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ASSESSING THE IMPACT OF A YOGA INTERVENTION ON SLEEP IN FEMALE VETERAN AND NON-VETERAN COLLEGE STUDENTS

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Assessing the Impact of a Trauma Informed Yoga Intervention on Sleep in Female Veteran and Non-Veteran College Students

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Abstract

Early sleep research in the 1970's reported that sleep problems were due to cognitive and physiological arousal (Kennedy, 2014; Ong, Ulmer, & Manber, 2005). Recent research suggests that in addition to arousal, maladaptive beliefs and attitudes contribute to sleep problems (Kennedy, 2014; Ong et al., 2005). Techniques to decrease cognitive and physiological arousal include exercise, relaxation techniques, and talk therapy (Kennedy, 2014; Ong et al., 2005. To address maladaptive attitudes and beliefs mindfulness and acceptance techniques such as yoga are recommended (Kennedy, 2014; Ong et al., 2005). Untrue beliefs about how much sleep is needed and a tendency to avoid distressing emotions are patterns in individuals with sleep problems (Kennedy, 2014; Ong et al., 2005). Yoga was historically thought to balance physical, mental, emotional, and spiritual dimensions of an individual (Ross and Thomas, 2010). During a yoga class, individuals are encouraged to practice self- awareness and acceptance of their cognitive and emotional states (Ong et al., 2005). Yoga could change individuals' maladaptive beliefs and attitudes in addition to decreasing cognitive and physiological arousal (Ong et al., 2005).

To test the impact of yoga on sleep, this researcher analyzed secondary sleep data from a pilot research study that was conducted in the spring of 2018 at University of Montana's (UM) Mind Body lab. Twelve female participants in the pilot study completed a one-hour trauma-informed Hatha yoga class once per week for four weeks and recorded sleep measures for five weeks. The researcher was interested in whether participants' sleep scores significantly differed during the five-week study. A secondary research question asked whether female veteran college students composite sleep scores differed over the five-week study and whether female non-veteran college students composite sleep scores differed over the five-week study. This researcher also asked whether four sleep variables differed over the five-week study and whether those four variables and a composite score differed in each age group over the five-week study. Results were non- significant and, this research confirms that further studies on trauma-informed yoga and sleep need to be conducted.

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Introduction

Benefits of Yoga

The benefits of practicing yoga address many health problems. The mechanism by which these benefits occur is in part due to the vagus nerve (Ross & Thomas 2010; Streeter, Gerbarg, Saper, Ciraulo, & Brown, 2012). The body's stress response by means of the sympathetic nervous system can be a contributor of disease progression (Ross and Thomas, 2010). While useful in the short term, the stress response is a self-perpetuating cycle. Over long periods of time, hormones involved in the stress response lead to brain changes that are visible with magnetic resonance imaging (MRI) (McEwen, 1999; Ross & Thomas, 2010). For example, post-traumatic stress disorder (PTSD) is seen in the brain as hippocampus atrophy (McEwen, 1999). Yogic breathing and movement stimulate the vagus nerve which increases parasympathetic activity (Ross & Thomas 2010; Streeter, Gerbarg, Saper, Ciraulo, & Brown, 2012). Stimulation of the vagus nerve downregulates the hypothalamic-pituitary-adrenal (HPA) axis, thus, reversing the effect of the sympathetic stress (Ross & Thomas, 2010). The parasympathetic nervous system can counteract detrimental effects of sympathetic nervous system. Therefore, yoga has the potential to reverse damage from an overactive sympathetic nervous system.

A review of studies by Ross and Thomas (2010) reported that the benefits of yoga span from psychological, social, occupational, and physiological. Yoga improved psychological symptoms in three studies (Chattha, Nagarathna, Venkatram, and Hongasandra, 2008; Duraiswamy, Thirthalli, Nagendra, and Gangadhar, 2007; Innes and Selfe, 2012). Psychotic symptoms, social and occupational functioning, and quality of life were also improved (Duraiswamy et al., 2007). A study by Chattha et al. (2008) reported improved neuroticism,

somatic symptoms, and decrease in stress. Two studies also reported that perception of stress was improved after a yoga intervention while one also reported a reduction in negative affect after the yoga intervention (Innes and Selfe, 2012; West, Otte, Geher, Johnson, and Mohr, 2004). Ratcliff et al. (2014) reported that general health perception improved more in the yoga group than control group participants. Physiological results indicated heart rate variability (HRV) improved in yoga practitioners (Bowman et al., 1997; Khattab, Khattab, Ortak, Richardt, and Bonnemeier, 2007). A 2007 study by Khattab et al. (2007) reported that long term Iyengar yoga practitioners exhibited better HRV while practicing yoga than while walking in a park (Khattab et al. 2007). Both the psychological and physiological changes revealed after a yoga intervention could lead to improved sleep.

Yoga and Sleep

Insomnia research has progressed from a view that insomnia is a disorder of inappropriate physiological arousal, to a disorder of cognitive arousal, and, most recently, maladaptive beliefs and attitudes including daytime patterns of cognitive, behavioral, and emotional avoidance (Kennedy, 2014; Ong, Ulmer, & Manber, 2005). Sleep can become a distressing experience because of beliefs and attitudes. A person who believes that they need eight hours of sleep in order to function well the next day would feel distress when they are unable to fall asleep at their bedtime (Kennedy, 2014; Ong et al., 2005). This belief that eight hours of sleep are essential causes distress in addition to the original distressing event, inability to fall asleep. A new belief could be that there are ways to cope with getting less than eight hours of sleep.

Treatment methods such as Cognitive Behavioral Therapy for Insomnia (CBT-I) stemmed from the cognitive arousal hypothesis which suggest interventions targeted at thoughts,

emotion, and behavior can treat insomnia (Kennedy, 2014). In a CBT-I session, a therapist would suggest sleep hygiene tips to the client such as reducing caffeine intake and establishing a regular sleep schedule (Kennedy, 2014). However, CBT-I researchers reported a plateau in effectiveness due to low compliance with sleep hygiene tips (Kennedy, 2014). More recent research suggests that sleep is not under the behavioral control of an individual, rather, it is a state of consciousness (Kennedy, 2014; Ong et al., 2005). Treatment ought to treat maladaptive beliefs and attitudes in addition to thoughts, behavior, and emotions (Kennedy, 2014). Yoga was influenced by Buddhism which emphasizes self-awareness and acceptance of cognitive and emotional states (Ong et al., 2005). Mindfulness methods such as yoga could lead a person to be able to withstand distressing emotions associated with sleep difficulty.

Kennedy (2014) stated:

> If insomnia represents a resistance to sleep, a resistance to dreaming, and avoidance of self-awareness and if interventions that aim to overcome avoidant tendencies and promote self-awareness are effective in treating insomnia, then yoga has much to offer in the treatment of insomnia. (Kennedy, 2014, pp. 127)

A systematic review by Wang et al. (2016) analyzed studies on yoga interventions for sleep problems. Wang et al. (2016) found two studies that reported no difference in sleep between yoga and control group participants. However, three studies that Wang et al. (2016) analyzed reported a difference between yoga and control group participants; yoga group participant's Pittsburg Sleep Quality Index (PSQI) scores were better than the control group. Chen et al. (2010) also reported that PSQI scores improved after a yoga intervention. Overall, three out of five studies reported that yoga improved overall sleep quality.

Sleep quality is comprised of subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction (Buysse et al., 1988). Wang et al. (2016) analyzed these components in their review; sleep latency improved significantly more in the yoga intervention groups compared to the control groups. Significant improvement of sleep latency was observed in participants after a yoga intervention in three additional studies (Cohen, Warneke, Fouladi, Rodriguez, Chaoul-Reich, 2004; Khalsa, 2004; Mustian et al., 2013).

In some cases, long sleep latency qualifies as a sleep disorder; insomnia is a sleep disorder characterized by difficulty falling asleep or staying asleep (Merrigan et al., 2013). A study by Innes and Selfe (2012) reported significantly reduced insomnia in women who completed a yoga intervention. The ability to fall asleep and stay asleep appears to improve with yoga practice. For example, sleep duration increased in participants who completed a yoga intervention in four research studies (Cohen et al., 2004; Innes and Selfe, 2012; Khalsa, 2004; Mustian et al., 2013). Participants in these studies were able to get more sleep than they did before doing yoga.

Subjective sleep quality significantly improved in participants after completing a yoga intervention in two reviewed studies (Wang et al. 2016). Three research studies also revealed that subjective sleep quality significantly improved in participants after yoga intervention (Cohen et al., 2004; Innes and Selfe, 2012; Mustian et al., 2013). To the participants knowledge, their sleep improved.

Use of sleep medications was significantly reduced in yoga group participants compared to control in one study; these significant effects were sustained after three months (Wang et al. 2016). Two other research studies also reported that participant sleep medication use was

significantly reduced after yoga intervention (Cohen et al., 2004; Mustian et al., 2013). These results suggest that yoga interventions moderate participants perceived need for sleep medication.

Daytime dysfunction significantly improved in the yoga group participants compared to the control group participants in one reviewed study (Wang et al., 2016). A study by Chen et al. (2010) reported daytime dysfunction significantly improved after a yoga intervention $p = 0.015$, Innes and Selfe (2012) reported daytime dysfunction significantly improved after a yoga intervention $p=.002$, and Mustian et al. (2013) reported daytime dysfunction significantly improved after a yoga intervention $p < 0.01$. Also, fatigue was significantly reduced $p = 0.008$ in participants who completed a yoga intervention in a research study (Yurtkuran et al., 2007). Whether participants were able to function better during the day because of improved sleep or for another reason, the results were significant.

Sleep efficiency was significantly improved after a yoga intervention in a study by Innes & Selfe (2012) $p = 0.01$, a study by Khalsa (2004) $p < 0.001$, and a study by Mustian et al. (2013) $p < 0.01$. A study also reported that wake after sleep onset (WASO) was significantly reduced in participants after yoga intervention $p < 0.01$ (Khalsa et al., 2004). WASO was significantly reduced after a yoga intervention in a study by Kudesia and Bianchi (2012) $p < 0.02$ on nights participants practiced yoga compared to nights they did not. Sleep disturbance was significantly reduced following a yoga intervention during a research study by Innes and Selfe (2012) $p = 0.03$, Mustian et al. (2013) $p < 0.05$, and Yurtkuran, Alp, Yurtkuran, and Dilek (2007) $p = 0.04$. These sleep efficiency and WASO results reveal that participants were more successful at sleeping undisturbed during their designated sleep time.

A description of how yoga may improve sleep is offered by Chen et al., (2010) “Their bodies and minds were challenged and comforted at the same time which may be the possible reason for enhanced sleep quality and self-perception of health status and decreased depression state” (p. 161).

Female Students and Sleep

Gender is a source of complicated variation in reported sleep outcomes. Men and women are predisposed to have different sleep schedules, type of sleep, prevalence of sleep disorders, and recovery from sleep loss because they have different circadian rhythms and hormones. Differences in circadian rhythms may be the reason that women tend to go to bed earlier and wake up earlier than men (Baert, Omey, Verhaest, & Vereir, 2015; Tsai and Li, 2004). Women’s tendency to wake up earlier than men and to have longer sleep latency may be why more women than men have insomnia whereas more men have sleep apnea than women (Tsai and Li, 2004). Since women go to bed earlier and wake up earlier than men, they get more slow-wave deep sleep and less rapid eye-movement (REM) sleep than men (Baert et al., 2015). Women seem to recover from sleep loss better than men, this may be due to the memory formation process that starts in slow-wave deep sleep (Curcio, Ferrara & De Gennaro, 2006).

Further variation is evident in females who have family responsibilities and are correlated with worse sleep. A research study reported that women were more likely to have trouble falling and staying asleep, wake up feeling unrested, and take sleep medication than men in every family type (Nugent and Black, 2016). Sleep among women is complex because women go through hormone changes depending on their stage of life and stage of menstrual cycle (Moline, Broch, Zak, & Gross 2003).

Demands that are unique to university students may affect student sleep schedules and the amount of sleep they need. College students are responsible to participate in classes, exams, homework, jobs, family, and extracurricular responsibilities. A review by Ohayon, Carskadon, Guilleminault, & Vitiello (2004) reported that sleep latency increases with age and total sleep time decreases with age, a loss of about ten minutes per decade in adults. However, this trend does not hold for participants with sleep disorders (Ohayon et al., 2004). In a study that compared PSQI scores with objective sleep measures Buysse et al. (1989) reported that subjective sleep quality declines with age.

This is important because academic performance, personal relationships, and ability to function on the job are dependent on sleep quality (Merrigan, Buysse, Bird, & Livingston, 2013). REM and NREM are necessary for learning and memory; the brain integrates and stores knowledge, draws new associations, and consolidates memory during these stages of sleep (Baert et al., 2015; Curcio et al., 2006). The review by Ohayon et al. (2004) reported that the percentage of sleep spent in REM increased from childhood through adolescence until adulthood when the time spent in REM remains stable until age 60 after which a decrease is evident. Time spent in NREM decreased with age (Ohayon et al., 2004).

A research study by Baert et al. (2015) reported a positive correlation between sleep quality, including duration, and exam scores in undergraduate students. A review by Curcio et al. (2006) reported that sleep quality including duration was often associated with behavioral and cognitive difficulty which reduced academic achievement and learning.

Buboltz et al. (2009) reported that 11.1% of undergraduate students in their study experienced insomnia three or more times a week, 88.5% reported at least occasional sleep difficulties, and 74.3% believed that they do not get enough sleep during the week. Compared to

adults, adolescents ages 15-17 have shorter sleep latency (Ohayon et al., 2004). Despite a general recommendation of nine hours of sleep per night for an adolescent, optimal sleep duration varies between individuals (Buysse et al., 1989). The best way to determine how much sleep is needed may be to ask how sleepy one feels during the daytime (Buysse et al., 1989).

Yoga and Veterans

Veterans experience trauma while serving in the military and may have experienced trauma earlier in their life. One symptom of PTSD is sleep disturbance (Friedman, 2015). Consistent with popular explanations of insomnia by the hyperarousal and cognitive arousal hypotheses, sleep disturbance falls into the hyperarousal category of PTSD (Friedman, 2015). If these are the causes of sleep disturbance, down regulation of the HPA axis that occurs with yoga would reduce physiological arousal, therefore, yoga could improve sleep disturbances (Ross & Thomas, 2010). If the more recent hypothesis of insomnia that states that insomnia is an effect of maladaptive beliefs and attitudes, than effective treatment would include acceptance of cognitive and emotional states and increased self-awareness (Kennedy, 2014; Ong et al., 2005). Regardless of the cause, yoga could be an effective intervention for sleep disturbance.

A feasibility study by Staples et al. (2013) of a yoga intervention as a treatment for military related PTSD in mostly male veterans reported program evaluation data reported that veteran participants liked the yoga intervention. Veteran participants in four research studies reported significantly reduced overall PTSD symptoms and specifically hyperarousal symptoms of PTSD after a yoga intervention (Cushing et al.; Reinhardt et al., 2018; Staples et al.; Streeter et al., 2012). Two studies that measured sleep quality in addition to PTSD symptoms reported that overall sleep quality was improved (Cushing et al.; Staples et al.). Staples et al. reported that the daytime dysfunction component of the PSQI significantly improved in participants (Staples

et al.). While the study results are positive, the benefits of yoga ought to be explored in female veterans.

Active duty military personnel in the U.S. are 14% female (Carlson, Stromwall, & Lietz, 2013; Committee on the Initial Assessment, 2010). Surveyed female veterans reported exposure to trauma while serving in the military stemming from combat trauma and sexual, verbal, and physical abuse (Bradley et al., 2005; Carlson et al., 2013; Dobie et al., 2004). Carlson et al. (2013) reported in a review that that 50-90% of active duty military women experienced sexual harassment and 10-63% experienced sexual assault including attempts at assault and completed rape during their service. In a literature review and analysis of secondary data the Committee on the Initial Assessment (2010) reported that women in the military also experienced trauma stemming from conflict of feeling loyal and committed to their family and feeling loyal and committed to the military. Another challenge that active duty military women faced is that they received less support from their peers than men received (Carlson et al., 2013). Survey results reported that women veterans are twice as likely to develop PTSD after exposure to a traumatic event than male veterans (Dobie et al., 2004). Women are also more likely to participate in yoga classes than men (Ross, Friedmann, Bevans, & Thomas, 2013).

A study by Mitchell et al. (2014) assessed a yoga intervention as a form of treatment for PTSD in female veterans. A study by Reddy, Dick, Gerber, and Mitchell (2014) assessed a yoga trauma-sensitive intervention on alcohol and drug abuse behaviors with secondary outcomes on PTSD symptom perception. Both studies reported that following the intervention female veterans reported significantly reduced PTSD (Mitchell et al., 2014; Reddy, Dick, Gerber, & Mitchell, 2014). Mitchell et al. (2014) reported that female veterans experienced significantly less hyperarousal symptoms following the yoga intervention (Mitchell et al.). Reddy et al. (2014)

reported that female veterans noticed their PTSD symptoms less and 92% reported coping better with these symptoms after the yoga intervention. Additionally, the control group, who completed assessments but did not practice yoga, reported increased symptoms while nine percent reported better coping (Reddy et al., 2014). Results indicate that yoga demonstrates the potential to improve sleep in female veteran students.

Trauma Informed Yoga

The cause of trauma experienced by females serving in the military ranges from combat trauma, to physical, verbal and sexual assault (Bradley et al., 2005; Carlson et al., 2013; Dobie et al. 2004). While trauma symptoms differ for each cause of trauma common experiences include dissociation, a freeze response, and had a lack of choice in what happened to them (Emerson & Hopper, 2011). Sleep difficulty is a symptom of trauma, categorized under hyperarousal symptoms and more broadly as a physiological reaction. A study by Shea, Vujanovic, Mansfield, Sevin, & Liu (2010) reported that hyperarousal symptoms were the strongest predictors of poor overall functioning, distress, and overall PTSD severity out of all PTSD symptoms. Intrusion of traumatic memories is another category of PTSD symptoms that are categorized as a physiological reaction. Bradley et al. (2005) conducted an analysis of previously conducted research to test the effectiveness of treating PTSD with psychotherapy. Results revealed that participants with combat related PTSD improved less than participants with other causes of PTSD. Concurrently, talk therapy and eye movement desensitization and reprocessing therapy (EMDR) for PTSD all engage cognition, emotion and affect, not physiology (Staples et al., 2013).

Trauma informed yoga respect survivors' needs and ensures they are not further traumatized (Elliott, Bjelajac, Fallot, Markoff, Reed, 2005). Trauma affects the mind, body, and

spirit; therefore, treatment should engage the mind, body, and spirit (Emerson, Sharma, Chaudhry, & Turner, 2009). Like traditional forms of therapy, trauma survivors may experience overwhelming anxiety at times and, yoga provides the opportunity to act to make their experience more tolerable (Rhodes, 2015). Participants who completed a trauma informed yoga intervention reported being able to stay with painful sensations or changing the pose to be comfortable (Rhodes, 2015). Movement synchronized with other participants and with breath that occurs in trauma informed yoga helps with feeling connected, counteracting dissociation (Emerson & Hopper, 2011).

Another focus of trauma informed yoga is living in the present moment (Emerson & Hopper, 2011). Participants in a trauma informed yoga intervention reported that the relaxation they received from their yoga practice helped them to dissociate less (Rhodes, 2015). In a trauma informed yoga class, instructors empower students to choose a pace that is comfortable therefore gaining a sense of control (Emerson & Hopper, 2011). Participants in a trauma informed yoga intervention reported that yoga helped them see themselves in a positive way (Rhodes, 2015). The instructor also sets a tone of safety, gentleness, and non-judgmental self-study with invitatory language instead of instruction (Emerson et al., 2009).

Purpose

The purpose of this professional paper is to analyze sleep logs from a previously conducted study to assess changes in composite sleep scores in female veteran and non-veteran students participating in a four-week trauma informed Hatha yoga intervention with one week of posttest measurement.

Significance of Study

This professional paper will examine connections between trauma informed Hatha yoga, female students including veterans, and sleep. A study by Watson and Haynes (2007) reported that 12.2% of female university students at the University of Hawaii visiting a medical center meet the criteria for PTSD. Even higher prevalence of PTSD is reported in female veterans, a study at a Department of Veteran Affairs (VA) medical center reported that 21% of females screened positive for PTSD (Dobie et al., 2004). The researcher found two studies exploring female veterans and yoga; most research on veterans and yoga has been conducted on males. However, findings from those studies cannot be generalized to females. The number of females serving in the military is increasing while the number of males is decreasing and yet, a masculine culture still prevails (Carlson et al., 2013). Specifically, there is a need for programs individualized for female veteran students who experience trauma and PTSD. Traumatic experiences are associated with increased chances of developing behavioral medical problems (Carlson et al., 2013; Watson & Haynes, 2007). Many returning female Veterans do not seek medical attention at Veteran Administration Facilities therefore, services ought to be offered in other locations (Carlson et al., 2013). Female veteran students may need support, and, offering services in higher education could reach a population that is at risk for medical problems. This paper will contribute to a growing body of yoga intervention and sleep research. Results of the current study may be potentially used to implement trauma informed yoga interventions for the general female student population and, specifically, female student veterans.

Research Questions

Below is the guiding research question for this project:

1. Do participants' composite sleep scores significantly differ during a four-week trauma informed Hatha yoga intervention and one week of posttest measurement?

Secondary Research Question:

1. Do female veteran college students composite sleep scores differ over a four-week trauma informed Hatha yoga intervention and one week of posttest measurement?
2. Do female non-veteran college students composite sleep scores differ over a four- week trauma informed Hatha yoga intervention and one week of posttest measurement?
3. Do female veteran college students weekly average composite sleep scores differ from non-veteran college students weekly average composite sleep scores?
4. Do female veteran and non-veteran college students composite sleep scores, sleep duration, number of awakenings, and subjective sleep quality differ over a four-week trauma informed Hatha yoga intervention and one week of posttest measurement?

Exploratory Question:

1. Do each age group of participants composite sleep scores, sleep latency, sleep duration, number of awakenings, and subjective sleep quality differ over a four-week trauma informed yoga intervention and one week of posttest measurement?

Definition of Terms

Daytime Dysfunction- Having trouble staying awake during the day in the past month and having a problem with keeping up enthusiasm to get things done during the past month (Buysse et al., 1989).

Dissociation- A sense that mind and body are separate (Emerson & Hopper, 2011).

Freeze Response- Body responds as if in a life-threatening situation without option for escape, unable to act to improve the situation (Emerson & Hopper, 2011).

Heart Rate Variability- Indicates the efficiency of the nervous system to switch between sympathetic and parasympathetic responses. More change in time between heart beats signifies better (lower) parasympathetic tone (Khattab et al., 2007; Bowman et al., 1997).

Hyperarousal Symptoms- PTSD symptoms triggered by minor events and characterized by a hyper-reactive physiological state. Symptoms include irritability, insomnia, difficulty concentrating, heightened emotions, racing heart-beat, tense muscles, and overall agitation (Friedman, 2015).

Insomnia- Difficulty falling asleep or difficulty maintaining sleep; ie, frequent awakenings, difficulty returning to sleep after awakenings, or awakening too early with inability to return to sleep. A disorder of inappropriate physiological and cognitive arousal (Merrigan et al., 2013; Khalsa, 2004).

Intrusion Symptoms- PTSD symptoms characterized by racing heart-beat, rapid breathing, sweating, and persistence of thoughts, feelings, and behaviors specifically related to the traumatic event (Friedman, 2015).

Non-Rapid Eye-Movement Sleep (NREM)- A sleep state divided into four stages that are characterized by a synchronous electroencephalogram (EEG) pattern, minimal mental activity, and low muscle tone (Carskadon & Dement 2011).

Number of Awakenings- Indicates sleep disturbance which is defined as having trouble sleeping for any reason including to wake up in the middle of night or early morning, get up to use the

bathroom, unable to breath comfortably, cough or snore loudly, feel too cold or hot, have bad dreams, or pain (Buysse et al., 1989).

Objective sleep quality- Aspects of sleep detected by instruments.

Pittsburg Sleep Quality Index (PSQI)- Self-rating scale designed to measure general sleep disturbances (Buysse, Ancoli-Israel, Edinger, Lichstein, & Morin, 2006).

Post-Traumatic Stress Disorder (PTSD)- A stress disorder characterized by exposure to a traumatic event, persistent re-experiencing of the trauma, efforts to avoid triggers related to the trauma, and hyperarousal or physiologic reactivity (American Psychiatric Association, 2000).

Rapid Eye-Movement Sleep- A sleep state that occurs after NREM characterized by asynchronous EEG, toned muscles, bursts of rapid eye movement, and dreaming (Carskadon & Dement 2011).

Sleep Duration- Time difference between time falling asleep and time waking up (Tsai & Li 2004).

Sleep Efficiency- Total number of hours spent sleeping divided by the total number of hours spent in bed (Buysse et al., 1989).

Sleep Latency- Time difference between bedtime and falling asleep (Tsai & Li 2004).

Sleep Logs- A tool used to measure sleep symptoms and treatment effects (Buysse et al., 2006; Merrigan et al., 2013).

Sleep Medication Use- How often in the past month sleep medications, either prescription or over the counter, were used (Buysse et al., 1989).

Sleep Quality- Measured by the Pittsburg Sleep Quality Index which cumulates in seven scores that comprise overall sleep quality: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction (Buysse et al., 1989).

Subjective Sleep Quality- Quality of sleep rated on a four-point Likert scale (Buysse et al., 1989).

Trauma Informed Yoga- Led by a teacher with trauma informed yoga certification. The yoga class has a gentle, self-paced tone. A focus is on ensuring students are not further traumatized (Elliott et al., 2005).

Trauma Sensitive Yoga (TSY)- Led by a yoga teacher or licensed mental health care provider with trauma sensitive yoga certification, TSY approaches a physical practice of yoga that helps foster an internal sense of safety, personal agency, and choice (Emmerson & Hopper 2011).

Wake After Sleep Onset- The amount of time spent awake after falling asleep (Buysse et al., 1989).

Yoga- An ancient discipline designed to bring balance and health to the physical, mental, emotional and spiritual dimensions of the individual. Aspects of yoga include universal ethics, individual ethics, physical postures, breath control, control of the senses, concentration, and bliss (Ross & Thomas, 2010).

Methods

Previously Conducted Research Study

Secondary sleep data used for this professional paper came from a pilot study conducted in the spring of 2018 in the UM Mind Body lab. Self-selection criteria were UM students who

identified as female, were at least 18 years of age, and passed a Physical Activity Readiness Questionnaire (PAR-Q). Exclusion criteria included a change in medication in the past three months. To recruit veteran participants, an informational email was sent to female veteran students and an event held at the UM veteran center provided information on the study. Female students were also recruited through an announcement in an undergraduate Health and Human Performance course as well as an email to graduate Health and Human Performance students. Eligible participants met with the researcher to receive directions on filling out their sleep log and to sign the informed consent. Participants also agreed to abstain from caffeine for one hour prior to each research study session. The researcher instructed participants to continue exercise outside of the study as usual. Participants received incentives each week in the form of coupons & gift cards such as from the University of Montana bookstore, restaurants, and stores from various locations in the community.

Participants were 18 female self-selected students, eight of whom were veterans. They completed a one-hour trauma-informed Hatha yoga class once per week for four weeks. A researcher and certified trauma informed Hatha yoga instructor taught the class which progressed from beginner to more advanced and consisted of physical postures and simple breathing techniques. Modifications of props were offered to meet individual participant needs and participants were encouraged to opt out of a pose if it made them uncomfortable. Poses such as deep back bends, advanced inversions (including headstand), and happy baby (Ananda Balasana) were not included in the physical postures. Participants filled out their sleep logs every night starting one week prior to the start of the yoga intervention and ending one week after the intervention, a total of six weeks. The researcher later decided not to analyze the first week of data due to missing data, a total of five weeks was analyzed.

Sleep Measurement

In the previously conducted study all 12 participants completed a trauma informed Hatha yoga intervention once a week for four weeks. Sleep was measured with four variables including sleep latency (minutes), sleep duration (hours: minutes), and number of awakenings. These variables were recorded on a sleep log as recommended in a standardized sleep log by Carney et al. (2012). Subjective sleep quality was measured on a four-point Likert scale as recommended in a valid and reliable sleep log by Buysse et al., (1989). To measure these variables, participants recorded on a sleep log what time they went to bed, woke up, and how many times they woke up during the night. Averages were calculated so that participants received one score per variable per week as recommended by Buysse et al. (2006).

Sample

Participants in the spring 2018 pilot study were 18 self-selected female students at UM. One participant dropped out because of a lack of time. Four participants did not turn in sleep logs and one participant's sleep data was left out of analysis due to missing data. That left 12 participants, six of who were veterans.

Table 1

Characteristics of Participants (n=12)

Demographic	n	%
Veteran Status		
Veteran	6	50
Non-Veteran	6	50
Age (Years)		
21-30	5	42
31-40	4	33
41-50	2	17
51-60	1	8

Missing Data

Participant sleep logs contained some missing data. Missing variables were examined; a pattern of missing data at the beginning and end of the recording period was revealed. The first five days of data collection revealed 65% of data missing. Options to handle missing data were listwise deletion or mean imputation; the researcher used listwise deletion for the first five days and mean imputation method in some instances, an appropriate solution because the data was missing completely at random (Little & Rubin, 1987; Scheffer, 2002). Missing variables were replaced with the mean of all observed participants for that variable, that day (Little & Rubin, 1987).

Table 2

*Missing Data**

Participant	% Complete	Method Used
P01	82	Mean Imputation
P02**	33	Listwise Deletion
P03	90	Mean Imputation
P04	90	Mean Imputation
P05	100	None
P06	92	Mean Imputation
P07	92	Mean Imputation
P08	82	Mean Imputation
P09	100	None
P10	82	Mean Imputation
P11	99	Mean Imputation
P12	100	None
P13	99	Mean Imputation

*P = Participant, % Complete = Percentage of data reported out of 140 total possible data points for each participant.

** Participant 02 does not appear throughout the rest of the paper because listwise deletion was used due to 67% missing data.

Variables

Composite sleep scores for each participants' four average variable scores for each week of the study were calculated (Statistical Package for the Social Science, version 25). All scores

were weighted equally as recommended by Song, Lin, Ward, & Fine (2013). Sleep latency and number of awakenings variables were weighted with negative values to represent difficulty sleeping whereas sleep duration and subjective sleep quality variables were weighted with positive values (Song et al.). Each participant had five composite sleep scores.

Data Analysis

The Friedman test, a non-parametric alternative to one-way repeated measures ANOVA, was used to analyze secondary data (Pallant, 2016). The alpha was set at 0.05. The Friedman Test analyzes each participants' score when the research question asks whether scores differ significantly across multiple conditions. This researcher was interested in assessing changes in weekly sleep scores across the five-week study (Pallant, 2016; Verma, 2014; Zimmerman & Zumbo, 1993). Descriptive statistics assessed individual changes in each weekly variable that comprised the composite sleep scores. Descriptive statistics also compared composite sleep scores in female veteran and non-veteran students.

The University of Montana Institutional Review Board (IRB) approved the study.

Results

A Friedman test was conducted to evaluate differences in participants' composite sleep scores across five weeks. The test was non-significant $X^2(4, N = 12) = 4.20$, $p = .38$. Composite sleep scores worsened after week one and remained about the same for each consecutive week (see Table 3).

Veterans slept better on average than non-veterans (see Table 4). Veterans composite sleep scores improved from week four to posttest and non-veterans composite sleep scores worsened from week four to posttest (see Table 4).

Ten out of twelve participants attended four out of four yoga sessions (see Table 3). There was not a trend for dose of yoga sessions and composite sleep scores (see Table 6) Composite sleep scores worsened as age increased with the exception of age groups 31-40 and 41-50 which were similar (see Table 5). Sleep latency and sleep duration worsened with each increasing age group (see Table 5). Average sleep latency improved from week one (M = 30) to posttest (m = 27). The majority of participants sleep latency improved from week four to posttest (see Table 7). Average sleep duration decreased slightly each week except for weeks two to three (see Table 8). Number of awakenings stayed similar each week for most participants (see Table 9). Subjective sleep quality changed no more than one point out of four for each participant over the five-week study (see Table 10).

Table 3

Composite Sleep Scores

Participant	Week 1	Week 2	Week 3	Week 4	Post	Average	Yoga Sessions Attended
P01	122.75	104.25	113.00	93.75	99.25	106.60	4
P03	119.00	121.50	115.00	111.25	126.50	118.65	4
P04	142.00	118.00	134.50	131.00	132.00	131.50	2
P05	109.50	110.25	130.75	119.75	127.00	119.45	4
P06	113.50	103.25	108.75	101.25	104.75	106.30	4
P07	126.25	104.75	88.00	100.00	94.25	102.65	4
P08	117.75	106.75	87.00	102.25	78.50	98.45	4
P09	101.00	97.50	103.00	110.25	114.25	105.20	3
P10	117.00	110.00	107.50	112.25	106.50	108.15	4
P11	97.25	107.00	100.75	105.75	92.50	98.75	4
P12	138.75	134.00	133.75	116.50	124.25	122.15	4
P13	108.25	113.50	102.75	112.75	114.25	107.10	4
Average	117.75	110.90	110.40	109.73	109.50	110.41	4
SD	13.50	9.80	16.05	10.05	16.47	9.77	.60

Table 4

Mean and Standard Deviations of Veteran's (n=6) and Non-Veteran's (n=6) Composite Sleep Scores

	Week1		Week 2		Week3		Week4		Post		Average
Veteran Status	M	SD	M	SD	M	SD	M	SD	M	SD	M
Veteran	121.88	15.67	114.04	13.24	117.08	13.75	113.75	9.82	118.04	11.22	116.96
Non-Veteran	113.63	10.71	107.75	3.52	103.71	16.45	105.71	9.32	100.96	17.20	106.35

Table 5

Average Sleep Scores for Each Age Group

Age	N	Composite Score	Sleep Latency (min.)	Sleep Duration (hours: minutes)	Number of Awakenings	Sleep Quality (4-point scale)
21-30	5	114.93	37	8:09	2	3
31-40	4	107.19	27	7:44	6	3
41-50	2	107.63	23	7:34	1	4
51-60	1	106.30	14	7:13	2	3

Table 6

Effect of Yoga Dose on Composite Sleep Score

Dose (number sessions attended)	N	Average Composite Score
4	10	108.83
3	1	105.20
2	1	131.50

Table 7

Sleep Latency (minutes)

Participant	Week 1	Week 2	Week 3	Week 4	Post	Average
P01	29	26	32	39	24	29
P03	47	51	47	54	34	44
P04	25	15	15	21	20	21
P05	61	24	15	27	19	26
P06	9	23	5	12	6	14
P07	28	19	41	11	21	25
P08	30	67	107	58	92	66
P09	45	52	52	36	22	44

P10	30	16	14	21	31	25
P11	18	19	22	18	17	18
P12	24	20	19	16	14	19
P13	16	19	23	17	24	21
Average	30	29	33	28	27	29

Table 8

Sleep Duration (hours: minutes)

Participant	Week 1	Week 2	Week 3	Week 4	Post	Average
P01	8:40	7:21	8:02	6:53	7.00	7:30
P03	8:41	8:56	8:25	8:18	8:59	8:26
P04	9:53	8:09	9:15	9:07	9:10	8:49
P05	8:16	7:43	8:56	8:24	8:45	8:24
P06	7:43	7:14	7:19	6:56	7:04	7:12
P07	8:51	7:17	6:33	6:48	6:36	7:14
P08	8:22	8:12	7:32	7:43	6:43	7:29
P09	7:42	7:35	7:57	8:08	8:13	7:50
P10	8:22	7:34	7:21	7:48	7:34	7:35
P11	6:47	7:25	7:06	7:21	6:26	7:01
P12	9:40	9:17	9:16	8:04	8:32	8:53
P13	7:27	7:51	7:11	7:45	7:57	7:33
Average	8:22	7:53	7:55	7:47	7:45	7:50

Table 9

*Number of Awakenings**

Participant	Week 1	Week 2	Week 3	Week 4	Post	Average
P01	3	1	1	2	2	2
P03	1	2	1	2	2	2
P04	3	5	5	5	5	5

P05	0	0	0	0	0	0
P06	2	1	2	2	2	2
P07	1	2	3	0	1	2
P08	4	1	1	0	1	1
P10	4	2	1	2	1	2
P11	2	1	3	2	1	2
P12	4	4	5	6	5	5
P13	2	2	1	1	0	1
Average	2	2	2	2	2	2

*P09 number of awakenings was not included because it was an outlier.

Table 10

Subjective Sleep Quality

Participant	Week 1	Week 2	Week 3	Week 4	Post	Average
P01	3	3	3	3	3	3
P03	3	3	3	3	3	3
P04	3	3	3	3	3	3
P05	3	2	2	2	2	2
P06	2	3	3	3	3	3
P07	3	3	3	3	3	3
P08	3	3	4	4	4	4
P09	3	3	2	2	3	2
P10	3	4	4	4	4	4
P11	2	3	2	2	2	2
P12	3	3	3	4	4	4
P13	4	4	4	4	4	4
Average	3	3	3	3	3	3

Discussion

In this study sleep was measured across a four-week trauma informed Hatha yoga intervention. Posttest measures were collected one week after the yoga intervention ended. Participants composite sleep scores decreased week one to week two; following week two composite sleep scores stayed the same. Reasons this occurred could be attributed to secular trends influencing the results including the timing of the study, post intervention assessments occurred the last week of class in the school semester. Students' sleep could have been affected by their finals study schedules. A study by Zunhammer, Eichhammer, and Busch (2014) reported that university students' sleep quality worsened within the month before an exam period compared to an exam-free period. Other factors that may have influenced students sleep that were not measured included whether they had a family, nicotine, alcohol, and caffeine consumption, and birth control medication.

Veteran students' sleep scores and non-veteran students' sleep scores changed across five weeks. Results report that veteran and non-veteran students composite sleep scores only slightly changed during the four-week trauma informed Hatha yoga intervention period and were actually higher at the first week of intervention than they were during the intervention and at posttest. On average, veterans reported better sleep than non-Veterans. If veteran participants had PTSD, literature states that veteran student sleep scores would be expected to be worse than non-veteran students (Friedman, 2015). Our findings differ with a similar pilot study by Cushing et al. (2018). Cushing et al. (2018) studied nine females and nine males, ages 26-62 who had PTSD as determined by the PTSD Checklist Military version (PCL-M). Participants practiced trauma-sensitive Vinyasa yoga once a week for six weeks taught by a yoga teacher with military experience and multiple combat deployments (Cushing et al.). Results reported improved PSQI

scores from pretest to posttest, though measurements at posttest were indicative of sleep disturbance (Cushing et al.). Our findings also differ from similar pilot and feasibility study by Staples et al. (2013). Participants were 10 male and two female veterans diagnosed with PTSD, ages 58-64 (Staples et al.). Participants attended Krishnamacharya Healing and Yoga Foundation (KHYF) style yoga classes for one hour twice a week for six weeks (Staples et al.). Results reported significant decrease in PSQI scores $p < 0.05$.

As age increased, weekly composite sleep scores and sleep duration worsened during the four-week treatment period and one week of posttest. These findings concur with a meta-analysis by Ohayon et al. (2004) which analyzed studies that measured objective sleep quality using polysomnography or actigraphy, in participants ages five to 102. In adult participants there was a trend of worsening sleep and decreased total sleep time with increased age (Ohayon et al., 2004). Since Ohayon et al. (2004) measured total sleep time instead of sleep duration the similarity between their findings and this study's finding assume that participants in this study were not napping during the day. These findings differ from Buysse et al. (1989) which measured sleep with objective and subjective measures and reported no correlation between age and sleep duration. Despite worsening sleep and decreased sleep duration, participants in this pilot study reported improved sleep latency as age increased which differs from Ohayon et al. (2004) findings that sleep latency decreases with age. No trends were apparent for subjective sleep quality in this pilot study which differs from Buysse et al. (1989) findings which reported that subjective sleep quality declines with age.

Some participants reported sleep measures that indicate sleep difficulty. A sleep duration of less than seven hours indicates sleep difficulty (Baert et al., 2015; Tsai & Li, 2013). Also, a sleep latency longer than 30 minutes and awakening more than once indicates sleep difficulty

(Tsai & Li, 2013). In this study, the average sleep latency of participants was more than 30 minutes during weeks one and three. Three participants reported an average sleep latency of more than 30 minutes. Participants had an average of more than one awakening per night. Participant nine had a high number of awakenings per night which lead the researcher to omit their data. These indications of sleep disturbance could mean that participants had a sleep disorder. Participants average sleep duration was more than seven hours per night, indicating that no difficulty was present.

If yoga does have a causative effect on sleep, it is not yet known whether sleep improvements are immediate and short-term (acute) or delayed and long-lasting (chronic) (Kudesia & Bianchi, 2012). Participants who attended all four yoga sessions (n=10) slept better than the one participant who attended three yoga sessions. However, the one participant who attended two yoga sessions reported better sleep than those who attended all four sessions. Participants who attended two or three sessions as opposed to four did so because they were not able to attend four sessions. These findings concur with Kudesia & Bianchi (2012) findings of no significant improvement in sleep quality. Kudesia & Bianchi (2012) measured subjective sleep and objective sleep during a 14-day period. Participants were asked to complete a Bikram yoga intervention on their choice of two to 12 days during the study; the median number of days participants chose to perform yoga was four (Kudesia & Bianchi, 2012). Findings in a study by Khalsa (2004) differ; participants reported total sleep time, sleep efficiency, wake after sleep onset, and sleep latency improved. The non-controlled study measured sleep with sleep logs during two weeks of baseline and included eight weeks of nightly Kundalini yoga sessions lasting about 30 minutes. Participants were 18 women and two men, ages 30-64 with chronic insomnia.

Some limitations could have impacted results. Self-report in sleep is not always accurate; in cases of insomnia, perception of sleep latency and duration is skewed, participants tend to overestimate sleep latency and underestimate sleep duration in comparison with objective measures of sleep (Buysse et al., 2006; Buysse et al.1989). Although participants received verbal and written instruction to fill out their sleep log daily, the possibility exists that participants filled out their log later than the day after the previous night's sleep. Participants did turn in their log at the end of the five-week study. Participants were not asked to record daytime sleep such as naps which could have impacted their nighttime sleep.

Yoga has its roots in Buddhism which emphasizes cognitive and emotional acceptance and self-awareness (Ong et al., 2005). Students could have experienced an increase in self-awareness, therefore reported worse subjective sleep quality as they became more aware of their sleep. Participants could have also experienced distress with increasing awareness of cognitive and emotional states, indirectly effecting sleep. Furthermore, the study ended at the start of finals week. Students could have been experiencing increasing stress from school as the study progressed which impacted their sleep.

Sleep duration is partly a choice. However, sleep latency, number of awakenings, and quality are not under the control of students. Sleep is a state of consciousness that is affected by beliefs and attitudes including daytime patterns of cognitive, behavioral, and emotional avoidance (Kennedy, 2014; Ong, Ulmer, & Manber, 2005). To improve sleep students could practice sleep hygiene habits. Students could learn the number of hours of sleep they need to optimize their sleep duration. Mind body practices like yoga could be beneficial in targeting students' beliefs and attitudes. An increase in self-awareness and a decrease in avoidance tendencies gained from yoga could improve students overall sleep.

Future Directions

The researcher recommends that future studies control for the age of participants, restricting eligibility criteria to university age students. Eligibility criteria could also specify participants who do or do not take hormonal birth control medication. A future study could collect more demographic data such as military rank. It would also be beneficial to ask participants to record amount of caffeine, nicotine, and alcohol consumed during the data collection period as recommended by Zunhammer et al. (2014).

A controlled study design such as a waitlist control group or different type of yoga to compare the trauma informed Hatha yoga treatment group to a group receiving different treatment would be advantageous. Baseline data should be recorded to enable a comparison from baseline to posttest sleep measures. It would be beneficial to measure sleep using objective measures that can be used at home such as polysomnography or actigraphy in addition to subjective sleep logs to control for skewed perception of sleep that can occur with subjective measures, particularly in cases of insomnia (Buysse et al.1989; Rogers, Caruso, & Aldrich 1993). Future studies could also add a qualitative follow-up which would enable researchers to ask participants about data collection. The measure of daytime dysfunction could be measured to account for individual differences in sleep needed. A study design with more frequent does of trauma informed Hatha yoga and a longer intervention period is recommended for future studies. Trauma informed Hatha yoga could be taught to veterans by a teacher with military experience as recommended by Cushing et al. (2018). A researcher could remind participants fill out their sleep logs each morning with a booster sent to participant's cell phones.

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Appendix

SLEEP LOG

MONDAY - DATE: _____

Bed time: _____ **Fall asleep time:** _____ **Wake up time:** _____

Number of awakenings last night: ____

My sleep quality was...

Very poor Poor Fair Very Good

TUESDAY - DATE: _____

Bed time: _____ **Fall asleep time:** _____ **Wake up time:** _____

Number of awakenings last night: ____

My sleep quality was...

Very poor Poor Fair Very Good

WEDNESDAY - DATE: _____

Bed time: _____ **Fall asleep time:** _____ **Wake up time:** _____

Number of awakenings last night: ____

My sleep quality was...

Very poor Poor Fair Very Good

THURSDAY - DATE: _____

Bed time: _____ **Fall asleep time:** _____ **Wake up time:** _____

Number of awakenings last night: ____

My sleep quality was...

Very poor Poor Fair Very Good

FRIDAY - DATE: _____

Bed time: _____ **Fall asleep time:** _____ **Wake up time:** _____

Number of awakenings last night: ____

My sleep quality was...

Very poor Poor Fair Very Good

SATURDAY - DATE: _____

Bed time: _____ **Fall asleep time:** _____ **Wake up time:** _____

Number of awakenings last night: ____

My sleep quality was...

Very poor Poor Fair Very Good

SUNDAY - DATE: _____

Bed time: _____ **Fall asleep time:** _____ **Wake up time:** _____

Number of awakenings last night: ____

My sleep quality was...

Very poor Poor Fair Very Good