
Air Education and Training Command Instruction (AETCI) 91-207	The U.S. Air Force Traffic Safety Program
United States Air Force Academy Instruction (USAFAI) 36-2014	Allocation of Cadet Time
United States Air Force Academy Instruction (USAFAI) 36-3518	Intercollegiate Athletic Programs
Army	
Army Training and Doctrine Command (TRADOC) Pamphlet 600-4	IET Soldier Handbook
Army Training and Doctrine Command (TRADOC) Regulation 350-6	Enlisted Initial Entry Training (IET) Policies and Administration
Marine Corps	
Marine Corps Order (MCO) 1510.32E	Recruit Training
Marine Corps Order (MCO) 1553.2B	The Management of Marine Corps Formal Schools and Training Detachments
Navy	
Naval Service Training Command (NSTC) M-1533.2	Regulations for Officer Development (ROD) Programs
Navy and Marine Corps	
Navy/Marine Corps (NAVMC) 3500.18	Marine Corps Common Skills (MCCS) Training and Readiness (T&R) Manual

Table F.2
Sleep-Related Operational Policies, by Service

Policy Number	Policy Title
DoD	
U.S. Department of Defense Instruction (DoDI) 6055.04	DoD Traffic Safety Program
Naitoh et al., 1986	Sleep Management in Sustained Operations User's Guide
N/A	Alertness Management and Military Operations (AMMO)
N/A	Fatigue Avoidance Scheduling Tool (FAST)
N/A	FlyAwake
Air Force	
Air Force Instruction (AFI) 11-202, Vol. 3	General Flight Rules
Air Force Instruction (AFI) 11-2AE, Vol. 3	Aeromedical Evacuation (AE) Operations Procedures
Air Force Instruction (AFI) 11-2B-1, Vol. 1	B-1 Aircrew Training
Air Force Instruction (AFI) 11-2B-2, Vol. 1	B-2 Aircrew Training
Air Force Instruction (AFI) 11-2C-130	C-130 Operations Procedures
Air Force Instruction (AFI) 11-2C-130J	C-130J Operations Procedures
Air Force Instruction (AFI) 11-2C-17, Vol. 3	C-17 Operations Procedures
Air Force Instruction (AFI) 11-2C-21, Vol. 3	C-21 Operations Procedures
Air Force Instruction (AFI) 11-2C-32B, Vol. 3	C-32B Operations Procedures
Air Force Instruction (AFI) 11-2C-38, Vol. 3	C-38 Operations Procedures
Air Force Instruction (AFI) 11-2C-5, Vol. 3	C-5 Operations Procedures
Air Force Instruction (AFI) 11-2EC-130H, Vol. 3	EC-130H Operations Procedures
Air Force Instruction (AFI) 11-2EC-130J, Vol. 3	EC-130J Operations Procedures
Air Force Instruction (AFI) 11-2EC-137	EC-137 Operations Procedures
Air Force Instruction (AFI) 11-2HC-130J, Vol. 3	HC-130J Operations Procedures
Air Force Instruction (AFI) 11-2HC-130, Vol. 3	HC-130 Operations Procedures
Air Force Instruction (AFI) 11-2KC-10, Vol. 3	KC-10 Operations Procedures
Air Force Instruction (AFI) 11-2KC-135, Vol. 3	KC-135 Operations Procedures
Air Force Instruction (AFI) 11-2MC-12W, Vol. 3	MC-12W Operations Procedures
Air Force Instruction (AFI) 11-2SAM/CSM, Vol. 3	Special Air Missions (SAM) Command Support Missions (CSM) Operations Procedures

Table F.2—Continued

Policy Number	Policy Title
Air Force Instruction (AFI) 11-2VIP, Vol. 3	VIP Operations Procedures
Air Force Instruction (AFI) 11-401	Aviation Management
Air Force Instruction (AFI) 11-403	Aerospace and Operational Physiology Training Program
Air Force Instruction (AFI) 16-1202	Pararescue Operations, Techniques, and Procedures
Air Force Instruction (AFI) 21-101	Aircraft and Equipment Maintenance Management
Air Force Instruction (AFI) 31-101	Integrated Defense
Air Force Instruction (AFI) 48-149	Flight and Operational Medicine Program (FOMP)
Air Force Instruction (AFI) 91-202	The U.S. Air Force Mishap Prevention Program
Air Force Instruction (AFI) 91-203	Air Force Consolidated Occupational Safety Instruction
Air Force Instruction (AFI) 91-204	Safety Investigations and Reports
Air Force Instruction (AFI) 91-207	The U.S. Air Force Traffic Safety Program
Air Force Manual (AFMAN) 31-201, Vol. 3	Flight Operations
Air Force Tactics, Techniques, and Procedures (ATTP) 3-42.2	Health Service Support and Casualty Prevention for Expeditionary Operations
McConnell Air Force Base Instruction (MCCONNELLAFBI) 34-101	McConnell Air Force Base Honor Guard
N/A	Air Mobility Command's (AMC) Operational Risk Assessment and Management (OpsRam)
N/A	Memorandum for AF South Deployed Units: Operational Use of No-Go/Go Pills
N/A	Warfighter Endurance Management During Continuous Flight and Ground Operations: An Air Force Counter-Fatigue Guide
Air Force Instruction (AFI) 21-202, Vol. 1	Missile Maintenance Management
Air Mobility Command Instruction 31-104	Phoenix Raven Program (Security)
Pacific Air Forces Instruction (PACAFI) 24-101	PACAF Combat Mobility Flights (Transportation)
Army	
Army Field Manual (FM) 3-01.85	Patriot Battalion and Battery Operations
Army Field Manual (FM) 3-04.113	Utility and Cargo Helicopter Operations
Army Field Manual (FM) 3-04.120	Air Traffic Services Operations
Army Field Manual (FM) 3-04.126	Attack Reconnaissance Helicopter Operations

Table F.2—Continued

Policy Number	Policy Title
Army Field Manual (FM) 6-22.5	Combat and Operational Stress Control Manual for Leaders and Soldiers
Army Field Manual (FM) 7-0	Training for Full Spectrum Operations
Army Field Manual (FM) 3-19.4	Military Police Leaders' Handbook
Army Regulation (AR) 95-3	Aviation: General Provisions, Training Standardization, and Resource Management
Leader's guide from the U.S. Army Aeromedical Research Laboratory and U.S. Army Safety Center	Leader's Guide to Crew Endurance
Marine Corps	
Marine Corps Order (MCO) 5530.15	U.S. Marine Corps Interior Guard Manual
Marine Corps Order (MCO) P5102.1B	Navy and Marine Corps Mishap and Safety Investigation, Reporting, and Record Keeping Manual
Marine Corps Reference Publication (MCRP) 6-11C/Navy Tactics, Techniques, and Procedures (NTTP)	Combat and Operational Stress Control
Navy	
Naval Operations Instruction (OPNAVINST) 5102.1D	Navy and Marine Corps Mishap and Safety Investigation, Reporting, and Record Keeping Manual
Naval Operations Instruction (OPNAVINST) 1000.16K, change 1	Navy Total Force Manpower Policies and Procedures
Naval Operations Instruction (OPNAVINST) 3710.7U	NATOPS General Flight and Operating Instructions
Naval Operations Instruction (OPNAVINST) 3750.6R, change 4	Naval Aviation Safety Program
Navy Medical Publication (NAVMED) P-6410	Performance Maintenance During Continuous Flight Operations
Naval Operations Instruction (OPNAVINST) 5100.19E	Navy Safety and Occupational Health (SOH) Program Manual for Forces Afloat
Naval Operations Instruction (OPNAVINST) 5100.23G	Navy Safety and Occupational Health Program Manual, Appendix 23-E: Ergonomic Considerations for Shift Workers
SECNAVINST 5100.10J	Department of the Navy Policy for Safety, Mishap Prevention, Occupational Health and Fire Protection Programs
Navy Tactics, Techniques, and Procedures (NTTP) 1-15M/Marine Corps Reference Publication (MCRP) 6-11C	Combat and Operational Stress Control

Table F.3
Sleep-Related Medical Policies, by Service

Policy Number	Policy Title
DoD	
Department of Defense (DoD) 5210.42	Nuclear Weapon Personnel Reliability Program (PRP) Regulation
Department of Defense Directive (DoDD) 1010.10	Health Promotion and Disease Injury Prevention
Department of Defense Directive (DoDD) 6200.04	Force Health Protection (FHP)
Department of Defense Instruction (DoDI) 1332.38	Physical Disability Evaluation
Department of Defense Instruction (DoDI) 6130.03	Medical Standards for Appointment, Enlistment, or Induction in the Military Services
Department of Defense Instruction (DoDI) 6490.03	Deployment Health
Department of Defense Instruction (DoDI) 6490.07	Deployment-Limiting Medical Conditions for Service Members and DoD Civilian Employees
Department of Defense Instruction (DoDI) 6490.11	DoD Policy Guidance for Management of Mild Traumatic Brain Injury/Concussion in the Deployed Setting
Department of Defense Instruction (DoDI) 6490.4	Requirements for Mental Health Evaluations of Members of the Armed Forces
Department of Defense Manual (DoD) 6055.5-M	Occupational Medical Surveillance Manual
Medical Readiness Leader Guide	Medical Readiness Leader Guide
TRICARE publication	TRICARE Covered Services: Sleep Studies
DoD/VA	
Clinical Practice Guidelines (CPGs) for mental health	Bipolar Disorder in Adults
Clinical Practice Guidelines (CPGs) for mental health	Major Depressive Disorder
Clinical Practice Guidelines (CPGs) for mental health	Post Deployment Health
Clinical Practice Guidelines (CPGs) for mental health	Posttraumatic Stress Disorder
Warfighter Sleep Kits, Quick Series	Healthy Sleep for the Warfighter
N/A	VA Pharmacy Benefits Guide for the Treatment of Insomnia in Veterans in the Primary Care Setting
Veteran's Affairs (VA) publication	Federal Benefits for Veterans, Dependents, and Survivors, 2012 Edition

Table F.3—Continued

Policy Number	Policy Title
Air Force	
Air Force Guidance Memorandum (AFGM) 44-01.2	Deployment Related Concussion Management
Air Force Instruction (AFI) 44-153	Disaster Mental Health Response and Combat and Operational Stress Control
Air Force Instruction (AFI) 44-172	Mental Health
Air Force Instruction (AFI) 48-123	Medical Examinations and Standards
Air Force Manual (AFMAN) 10-3902	Nuclear Weapons Personnel Reliability Program (PRP)
Army	
Army Regulation (AR) 40-501	Standards of Medical Fitness
Army Regulation (AR) 600-63	Army Health Promotion
Navy	
Secretary of the Navy Instruction (SECNAVINST) 5510.35B	Department of the Navy Nuclear Weapon Personnel Reliability Program (PRP)
Secretary of the Navy Instruction (SECNAVINST) 1850.4E	Enclosure 8: Medical Conditions and Physical Defects Which Normally are Cause for Referral to the Physical Evaluation Board (PEB)
Chief of Naval Operations Policy Letter Ser. N453E/1U595168	Navy Policy for Conducting Human Health Risk Assessments Under the Environmental Restoration Program
Navy Medicine Publication (NAVMED) P-117	Manual of the Medical Department (MANMED)

Key Informant Interview Protocol

Key informants were selected to ensure a broad representation of individuals who were knowledgeable about clinical and operational perspectives of military sleep policies. Our strategy was designed to gather a range of expertise from within both the military health system and the military departments.

Key informants selected for interviews from within the military departments include personnel from a variety of conventional force branches or career fields, and specifically aviation forces; each was chosen to represent the varying ways in which sleep policies may be implemented for different occupational codes. A broad sampling of informants was necessary because each service branch or career field may place varying degrees of emphasis on the importance of sleep. Specifically, aviation forces were designated as a distinct category of informants because of the codified set of existing policies and regulations related to sleep within the aviation community. Aviation forces have a culture developed around strict sleep requirements, a historical use of medical tools to manage sleep, and a tradition of 24/7 operations.

We identified potential interviewees using a variety of strategies, including a formal request for information through official Office of the Secretary of Defense memoranda and their identification through research publications or leadership roles related to sleep policies in the military. We then recruited additional informants through referrals with the individuals we identified in the first phase (snowball). The key informant interviews were conducted by phone (each lasting 30–60 minutes), recorded, and then transcribed. RAND interviewers relied on a semi-structured interview guide that included questions about the respondent's awareness of policies related to post-deployment sleep; the process for and barriers to preventing, identifying, and treating sleep problems; and perceived barriers to the implementation and enforcement of policies. Interview transcripts were reviewed and coded according to the methods of applied thematic analysis (Guest, MacQueen, and Namey, 2011). Two coders extracted data from interviews and binned responses into thematic categories: identification of sleep problems; perceived risk and protective factors; use of sleep medications and stimulants; awareness of policies in garrison, in theater, and post-deployment; monitoring for compliance; gaps in existing policies and ways to improve; and barriers to enforcement and adherence. Ten percent of interviews were coded by both coders to check

for consistency in coding practices. Any inconsistencies were discussed, and the final codes were mutually agreed upon. Additional “subthemes” within these overarching categories were articulated and refined as the analysis progressed.

Key Informants

Table G.1 shows the total number of *individuals* (40) with whom we *completed* interviews. Thus, the grand total represents individual participants, not the total number of interviews. The total number of interviews was fewer, as some interviews were attended by multiple participants. The column headings are not mutually exclusive; rather, respondents are simply binned by the most recent position held or by primary scope of responsibility. Respondents may have provided comments in all domains: training, operational, and medical.

Table G.2 shows the number of individuals with whom we *requested* interviews who either declined to participate or did not respond to our requests. We achieved a roughly 56-percent response rate (that is, 56 percent were willing to participate in interviews).

Table G.1
Total Numbers of Completed Interviews

Service	Domain			Total
	Medical	Operational	Training	
Air Force	4	1		5
Army	4	2		6
Marine Corps	2	5	1	8
Military sleep experts	2			2
Navy	16	1		17
Office of the Secretary of Defense	2			2
Total	30	9	1	40

Table G.2
Total Numbers of Unsuccessful Interview Requests

Service	Domain			Total
	Medical	Operational	Training	
Air Force	4	1	6	11
Army	3	3		6
Marine Corps	3			3
Military sleep experts	1			1
Navy	2	3	4	9
Office of the Secretary of Defense	1			1
Total	14	7	10	31

Sleep in the Armed Forces Working Group Proceedings

This appendix describes the proceedings of a one-day expert panel meeting, held in RAND's Arlington, Virginia, office on February 21, 2014. Specifically, the one-day RAND Sleep in the Armed Forces Meeting offered a unique opportunity to convene an invited group of DoD and civilian professionals, representing diverse backgrounds, including clinical, policy, and operational perspectives, to discuss current best practices, gaps, barriers, and recommendations to promote healthy sleep in the Armed Forces. Across the four pre-determined topic areas (self-identification of sleep problems and disorders, prevention of sleep disorders, sleep practices and programs in operational or training contexts, and sleep practices and programs in clinical and medical contexts), several common themes emerged concerning barriers to implementing best practices and recommendations to overcome these barriers, with the ultimate goal of improving sleep in military environments.

In regards to barriers, *military cultural attitudes* that have historically tended to undermine the importance of sleep were identified as an ongoing challenge. These cultural attitudes can serve as significant barriers to implementing healthy sleep practices across all of the working group topic areas. For instance, stigma associated with expressing a greater need for sleep may deter servicemembers from self-identifying or seeking help before a sleep problem becomes chronic and debilitating. At the operational level, the culture emphasizes mission first, with need for sleep perceived as a sign of weakness. On the other hand, data presented from some Navy attendees suggested that promoting healthy sleep by optimizing crew shift schedules can actually promote performance, and dissemination of such strategies may be useful to overcome these cultural attitudes.

Lack of awareness regarding the importance of sleep behaviors was also noted as a barrier to recognizing and addressing sleep problems. Such lack of awareness is due, at least in part, to limited education and training among leadership about the importance of sleep, and a lack of a centralized DoD-wide source on how to identify or manage sleep problems, or more broadly how to promote healthy sleep. Finally, the group noted a lack of adequate screening tools, procedures, and systems for the detection of sleep problems in military contexts.

The group also noted several best practices or recommendations for improving sleep in military environments. *Better messaging about sleep* was suggested as a means for raising awareness about sleep issues and promoting cultural change. One suggestion was the use of new terminology, such as “operational sleep” and “sleep casualties.” The group also recommended that the military *improve its education regarding the importance of sleep* and include a sleep component in basic training. Bolstered screening efforts were also recommended. For example, the group suggested that the military *use technology to help individuals monitor sleep behaviors and detect sleep problems early*, before they become chronic or debilitating. A *need for more comprehensive data* about the role of fatigue in accidents was also noted. Moreover, *optimization of sleep schedules and environments*, where possible, was suggested as a strategy for improving sleep. Finally, the group suggested that the military *leverage its existing sleep initiatives*, such as the Army Surgeon General’s Performance Triad Initiative as well as promising operational strategies, such as current efforts to change watch bill schedules on Navy ships, to scale up efforts to promote healthy sleep behaviors and recovery from periods of insufficient sleep.

Meeting of Experts

One of the primary goals of the parent research project funded by DCoE is to identify and evaluate resources to help address post-deployment sleep among servicemembers. To inform this goal, RAND NDRI organized and convened a meeting of experts with clinical, operational, and policy backgrounds related to sleep. The meeting was composed of 31 researchers and clinicians, both civilian and military, as well as other uniformed personnel and RAND staff currently involved in various aspects of sleep and servicemember health research. The goals of this event were

1. to share information and establish a common understanding about the sleep problems faced by military personnel upon returning from deployment
2. to identify strategies for promoting healthy sleep in servicemembers with a focus on the post-deployment period
3. to prioritize actionable recommendations on sleep policies and programs across the Services.

Meeting Structure

In consultation with DCoE, the RAND research team developed four focus areas for the meeting. These topics were chosen, in part, based on research efforts conducted to date for this project. The four focus areas were as follows:

1. self-identification of sleep problems

2. prevention of sleep disorders
3. best sleep practices and programs in operational/training contexts
4. best sleep practices and programs in clinical/medical contexts.

We selected participants to invite based on a review of authors of government and academic sleep publications and policies, documented experience with military clinical or operational sleep interventions, recommendations from our DCoE sponsors, and input from the scientific community. During the online event registration period from November to mid-February 2014, invited participants indicated their ranked preferences for participation in each of the focus areas, and the RAND research team ensured those preferences were factored into the final assignment of working groups, while balancing Service, discipline area (e.g., policy, clinical, operational), and professional affiliation (e.g., academic organization, government research agency, military).¹ One week prior to the meeting, participants were provided with a short set of guiding questions specific to their assigned focus area. Based upon final event registration, six working groups comprising clinicians, line leaders, and sleep research experts were organized to discuss the focus areas listed above. To balance the size and composition of groups, participants from both the operational/training and clinical/medical focus areas were broken into two working groups that each covered and each presented to the larger group on the same guiding questions.

The RAND research team provided each working group with a Power Point briefing template to help guide the content of the presentations. Working groups were free to add additional slides or modify the briefing template as necessary for their respective presentations. A representative from each of the six working groups was chosen by the group to present their material to the larger meeting audience. In addition to the day-of presentations, each working group was responsible for producing a two-page written summary following the meeting that provided more details of group discussions. The content of these summaries was discussed in Chapter Two.

Pre-Meeting Worksheets for Working Group Topics

Here, we present the four worksheets provided to participants prior to attending the proceedings.

¹ Other considerations for focus area assignment were civilian/military mix and background (e.g., clinical, operational, policy, administration).

Pre-Meeting Worksheet: Self-Identification of Sleep Problems and Disorders Among Servicemembers

Instructions: This worksheet is designed to help you structure your ideas and opinions for how the Department of Defense (DoD) may optimize healthy sleep in servicemembers especially during post-deployment. Early awareness and self-identification of sleep problems is crucial to prevent the development of sleep disorders and to promote healthy sleep practices. Your working group of military leaders, medical professionals and researchers will discuss policies and strategies to enhance self-identification of sleep problems. In considering these challenges, we would like you to consider individual-level and system-level factors that either facilitate or impede self-identification of sleep problems:

1. What practices (both individual and system-level) are currently in place to prevent sleep problems or disorders?
 - a. What seems to be working? Is there any evidence of effectiveness?
 - b. What seems not to be working? Why in your opinion?
 - c. What innovative strategies could enhance servicemember self-identification of sleep problems (e.g., use of technology, online assessments)?
2. What are barriers and facilitators to current practices or innovative strategies?
3. Based on the responses above, what are the top priority changes you would recommend, including areas of further research, policies, or programs?
4. What specific strategies would you recommend for implementation and evaluation (i.e., consider who, what, when, where, and how)?

Questions to consider in #4: Who writes/signs policy, who does the policy target, who is responsible for implementation and evaluation, what does the policy aim to accomplish, when/where/how should the policy be implemented, and how will we know if the policy is properly implemented as well as effective?

Pre-Meeting Worksheet: Prevention of Sleep Problems and Disorders Among Servicemembers

Instructions: This worksheet is designed to help you structure your ideas and opinions for how the Department of Defense (DoD) may optimize healthy sleep in servicemembers, especially during post-deployment. Early awareness, identification, and promotion of healthy sleep behaviors are crucial to prevent the development of sleep disorders. Your working group of military leaders, medical professionals, and researchers will discuss policies and strategies to prevent sleep disorders. In considering these challenges, we would like you to consider individual-level and system-level factors that either facilitate or impede prevention of sleep disorders.

1. What practices (both individual and system-level) are currently in place to prevent sleep problems or disorders?
 - a. What seems to be working? Is there any evidence of effectiveness?
 - b. What seems not to be working? Why, in your opinion?
 - c. What innovative strategies could enhance servicemember self-identification of sleep problems (e.g., use of technology, online assessments)?
2. What are barriers and facilitators to current practices or innovative strategies?
3. Based on the responses above, what are the top priority changes you would recommend, including areas of further research, policies, or programs?
4. What specific strategies would you recommend for implementation and evaluation (i.e., consider who, what, when, where, and how)?

Questions to consider in #4: Who writes/signs policy, who does the policy target, who is responsible for implementation and evaluation, what does the policy aim to accomplish, when/where/how should the policy be implemented?

Pre-Meeting Worksheet: Best Sleep Practices and Programs for Clinical and Medical Contexts

Instructions: This worksheet is designed to help you structure your ideas and opinions for how the Department of Defense (DoD) may optimize healthy sleep in servicemembers, especially during post-deployment. Your working group of military leaders, medical professionals, and researchers will be discussing best practices and programs for clinical management of sleep problems at the individual patient level and strategies to promote sleep health from a population perspective. The clinical and medical settings not only impact the servicemembers directly with sleep problems, but also influence policies, programs, and guidance implemented across installations, Services, and the military population.

1. What are current best practices related to the clinical management of sleep disorders?
2. Where are the gaps or areas needing improvement related to the clinical management of sleep problems, especially in the post-deployment period?
3. Sleep health is not merely the absence of sleep disorders. From a population health perspective,
 - a. What practices or programs are currently in use to promote sleep health?
 - b. Are the existing strategies working? If not, why?
 - c. What else could be done? What innovative strategies could be used to promote sleep health at the population level?
4. What are barriers and facilitators to clinical management of sleep disorders and promotion of sleep health?
5. Based on the responses above, what would you recommend as the greatest needs for new policies/programs, reinforcement of existing policies/programs, or further research related to clinical sleep management and promotion of sleep health?
6. What specific strategies would you recommend for implementation and evaluation (i.e., consider who, what, when, where, and how)?

Questions to consider in #6: Who writes/signs policy, who does the policy target, who is responsible for implementation and evaluation, what does the policy aim to accomplish, when/where/how should the policy be implemented, and how will we know if the policy is properly implemented as well as effective?

***Pre-Meeting Worksheet: Best Sleep Practices and Programs for
Operational and Training Contexts***

Instructions: This worksheet is designed to help you structure your ideas and opinions for how the Department of Defense (DoD) may optimize healthy sleep in service-members, especially during post-deployment. Your working group of military leaders, medical professionals, and researchers will be discussing best practices and programs to optimize healthy sleep in operational and training settings. These settings include both the deployed environment and the unit/garrison environment for each Service. Balancing the demands of the operational and training settings is vital to consider in implementing practices, policies, or programs to optimize healthy sleep in any particular Service and across the military.

1. From an operational/training perspective,
 - a. What are key influences on servicemember sleep (e.g., policy, guidance, or informal procedures), especially in the post-deployment period?
 - b. Where are gaps in policies, guidance, or informal procedures? How can they be improved or modified?
 - c. What are innovative strategies or policies to optimize healthy sleep in servicemembers?
2. What are barriers and facilitators to optimize healthy sleep in operational/training settings?
3. Based on the responses above, what would you recommend as the greatest needs for new policies/programs, reinforcement of existing policies/programs, or further research?
4. Where are sleep policies most impactful, most visible, and most enforceable on optimization of healthy sleep?
5. What specific strategies would you recommend for implementation and evaluation (i.e., consider who, what, when, where, and how)?

Questions to consider in #5: Who writes/signs policy, who does the policy target, who is responsible for implementation and evaluation, what does the policy aim to accomplish, when/where/how should the policy be implemented, and how will we know if the policy is properly implemented as well as effective?

Meeting Agenda

The one-day event began with general participant orientation and was followed by a plenary session featuring three keynote speakers presenting material to orient the subsequent small-group breakout sessions. The keynote speaker topics, presenters, and affiliations were as follows:

- Self-identification/prevention: Nancy Wesensten, Walter Reed Army Institute of Research
- Clinical sleep programs/practices: Anne Germain, University of Pittsburgh
- Operational sleep programs/practices: Nina Shattuck, Naval Postgraduate School

Following the morning plenary session, participants transitioned to their assigned working group for breakout sessions lasting the remainder of the morning period. The facilitator for each working group was assigned prior to the event. This facilitator was responsible for guiding the group discussion and ensuring that the working group produced a complete presentation for the afternoon plenary session.

A one-hour period of wrap-up and group discussion facilitated by the RAND research principal investigators, Wendy Troxel and Regina Shih, concluded the day.

Working Group Proceedings: Barriers and Recommendations to Improving Post-Deployment Sleep

For each of the four topic areas, groups were invited, though not required, to follow the facilitation guide, which focused on the following key areas: (1) identifying best practices in the topic area, (2) identifying gaps in best practice and knowledge, (3) discussing barriers to implementing change, and (4) making recommendations for improvement. In this section, we synthesize the main findings under these four key areas within each discussion topic of self-identification of sleepiness and sleep disorders, prevention of sleep disorders, clinical management of sleep disorders, and optimizing healthy sleep in operational and training settings

Self-Identification of Servicemembers with Sleepiness and Sleep Disorders

Best Practices for Self-Identification

The commonly used practice to help servicemembers self-identify sleep problems is self-reporting. Group members recognized the value of self-identification of sleep problems before they become chronic or debilitating; however, at the same time, they questioned whether current approaches to self-identification are sufficient.

Gaps for Self-Identification

In particular, it has been well established that an individual's self-rating of sleepiness does not correlate with that individual's performance as objectively measured. This

holds true for both normal, healthy individuals as well as those with sleep disorders, such as OSA. Therefore, the group generally expressed skepticism that self-identification of sleepiness and sleep disorders can provide a useful index of a servicemember's ability to perform effectively or safely. Some group members expressed concern that there does not currently exist a common DoD-wide tool for use in self-identification. They thought that current strategies that rely on passive communication (e.g., social media) are not effective. Rather, leadership must engage to make self-identification of sleep problems a priority.

Barriers to Self-Identification

According to the group members, the main barrier to educating servicemembers about sleep requirements and healthy behaviors is cultural. Historically, the military has promoted a “suck-it-up” culture: Prevailing attitudes toward sleep have generally held that “needing sleep is a sign of weakness” or similar views that are not consistent with maintaining mental acuity and behavioral health. Group members commented that there still exists a military cultural stigma in self-identifying sleep problems. Some organizations, such as the Navy Safety Center, are starting to collect data on sleep or fatigue-related accidents to help make a case to sailors that self-identification could help prevent mishaps. The group noted that sleep problems (and specifically insomnia) are a “signature illness” in the military but is not recognized as such.

Facilitators for Self-Identification

Members of the group agreed that a more promising approach than simply asking individuals about their sleepiness would be to raise awareness among servicemembers about sleep issues, including daily sleep requirements, behaviors that contribute to healthy sleep, and signs and symptoms of sleep disorders (for example, whether one's bed partner reports snoring or episodes of interrupted breathing during sleep). This approach needs to include education and training all the way up the chain of command in the basic fact that sleep is a biological necessity, no different from adequate nutrition or hydration. Such efforts are already under way in military circles. One example is the Army Surgeon General's Performance Triad Initiative, which focuses on behaviors that lead to sufficient daily sleep and promote sleep quality. The initiative also recognizes that mission requirements may preclude adequate sleep, and tries to equip servicemembers with strategies to plan for and recover from insufficient sleep.

Recommendations for Self-Identification

The group identified five priorities for promoting cultural change in the military's view of sleep and improving awareness of sleep requirements and the value of healthy sleep.

- *Changes in terminology: “Sleep casualties.”* Using the analogy of “heat casualties” (that result from insufficient hydration in the presence of high temperatures), the military can refer to individuals whose performance suffers from insufficient sleep

as “sleep casualties.” This use of terminology emphasizes the point that sleep-related performance decline is not weakness or lack of discipline but stems from a failure to meet a basic biological need.

- *Include sleep-related information when collecting data on mishaps.* DoD currently has a mishap investigation and analysis tool known as the Human Factors Analysis and Classification System. However, according to the group participants, information on the possible role of sleep deprivation is not routinely collected when mishap data are gathered. Analysts could assess whether sleep factors were involved by logging the time of day when the incident occurred, examining the 72-hour sleep histories of the individuals involved, and making a determination about the likely role played by insufficient sleep.
- *Prioritize clinical evaluations.* Clinical evaluations of sleep health should be put into place for those with high-risk military operational skills, including those in high-combat-exposed occupations and shift workers.
- *Incorporate sleep education into formal training at all levels.* Recognition of sleep requirements should be incorporated into as many forms of training as possible. For example, in the Army context, these forms include (1) indoctrination into good sleep practices during basic training; (2) NCO/drill instructor training about developing sound sleep practices in servicemembers and avoiding sleep casualties; (3) Captain’s Career Course (O-3 level): unit-level sleep assessments, scheduling sleep in garrison and operational environments; (4) intermediate-level education (O-4–O-5), focused on how to mitigate the effects of insufficient sleep in operational environments; (5) Army War College (O-6) education, focused on the strategic implications of sleep for senior leaders; and (6) training for military medical providers in promoting good sleep practices among all servicemembers.
- *Standardize DoD assessments.* There are currently no standardized assessment tools for risk-stratifying servicemembers with various sleep issues—from short sleep duration to clinically significant sleep disorders. A new, brief intake questionnaire with standardized cut-points indicating clinically meaningful sleep problems would help inform servicemembers whether their current sleep habits fall below the cut-point and whether further medical evaluation is needed.

Prevention of Sleep Disorders

Best Practices for Prevention

The group noted that there are no evidence-based practices to prevent sleep disorders in civilian or military settings. However, the group identified several behavioral and practical strategies to mitigate specific sleep disorders (e.g., weight loss to reduce apnea risk) or avoid sleep problems (e.g., using ear plugs and sleep masks to aid sleep in a noisy or brightly lit environment). Moreover, to the extent that sleep disorders are associated with mental disorders such as depression, primary prevention of the mental disorder may help to prevent the development of sleep problems.

Gaps for Prevention

The group identified two types of gaps in applying best practices to prevent sleep problems: gaps in the science and gaps in DoD-wide prevention initiatives.

The scientific gaps include a lack of (1) scientifically grounded strategies to prevent sleep disorders, (2) biomarkers or highly specific vigilance tests to measure alertness, and (3) constructs for defining terms rigorously when describing sleep health to improve study design and interpretation.

There are also significant gaps regarding initiatives to promote sleep health. In fact, there are no DoD-wide policies or initiatives for promoting healthy sleep. In addition, there are no surveillance systems to quantify the nature or extent of sleep deficits/problems among servicemembers, or to measure trends; and there are currently no policies mandating appropriate scheduling of shift workers in training and operational environments (i.e., shift scheduling informed by knowledge of circadian rhythms). There is also no accountability in training environments to support development of healthy sleep habits among trainees.

Barriers to Prevention

The main barrier to developing and implementing best practices for preventing sleep problems is cultural. An individual's ability to perform with little or no sleep has traditionally been viewed as a badge of honor rather than a risk or a problem. Changing the military culture's perception of sleep needs is the first step toward developing best practices for sleep prevention. Individual differences in the perception of sleepiness and sleep requirements are also barriers, as are individual differences in reactions to chronic sleepiness. Some individuals become inured to sleep deprivation and overestimate their alertness while underestimating their need for more sleep. Finally, the lack of evidence linking fatigue to suboptimal mission performance is a barrier to demonstrating the importance of sleep and contributes to poor messaging about the importance of sleep.

Facilitators for Prevention

The group also identified three facilitators. First, the importance of healthy sleep is gaining traction in military circles, in part due to increased media attention and greater attention more broadly to the connections between sleep and mental and physical health. Second, technology such as mobile device apps to monitor sleep duration and patterns may be used more broadly to facilitate prevention efforts. Third, changes in requirements for physicians, particularly primary care providers, to increase their knowledge of sleep problems and sleep-related health behavior promotion may increase the likelihood of identifying behavioral changes when sleep problems are acute or transient, with the ultimate goal of preventing chronic sleep disorders.

Recommendations for Prevention

The group categorized its recommendations according to their relevance for accomplishing sleep prevention goals in the short, medium, and long term.

In the short term, sleep problems and disorders can be prevented through a number of steps: (1) improvements in the sleep environment (lighting, sound, temperature); (2) optimized schedules, especially shift work, that follow circadian rhythms; (3) leader education about the importance of adequate sleep and healthy sleep behavior; (4) DoD-wide policies to mandate changes for all trainees to encourage healthy sleep behavior; (5) DoD-wide policies specifically aimed at standardizing system-wide efforts to prevent sleep disorders. An intermediate step for the DoD would be to begin surveillance of individual and unit alertness by collecting data and by conducting random screenings for vigilance using state-of-the-art technology. In the long term, DoD may work toward conducting or sponsoring scientific research to develop biomarkers to assess sleep health and may develop real-time systems to monitor alertness among all servicemembers.

Clinical Management of Sleep Disorders and Promotion of Sleep Health

Best Practices for Clinical Management

The two groups that discussed clinical management of sleep problems and promotion of sleep health identified the AASM Practice Guidelines as the primary source for best practices regarding assessment and treatment of sleep disorders. In particular, the availability of tools for assessing sleep apnea (polysomnography) and treating it (airway pressure treatment) were seen as adequate.

Gaps in Clinical Management

At the same time, the AASM Practice Guidelines were seen to be limited for military purposes. In particular, they presume a civilian context and assign less importance to circadian disruptions and their interaction with other sleep medical issues than is optimal in a military context.

Barriers to Clinical Management

The groups identified numerous barriers to improving clinical management of sleep problems, including

- insufficient awareness of sleep issues or recognition of sleep disturbances among military populations at all levels
- devaluation of sleep issues among military populations
- perceptions that sleep health is only a deployment or post-deployment issue and not a general concern for the armed forces
- stigma associated with seeking treatment for sleep concerns
- the lack of evidence-based educational tools, resources, and individualized interventions matched to particular settings (such as aboard ships)
- the underuse of available technological tools related to sleep monitoring

- a shortage of resources and facility space allocated to the treatment of sleep problems, resulting in most assessment and treatment being delivered by network providers or inadequately trained behavioral health providers.

Recommendations for Clinical Management

The groups recommended several action steps:

- *Build on the AASM practice guidelines.* Build on the AASM practice guidelines and develop a set of clinical practice guidelines for the treatment of sleep problems specifically for military populations. This practice guideline would be specific to sleep disorders, as opposed to having sleep disorders embedded within other clinical practice guidelines related to behavioral disorders, or other medical problems.
- *Develop a centralized sleep health policy.* Develop a centralized sleep health policy that consolidates resources, training, and policies across the Services. Raise sleep guidance, such as that seen in Service-specific operational stress manuals, for example, to a consistent, DoD-level guidance publication.
- *Create military-specific assessment tools.* Create military-specific assessment tools and educational resources related to sleep issues for all military populations, and add sleep assessments to routine primary care and other intervention points, such as annual physicals. Training should be enhanced for military health care providers, as well as for allied professionals, such as chaplains, occupational therapists, and paraprofessionals.
- *Increase the use of technology.* Increase the use of technology for monitoring sleep and alertness. There are numerous commercial off-the-shelf tools, such as wristwatches, wristbands, or other devices, that military personnel could use to monitor their sleep/rest cycles; however, validation of these instruments is needed before broader dissemination is recommended.
- *Continue to research evidenced-based practices for advancing healthy sleep.* Create a dedicated research agenda aimed at improving the evidence base for advancing best practices as well as for evaluating existing programs and validating current and emerging technologies for assessing, treating, and monitoring sleep issues.

Promoting Healthy Sleep in Operational and Training Settings

Key Factors for Operational and Training Settings

Two groups focused on promoting healthy sleep in operational and training settings. They began their discussions by identifying key factors (rather than best practices) to consider. First, they noted that operational environments may differ dramatically from training environments, and there is more control over sleep conditions in the latter, while the former are characterized by unpredictability and disruptions. Second, sleep habits formed during training, pre-deployment, and deployment lead to issues later

(sleep studies during basic training show early imprint of low sleep), suggesting that incorporating sleep guidance and accountability into initial training can be valuable. Third, work force management issues are critical in both environments, but manning and workload considerations in either environment are seldom if ever linked to consideration of sleep requirements.

Gaps in Operational and Training Settings

The groups cited a lack of standardized operational policy and guidance across the Services related to sleep requirements, as well as a lack of specificity in the sleep requirements necessary to establish a baseline sleep policy. What sleep policies exist at the DoD or Service level may not be properly communicated or enforced. Also, the groups identified the difficulty in translating clinical sleep terms into understandable and relevant operational language. Regulations exist for deployed environments but are not implemented or followed uniformly. In addition, there is a lack of post-deployment policy guidance about sleep behaviors, both DoD-wide and within each Service.

Barriers in Operational and Training Settings

The same cultural barrier cited by the other groups emerged from these groups' discussions as well: Sleep is viewed as a weakness or crutch, not a basic need. Other barriers included a lack of awareness about the importance of sleep; the belief that operational tempo associated with mission needs always supersedes sleep requirements, however defined; staffing shortages; the fact that punitive assignments in both settings frequently conflict with sleep time and thus can compound fatigue issues; and varying policies based on occupations that may feed into occupational competitions over which unit or group can function on less sleep. Finally, the group discussed heavy use of stimulants and sleep medications as a barrier to optimizing sleep.

Recommendations for Operational and Training Settings

The groups recommended several steps for addressing these barriers and for creating new policies and programs and conducting needed research to address sleep issues in operational and training environments.

- *Create standardized guidance across the Services.* There is a need for standardized guidance across the Services. The groups suggested that DoD create overarching, less prescriptive operational sleep guidance and allow the Services to tailor to meet their needs (e.g., more restrictive, occupation-specific guidelines). Currently, the only units with clear sleep requirements are aviation crews. There are existing initiatives that could be leveraged and scaled up, including the Army Performance Triad initiative (which groups nutrition, exercise, and sleep in resilience-building exercises), as well as newly published policies for ground operators (Air Force security).

- *Define sleep as a “need” and an “operational imperative.”* DoD should craft and deliver clear messages about good sleep habits as a way to address existing cultural attitudes about sleep and to educate servicemembers about the value of sleep as a component of readiness. The use of new terminology—such as the concept of “operational sleep”—could help. These messages should be incorporated into all levels of Professional Military Education curriculums to present the ideas early and often in servicemembers’ careers.
- *Incorporate circadian considerations into watch/duty rotations.* Explore more widely the idea of circadian watch/duty rotations, and create settings where these can be implemented (sleep rooms, berthing policies, sleep space design). For example, circadian rhythm considerations should be factored into developing watch/duty rotations to the extent possible, similar to considerations given for chow times, higher headquarters’ schedule, gym facilities, etc. Additionally, consider the physical sleeping environment, and shift schedules of roommates or tent-mates, when assigning duty.
- *Leaders and troops should take responsibility for enforcing healthy sleep.* Instill responsibility for enforcing good sleep behavior at all levels, from command down to squad and team leaders and ultimately to individual servicemembers. For example, senior leaders should ensure that their subordinate leaders are considering the sleep needs of their troops when managing operations. However, it is ultimately the individual’s responsibility to ensure proper amounts of sleep in an appropriate environment. Therefore, leaders can also support healthy sleep in their subordinates by modeling such behaviors themselves. Thus, when a servicemember is provided adequate education, environment, and opportunity by leadership, he or she should be held accountable for problems that arise from a lack of proper sleep.
- *Address the issue of fatigue management with senior operational leadership.* Fatigue is an operational issue that affects readiness, but this issue is not a focus of operational leaders. Present the results of this survey to appropriate forums to flag and general officers (e.g., at commanders’ conferences) to encourage their support and advocacy of these recommendations.
- *Continue to promote sleep education and research efforts.* Create a research agenda to inform the development of DoD-wide sleep initiatives. Specific steps include
 - briefing fatigue impacts to top commanders and operational leadership
 - using research examples comparing military and civilian sleep needs to inform messaging about sleep
 - involving operational commanders in actual sleep studies to heighten awareness of sleep problems
 - establishing pre-deployment screening procedures and data collection procedures to identify issues early
 - addressing the use of stimulants and sleep medications with consistent policy

- improving the education of health providers in theater in diagnosing and treating fatigue problems and the use of stimulants and sleep medications
- ensuring that top commanders and operational leadership are briefed on research that demonstrates the impacts of sleepiness and fatigue on performance.

Working Group Experts

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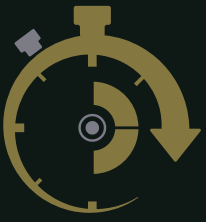
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Sleep disturbances are a common reaction to stress and are linked to a host of physical and mental health problems. Given the unprecedented demands placed on U.S. military forces since 2001, there has been growing concern about the prevalence and consequences of sleep problems for servicemembers. Sleep problems often follow a chronic course, persisting long after servicemembers return home from combat deployments, with consequences for their reintegration and the readiness and resiliency of the force. Therefore, it is critical to understand the role of sleep problems in servicemembers' health and functioning and the policies and programs available to promote healthy sleep. This report provides the first comprehensive review of sleep-related policies and programs across the U.S. Department of Defense (DoD), along with a set of actionable recommendations for DoD, commanders, researchers, and medical professionals who treat U.S. servicemembers. This multimethod study also examined the rates and correlates of sleep problems among post-deployed servicemembers, finding negative effects on mental health, daytime impairment, and perceived operational readiness. The research reviewed evidence-based interventions to treat sleep disturbances among servicemembers and veterans and exposed several individual- and system-level barriers to achieving healthy sleep. Implementing evidence-based treatments is just one step toward improving sleep across the force; as the research recommendations highlight, it is equally important that policies and programs also focus on preventing sleep problems and their consequences.

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