ASSESSING SLEEP AND ITS BENEFITS IN COMBAT VETERANS

Ariel Woods

Mentor: Jenny Howland, PsyD

Abstract

Research Question: Does the delivery of Boot Campaign's existing novel, holistic virtual Resilience and Recovery program that teaches skills on the highest yield components of resilience in the veteran family population result in an increase in overall well-being and specifically an increase in quality and/or quantity of sleep? What are the most salient components of sleep that still need to be addressed and what is the best format in which to address these in order to construct a virtual program to address these and continue treatment for veterans all across the United States and eventually, internationally?

Introduction, Significance and Rationale: It is widely documented that a disproportionate number of U.S. military veterans suffer from invisible wounds of war, such as posttraumatic stress disorder (PTSD), chronic pain, and traumatic brain injury (TBI). Sequelae can result in disruption in daily life, including suffering from negative emotional responses, memory processing problems, disrupted social relationships and decreased physical fitness. Because many veterans living with PTSD and TBI experience drastic disturbances in their sleep habits, they can experience difficulty with processing memories, have flashbacks of traumatic events, and can have irrational emotional responses to small disruptions in their daily lives and social relationships. A lack of sleep can also result in decreased testosterone levels, contributing to lower muscle mass, slower metabolism and uneven body fat distribution, and overall decreased self-confidence. In concert with the impact from other invisible wounds of war, veterans can experience significantly lower quality of life. There is also evidence to suggest a correlation between insomnia and suicidality, which remains a problem that plagues the military and veteran community.

Materials and Methods: Our objective was to identify if Boot Campaign's already existing holistic Resilience and Recovery virtual program addressing overall improvement in our veterans' lifestyle, emotional well-being and social relationships is sufficient to address sleep concerns. De-identified standardized self-report measure data provided by Boot Campaign was analyzed from veterans who completed this program. Our subject population was taken from veterans who are enrolled in Boot Campaign's Resilience and Recovery Program. All participants were former members of the United States Armed Services who have been diagnosed with PTSD and TBI, and who also reported co-occurring insomnia. Inclusion criteria for de-identified subjects included that the participant was a US military veteran, aged 20-70, who is a proficient English speaker diagnosed with PTSD and mild-to-moderate TBI, and who

also reported co-occurring insomnia. Exclusion criteria included those in acute crisis, those with severe psychopathology or severe brain injury, and those who were unable to access virtual technology. We collected data through the standardized, self-reporting Pittsburg Sleep Quality Index (PSQI) questionnaire for each participant both pre- and post-training. We then used a paired t-test to analyze changes in the rate of improvement of each of the above components in the veterans undergoing training. These groups were assessed for their rates of improvement at two different time points (baseline and post-training). Significant results were assessed using a p-value = 0.05.

Results: Our analysis of the results from the currently existing Resilience and Recovery Virtual Program identified that while successful in multiple areas of wellness, the comparison of pre- and post-training sleep shows less of an improvement in our population. Although we identified an improvement of mean scores of the Pittsburgh Sleep Quality Index (PSQI), these results were largely not statistically significant. The results of this data analysis support our hypothesis that the currently existing Resilience and Recovery program, while improving overall veteran well-being in a variety of areas, is not sufficiently addressing sleep as a very important independent factor. As such, this research project assisted with the design and development of a novel Virtual Sleep Program (VSP) for veterans.

Conclusions: Upon completion and implementation of the Virtual Sleep Program, we anticipate that veterans will experience an increase in self-reported overall well-being and quality of life, including decreases in stress, improved social relationships, improved sleep quality and/or quantity, and improved physical and emotional health. We hope this will help improve relationships and possibly stress levels in those surrounding the veterans, including adult family members, caregivers, physicians, and friends.

Research Question

Does the delivery of Boot Campaign's existing novel, holistic virtual Resilience and Recovery program that teaches skills on the highest yield components of resilience in the veteran population result in an increase in veteran's overall well-being, and specifically does it result in an increase in quality and/or quantity of sleep? We aim to determine what, if any, are the most salient components of sleep that still need to be addressed, as well as the best format in which to address these.

Hypothesis: We hypothesize that veterans will require more targeted treatment focusing on sleep than the current virtual Resilience and Recovery program is providing. We hypothesize that designing a virtual curriculum component specific to sleep will fill an existing gap in this program and thus will become the basis of a future programmatic element.

Introduction, Significance and Rationale

Introduction

Based on the data from the US Census Bureau, Pew Research Center surveys and the Department of Veterans Affairs, approximately 6% of the country's adult population are represented by living veterans, most who have served in the last 30 years, accounting for more than 18 million US citizens[1]. Veterans overall have worse health outcomes than the general population, in part due to the physical and psychological stress from deployments and combat, but also because of a hesitance to seek out medical care due to mistrust or for fear of judgment or consequences[2].

There are many factors that contribute to overall veteran health and well-being, including nutrition, sleep, physical fitness, relationship health, and management of general stress. It is widely documented that addressing holistic lifestyle factors such as these work independently and in concert with one another to promote wellness and assist in addressing invisible wounds of war such as PTSD and TBI[3]. Wellness for combat veterans has been studied in more recent years, but still has further investigation needed into the crucial elements for living successfully in society.

Care for physical and visible wounds is more often addressed than care for invisible mental and emotional wounds, such as posttraumatic stress disorder (PTSD), chronic pain, traumatic brain injury (TBI), and insomnia. These invisible wounds of war are largely neglected in the majority of the veteran population unless they cause significant medical dysfunction, which results in many healthcare providers ignoring the impact of these effects on veteran daily life, relationships, and ability to function efficiently in society.

One such factor that continues to be of concern to our nations' veterans and one that is of critical importance for veteran wellness is disruption in sleep due to insomnia or other factors. However, adequate sleep is an essential part of our daily routines and in keeping us mentally, physically, and emotionally healthy. While we sleep, we progress through cycles which contain two distinct classes of sleep: non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep. Throughout the night, humans usually cycle between the 4 substages of NREM sleep and REM sleep every 90 minutes, beginning with NREM sleep and REM sleep predominantly taking place later in the night[4].

During NREM sleep, many cholinergic systems that release the neurotransmitter acetylcholine in the brainstem and forebrain are decreased in their activity as well as a reduction in activity of the thalamus, basal ganglia, and prefrontal and temporal lobes. Research has shown that, aside from these decreases in activity, NREM sleep is closely associated in the consolidation and recall of episodic declarative memory - memories of specific facts and events. It has been recently shown that sufficient NREM sleep is also important in mediating the act of forgetting, including forgetting of traumatic events[5].

REM sleep, however, increases activation of cholinergic systems to higher functioning levels than when we are awake, specifically in the pons, thalamus, occipital cortex, prefrontal lobes, and in emotion-related centers including the amygdala, anterior cingulate cortex and hippocampus[6]. There is also a significant reduction in norepinephrine levels during REM sleep when compared to wake or NREM sleep, which is shown to be essential in emotional processing. Loss of REM sleep, when accumulated over time, results in the amplification of negative emotional responses and increases stress, anxiety, and anger[7].

Along with regulating emotional processing, memory, and cognition, sleep also allows our bodies to regulate biologically essential processes, specifically our metabolism and hormones. Testosterone, an anabolic steroid hormone that contributes to the growth of muscle mass and even fat distribution, naturally decreases as we age[8]. During each 90-minute sleep cycle, there is an increase in luteinizing hormone (LH) which leads to an increased amount of testosterone production. Disruptions in sleep duration and quality have shown to result in a decrease in testosterone levels, leading to difficulty putting on muscle mass and an uneven distribution of fat[9]. All of these factors combined wreak havoc on any human who experiences sleep disruption, however, when insomnia is comorbid with invisible wounds of war such as PTSD and TBI, the result can be detrimental to a veteran’s health and wellbeing.

Additionally, of critical importance remains the veteran suicide rate. It is widely documented that suicidal ideation in veterans is correlated with the presence and history of invisible wounds of war, with insomnia specifically having been pinpointed as a risk factor. For those who have no trouble with sleep, it may be difficult to understand the astounding impacts sleep disturbances can impose on those who cannot fall asleep, stay asleep, or have traumatic nightmares. Several studies have shown that among participants with insomnia (difficulty initiating or maintaining sleep) or nightmares, there is an association with suicidal thoughts and behaviors[10]. Veterans

receiving care at the Veterans Health Association are shown to be at an increased risk of suicide compared to the general US population, representing at least 5% of suicides in the US annually[11]. One study, searching through databases from 1966-2011, found that sleep disturbance was significantly associated with an increased relative risk for suicidal ideation, attempt, and completed suicide among the US population[12]. For many, sleep is a given part of our daily lives – we work, eat, sleep, repeat. Those who suffer from sleep disturbances, however, are at risk for suicidal thoughts and behavior, amongst other complications many people would not expect. However, research has demonstrated that sleep specific Cognitive Behavioral Therapy for Insomnia (CBTi) can lead to reduction in suicidal ideation in the veteran population[13].

Addressing the complexities associated with comorbid invisible wounds of war is a challenging task for many civilian health professionals who lack cultural competence in this unique population. Additionally, accessing care for invisible wounds of war, including insomnia, within the civilian sector can be costly and is often not sufficient to address the dynamics of whole veteran wellness in a comprehensive and holistic manner. Additionally, while some veterans are able to seek treatment at the Veterans Administration (VA), wait times are often long, providers rarely communicate with one another across disciplines, and veterans often have a general mistrust of the VA system, according to correspondence with Dr. Jenny Howland, a Licensed Clinical Psychologist at the Boot Campaign. Moreover, sleep is often dismissed or not addressed as part of a veteran's care plan, with the exception of prescription medications.

Significance & Rationale

A study by the Armed Forces Health Surveillance Center found between 2000 to 2009 there was a 73% increase in insomnia diagnoses among active-duty US military members. As of 2018, the prevalence of insomnia, described as difficulty falling asleep or staying asleep and/or poor sleep leading to dysfunction during daily life, in veterans is 27-54%[14]. These rates are 2-3 times higher than in the civilian population, where prevalence of insomnia is approximately 17-19%[15]. Insomnia is also a consistent risk factor for TBI, PTSD, chronic pain and pain management, and suicide. Additionally, research has demonstrated insomnia is correlated with other serious health challenges including, but not limited to, high blood pressure, heart attack, obesity, and depression[16]. Decreases in testosterone levels as a consequence of losing sleep can also impact veterans in their physical health as well as self-confidence. Currently, prescription medications are the most widely used treatment for insomnia but include potentially

serious problematic side effects such as grogginess, slowed cognitive processing and slowed reaction time.

In individuals with PTSD, nightmares are one of the most common symptoms experienced[17]. These terrifying dreams that bring back images and emotions of traumatic events during either NREM or REM sleep lead to a variety of sleep disorders in veterans suffering from PTSD, with insomnia being the most common - primarily coming from NREM sleep disruption[18]. Because of the importance of NREM sleep in episodic memory recall and also in the act of forgetting, disturbances in this part of the sleep cycle can lead to traumatic event recall while an individual is awake and can hinder their ability to forget or suppress the negative emotions and images associated with these times. This inability to escape the trauma can lead to severe anxiety and depression in those with PTSD.

Additionally, due to the importance of REM sleep in emotional regulation and processing, disruptions during this part of the sleep cycle can lead to emotional responses and day-to-day disturbances that can seem “irrational” and “dramatic.” These disturbances can cause significant distress within family and social relationships, hinder the ability to work, and can also lead to depression and anxiety related to embarrassment over these seemingly uncontrollable reactions.

Traditional treatment for PTSD includes various types of therapies, including Cognitive Behavioral Therapy (CPT), Cognitive Processing Therapy (CPT), and Eye Movement Desensitization and Reprocessing (EMDR). Medications can also be used to treat depression and anxiety that are often comorbid with invisible wounds of war. Unfortunately, while these treatments may provide some relief from daytime symptoms and even in some cases help remediate nightmares, sleep quality and quantity often still suffer due to the complex issues resulting from co-occurring invisible wounds of war.

Recent research has shown that although a treatment program for PTSD can be considered successful and lower intrusive memories, feelings of detachment/estrangement, and restricted emotions, difficulties with sleep and hyperarousal/insomnia are not concurrently solved without a direct targeted therapy for sleep disturbances[19]. A study published in 2016 demonstrated that insomnia was the most frequently reported symptom in 108 active-duty US Army soldiers who participated in a randomized clinical trial comparing Group Present-Centered Therapy with

Group Cognitive Processing Therapy – Cognitive Only Version. 92% of participants reported baseline insomnia, with 74-80% of participants reporting insomnia following treatment for PTSD[20]. Although research indicates that alleviating chronic pain can improve insomnia, Qualitative reports from over 1,000 Boot Campaign Health and Wellness Program participants indicated that sleep is not sufficiently improved following chronic pain treatment[21].

These results are indications that treatment for PTSD, TBI, and chronic pain alone is insufficient for treating insomnia in veterans without a specific, targeted treatment for sleep insomnia itself. The current gold-standard in sleep-specific treatment is Cognitive Behavioral Therapy for Insomnia (CBTi). While not developed specifically for military or veteran populations, CBTi has been shown to be an effective tool in remediating sleep issues in the general population. Building upon the success of CBTi in military populations, a military-specific version (CBTiM) was developed. Although not widely studied, we explored research by Dr. Daniel Taylor to understand if CBTiM is an adequate tool to utilize in the development of a virtual sleep program. According to Dr. Taylor's research in a study of 100 active-duty US Army Personnel, in-person and internet CBTiM proved to be significantly effective in positively impacting sleep quality and quantity[22].

Boot Campaign

Boot Campaign is a national 501(c)(3) non-profit organization with a mission to unite Americans to honor and restore the lives of Veterans and military families through individualized, life-improving programs. Boot Campaign's largest initiative is the Health and Wellness Program, which was built on the principles of providing individualized holistic treatment to veterans with invisible wounds of war with a goal of reducing veteran suicide. The program evaluates and treats diverse health challenges as a result of PTSD and TBI, as well as trauma-based insomnia, chronic pain, and self-medication/substance abuse. The customized-care methodology fosters a culture of healing and lifelong habits that support whole person physical health, cognitive health and mental wellness not seen regularly in the veteran care space and addressing the gaps in care that currently exist. Boot Campaign's program has been highly successful in reducing suicidal ideation as a result of comprehensive treatment of invisible wounds of war.

Boot Campaign has a successful Health and Wellness program that, since 2016, has treated veterans through different, individualized treatment programs, including but not limited to

psychotherapy, physical and occupational rehabilitation, functional medicine, stress reduction training, and treatment for brain injury. To address the need for greater access to holistic virtual care during the COVID-19 pandemic, as part of the Health and Wellness Program, Boot Campaign launched a virtual Resilience and Recovery holistic health coaching program in 2020. This novel virtual program was intended to provide a more easily accessible and comprehensive set of tools for military families by incorporating the highest yield components known to impact resilience with a heavy emphasis on improving heart rate variability (HRV).

Thus far, positive results have been obtained, showing overall decrease in suicidal ideation, physical and emotional distress, and stress related to financial stance, work, and social relationships as well as increases in adaptability, resilience and vitality in veterans. However, veterans continue to report difficulties in sleep quality and/or quantity that significantly impact their quality of life when meeting with their virtual coaches.

While there have been no research studies to date - that we are aware of - exploring whether holistic concurrent or successive treatment for all of these invisible wounds of war can reduce suicidal ideation, Boot Campaign's prior successful outcomes in the Health and Wellness Program indicate that treating these conditions via holistic and comprehensive individualized care can significantly improve veteran well-being. Specifically, Boot Campaign's programs have demonstrated clinically and statistically significant improvements in veteran symptoms in the areas of chronic pain, PTSD, TBI, self-medication, depression, anxiety, stress, relationships, and overall quality of life. Nonetheless, veterans in the program continue to anecdotally report insomnia remains a significant concern. Thus, we selected a representative cohort and measured sleep in these veterans using the PSQI, a gold-standard self-report standardized measurement of sleep.

If the hypothesis of our study is supported by analysis of Boot Campaign's outcome measure data for the PSQI, it will suggest that veterans suffering from PTSD, TBI and associated negative symptoms continue to be impacted greatly by the poor quality and quantity of their sleep despite improvement in other areas. As such, this will support the view that sleep is a necessity not only for essential functioning but also for an improved lifestyle as a whole that cannot be overlooked in treatment of trauma-related disorders. Combining sleep-specific therapy into a culturally competent and intentionally designed program augmenting other

therapies and treatments has the potential for a significant and much needed positive impact on overall veteran functioning.

Materials and Methods

General Study Details and Resources

In order to determine if Boot Campaign's existing Resilience and Recovery program is sufficiently addressing veteran sleep concerns, we analyzed pre- and post-outcome measures of those participating in the program. Data was provided by Boot Campaign for analysis in a de-identified format.

Our subject population was taken from veterans who are enrolled in Boot Campaign's Resilience and Recovery Program. All participants were former members of the United States Armed Services who have been diagnosed with PTSD and TBI, and who also reported co-occurring insomnia. Inclusion criteria for de-identified subjects included that the participant was a US military veteran, aged 20-70, who is a proficient English speaker diagnosed with PTSD and mild-to-moderate TBI, and who also reported co-occurring insomnia. Exclusion criteria included those in acute crisis, those with severe psychopathology or severe brain injury, those with addiction to substance or self-medication issues, and those who were unable to access virtual technology. The subject population included 30 individuals. Veterans were between the ages of 27 and 74, 80% male and 20% female, represented 4 of the 6 branches of the military (Army, Air Force, Marine Corps, and Navy), between 2 and 35 years in service, 80% married, 10% separated, and 10% engaged/living with a partner. 100% identified as having either PTSD or previous TBI (73% identified as having a previous TBI;90% reported having PTSD), 70% reported having chronic pain, and 100% reported currently living with insomnia.

We collected data through the standardized, self-reported Pittsburgh Sleep Quality Index (PSQI) questionnaire for each participant both pre- and post-training. Despite the prevalence of sleep complaints among psychiatric patients, few questionnaires have been specifically designed to measure sleep quality in clinical populations. The PSQI is a self-rated questionnaire which, over one month, assesses sleep quality and disturbances. There are nineteen individual items that generate scores for seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The sum of scores for these seven components yields one global score. Within the PSQI, each of the sleep components yields a score ranging from 0 to 3, with 3 indicating the greatest dysfunction. The sleep component scores are summed to yield a total score ranging from 0 to 21 with the higher total score (referred to as global score) indicating worse sleep

quality. A score of 5+ indicates poor sleep. Each of the seven components of the PSQI that were reported on are described below:

1. Sleep Quality - self-report of how the participant felt the quality of sleep was
2. Sleep latency - how long it takes to fall asleep
3. Sleep duration - amount of time spent in sleep each night
4. Sleep efficiency - hours in bed versus hours slept
5. Sleep disturbances - things that impacted the ability to sleep, such as environmental factors (temperature, dreams, pain, needing to use the restroom, etc.)
6. Sleep medication use - did they or did they not use sleep medication
7. Daytime dysfunction - how it impacted their daily life; ability to stay awake during the day and having enough energy to perform at work and home

Data Analysis and Results

We used a paired t-test to analyze changes in the rate of improvement of each of the above components in the veterans undergoing training. These groups were assessed for their rates of improvement at two different time points (baseline and post-training). Significant results were assessed using a p-value = 0.05 as shown in Table 1. Significant results are highlighted in green.

Table 1. Comparison of Baseline vs Post-Training PSQI Scores

Components	N	Mean	Two-sided p value
global score (baseline)	30	10.333	
global score (post training)	30	8.367	<.001
subjective sleep quality (baseline)	30	1.933	
subjective sleep quality (post training)	30	1.633	.048
sleep latency (baseline)	30	1.633	
sleep latency (post training)	30	1.533	.501
sleep duration (baseline)	30	2.033	
sleep duration (post training)	30	1.867	.169
habitual sleep efficiency (baseline)	30	1.400	
habitual sleep efficiency (post training)	30	0.733	<.001
sleep disturbances (baseline)	30	1.933	
sleep disturbances (post training)	30	1.700	.109
use of sleeping medication (baseline)	30	0.633	
use of sleeping medication (post training)	30	0.533	.264
daytime dysfunction (baseline)	30	0.767	
daytime dysfunction (post training)	30	0.367	.005

In our paired t-test results, we observed that most components did not have a statistically significant improvement from baseline to post-training after completing the Resilience and Recovery Program. While comparing means, it does initially look as if each component improved, evident by the lower mean scores in each component post-training. However, the decrease in mean score for most areas is not statistically significant. There are three areas which do show a significant improvement. The global overall score, habitual sleep efficiency, and daytime dysfunction all showed significant improvements in the reported PSQI data following veteran completion of the R&R curriculum. While there was a statistically significant improvement in the overall sleep score, it is of note that overall mean score continues to remain clinically significant for sleep disturbance.

When we further evaluate the goals of the Resilience and Recovery program to improve areas of veteran life such as stress, emotional well-being, and productivity, we are able to understand the reasoning behind the statistical significance of some areas of improvement without a targeted sleep therapy. The overall global score, sleep efficiency, and daytime dysfunction are three components of the PSQI that can be subjectively improved by making changes in daily behaviors. When a participant notices a positive change in their productivity, emotional responsiveness, and stress, it is a normal response to assume that their sleep is more effective, contributing to this overall improvement in daily life and decrease in daytime dysfunction. The remainder of the components of the PSQI, however, are less subjective and more specific to the actual improvement in their sleep quality and quantity. Sleep disturbances, for example, are largely environmental in cause. Sleep latency and sleep duration are also affected by the environment, as well as a participant's knowledge on sleep hygiene.

The results of this data analysis support our hypothesis that the currently existing Resilience and Recovery program, while improving overall veteran well-being in a variety of areas, is not sufficiently addressing sleep as a very important independent factor. As such, this research project assisted with the design and development of a novel Virtual Sleep Program (VSP) for veterans. This new program will build upon the already successful Resilience and Recovery program while focusing specifically on sleep as a crucial element in need of its own extensive, targeted curriculum to further improve veteran well-being.

Design of Sleep Program

Program Design

The significance of sleep on veteran overall well-being and correlation between insomnia and suicidality is well-documented. Although more comprehensive than many treatments available to veterans, our analysis of outcome measure data of Boot Campaign's existing Resilience and Recovery virtual program indicated it does not specifically or sufficiently address sleep. Thus, we have designed a separate program to augment currently available treatments.

The sleep program we have designed is a fully comprehensive program that is specific to the veteran population and their unique challenges with obtaining adequate sleep. While there are other virtual programs built to educate those on sleep and how to gain skills to create a satisfactory sleep regimen, our curriculum is unique in that it includes the following:

1. **Environmental Modification and Assessment:** Prior to engaging in any therapy or peer coaching, a complete assessment and modification (as needed) of the veteran's sleep environment will be conducted. This modification allows us to proactively correct environmental disturbances to sleep, more closely standardize each participant's environment, and ensure the most optimal conditions for successful treatment.

2. **Self-Paced Virtual Learning Modules**: A comprehensive, virtual and self-paced psychoeducational curriculum to complement the therapy component is a cornerstone of the uniqueness of this program. This six-module curriculum can be accessed prior to, during, and after therapy and will serve to reinforce healthy sleep habits. Curriculum modules are based on scientific principles of sleep wellness and designed specifically for the veteran and military population, utilizing real-world and practical examples veterans can easily relate to and understand. The modules (described below) will address the most salient components of sleep wellness and serve as a basis for peer-led integration coaching.

3. **CBTiM:** Veterans will be provided access to the gold-standard of treatment for insomnia in the military population, CBTiM. This structured, culturally competent, evidence-based therapy model serves as the core of the treatment protocol.

4. **Peer Coaching and Integration:** Veterans will be provided a non-therapeutic individualized preparation and integration peer coaching protocol with touchpoints prior to, during, and after the veteran undergoes therapy. The intention of this peer-based coaching is to assist the veteran in preparing mentally, emotionally, and physically to gain the most benefit possible from therapy, to serve as motivation and accountability in a non-threatening manner, and to ensure sustainability of habits post-therapy.

Environmental Assessment

It is no surprise that many people have their preferences for the conditions in which they sleep - do they want the fan on, TV off, sound machine, and a heavy comforter? Despite being what most would consider common knowledge, the environment in which one sleeps has been significantly neglected as a topic in clinical research. The main environmental factors that have been shown to impact sleep quality that we are focusing on in our research are noise, temperature, light, mattresses/bedding, and other people/pets.

By beginning with an environmental assessment of each participant, we are able to modify their surroundings prior to the beginning of the virtual learning and therapy portion of the program. This will allow for better analysis of results that are mostly from the effects of the learning modules and CBTi.

Self-Paced Virtual Learning Modules

With the creation of a virtual model for the delivery for our holistic sleep program, participants will have access to materials wherever they are located and at their own pace. As most Americans today, most of our participants have little time during their schedules to dedicate specific, scheduled time to add in an additional task to their already busy lives. The virtual program learning modules are self-paced to allow each participant the freedom to work through each module at their own pace, repeat modules if necessary to strengthen understanding, and not feel any additional, counterintuitive stress. The participants will complete each of the following modules prior to engaging in any CBTiM materials to educate themselves on the various factors that can impact their sleep. Participants will have continued access to the modules during the therapy portion of the virtual program.

Module One: Importance of the Environment on Sleep

The environment in which we sleep is essential to the quality of our rest and can have significant impacts on the quality as well as quantity of our sleep. For our program, we specifically focus on noise, light, temperature, bedding materials, and other people/pets in the surrounding environment of participants. Each of these disturbances have been studied and shown to negatively affect sleep in various ways.

Nocturnal noise can fragment sleep and disrupt the ideal amount of time spent in different sleep stages. It mostly increases the wake and stage 1 sleep and decreases REM sleep, which is an overall decrease in deep sleep. It can provoke metabolic and endocrine dysfunction such as increased secretion of adrenaline and cortisol, raising heart rate, arterial pressure, and movement[23].

Body temperature fluctuates with the body's natural circadian rhythm. It falls throughout the night by about 2 degrees, starting to decrease approximately 2 hours before sleep when the body starts producing melatonin. A cool temperature is a way to mimic the body's natural decrease in temperature, helping keep on track with the circadian rhythm. A room that is too hot can make one sweaty and generally uncomfortable, making it difficult to fall asleep. It also has been associated with a decrease in deep, slow wave sleep as well as increased frequency of awakenings. Hot temperatures also lessen the time spent in REM sleep[24].

Regular light and blue light (from smartphones, tablets, TVs, etc.) disrupt the natural circadian rhythm (the body's natural 24-hour clock, located in the suprachiasmatic nucleus (SCN) of the hypothalamus), making it difficult to fall asleep at night and stay asleep[25]. Light is perceived by the SCN as daytime, and decreases melatonin secretion from the brain, leading to delayed sleep onset and messing up the natural sleep wake cycle. Light exposure at night can reduce the quality of sleep by adversely affecting transitions between sleep cycles, creating a fragmented night of sleep.

Other humans and pets can be a source of heat throughout the night, making it difficult to fall and stay asleep. Movements and noises from other humans and pets can cause disturbances during sleep and cause frequent awakenings or inhibited transitions into deep sleep. Studies have shown that sleeping with children increases the disturbances to a night's rest due to their more frequent movements, noises, and need for a parent/guardian during the night. The type of

pet has also been proven to impact sleep variably. A variety of studies have found that owners of dogs who sleep with their dogs found it easier to fall asleep at night due to the emotional comfort of their pet[26]. A study by Xin et al, however, showed that pet owners had a higher prevalence of insomnia and nighttime awakenings than those without pets, due to the movements of pets, need to let the pets go to the restroom, and noises from pets[27].

Mattresses need to provide proper back alignment, temperature regulation, and pressure relief. A mattress that is too soft or too hard can make it difficult to fall asleep and cause back and neck pain, leading to back pain and headaches throughout the day. It has been found that a medium firm mattress with adjustable inflation is the best for comfort and quality of sleep, but mattress preference is up to the individual and is based on sleep position, weight, and temperature of room. Pillows are essential for proper neck alignment to prevent neck and shoulder pain. Aligning the spine is important to prevent pain for the next day, but also to prevent awakenings throughout the night to reposition a flimsy pillow. Bedding and clothing need to be breathable and allow for an individual to be at an ideal temperature for sleep. This can depend on the room temperature and an individual's weight. Weighted blankets can decrease anxiety and promote relaxation, decreasing the amount of time it takes to fall asleep[28].

Module Two: Importance of sleep for health

Our overall health is greatly affected by sleep. Fragmented sleep can disrupt the body's metabolism and endocrine system (hormones), cardiovascular system, and brain, leading to dysregulation of blood pressure, blood sugar, and reproductive hormones. This can lead to weight gain, heart disease, diabetes, and many more physical ailments. Inadequate sleep also increases cortisol levels, the stress hormone, which leads again to a decrease in ability to fall asleep and stay asleep at night. Adequate sleep prevents the decline of these systems, therefore promoting longevity and overall health[29]. Essential for cognitive function, a sufficient amount of sleep contributes to our brain health. Disrupted REM sleep interrupts our ability to control emotional reactivity and cognitive processing abilities. Adequate sleep is necessary for learning and long-term memory development. Fragmented sleep can lead to difficulty focusing, processing emotions, thinking clearly, and forming memories[30]. Decreased adequate sleep has been shown to increase an individual's reaction time and puts individuals at an increased risk of being involved in tragic situations such as motor vehicle accidents[31].

Module Three: Importance of Sleep in Daily Life

Two crucial parts of one's daily life are their relationships with those around them and their performance in work and at home. Poor sleep affects your amygdala in your brain, which allows one to connect emotions and memories. Inadequate sleep can make us more emotional reactive and less empathetic, impacting the quality of our relationships[32]. Inadequate sleep also increases cortisol levels, the stress hormone, therefore making us more on edge. Sleep deprivation has also been shown to make us more judgmental of others and increase feelings of loneliness and lean toward isolation. As stated above, disrupted REM sleep interrupts our ability to control emotional reactivity and cognitive processing abilities. Decreased adequate sleep has been shown to increase an individual's reaction time, decreased ability to process complex problems and think quickly, and make good decisions. Lack of sleep also decreases one's ability to learn and form memories, making their work performance decrease.

Module Four: Impact of Trauma on Sleep

The individual veterans participating in our program have experienced significant trauma in varying forms. There has been extensive research on how trauma impacts our physical health. Trauma of various forms, either in childhood or adult life, causes an increase in cortisol levels in the body, raising heart rate and blood pressure and stimulating the sympathetic (fight or flight) nervous system, leading to difficulty relaxing to fall asleep and stay asleep. Flashbacks and nightmares can occur, especially in REM sleep, leading to distress and frequent awakenings. Disrupted REM sleep interrupts our ability to control emotional reactivity and cognitive processing abilities. Childhood trauma can continue to affect individuals throughout their life, reflecting in poor sleep quality as an adult. There are multiple trauma associated sleep disorders including vivid nightmares/sleep terrors, disruptive nocturnal behaviors (sleep talking/walking), and REM sleep without atonia (increased muscle tone and increased dream and nightmare activity during REM stage) [33].

Module Five: Self-Medication and Sleep

Aside from our environment and social/personal background, the daily and lifestyle habits that an individual practices affects their ability to get restful, sufficient sleep. Alcohol works as a nervous system depressant by increasing the amount of a neurotransmitter gamma-aminobutyric acid (GABA), signaling the brain to slow down, and decreasing chemicals like adenosine in our brain, which usually stimulate the brain[34]. Even a couple of drinks of alcohol suppresses REM sleep for the first few hours of one's sleep cycle[35]. Alcohol is also a diuretic,

increasing our body's functions to rid water, such as urination and sweating. The increased urination from alcohol can lead to frequent nighttime awakenings, and increased sweating can negatively impact the comfort and quality of sleep. Alcohol can also make one snore due to relaxing the muscles in your body, including those around the neck and mouth. This can also lead to an increased risk of developing sleep apnea, a condition which impairs breathing throughout the night. A common problem among those having trouble sleeping is the development of dependence on alcohol to get to sleep, leading to increased insomnia without alcohol[36].

Cannabinoids bind to receptors in the brain and increase levels of sleep promoting chemicals like adenosine, typically inducing a sedating effect. They also suppress the brain's system of arousal, leading to feeling sleepy and decreasing the amount of time it takes to fall asleep. Tetrahydrocannabinol, commonly referred to as THC, has been proven to improve chronic pain in patients with conditions such as fibromyalgia, Complex Regional Pain Syndrome, and anxiety[37]. Despite these benefits, however, THC can have an opposite, stimulating effect for some people, leading to an increased amount of time it takes to fall asleep[38]. Different strains of THC can have varying effects on people, so one may not know how certain types of THC will affect them and could end up increasing insomnia or poor quality of sleep. THC increases time spent in deep sleep, but decreases time spent in REM sleep[39]. This decreased time in REM may benefit those with PTSD since REM sleep is typically when nightmares occur. However, disrupted REM sleep interrupts our ability to control emotional reactivity and cognitive processing abilities. Similarly to alcohol, those using THC can develop dependence on THC to fall asleep.

Module Six: Fitness and Nutrition

Similar to substances that are common in daily lifestyles, an individual's dietary habits impact their quality of sleep. Fatty and high protein foods can make you feel excessively full due to their slow digestion and can lead to grogginess during the day, resulting in naps and a disrupted circadian rhythm. Spicy foods can cause heartburn and acid reflux that intensifies when you lay flat, making it harder to fall asleep and stay asleep. There is research to suggest that heartburn can worsen effects of already existing sleep apnea. Some spicy foods can raise your temperature, causing sweating and disrupting sleep[40]. Caffeine is an obvious stimulant that can keep people from falling asleep and reaching a deep sleep. Caffeine is not only just in coffee,

soda, and energy drinks, but also in food like chocolate. It is recommended to stop caffeine consumption at least 6 hours before bedtime[41].

Exercise causes your body to burn more calories at a basal rate, which uses its resources faster than without exercise. This can reduce the time it takes to fall asleep at night and increase the quality of sleep. Indirectly, exercise benefits sleep quality by reducing excess weight, which contributes to sleep apnea, discomfort during sleep, and sweating. Exercise also increases natural dopamine levels in the brain, which can decrease stress and anxiety, leading to better sleep[42].

General stress in one's daily life can increase cortisol levels in the body, raising heart rate and blood pressure and stimulating the sympathetic (fight or flight) nervous system, leading to difficulty relaxing to fall asleep and stay asleep. Stress can also lead to anxiety, making it difficult to fall asleep and stay asleep[43].

CBTi

Many in the US are currently prescribed sleep medications to combat this disturbance in their life, yet the potential side effects of grogginess and slowed cognition during the day have significant negative impacts on many individuals' abilities to function efficiently and safely in their daily life[45]. These less than desired effects can be especially dysfunctional to the daytime functioning, and even nocturnal functioning, of those in the military. First line therapy for insomnia is Cognitive Behavioral Therapy for Insomnia, or CBTi, and CBTi for military, or CBTiM, despite the more common use of pharmacological interventions[46].

CBTi is a therapy that helps guide patients through changing their thoughts, habits, and beliefs about life and sleep that aid in improving overall sleep quality. A longitudinal study of veterans receiving CBTi treatment for sleep disturbances found that in the 405 participants, there was a statistically significant reduction in suicidal ideation among veterans receiving CBTi, with a correlation between amount of insomnia symptom reduction; that is, the more insomnia symptoms decreased as did suicidal ideation. The authors posit several potential reasons for this, including that irregular sleep may desensitize the serotonergic 1A receptor system, links between medial prefrontal cortex connectivity with the amygdala resulting in poor decision making, as well as increased feelings of being able to handle life's challenges when one is well-rested[13]. As such, veterans will be provided CBTi with a specific focus for military veterans as

the core of this program, known as CBTiM. Standard CBTiM treatment includes 6 sessions and can be delivered by either civilian or military therapists with additional training specific to treating active or veteran military members. Thus, we have concluded that CBTiM is the gold standard treatment for our population.

Transformational Peer Coaching and Integration

To assist the veteran in preparing mentally, emotionally, and physically to gain the most benefit possible from therapy, veterans will be provided a non-therapeutic individualized preparation and integration peer coaching protocol. This protocol will include touchpoints prior to, during, and after the veteran undergoes therapy. The intention of this aspect of the program is to provide non-therapeutic support and accountability from one veteran to another. Ultimately, our goal is to ensure willingness of the veteran to fully engage in our program, as well as sustain healthy sleep habits post-therapy.

We will utilize the organization Being True to You to provide the peer coaching and integration. Established in 2010, Being True to You is the first coaching company to provide preparation and integration to alternative treatment programs. Being True to You's model of coaching helps individuals understand "stuck points" in the way of transformational change and helps connect veterans with their ability to change things. The coaching examines mindset, lifestyle, and allegiances and helps identify areas impeding progress. The organization will develop a specific coaching protocol for Boot Campaign participants in which veterans are uniquely matched with coaches that they can identify with, including that coaches are other veterans. The intention of this aspect of our model is to help program participants with integrating incremental changes into daily life.

Discussion/Innovation

The current Health and Wellness Program at the Boot Campaign is a desperately needed resource for veterans around the US that are living with difficulties from TBI, PTSD, and other war-related ailments. Through the Resilience and Recovery curriculum, Boot Campaign has identified that a curriculum delivered virtually to specific participants can vastly improve multiple facets of a veteran's day to day life. In discussion with coaches and participants of the RR program, however, we learned that sleep may not be adequately addressed within the holistic program and needs a more specific approach. After conducting a paired t-test on the data collected from all 30 participants' PSQIs, we are able to see the actual need for a targeted program to positively impact our participants' sleep. Although on first look comparison of means at baseline vs post-training for each of the PSQI components, there was not a statistically significant improvement in 5 out of the 7 areas of sleep: subjective sleep quality, sleep latency, sleep duration, sleep disturbances, and use of sleep medication.

This data is evidence for a need to develop a comprehensive virtual curriculum to specifically modify a participant's environment before providing education on lifestyle choices and other factors that affect quality and quantity of sleep. The virtual sleep program has been designed to supplement the already existing Resilience and Recovery program, focusing on delivering a fully comprehensive sleep therapy that not only identifies environmental disturbances impacting sleep, but modifies them, allowing for participants to get full benefit of treatment. With the improvement of sleep through this particular curriculum, our goal is to further decrease stress, suicidal ideation, delays in productivity, and overall dysfunction in participants' lives. Quality sleep is essential to a human's ability to lead a positive, joyful life, and our aim is to assist in leading veterans to a fulfilled life minimally impacted by their past.

Future Directions

Future study direction includes piloting and exploring objective measures of our newly designed Sleep Program on physiology, including balance of the autonomic nervous system (which is often disrupted by trauma), increase metabolism and overall muscle mass through the increase of testosterone, decrease negative emotional responses which will reduce clinical symptoms of depression and anxiety, with the goal that sleep can perhaps become a target for PTSD therapy. By incorporating this cutting-edge care to our existing array of treatment protocols offered, Boot Campaign will further bridge the gap between veterans and the individualized care they need to be fundamentally healthy and move forward to a prosperous future. Boot Campaign has received $100,000 in grant money to fully develop and conduct a pilot program of our proposed virtual sleep curriculum.

Conclusions

Insomnia is a condition that affects approximately 16% of the civilian population and an even greater portion of veterans and those in the active military[44]. Between 2000 to 2009 there was a 73% increase in insomnia diagnoses among active-duty US military members and the prevalence of insomnia, described as difficulty falling asleep or staying asleep and/or poor sleep leading to dysfunction during daily life, in veterans is 27-54% as of 2018. Poor regulation of stress, whether physical, psychological, or emotional contribute to an increased risk of insomnia. These stressors are elevated in the military population, partly due to war zone trauma, irregular sleep/work schedules, uncomfortable sleeping environments, and travel to many time zones across the world.

Veteran healthcare is known to be widely inadequate in the United States, and often, does not address the “hidden wounds” of war such as PTSD that leads to mild to severe sleep disturbances such as nightmares and insomnia. Veterans are, most commonly, subjected to pharmacological therapies to treat symptoms of PTSD and the depression, anxiety, and decline in physical health that can follow. Sometimes, these treatments include medications that are contraindicated in their use with one another or can lead one down the road of addiction.

Boot Campaign’s Health and Wellness Program, however, is committed to an integrated approach to treating the multiple aspects of a human, encompassing the social, emotional, and mental factors of someone’s life as well as the physical and biological aspects. Through this holistic approach and paired with the existing Resilience and Recovery program offered through Boot Campaign, this study on the impact of sleep and the development of a specific sleep program curriculum can allow for increased physical and emotional wellness in veterans as well as provide a positive impact on their social relationships and their private, traumatic memories.

Improved sleep, if achieved through better routines and personal growth, does not require appointments with physicians, does not require taking multiple trips to the pharmacy and multiple medications each day, and is something that can provide multiple health benefits from the comfort of one’s home. By modifying environment, providing gold standard CBTiM therapy, engaging the veteran with peer transformational integration coaching, and providing psychoeducation on salient sleep components, our program has the potential to fully address significant sleep concerns that plague our nation’s veterans, and thus the potential to reduce the veteran suicide rate as a byproduct.

Compliance

Due to the nature of this project and not engaging directly with identified human subjects, IRB approval was not required for completion of our project.

References

[1] Schaeffer, K. The changing face of America's veteran population. Pew Research Center. Published November 8, 2023. Accessed (12/13/23). https://www.pewresearch.org/short-reads/2023/11/08/the-changing-face-of-americas-veteran-population/#:~:text=The%20overall%20number%20of%20women,under%2010%20million%20in%202048

[2] Oliver A. The Veterans Health Administration: an American success story? Milbank Q. 2007;85(1):5-35. doi: 10.1111/j.1468-0009.2007.00475.x. PMID: 17319805; PMCID: PMC2690309.

[3]Horn SR, Charney DS, Feder A. Understanding resilience: New approaches for preventing and treating PTSD. *Exp Neurol*. 2016 Oct; 284(Pt B):119-132.

[4] Walker, MP, & van der Helm, E. Overnight therapy? The role of sleep in emotional brain processing. *Psychological bulletin*. 2009; 135(5): 731–748.

[5] Saletin, JM, Goldstein, AN, & Walker, MP. The role of sleep in directed forgetting and remembering of human memories. *Cerebral cortex*. 1991; 21(11): 2534–2541. https://doi.org/10.1093/cercor/bhr034

[6] Nofzinger EA. Functional neuroimaging of sleep. *Semin Neurol*. 2005 Mar; 25(1):9-18. doi: 10.1055/s-2005-867070. PMID: 15798933.

[7] Goldstein, AN, & Walker, MP. The role of sleep in emotional brain function. *Annual review of clinical psychology*. 2014; 10: 679–708. https://doi.org/10.1146/annurev-clinpsy-032813-153716

[8] Kaufman JM, Vermeulen A. The decline of androgen levels in elderly men and its clinical and therapeutic implications. *Endocr Rev*. 2005 Oct; 26(6): 833-76. doi: 10.1210/er.2004-0013.

[9] Wittert G. The relationship between sleep disorders and testosterone in men. *Asian journal of andrology*. 2014; 16(2): 262–265. https://doi.org/10.4103/1008-682X.122586

[10]Agargun MY, Beşiroğlu L. Sleep and suicidality: do sleep disturbances predict suicide risk? *Sleep*. 2005 Sep;28(9):1039-40. PMID: 16268368.

[11]McCarthy JF, Valenstein M, Kim HM, Ilgen M, Zivin K, Blow FC. Suicide mortality among patients receiving care in the veterans health administration health system. *Am J Epidemiol*. 2009 Apr 15;169(8):1033-8. doi: 10.1093/aje/kwp010. Epub 2009 Feb 27. PMID: 19251753.

[12] Pigeon WR, Pinquart M, Conner K. Meta-analysis of sleep disturbance and suicidal thoughts and behaviors. Psychiatrist.com [Internet]. 2021 Feb 4 [cited 2024 Apr 25]; Available from: https://www.psychiatrist.com/jcp/depression/suicide/meta-analysis-sleep-disturbance-suicidal-thoughts/

[13]Trockel M, Karlin BE, Taylor CB, Brown GK, Manber R. Effects of cognitive behavioral therapy for insomnia on suicidal ideation in veterans. *Sleep*. 2015 Feb 1;38(2):259-65. doi: 10.5665/sleep.4410. PMID: 25515115; PMCID: PMC4288607.
[14] Hughes JM, Ulmer CS, Gierisch JM, Nicole Hastings S, Howard MO. Insomnia in United States military veterans: An integrated theoretical model. *Clin Psychol Rev*. 2018 Feb;59:118-125. doi: 10.1016/j.cpr.2017.11.005. Epub 2017 Nov 20. PMID: 29180102; PMCID: PMC5930488.
[15] Ford ES, Cunningham TJ, Giles WH, Croft JB. Trends in insomnia and excessive daytime sleepiness among U.S. adults from 2002 to 2012. *Sleep Med*. 2015 Mar;16(3):372-8. doi: 10.1016/j.sleep.2014.12.008. Epub 2015 Jan 14. PMID: 25747141; PMCID: PMC4763609.
[16] Kripke DF, Garfinkel L, Wingard DL, Klauber MR, Marler MR. Mortality associated with sleep duration and insomnia. *Arch Gen Psychiatry*. 2002 Feb;59(2):131-6. doi: 10.1001/archpsyc.59.2.131. PMID: 11825133.
[17] van der Kolk B, Blitz R, Burr W, Sherry S, Hartmann E. Nightmares and trauma: a comparison of nightmares after combat with lifelong nightmares in veterans. *Am J Psychiatry*. 1984 Feb; 141(2): 187-90. doi: 10.1176/ajp.141.2.187. PMID: 6691477.
[18] Germain A. Sleep disturbances as the hallmark of PTSD: where are we now? *The American Journal of Psychiatry*. 2013; 170(4): 372–382. https://doi.org/10.1176/appi.ajp.2012.12040432
[19] Schnurr PP, Lunney CA. Residual symptoms following prolonged exposure and present-centered therapy for PTSD in female veterans and soldiers. *Depress Anxiety*. 2019 Feb;36(2):162-169. doi: 10.1002/da.22871. Epub 2018 Dec 21. PMID: 30576030.
[20] Pruiksma KE, Taylor DJ, Wachen JS, Mintz J, Young-McCaughan S, Peterson AL, et al. Residual sleep disturbances following PTSD treatment in active duty military personnel. *Psychological Trauma: Theory, Research, Practice, and Policy*. 2016;8(6):697–701. https://doi.org/10.1037/tra0000150
[21]Tang NK. Insomnia Co-Occurring with Chronic Pain: Clinical Features, Interaction, Assessments and Possible Interventions. *Rev Pain*. 2008 Sep;2(1):2-7. doi: 10.1177/204946370800200102. PMID: 26525182; PMCID: PMC4589931.
[22]Taylor DJ, Peterson AL, Pruiksma KE, Young-McCaughan S, Nicholson K, Mintz J; STRONG STAR Consortium. Internet and In-Person Cognitive Behavioral Therapy for Insomnia in Military Personnel: A Randomized Clinical Trial. *Sleep*. 2017 Jun 1;40(6). doi: 10.1093/sleep/zsx075. PMID: 28472528.

[23] Halperin D. Environmental noise and sleep disturbances: A threat to health? *Sleep science* (Sao Paulo, Brazil). 2014 Nov 15. https://pubmed.ncbi.nlm.nih.gov/26483931/
[24] Okamoto-Mizuno K, Mizuno K. Effects of thermal environment on sleep and circadian rhythm. *J Physiol Anthropol*. 2012 May 31;31(1):14. doi: 10.1186/1880-6805-31-14. PMID: 22738673; PMCID: PMC3427038.
[25] Blume C, Garbazza C, Spitschan M. Effects of light on human circadian rhythms, sleep and mood. *Somnologie (Berl).* 2019 Sep;23(3):147-156. doi: 10.1007/s11818-019-00215-x. Epub 2019 Aug 20. PMID: 31534436; PMCID: PMC6751071.
[26] Mein G. and Grant R. A cross-sectional exploratory analysis between pet ownership, sleep, exercise, health and neighbourhood perceptions: The Whitehall II cohort study. *BMC Geriatrics.* 2018*;*18, 176.
[27]Xin X., Cheng L., Li S., Feng L., Xin Y., & Wang S. Improvement to the subjective well-being of pet ownership may have positive psychological influence during Covid-19 epidemic. *Animal Science Journal*. 2021;92(1). https://doi.org/10.1111/asj.13624
[28] Taylor DJ and Roane BM. Treatment of insomnia in adults and children: A practice-friendly review of research. *Journal of Clinical Psychology*. 2010;66(11), 1137–1147.
[28] Wang Y, Liu Y, Song C, & Liu J. Appropriate Indoor operative temperature and bedding micro climate temperature that satisfies the requirements of sleep thermal comfort. *Building and Environment*. 2015;92, 20–29. https://doi.org/10.1016/j.buildenv.2015.04.015.
[29] Vgontzas A.N., Tsigos C., Bixler E.O., Stratakis C.A., Zachman K., Kales A. Chronic insomnia and activity of the stress system: a preliminary study. *J Psychosom Res.* 1998;45(1):21–31.
[30] Rasch B, Born J. About sleep's role in memory. *Physiol Rev*. 2013 Apr;93(2):681-766. doi: 10.1152/physrev.00032.2012. PMID: 23589831; PMCID: PMC3768102.
[31] Taheri M, Arabameri E. The effect of sleep deprivation on choice reaction time and anaerobic power of college student athletes. *Asian J Sports Med*. 2012 Mar;3(1):15-20. doi: 10.5812/asjsm.34719. PMID: 22461961; PMCID: PMC3307962.
[32] Vandekerckhove M, Wang YL. Emotion, emotion regulation and sleep: An intimate relationship. *AIMS Neurosci*. 2017 Dec 1;5(1):1-17. doi: 10.3934/Neuroscience.2018.1.1. PMID: 32341948; PMCID: PMC7181893.
[33] Colvonen PJ, Masino T, Drummond SP, Myers US, Angkaw AC, & Norman SB. Obstructive Sleep Apnea and Posttraumatic Stress Disorder among OEF/OIF/OND Veterans. *Journal of clinical sleep medicine*. 2015;11(5), 513–518. https://pubmed.ncbi.nlm.nih.gov/25665698/

[34] Roehrs T, Roth T. Sleep, sleepiness, and alcohol use. *Alcohol Res Health*. 2001;25(2):101-9. PMID: 11584549; PMCID: PMC6707127.
[35] Colrain IM, Nicholas CL, Baker FC. Alcohol and the sleeping brain. *Handb Clin Neurol.* 2014;125:415-31. doi: 10.1016/B978-0-444-62619-6.00024-0. PMID: 25307588; PMCID: PMC5821259.
[36] Conroy D, Arnedt JT, & Brower, KJ. Insomnia in patients with addictions: A safer way to break the cycle. *Current Psychiatry*. 2008;7(5), 97–109.
[37] Whiting PF, Wolff RF, Deshpande S, Di Nisio M, Duffy S, Hernandez AV, Keurentjes JC, Lang S, Misso K, Ryder S, Schmidlkofer S, Westwood M, Kleijnen J. Cannabinoids for Medical Use: A Systematic Review and Meta-analysis. *JAMA*. 2015 Jun 23-30;313(24):2456-73. doi: 10.1001/jama.2015.6358. Erratum in: JAMA. 2015 Aug 4;314(5):520. Erratum in: JAMA. 2015 Aug 25;314(8):837. Erratum in: JAMA. 2015 Dec 1;314(21):2308. Erratum in: JAMA. 2016 Apr 12;315(14):1522. PMID: 26103030.
[38] Piomelli D, & Russo EB. The Cannabis sativa versus Cannabis indica debate: An interview with Ethan Russo, MD. *Cannabis and Cannabinoid Research*. 2016;1(1), 44–46.https://pubmed.ncbi.nlm.nih.gov/28861479/
[39] Gordon HW. Differential Effects of Addictive Drugs on Sleep and Sleep Stages. *J Addict Res (OPAST Group).* 2019;3(2):10.33140/JAR.03.02.01. doi: 10.33140/JAR.03.02.01. Epub 2019 Jul 15. PMID: 31403110; PMCID: PMC6688758.
[40] St-Onge MP, Mikic A, Pietrolungo CE. Effects of Diet on Sleep Quality. *Adv Nutr*. 2016 Sep 15;7(5):938-49. doi: 10.3945/an.116.012336. PMID: 27633109; PMCID: PMC5015038.
[41] O'Callaghan F, Muurlink O, Reid N. Effects of caffeine on sleep quality and daytime functioning. *Risk Manag Healthc Policy*. 2018 Dec 7;11:263-271. doi: 10.2147/RMHP.S156404. PMID: 30573997; PMCID: PMC6292246.
[42] Kline CE. The bidirectional relationship between exercise and sleep: Implications for exercise adherence and sleep improvement. *Am J Lifestyle Med*. 2014 Nov-Dec;8(6):375-379. doi: 10.1177/1559827614544437. PMID: 25729341; PMCID: PMC4341978.
[43] Kalmbach DA, Anderson JR, Drake CL. The impact of stress on sleep: Pathogenic sleep reactivity as a vulnerability to insomnia and circadian disorders. *J Sleep Res*. 2018 Dec;27(6):e12710. doi: 10.1111/jsr.12710. Epub 2018 May 24. PMID: 29797753; PMCID: PMC7045300.
[44] Morgenthaler T, Kramer M, Alessi C, et al. : Practice parameters for the psychological and behavioral treatment of insomnia: an update. An American Academy of Sleep Medicine report. *Sleep* 2006; 29(11): 1415-19.

[45] Okajima I, Komada Y, Inoue Y: A meta-analysis on the treatment effectiveness of cognitive behavioral therapy for primary insomnia. *Sleep Biol Rhythms* 2011; 9(1): 24-34.
[46] Qaseem A, Kansagara D, Forciea MA, Cooke M, Denberg TD: Management of chronic insomnia disorder in adults: a clinical practice guideline from the American college of physicians. *Ann Intern Med* 2016; 165(2): 125-33.