AN EXPLORATION OF SLEEP HYGIENE AS A PREDICTOR OF MIGRAINE HEADACHE DISABILITY

by

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ABSRACT

This study explored the relationship between migraine disability and sleep hygiene. Specifically, the potential impact of sleep hygiene on migraine disability, and sleep hygiene acting as a mediator for the relationship between sleep efficiency and migraine disability were of interest. Ninety-five undergraduate participants were surveyed to measure migraine disability and sleep hygiene, in addition to other known covariates of migraine disability. Results indicated a positive correlation between poor sleep hygiene and migraine disability that remained statistically significant after controlling for other related covariates. In the tested mediation model, no significant direct effect of sleep efficiency on migraine disability observed; however, small to medium sized effects were observed among the indirect path from sleep efficiency, to sleep hygiene, to migraine disability. Taken together, these findings suggest that migraine disability may be influenced by sleep hygiene, which could predicate somewhat accessible forms of intervention to improve sleep for those with migraine headaches.

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CHAPTER I

INTRODUCTION

Migraine headaches are one of the most prominent disabling health conditions that can have detrimental effects on one's quality of life (Lombard et al., 2020). An intricate relationship between migraine headaches and sleep has been studied, in which aspects of sleep, including sleep deprivation, excess sleep, and poor sleep quality, are common precipitants for migraine headaches (Andress-Rothrock et al., 2010). The amalgamation of behavioral and environmental factors that influence sleep are referred to as sleep hygiene, which has been exhibited to impact sleep quality in healthy populations. With this, there may be a potential relationship that could indicate those with migraine headaches may experience more debilitating migraines when engaging in poor sleep hygiene. The relationship between sleep hygiene and migraine has primarily been researched with children and adolescents, but less has been researched for adults. There is some evidence to suggest that behavioral changes related to sleep hygiene can be beneficial in those with transformed migraine having a reversal effect to episodic migraine for adults, decreasing the overall frequency of headaches (Bruni et al., 2013; Calhoun & Ford, 2007).

This study seeks to observe the influence that sleep hygiene may have on migraine headaches and determine if a significant relationship exists between these that could provide a foundation for an experimental design. It was hypothesized that in a population of college students with migraine headaches, those who report poor sleep hygiene will experience greater migraine disability and poorer sleep quality than those

who report adequate sleep hygiene. Influential factors relevant to control for that may help in explaining the relationship between sleep and migraine headaches would include sex, age, reported anxiety, and morningness-eveningness wake preference. It was also hypothesized that the relationship between sleep quality and migraine disability will be somewhat mediated by sleep hygiene. If the results of this study support these hypotheses, behavioral modifications implicated with sufficient sleep hygiene could create accessible forms of migraine prevention and potentially serve as a protective factor for this disabling condition.

Migraine Headaches

Prevalence and Relevance

Migraine is a debilitating type of headache characterized by intense head and neck pain, unilateral eye pain, nausea, vomiting, as well as sensitivity to light, smells, and sounds. This form of headache oftentimes interferes with one's functioning so much so that they are unable to operate machinery, socialize, or participate in their typical daily activities due to the pain and intensity of these symptoms. Migraine is notably the second most disabling condition worldwide occurring in approximately 12% of the United States population and approximately 13% of the global population (Burch et al., 2019). Not only does migraine interfere with one's daily life during a headache, but it also predisposes one to other chronic health conditions such as cardiovascular disease and stroke (Bigal et al., 2009; Spector et al., 2010). The pervasiveness of migraine headaches and the potential corresponding health consequences that could increase the likelihood of

premature mortality make migraine headaches a disorder that requires further research on methods to prevent and treat this painful headache.

Etiology

Although the etiology behind this type of headache is not fully understood at this time, there are biological and psychological aspects to the condition that are instrumental to our current understanding of migraine. These aspects may contribute to the dysfunction experienced and disabling nature of migraine, thus impacting the quality of life for those with migraine. Some notable aspects that have provided direction for further determining the etiology of migraine include a difference in sex, psychological, and physiological aspects. Utilizing these influential aspects involved in migraine headaches in concert contributes to our understanding of the intricacies of this neurological disorder.

Sex Difference. The sex difference with migraine headaches has been well documented throughout the study of this condition, whereas two to three times as many women experience migraines compared to men (Vetvik & MacGregor, 2017). Women also tend to experience greater frequency, severity, and duration of headaches compared to men, with this discrepancy being most drastic for those in the age range of the onset of puberty to middle age. Although the differences observed between migraines for men and women declines around the onset of middle age, women still experience more disabling migraines than men throughout their lifetimes (Lay & Broner, 2009). Interestingly, migraine prevalence among children exhibits that both sexes have a similar experience of disability, suggesting that these sex differences begin around the onset of puberty (Vetvik & MacGregor, 2017). With this, it can be presumed that differences in hormones for each

sex play a role not only in the sex differences of migraine, but also the disability experienced.

Psychological and Environmental Aspects. The psychological and environmental influences of migraine headaches are notable contributors for the onset of a headache for some or may play a part in the residual effects of the headache. There are several psychological and environmental stimuli, often referred to as "triggers", that have been identified as noteworthy features of this disorder. The findings of a study conducted by Mollaoğlu (2013) reported that the primary subjective causes of migraine headache in descending order of significance are emotional stress, sleep disturbance, dietary factors, environmental factors, hormonal factors, and physical activity.

In this study, emotional stress was reported as the most common trigger for a migraine headache, with criteria for this precipitant related to crying, conflict, argument, and aggressiveness, with "aggressiveness" being the most reported trigger. Many of the participants also exhibited at least one trigger related to difficulties sleeping with "lack of sleep" being the most frequently reported. Hunger was the most frequently reported factor for dietary triggers, which may be due to hormone dysregulation of hunger hormones ghrelin and leptin. Environmental factors endorsed were smell (perfume, gasoline, food, and cleaning products), sun/clarity, cigarette smoking, and weather temperature. The most reported trigger for hormonal factors was menstruation, which coincides with the prominent sex difference of migraine as previously discussed. General physical activity was endorsed as a trigger for migraine, but there were less reports of this compared to the aforementioned triggers (Mollaoğlu, 2013).

A 2017 study examined the symptoms related to anxiety and depression in migraine compared to healthy controls. Symptoms of anxiety were endorsed by the migraine group more often than symptoms of depression when using the General Anxiety Disorder – 7 (GAD-7) and Patient Health Questionnaire-9 (PHQ-9) for the respective measures. Items most frequently endorsed for anxiety were those related to worrying, difficulty relaxing, and nervousness, and frequently endorsed items for depression were related to physical symptoms such as appetite, fatigue, and difficulties with sleep rather than emotional symptoms of depression like hopelessness or sadness (Peres et al., 2017). Responses to emotional stress experienced are consistent with the findings of other studies, such that symptoms of depression and anxiety contribute to perceived emotional stress in those with migraine headaches, and symptoms of anxiety are more prevalent than symptoms of depression (Lantéri-Minet et al., 2005; Malone et al., 2015; Moon et al., 2017).

Although there are reported subjective experiences for environmental aspects as triggers for migraine headaches, there is conflicting evidence among the literature for visual, auditory, and olfactory stimuli inducing a headache (Friedman & de Ver Dye, 2009). However, some findings suggest that those with migraine may have increased sensitivity to processing stimuli in the environment, such that they may have a heightened sensory experience compared to those without migraine headaches. It was hypothesized that symptoms of anxiety may partially mediate this, as greater sensory sensitivity and sensory avoidance are experienced for those with migraine (Demarquay & Mauguière, 2016; Price et al., 2021). With this, there are consistent implications for the experience of

emotional stress related to symptoms of anxiety, interferences with sleep, eating habits, and other changes as noteworthy contributors to the origin of migraine. Each of these psychological aspects have physiological mechanisms that may help facilitate migraine headaches.

Physiological Aspects. The pathophysiology of migraine is multifaceted with several complex contributors that play a part in our understanding of the onset and prevalence of this disease. A postulated key contributor to migraine would be genetics, which influence the severity, symptomology, and comorbidities that one may experience or be predisposed to (Goadsby, 2005). Specific gene mutations have been identified in those who experience migraine with aura, but less is known for migraine without aura, the most common form of migraine. The evidence gathered from some of the rarer forms of migraines, such as familial hemiplegic migraine, has helped us understand that genetic components lay the foundation for migraine headaches. Genome-wide association studies are actively seeking to discover more causal evidence for migraine genetic mutations (Sutherland et al., 2019).

Another contributor to the pathophysiology of migraine is the cardiovascular system. Historically, vasodilation has been a popular hypothesis for the etiology of migraine, and although it is a relevant component of the physiology of migraine, it is not influential enough to cause the pain experienced during a migraine headache (Pietrobon & Moskowitz, 2013). There is a notable relationship between migraine and cardiovascular disease in which it was hypothesized that there is a causal association, shared predisposition, and common comorbidities, such as obesity, which enforce this

comorbid relationship. With this, there also exists a risk of ischemic stroke for those with migraine, especially for those who experience migraine headaches with aura (Bigal & Lipton, 2009).

Hypothalamic activity has been a notable contributor to the understanding of the etiology of migraine. There is evidence to suggest that hypothalamic-pituitary-adrenal (HPA) axis activity occurs during migraine headaches (Denuelle et al., 2007) in addition to trigeminal activity (Robert et al., 2013) providing some implications regarding the stress and pain responses experienced during migraine (Noseda & Burstein, 2013). As previously mentioned, hormones play an important role in the sex difference of migraine between men and women, but they may also contribute to the reported triggers of migraine headaches that have hormonal influences such as menstruation in women, stress induced arousal, and skipping meals or fasting.

Consistent with other pain disorders and disease states, these known influential factors of migraine are made up of psychological and physiological components that coincide to create the unique and specific migraine headache experience. In particular, the hormonal mechanisms behind symptoms of anxiety, sleep, and hunger, may be especially important the potential causes of migraine and explored to help determine efficacious treatment options that address the severity, frequency, and disability of this disorder. The restorative properties of sleep that support homeostatic balance of hormones and other physiological processes may be a common denominator in this puzzle that influences the development and disability of migraine headaches.

Sleep and Migraine Headaches

Sleep is a necessary biological mechanism that physiologically maintains homeostasis to allow our somatic systems to function at an optimal level to support our general health. The experience of poor sleep over a long period of time can make one more vulnerable to chronic health conditions such as heart attack, coronary artery disease, and stroke (CDC, 2021). This occurs as a function of overarousal from our stress response systems, with these inflicting damage upon our cardiovascular and immune systems (Medic et al., 2017; Okun, 2011). For most adults, healthy sleep consists of sleeping seven to nine hours per night, short sleep latency, few awakenings during sleep, and few awakenings after sleep onset (Ohayon et al., 2017). The Centers for Disease Control and Prevention states that adults need seven or more hours of sleep per night but given our daily lives with the modern stressors and various expectations that are had, many are not getting enough sleep (CDC, 2021).

Consequences of Poor Sleep

Chronic short duration and poor-quality sleep can contribute to development of chronic health conditions such as heart attack, stroke, and cancer (CDC, 2021). Sleep has physiologically restorative properties and experiencing poor sleep over time increases the risk of weakening the immune system, dysregulating endocrine function, and increasing risk of overall mortality. Short-term effects of poor sleep include cognitive deficits, changes in mood, and increases in stress (Okun, 2011). Our sleep and endocrine function have a mutually influential relationship, such that healthy sleep supports and repairs the organ systems relevant in hormone function, and poor sleep could lead to dysregulation

of endocrine functioning. Sufficient hormonal functioning is necessary for a multitude of responses, such as hunger and arousal. Dysregulation of these as a function of poor sleep could contribute to chronic health issues such as obesity and type 2 diabetes (Leproult & van Cauter, 2010). With this, the risk for chronic health conditions like cardiovascular disease, chronic kidney disease, and early mortality are compounded, thus highlighting the importance of healthy sleep.

Relationship Between Sleep and Migraine

Poor sleep quality is a hallmark ailment in those with migraine headaches, and comorbid sleep disorders common with migraine include insomnia, obstructive sleep apnea, restless leg syndrome, circadian rhythm disorders, and narcolepsy (Rains, 2018). As previously stated, sleep is both a notable trigger for migraine headaches and further contributes to chronic health conditions, emphasizing the importance of good sleep quality for those with migraines. This relationship is not yet fully understood, but research has been conducted to examine how sleep quality influences the pain and disability inflicted by migraine.

In a study examining the objective and subjective sleep quality and pain thresholds in those with migraine during the interictal, preictal, and postictal phases of migraine, Engstrøm et al. (2013) found that the migraine participants reported more sleep related symptoms including anxiety, insomnia, and subjective tiredness than controls in sleep diaries, although the differences exhibited by the objective sleep quality variables and sleep diaries indicated smaller differences than what was reported. The migraine participants exhibited a lower pain threshold and a strong tendency to more slow wave

sleep than the healthy controls, to which the authors hypothesize is due to increased sleep pressure in the interictal phase of migraine. These findings suggest that those with migraines may require more sleep than those without migraines as this lack of sufficient sleep may predispose one to a headache and contribute to increased subjective feelings of poor sleep quality, thus influencing their overall quality of life.

Sleep Quality and Chronotype. As previously stated, poor sleep quality is often reported by those with migraine headaches (Rains, 2018). There have been various hypotheses to determine why poor sleep quality is such a prevalent experience in those with migraine and what physiological mechanisms could potentially be contributing to this, with chronotype being an interesting contender.

Sullivan and Martin (2017) examined the relationship between sleep and migraine to compare the differences experienced with non-migraine headaches and sleep in relation to chronotype and obstructive sleep apnea risk. The results of this study indicated the frequency of migraine was significantly associated with sleep duration and poor sleep quality. Migraine frequency was not significantly correlated with chronotype, however morning chronotype was a significant predictor of a chronic migraine diagnosis. Similarly, non-migraine headache frequency was correlated with sleep duration and poor sleep quality but was not significantly associated with chronotype. Depression, anxiety, and stress did not have a significant impact on sleep quality. These results indicate that for migraine and non-migraine headaches, sleep quality and duration are important factors that influence the frequency of migraine headaches, and those with morning chronotype who experience migraine could qualify for a diagnosis of chronic migraine

(Sullivan & Martin, 2017). With this, there may be biological differences in those with migraine compared to those without migraine that contribute to the propensity toward a morning or evening chronotype.

Several studies have been conducted that examine the influences of sleep quality, chronotype, and circadian rhythm on migraine headaches. Gori et al. (2005) considered the impact of sleep quality, chronotype, and preferential timing on migraine headaches. They found that sleep quality scores were significantly different between controls and migraines, and the sleep quality scores correlated with scores for measures of depression and anxiety. Normal chronotype was less often endorsed than morning and evening for migraine participants, and controls reported normal chronotype more frequently. Sleep quality scores did not correlate with frequency and disability values from a measure of migraine disability. With this, the authors hypothesized that perhaps poor sleep quality and higher disability with migraine can inspire a desynchronization between our biological circadian rhythm and lifestyle (Gori et al., 2005).

van Oosterhout et al. (2018) conducted a study considering the impact of chronotype and circadian timing for those with migraine. Like Gori et al. (2005), the participants with migraine endorsed being of early and late chronotype more frequently than they endorsed being of a normal chronotype. It was also observed that changes in circadian rhythm for migraine led to reports of feeling more tired and experiencing more difficulty adapting to being active at a different time. With this, migraine sufferers may be less flexible to changes in their sleep/wake cycle when compared to healthy controls. These findings may suggest that those with migraines could experience a dysfunctional

circadian clock to which the mechanisms involved in migraine headaches could be impacted by circadian functions (van Oosterhout et al., 2018).

de Tommaso & Delussi, (2018) examined circadian rhythms in those with episodic and chronic migraine and found that chronic migraine patients were older than those with episodic migraine, and experienced longer duration of headache, higher anxiety and depression scores, lower quality of life scores, slept for fewer hours, and experienced severe disability due to migraine headaches. There was no uniform distribution of headache times, although peak times were between 10:00 AM and 10:00 PM. Most participants did not report a pattern of migraine times and generally experienced headaches that varied at onset time. With this, there may not be a circadian rhythm of the migraine headache onset, but rather the onset could be experienced at any time. However, the significant differences in duration, quantity of sleep, quality of life, and other indicators of disability between the chronic and episodic migraine participants are important in understanding the different experiences between the groups, and the authors hypothesize the role of age in migraine headaches developing into chronic disorders, perhaps influenced by the age-related changes in sleep (de Tommaso & Delussi, 2018).

Hyperarousal. Hyperarousal is a facet of anxiety that is defined as an increased psychophysiological response to stressors that is more frequent and intense than a typical reaction to stressors. Hyperarousal is often associated with trauma, which can result in increased awareness of potentially threatening stimuli (Pérez et al., 2012). Symptoms consist of hypervigilance, irritability, avoidance, as well as difficulties with concentration

and sleep (APA Dictionary of Psychology, n.d.). There is also a well-established conceptualization for hyperarousal as a primary contributor to insomnia (Riemann et al., 2010). Therefore, it is beneficial to consider the effects of hyperarousal on sleep for those with migraine headaches to explore how these mechanisms might interact.

Engstrøm et al. (2014) conducted a study to examine sleep quality and arousal in both tension type and migraine headaches and found that both groups endorsed more symptoms of anxiety and poor sleep than the healthy controls. Aside from this study, there have not been other studies examining the effects of hyperarousal on sleep in those with migraine headaches. As previously discussed, Peres et al. had found that symptoms of anxiety that were highly endorsed included worrying, difficulty relaxing, and nervousness (Peres et al., 2017). With these findings in conjunction with a potentially increased sensory experience (Demarquay & Mauguière, 2016), those with migraine may attribute the genesis of this type of headache to be somewhat influenced by symptoms of anxiety, specifically those that are related to being in a state of arousal.

Sleep Hygiene. Sleep hygiene is a combination of behavioral and environmental efforts that assist in promoting healthy sleep. Some behavioral aspects of sleep hygiene include setting a routine sleep and wake time, avoiding stimulating substances like caffeine and nicotine, and being physically active during the day to help create a desire for sleep. Environmental aspects of sleep hygiene include ensuring one's bedroom is dark, cool, and quiet, as well as having a comfortable bed (CDC, 2022). Sleep hygiene education has been a useful tool when treating sleep disorders like insomnia, although for those who meet diagnostic criteria for sleep disorders, other forms of intervention, such

as cognitive-behavioral therapy for insomnia, are necessary (Chung et al., 2018). Although sleep quality in those with migraine has been well-researched, less has been conducted on the potential influences of sleep hygiene on the migraine experience.

In a study observing the relationship between sleep disturbances and affective comorbidities in a population of individuals with episodic migraine, Walters et al. (2014) found that interestingly, participants highly endorsed several attributes on a measure of sleep hygiene that would be consistent with poor sleep hygiene, but the statistical analysis did not indicate any significance for this scale. The authors note that when controlling for affective symptomology, the association of sleep hygiene and sleep quality was not as significant. However, the population observed were those with episodic migraine specifically, which could contribute to the insignificance (Walters et al., 2014). With this, further investigation is necessary to determine whether sleep hygiene could be an influential factor in those with migraine.

Purpose of the Present Study and Hypotheses

Migraine headaches are a disabling heath condition that affects the lives of many across the globe. The literature has exhibited that quality of sleep and other indices related to sleep are important in the presentation of migraine headaches. To further examine the relationship between sleep and migraine, sleep hygiene should be considered as a potential contributor to migraine headache etiology, as it is influential to sleep quality. As sleep quality, symptoms of anxiety, and specific chronotype are hallmark features of migraines, it would be advantageous to explore if sleep hygiene plays a role in this form of headache. If sleep hygiene is an important mediator in the relationship

between sleep quality and migraine disability, sleep hygiene could be incorporated as a form of behavioral intervention to improve sleep quality and potentially decrease migraine headache disability.

The present study seeks to explore the possible mediating effects of sleep hygiene on sleep quality and migraine disability among college students with migraine headaches. With the established literature in mind, the following hypotheses were considered:

H1: (a) A significant bivariate relationship will exist between sleep hygiene as measured by the Sleep Hygiene Index (SHI) and migraine disability as measured by the Migraine Disability Assessment Scale (MIDAS). Specifically, it was predicted that those with poorer sleep hygiene would experience greater migraine disability. (b) Sleep hygiene will be associated with migraine disability after controlling for the covariates of age, sex, morningness-eveningness preference as measured by the Reduced Morningness-Eveningness Questionnaire (rMEQ), and anxiety as measured by the General Anxiety Disorder – 7 (GAD-7).

H2: (a) Those with poorer sleep quality as measured by the Pittsburgh Sleep Quality Index (PSQI) will also experience poorer sleep hygiene, (b) and poorer sleep quality will be related to greater migraine disability. (c) The relationship between sleep quality and migraine will be partially mediated by sleep hygiene.

CHAPTER II

METHOD

Participants

The present study examined a subset of data from a larger project that was collected during the spring semester of 2022. All data that was included in this project came from Middle Tennessee State University students, who were 18 years of age or older, had a history of migraine headache, and passed the larger study's embedded effort validity measures. The total sample consisted of 95 participants, 82 of the participants being women (M_{age} = 20.22, SD_{age} 3.74). With respect to the aims of the present project, a priori power analyses conducted using G Power 3.1 (Faul et al., 2009) revealed that a sample size of 84 participants was necessary to observe a medium sized effect for the analysis associated with H1(a) and H2(a, b), and that a sample size of 92 participants will be necessary to observe moderate sized effects for H1(b). Finally, Fritz and MacKinnon (2007) report that a sample size of 71 participants will be necessary to observe medium sized effects among the variables of intertest in the mediation model planned for H2(c). One hundred and one responses were gathered in total. After reviewing the data for missing values and noting one outlier, a total of 95 participant responses were used in this study. The outlier was removed when inspecting the data for normality, and the MIDAS total score was notably greater than the rest of the participants scores. With this, it was decided to remove this data point from this study.

Table 1
Descriptive Frequencies of the Final Sample

Variable	*%*	*N*
Race/Ethnicity		
African American/Black	20	19
Asian	6.3	6
Hispanic or Latina/o	4.2	4
Native American or Native Alaskan	2.2	2
White/Caucasian	65.3	62
Other	2.1	2
Age (in years)		
18 – 24	9.6	88
25 – 30	5.3	5
31+	2.1	2

Materials & Measures

Migraine Screener Item

A screener item was used to ensure that participants experience migraine headaches as opposed to tension type headaches. This was differentiated by requiring participants to select all listed symptomology typical of migraine headaches that they may experience. Participants were instructed to select all symptoms that apply to them during a migraine headache, including eye pain, sensitivity to light, sensitivity to smells, sensitivity to sound, nausea/vomiting, worse pain on one side of the head, pounding, pulsing, or throbbing pain, to which respondents could choose one or more of these symptoms, or choose none of these apply to me (See Appendix B). Eligible migraine participants had to choose at least one of the symptoms listed and would be omitted if they chose the last option that indicated they did not experience migraine headaches. In

this sample, all participants who reported that they did have migraine headaches affirmed at least one related symptom.

Migraine Disability Assessment Test (MIDAS)

The MIDAS was used to measure the disability experienced due to migraine headaches. This scale was developed by (Stewart, Lipton, & Whyte., 1999) to assess the disruption in one's life due to the disabling effects of migraine headaches. The MIDAS has a total of 7 items and requires respondents consider all the headaches they have experienced over the last 3 months and assesses how many headaches have interfered with their work/school and household productivity as well as in their social and leisure activities with the first 5 items, to which the number of days in which a particular activity has been affected due to headache. The final 2 items were not included in this survey as they are the provider's queries and are not included in the final score. Scores of this measure determine level of disability, with 0-5 indicating little or no disability, 6-10 indicating mild disability, 11-20 indicating moderate disability, and 21+ indicating severe disability. For this study, the total score from the 5 items was used to measure migraine headache disability as a continuous variable.

The MIDAS has exhibited adequate internal consistency in the United States (α = 0.76) and adequate test-retest reliability with 0.80 in the United States. The validity of the MIDAS was determined by comparing the measures to diary data entry, to which these were correlated (r = 0.63). The MIDAS has also demonstrated face and clinical validity as exhibited by correlation with physician's clinical judgement (r = 0.69; Stewart, Lipton, & Whyte, 1999; Stewart, Lipton, & Kolodner, 1999).

General Anxiety Disorder-7 (GAD-7)

The GAD-7, an indicator of anxious distress, was used to measure hyperarousal. This scale was developed by Spitzer et al. and published in 2006 to assess symptoms of anxiety experienced by the respondent within the last two weeks. The 7 items address the impact that symptoms including nervousness, worrying, irritability, and difficulty relaxing have influenced the respondent's life by using a 4-point Likert scale with the responses being not at all, several days, more than half the days, and nearly every day, and are scored as 0, 1, 2, and 3, respectively. Scores range from 0 to 21, and severity of anxiety experienced is determined by the cut-off points of 5, 10, and 15 indicating mild, moderate, and severe anxiety respectively (Löwe et al., 2008; Spitzer et al., 2006, Williams, 2014). For this study, the total score was used as a continuous variable to measure anxiety.

The GAD-7 demonstrates very good reliability as indicated by internal consistency ($\alpha = 0.89$) and adequate construct validity was determined by intercorrelations with the Patient Health Questionnaire (PHQ-2; $r = 0.64$) and Rosenberg Self-Esteem Scale, ($r = -0.43$; Löwe et al., 2008). Williams (2014) reported that the GAD-7 has a sensitivity of 89% and specificity of 82% for screening for generalized anxiety disorder, and can moderately screen for panic disorder, social anxiety disorder, and post-traumatic stress disorder with sensitivity ranging from 66-74% and specificity ranging from 80-81% (Williams, 2014).

Pittsburgh Sleep Quality Index (PSQI)

The Estimated Sleep Efficiency score in the PSQI was used to determine relative quality of sleep. The PSQI was developed to assess sleep dysfunction in clinical populations and has also been determined to be useful in nonclinical populations as well (Buysse et al., 1989; Mollayeva et al., 2016). The first 9 items on the PSQI assess indices related to the respondent's sleep over the last month including usual bedtime, factors that interrupt or prevent sleep onset, and other indices related to sleep. Item responses vary from blank response requirements (e.g., "During the past month, when have you usually gone to bed at night?"), rating (e.g., very good, fairly good, fairly bad, and very bad for rating overall sleep quality), and rating frequency of factor experienced (e.g., "During the past month, how often have you had trouble sleeping because you…" with response options as not during the past month, less than once a week, once or twice a week, and three or more times a week). A global score ranging from 0 to 21 is derived, with higher scores indicating poorer sleep quality. (Buysse et al., 1989). For this study, estimated sleep efficiency scores were used as an indicator of sleep quality by calculating the amount of time spent in bed proportional to the amount of time spent asleep. A percentage is derived, and greater percentages indicate better sleep quality (Ohayon et al., 2017).

Mollayeva et al. (2016) conducted a meta-analysis to determine the reliability and validity of the PSQI for clinical and nonclinical populations. The PSQI has acceptable reliability indicated by internal consistency for clinical ($\alpha = 0.70 – 0.83$) and nonclinical ($\alpha = 0.67 – 0.69$) samples. Good construct validity was evident by high correlations with

other measures of sleep including the Insomnia Severity Index and polysomnography variables, in addition to correlations with clinical diagnoses related to sleep, such as insomnia. There is also appropriate content, divergent construct, and known-group validity. There is mixed data for the adequacy of the test-retest reliability of the PSQI, but with a limited and variable construct like sleep quality, some variability is to be expected over time (Mollayeva et al., 2016).

Reduced Morningness-Eveningness Questionnaire (rMEQ)

The rMEQ was used to assess morningness-eveningness, a quality related to preferential, trait wake, and sleep behaviors. The rMEQ is a 5-item derivative of the original 19-item Morningness-Eveningness Questionnaire (MEQ) to determine which of 3 preferential types (morning type, evening type, and intermediate/normal type) to which a person could be assigned based on their circadian rhythm and other indices of when they feel the best during the day (Chelminski et al., 2000; Horne & Ostberg, 1976). A critique of the MEQ was that it was too long, and so Adan and Almirall (1991) sought to take the "best" 5 items from the MEQ to create a questionnaire that is more efficient yet still a reliable and valid measure of morningness-eveningness (Adan & Almirall, 1991). The items of the rMEQ address the respondent's sleep-wake cycle and how they feel during the day, with response items being time ranges for the 3 items assessing timing, for the item assessing tiredness the response options are very tired, fairly tired, fairly refreshed, and very refreshed, and for the item regarding the type the respondent considers themselves to be includes responses of definitely a "morning" type, rather more a "morning" type than an "evening" type, rather more an "evening" type than a

"morning" type, and definitely an "evening" type. Items are scored by assessing time choices, tiredness responses, and perceived type, and participants are assigned to be in the evening, neither, or normal category if their total scores fall within 0-11, 12 – 17, and 17+ respectively. *Z*-scores for each response were calculated to identify the extreme scores provided, and the absolute value was taken for each response to identify the morning and evening preferences. This was executed as the literature suggests that many who experience migraine headaches tend to be preferential to mornings and evenings, and this calculation provides us with the information as to whether this preference is influential to migraine disability experienced.

To observe the reliability and validity of the rMEQ, it should be stated that the MEQ has good internal consistency ($\alpha = 0.83$) and high test-retest reliability ($r = 0.77$), as Chelminski et al. (2000) sought to determine the reliability of the rMEQ compared to the MEQ. The Spearman correlation coefficients between MEQ and rMEQ were significant ($r = 0.90$ $p < 0.01$). Internal consistency for the rMEQ was higher than that of the MEQ, with adequate inter-item correlations and sensitivity to type classification for the rMEQ with respect to the original (Chelminski et al., 2000).

Sleep Hygiene Index (SHI)

The SHI, a measure of sleep hygiene, was used to evaluate the behavioral and environmental aspects conducive to healthy sleep. This scale was developed by Mastin et al. (2006) as a tool to assess behavioral and environmental aspects of one's sleep habits. The SHI is a 13-item scale that addresses aspects including consistent bedtimes, arousing activities, and comfort with groups of statements to which respondents are instructed to

choose the appropriate response regarding how true each statement is for them, with the responses being never, rarely, sometimes, frequently, and always. Higher scores are indicative of poorer sleep hygiene (Mastin et al., 2006).

The SHI demonstrates adequate reliability ($\alpha = 0.66$), superior to previous measures of sleep hygiene, and good test-retest reliability ($r = 0.71$; Mastin et al., 2006). Items on the SHI had a small to moderate relationship with the Epworth Sleepiness Scale and a moderate to large relationship with the Pittsburgh Sleep Quality Index (Mastin et al., 2006). As these the reliability of this measure was conducted for a nonclinical population, Cho et al. (2013) determined there is acceptable reliability, measurement error, concurrent and incremental validity in a sample of patients with chronic pain (Cho et al., 2013).

Demographic Questionnaire

Participants were given a measure of demographics after completing all other measures. They were asked their age in years, assigned sex at birth (Female, Male, or Intersex), and ethnicity (African American/Black, Asian, Hispanic or Latina/o, Native American or Native Alaskan, Native Hawaiian or Pacific Islander, White/Caucasian, or Other; See Appendix C).

Effort/Validity Testing

It has been observed that when using student populations as research participants, the accuracy of their responses may not be as effortful as they should be, as many students are required to participate in research or are provided with compensation as an incentive to participate (An et al., 2012; Mesghina et al., 2022). To address the potential

of random responding or decreased effort, two items were included and were used to ensure appropriate quality of responses. The first item instructed that the participant answer the question, “What does 20 – 7 equal?” to which respondents selected in multiple choice format from the options of 17, 15, 13, and 27. The second item instructed the participant to determine whether the statement “The sky is green and the grass is blue,” was true or false (See Appendix D). Data for participants who provided incorrect reposes to either of these items will not be used to ensure adequate quality of data.

Procedure

Institutional Review Board approval from the Middle Tennessee State University IRB was obtained before unitizing the subset of data from the larger data collection from the spring semester of 2022 (See Appendix A). After receiving approval, the data for variables relevant to this study and demographic data was retrieved and analyzed.

After obtaining informed consent (See Appendix E), participants were randomly administered the SHI, PSQI, rMEQ, and GAD-7. Once these scales were completed, participants were then prompted with a yes or no question regarding if they experience migraine headaches. If they responded “no,” participants were oriented to the demographics section and completed the study. If “yes,” the migraine screener question was prompted, followed by the MIDAS, and demographics. After completing the study, participants were debriefed and received their course credits for participating in the study (See Appendix F).

CHAPTER III

RESULTS

Descriptive Statistics

The statistical software SPPS (version 26) was used to perform all bivariate correlations and multiple regression analysis. SAS Studio (version 3.80) was used to perform the mediation analysis. Mean scores and standard deviations for anxiety, morningness-eveningness preference, sleep hygiene, and estimated sleep efficiency are reported in Table 2. Bootstrapping methods were used to ensure normality.

Table 2

Descriptive Statistics and Coefficient alphas for GAD-7, SHI, rMEQ, MIDAS, and Estimated Sleep Efficiency

Variable	Mean	*SD*	Coefficient α
GAD-7	9.34	5.90	0.91
SHI	24.23	7.22	0.74
rMEQ	0.79	0.59	0.74
MIDAS	12.40	11.61	0.80
Sleep Efficiency	0.85	0.13	-

Note. $n = 95$

Hypothesis Testing

Hypothesis 1. Hypothesis one (a) predicted a significant bivariate relationship between sleep hygiene and migraine disability as measured by the SHI and MIDAS, respectively. A statistically significant correlation was observed between sleep hygiene and migraine disability ($r = 0.42$, $p < 0.001$, 95% CI [.24, .58]). Hypothesis one (b) predicted a significant relationship between sleep hygiene and migraine disability when

accounting for sex, age, anxiety measured by the GAD-7, and morningness-eveningness preference as measured by the rMEQ. Among the bivariate relationships between the predictor and criterion variables, anxiety was the only other variable beyond sleep hygiene that was significantly related to migraine disability ($r = 0.30$, $p = 0.003$, 95% CI [.11, .47]). A simultaneous multiple regression was performed to determine if sleep hygiene was still a significant predictor when considering age, sex, anxiety, and morningness-eveningness preference. The five-factor model was significant, accounting for 21% of the variance in migraine disability ratings, F (5, 89) = 4.77, $R^2 = .21$, $p <$ .0001, 90% CI [.06, .30]. Of the predictors included in the model, only sleep hygiene was a significant independent predictor ($sr = .26$, $p = .02$, $sr^2 = .07$). All bivariate comparisons can be found in Table 3, and the summary statistics for the multiple regression can be found in Table 4.

Table 3
Pearson's correlation among the variables of interest

	1	2	3	4	5	6
1. MIDAS	-					
2. Sex	-.14	-				
3. Age	-.16	.13	-			
4. GAD-7	.30**	-.26*	-.21*	-		
5. rMEQ	.12	-.06	.07	-.004	-	
6. SHI	.42**	-.06	-.25*	.56**	-.36	-
7. Sleep Efficiency	-.12	.13	-.09	-.03	.05	-.21*

Note. *$p < .05$, **$p < .01$.

Table 4

Simultaneous multiple regression predicting migraine disability

Predictor	Zero-order *r*	*β*	*sr*	*b*	*p*
Sex	-.14	-	-.09	-2.86	.39
Age	-.16	-.06	-.06	-.17	.58
GAD-7	.30	.06	.04	.11	.64
rMEQ	.12	.13	.14	2.53	.18
SHI	**.42**	**.38**	**.26**	**.61**	**.002**

Note. Exact *p* values are for the unique effects of the predictors. Significant predictors are bolded.

Hypothesis 2. Hypothesis 2 (a) predicted a significant bivariate relationship exists between sleep hygiene and estimated sleep efficiency, with poorer sleep hygiene and poorer sleep efficiency being related. A significant negative correlation was observed for sleep hygiene and estimated sleep efficiency scores (r = -0.21, p = 0.02, 95% CI [-.004, -.39]). Hypothesis 2 (b) predicted that a significant relationship exists between estimated sleep efficiency and migraine disability. A correlation analysis indicated no statistically significant relationship between estimated sleep efficiency and migraine disability (r = -0.12, p = 0.24, 95% CI [-.32,.08]). With this, the data does not support hypothesis 2 (b), As hypothesis 2 (b) is integral to hypothesis 2 (c). Therefore, the data does not support hypothesis 2 (c), and it would not typically be necessary to conduct the mediation analysis without a significant relationship between sleep efficiency and migraine disability.

Regardless, the mediation analysis was conducted to complete the proposed statistical analyses. Hypothesis 2 (c) predicted that sleep hygiene partially mediates the

relationship between estimated sleep efficiency and migraine disability. The total effect of sleep efficiency on sleep hygiene was not significant (β = -0.12, *SE* = 0.10, BC 95% CI [-0.29, 0.05]). The direct effect of sleep efficiency on migraine disability was also not significant (β = -0.04, *SE* = 0.10, BC 95% CI [-0.20, 0.15]. Finally, the indirect effect of sleep efficiency on migraine disability through sleep hygiene was not significant (β = -0.9, *SE* = 0.05, BC 95% CI [-0.20, 0.0002]). With these findings, sleep hygiene does not act as a mediator in the relationship between sleep efficiency and migraine disability due to the observed non-significant relationship between sleep efficiency and migraine severity; however, sleep hygiene does have some effect on migraine disability, although this is not explained in the context of sleep efficiency. For the path statistics see Table 5, and for the path diagram see Figure 1.

Table 5

Observed Path Values for the Tested Mediation Analysis

	B	*β*	*SE*	*t*
a (PSQI ESE - SHI)	-11.26	-.21	.10	-2.08*
b (SHI - MIDAS)	.67	.42	.09	-4.8***
c′ (PSQI ESE - MIDAS)	-3.10	-.04	.10	-.37

Note. $*p < .05$, $**p < .01$, $***p < .001$.

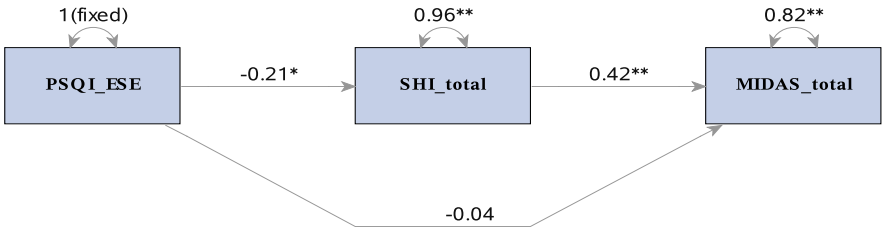

Figure 1. *Mediating relationship of SHI on ESE and MIDAS.*

Note. $*p < 0.05$. $**p < 0.01$.

CHAPTER IV

DISCUSSION

The influence of migraine headaches on the lives of millions is of great impact and prevalence. The disability that migraine headaches ensue can create downstream effects on the productivity and general enjoyment of the professional and personal lives of those who experience these headaches (Burch et al., 2019; Lombard et al., 2020). In addition to the discomforts experienced as a results of migraine headaches, those who experience migraines are also at a greater likelihood of developing chronic health conditions (Bigal et al., 2009; Spector et al., 2010). In our attempts to fully understand the many facets of migraine to create effective preventative and treatment methods, a few variables have been identified as influential, including the sex difference, anxiety, genetics, endogenous and exogeneous stressors, and sleep quality. Migraine headache literature posits that women tend to experience migraines more intensely and frequently than men, and a variety of stimulatory factors such as emotional stress, diet, and physical activity play a role in the onset and severity of migraine headaches (Lantéri-Minet et al., 2005; Lay & Broner, 2009; Malone et al., 2015; Mollaoğlu, 2013; Moon et al., 2017; Vetvik & MacGregor, 2017). Additionally, physiological variables including genetics, hormonal changes, and sensory experiences are part of the puzzle (Demarquay & Mauguière, 2016; Denuelle et al., 2007; Goadsby, 2005 Price et al., 2021; Sutherland et al., 2019).

Sleep is also reported as a contributor to the onset and disability of migraine headaches, with poor sleep quality and short quantity of sleep being frequently reported

issues (Andress-Rothrock et al., 2010). In healthy and clinical populations, it has been found that sleep hygiene can impact quality of sleep (CDC, 2022). With the plethora of reports in migraine headache literature noting poor quality sleep as a common factor among many who experience this form of headache, it would be appropriate to consider the relationship that sleep hygiene may have for those with migraine headaches (Mollaoğlu, 2013; Rains, 2018). If a relationship exists between sleep hygiene and migraine severity, it would be imperative to consider the preventative and treatment interventions that could be utilized to improve the disability experienced by those who have migraine headaches.

This study sought to explore the relationship between sleep hygiene and migraine disability while considering other potentially related factors in a sample of undergraduate students. At this time, little research has been conducted on the relationship between sleep hygiene and migraine headaches in adult populations but has been well-noted in child and adolescent populations with migraine headaches. Given the abundance of literature on sleep hygiene impacting sleep quality and sleep quality impacting migraine headaches, it was hypothesized that migraine disability and sleep hygiene would be significantly correlated, and our findings supported this. Participants who reported poorer sleep hygiene also reported greater migraine disability. It was also hypothesized that this relationship between sleep hygiene and migraine disability would still be significant after considering other potentially related factors including sex, age, anxiety, and morningness-eveningness preference. The results supported this as well, suggesting that the relationship between the behavioral and environmental factors that make up sleep

hygiene and migraine disability experienced are noteworthy. It was also found that anxiety was significantly related to migraine headache disability, which supports the literature discussed previously.

As aforementioned, the literature provides a vast amount of support for subjective sleep quality being impacted by sleep hygiene, and migraine headaches being impacted by sleep quality. With this, it was hypothesized that sleep hygiene would partially mediate the relationship between sleep quality and migraine disability. Results from the mediation model yielded some surprising results as there was no significant direct effect of sleep quality on migraine disability observed; however, there was a near significant indirect effect of sleep quality on migraine disability via sleep hygiene with significant small to medium sized path values observed in the indirect path. Specifically, participants with lower sleep quality endorsed poorer sleep hygiene, and those with poorer sleep hygiene endorsed greater migraine disability.

Interestingly, the significant bivariate relationship for sleep hygiene and migraine disability was statistically significant after controlling for potentially related variables. These findings suggest that the behavioral and environmental facets that contribute to healthy sleep may be intricate contributors to migraine headache disability. In addition to traditional forms of therapeutic intervention, sleep hygiene education has been an effective method in treating sleep disorders such as insomnia (Chung et al., 2018). Walters et al. (2014) noted in their findings that they suspected sleep hygiene would be a significant predictor of episodic migraine headache disability given the frequent reports of poor sleep hygiene by the participants in their sample, however no statistical

significance was observed. Calhoun and Ford (2007) discussed how sleep hygiene as a form of intervention for individuals whose migraine headaches transformed from episodic to chronic experienced a reversal effect and decrease the frequency of headaches.

The overall significant relationship between sleep hygiene and migraine disability in this sample of young adults is noteworthy, as various behavioral and environmental factors related to healthy sleep appears to be impactful so much so that is evidenced to have had a negative impact on the sleep of participants in this sample. If poor sleep hygiene increases migraine disability for young adults as the data from this sample suggests, it could be hypothesized that adults in middle and older ages would also be negatively impacted by sleep hygiene, potentially even more so than young adults due to the increase in stress and worsening of sleep as we age (CDC, 2022).

To reiterate, some behaviors that influence sleep hygiene and are subject to change as we age include taking naps, inconsistent sleep and wake times, engaging in stimulating activities before bed (i.e., exercise, hot showers), time spent in bed not sleeping, substance use (i.e., caffeine, alcohol, nicotine), feelings of stress, and engaging in behaviors in bed that don't support healthy sleep (i.e., studying, reading, or watching television, thinking/planning or worrying), or doing stressful work before bed (i.e., paying bills, creating a schedule). We tend to get busier as we age due to changes in responsibility, having children or others to care for, workload, and other life stressors. Additionally, environmental aspects of sleep hygiene include uncomfortable mattresses, pillows, blankets, temperature being too hot or too cold, brightness, and sound

disturbances. Further analyses to piece apart any aspects of sleep hygiene that appear to be more prevalent than others would be beneficial in going forward with potential interventions.

Likewise, the relationship between anxiety and migraine disability was also significant after controlling for related variables. This dovetails with the extensive literature documenting how symptoms such as worrying, having difficulty relaxing, and feeling nervous that are akin to experiencing hyperarousal in those who experience migraine headaches and the contribution that these symptoms have to poor sleep (Peres et al., 2017, Riemann et al., 2010). With this, pragmatic efforts to mitigate the symptoms of anxiety that may contribute to worsening of migraine headaches and potentially poor sleep should be sought out and implemented to assist in the amelioration of migraine severity.

As suspected, the relationship between sleep hygiene and sleep quality was statistically significant as well, with those who reported poor sleep hygiene also indicating poorer sleep quality. For many with migraine headaches, poor sleep in both quantity and quality are often reported as a trigger for migraine headaches (Rains, 2018). When examining the relationship between sleep quality and migraine headaches, Engstrøm et al. (2013) demonstrated how for those with migraine, lower pain thresholds and more sleep disturbance symptoms such as anxiety when trying to sleep and subjective tiredness were reported compared to healthy controls. The improvement of sleep quality when engaging in good sleep hygiene has been well-noted in healthy and clinical populations and given the similarities in the reports of poor sleep quality for those

with migraine headaches to various aspects of sleep hygiene, it may be fitting to emphasize the connection these attributes have with one another in relation to migraine headaches.

Contrary to the hypotheses for this study, there was no statistically significant relationship between sleep quality and migraine disability. These findings are incongruent with the established literature, which posits that for many with migraine headaches, sleep quality can be a trigger for headache onset (Mollaoğlu, 2013; Rains, 2018). The nonsignificant relationship between sleep quality and migraine disability observed in this sample may be explained by the overall young age of participants in this sample, as we know that even in healthy populations the sleep efficiency and sleep quality reduce as we age (CDC, 2022) therefore, results may have indicated a significant relationship if a more diverse age population had been represented. The average sleep efficiency score was in the 80's, indicating an overall good sleep efficiency ability from this sample (Buysse et al., 1989).

Limitations of this study include having a college sample that consisted primarily of White women. A sample that is more diverse in ethnicity and age would be more appropriate for future quasi-experimental designs. A sample that is more representative of sexes, ethnicities, and ages would make any potentially statistically significant findings of the relationship between sleep hygiene and migraine headaches more generalizable. To address this issue of homogeneity, data collection would need to consist of greater efforts of reaching individuals who are not often captured in the typical undergraduate sample. This may consist of sending out the survey to others via social media, or providing

appropriate forms of incentive, such as gift cards with monetary value, when approaching individuals in public. This study was a correlational design, which does not substantiate causality in that sleep hygiene and migraine have a true decisive relationship. To help substantiate potential causality in this relationship, future studies that also have results that exhibit a correlational relationship between sleep hygiene and migraine disability could create an experimental design to address this issue. For example, participants with migraine headaches could provide initial indices regarding their migraine disability, quality of sleep, and sleep hygiene reports. Then, randomly assign participants to the control and experimental group, to which the latter would make changes that encourage healthy sleep hygiene (i.e., cooling their room, making it quieter, avoiding stimulating behaviors before bedtime and in the bed/bedroom, etc.) and the former group makes no changes to their sleep hygiene. After several months, migraine disability, sleep quality, and sleep hygiene are reassessed for each group to determine if sleep hygiene improvement impacted migraine disability.

Another limitation would be that only self-report measures were used. More objective measures of sleep hygiene and sleep quality, in conjunction with self-report measures, would be beneficial in further understanding this relationship and helping to clear findings. Objective sleep quality could be determined via polysomnography and assessing sleep hygiene objectively might include gathering specific data points for each participant and their environment, such as documenting the temperature of their bedroom at night, identifying various waking features incorporated in their nighttime routine such

as presence of television or phone and room brightness, in addition to identifying the number of stimulating activities that may be conducted in bed or close to bedtime. Although validity measures were used in the survey to ensure accurate responding and any individuals who failed these measures were not included in the statistical analyses, we cannot be certain that all students were responding truthfully as noted by An et al. (2012) and Mesghina et al. (2022), so participant concordance could be a potential limitation of this study. Other health conditions, such as chronic pain conditions, psychiatric disorders, or other health concerns that could contribute to one's sleep and migraine disability were not utilized as exclusion criteria in this sample. Controlling these variables in future studies would be of great importance as these issues could be greater contributors to issues such as poor sleep and worsening migraine experience.

Finally, sleep and the underlying influences that impact sleep, including sleep hygiene, do not make the whole picture of migraine headaches. As previously stated, migraine headaches are a complex and multifaceted health condition that is not completely understood, and poor sleep is not a pathognomonic feature of migraine headaches. Certainly, there are many individuals who experience migraine headaches who do not experience this relationship with poor sleep. However, for those that do, perhaps considering their own sleep hygiene and how it may potentially contribute to their general sleep health and migraine disability could be of some benefit.

Despite these germane limitations, it is noteworthy that a relationship between sleep hygiene and migraine disability existed in this sample of undergraduate students. This significant relationship highlights the importance of healthy sleep for those with

migraine headaches. Health behaviors are a key feature of migraine headache mitigation, and the results of this study further support the encouragement of behavioral health habits to improve migraine disability. Healthy sleep that consists of enough quantity of sleep, a sleep environment that is cool, dark, and quiet, and going to sleep when sufficiently tired are all aspects that are congruent with healthy quality sleep. Engaging in exercise each day and having a healthy diet also contributes to good quality sleep and can also improve migraine disability. Additional methods to improve sleep and migraine include reducing stress experienced by means of engaging in stress reducing activities and exercises, as well as seeking appropriate treatment for any anxiety that is difficult to manage. For many, prophylactic medications are necessary to assist in the disability of migraine headaches, and so medical consultation may be appropriate (CDC, 2022; NIH, 2023).

Sleep hygiene may have a unique relationship with migraine headache disability, as the findings of this study indicated that poorer sleep hygiene was associated with greater migraine disability. Additional research should be conducted to determine if sleep hygiene is an influential aspect to migraine disability among a more diverse population. With a more thorough analysis of what aspects of sleep hygiene appear to be relevant, as applicable, we could improve our understanding of this vague headache condition that many individuals must manage. Noteworthy findings may provide those with migraines who experience poor sleep with treatment options that are primarily behavioral and environmental, and therefore somewhat accessible changes that could be made with appropriate financial and informative resources.

REFERENCES

Adan, A., & Almirall, H. (1991). Horne & Östberg morningness-eveningness questionnaire: A reduced scale. *Personality and Individual Differences*, *12*(3), 241–253. https://doi.org/10.1016/0191-8869(91)90110-W

American Psychological Association. (n.d.). Hyperarousal. In APA Dictionary of Psychology. Retrieved March 17, 2022, from https://dictionary.apa.org/hyperarousal

An, K. Y., Zakzanis, K. K., & Joordens, S. (2012). Conducting research with non-clinical healthy undergraduates: Does effort play a role in neuropsychological test performance? *Archives of Clinical Neuropsychology*, 27(8), 849–857. https://doi.org/10.1093/arclin/acs085

Andress-Rothrock, D., King, W., & Rothrock, J. (2010). An analysis of migraine triggers in a clinic-based population. *Headache: The Journal of Head and Face Pain, 50*(8), 1366–1370. https://doi.org/10.1111/j.1526-4610.2010.01753.x

Bigal, M. E., Kurth, T., Hu, H., Santanello, N., & Lipton, R. B. (2009). Migraine and cardiovascular disease: Possible mechanisms of interaction. *Neurology, 72*(21), 1864–1871. https://doi.org/10.1212/WNL.0b013e3181a71220

Bigal, M. E., & Lipton, R. B. (2009). The epidemiology, burden, and comorbidities of migraine. *Neurologic Clinics, 27*(2), 321–334. https://doi.org/10.1016/j.ncl.2008.11.011

Bruni, O., Dosi, C., Riccioni, A., della corte, M., Novelli, L., & Ferri, R. (2013). Comorbidities of sleep disorders in childhood and adolescence: Focus on migraine. *Nature and Science of Sleep,* 77-85. https://doi.org/10.2147/NSS.S34840

Burch, R. C., Buse, D. C., & Lipton, R. B. (2019). Migraine: Epidemiology, burden, and comorbidity. *Neurologic Clinics, 37*(4), 631–649. https://doi.org/10.1016/j.ncl.2019.06.001

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research, 28*(2), 193–213. https://doi.org/10.1016/0165-1781(89)90047-4

Calhoun, A. H., & Ford, S. (2007). Behavioral sleep modification may revert transformed migraine to episodic migraine. *Headache: The Journal of Head and Face Pain, 47*(8), 1178–1183. https://doi.org/10.1111/j.1526-4610.2007.00780.x

Center for Disease Control and Prevention – National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health – Sleep and Sleep Disorders. https://www.cdc.gov/sleep/index.html. November 20th, 2021.

Center for Disease Control and Prevention – National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health – Sleep and

Sleep Disorders: Tips for Better Sleep. https://www.cdc.gov/sleep/about_sleep/sleep_hygiene.html. September 13th, 2022.

Chelminski, I., Petros, T. v, Plaud, J. J., & Ferraro, F. R. (2000). Psychometric properties of the reduced Horne and Ostberg questionnaire. *Personality and Individual Differences, 29*(3), 469–478. https://doi.org/10.1016/S0191-8869(99)00208-1

Cho, S., Kim, G.-S., & Lee, J.-H. (2013). Psychometric evaluation of the sleep hygiene index: a sample of patients with chronic pain. *Health and Quality of Life Outcomes, 11*(1), 213. https://doi.org/10.1186/1477-7525-11-213

Chung, K.-F., Lee, C.-T., Yeung, W.-F., Chan, M.-S., Chung, E. W.-Y., & Lin, W.-L. (2018). Sleep hygiene education as a treatment of insomnia: A systematic review and meta-analysis. *Family Practice, 35*(4), 365–375. https://doi.org/10.1093/fampra/cmx122

de Tommaso, M., & Delussi, M. (2018). Circadian rhythms of migraine attacks in episodic and chronic patients: a cross sectional study in a headache center population. *BMC Neurology, 18*(1), 94. https://doi.org/10.1186/s12883-018-1098-0

Demarquay, G., & Mauguière, F. (2016). Central nervous system underpinnings of sensory hypersensitivity in migraine: Insights from neuroimaging and electrophysiological studies. *Headache: The Journal of Head and Face Pain, 56*(9), 1418–1438. https://doi.org/10.1111/head.12651

Denuelle, M., Fabre, N., Payoux, P., Chollet, F., & Geraud, G. (2007). Hypothalamic activation in spontaneous migraine attacks. *Headache: The Journal of Head and Face Pain, 47*(10), 1418 - 1426. https://doi.org/10.1111/j.1526-4610.2007.00776.x

Engstrøm, M., Hagen, K., Bjørk, M., Gravdahl, G. B., & Sand, T. (2013). Sleep-related and non-sleep-related migraine: Interictal sleep quality, arousals and pain thresholds. *The Journal of Headache and Pain, 14*(1), 68. https://doi.org/10.1186/1129-2377-14-68

Engstrøm, M., Hagen, K., Bjørk, M. H., Stovner, L. J., & Sand, T. (2014). Sleep quality and arousal in migraine and tension-type headache: The headache-sleep study. *Acta Neurologica Scandinavica, 129*, 47–54. https://doi.org/10.1111/ane.12237

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Friedman, D. I., & de Ver Dye, T. (2009). Migraine and the environment. *Headache: The Journal of Head and Face Pain, 49*(6), 941–952. https://doi.org/10.1111/j.1526-4610.2009.01443.x

Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science, 18*(3), 233–239. https://doi.org/10.1111/j.1467-9280.2007.01882.x

Goadsby, P. J. (2005). Migraine pathophysiology. *Headache: The Journal of Head and Face Pain, 45*(1), 14–24. https://doi.org/10.1111/j.1526-4610.2005.4501003.x

Gori, S., Morelli, N., Maestri, M., Fabbrini, M., Bonanni, E., & Murri, L. (2005). Sleep quality, chronotypes and preferential timing of attacks in migraine without aura. *The Journal of Headache and Pain, 6*(4), 258–260. https://doi.org/10.1007/s10194-005-0201-2

Horne, J. A., & Östberg, O. (1976). A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. *International journal of chronobiology, 4*(2), 97-110.

Lantéri-Minet, M., Radat, F., Chautard, M.-H., & Lucas, C. (2005). Anxiety and depression associated with migraine: Influence on migraine subjects' disability and quality of life, and acute migraine management. *Pain, 118*(3), 319–326. https://doi.org/10.1016/j.pain.2005.09.010

Lay, C. L., & Broner, S. W. (2009). Migraine in women. *Neurologic Clinics, 27*(2), 503–511. https://doi.org/10.1016/j.ncl.2009.01.002

Leproult, R., & van Cauter, E. (2010). Role of sleep and sleep loss in hormonal release and metabolism. *Pediatric Neuroendocrinology, 17*, 11–21. https://doi.org/10.1159/000262524

Lombard, L., Farrar, M., Ye, W., Kim, Y., Cotton, S., Buchanan, A. S., Jackson, J., & Joshi, S. (2020). A global real-world assessment of the impact on health-related quality of life and work productivity of migraine in patients with insufficient versus good response to triptan medication. *The Journal of Headache and Pain, 21*(1), 41. https://doi.org/10.1186/s10194-020-01110-9

Löwe, B., Decker, O., Müller, S., Brähler, E., Schellberg, D., Herzog, W., & Herzberg, P. Y. (2008). Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. *Medical Care, 46*(3), 266–274. https://doi.org/10.1097/MLR.0b013e318160d093

Malone, C., Wachholtz, A., & Bhowmick, A. (2015). Migraine: Treatments, comorbidities, and quality of life, in the USA. *Journal of Pain Research, 8*, 537-547. https://doi.org/10.2147/JPR.S88207

Mastin, D. F., Bryson, J., & Corwyn, R. (2006). Assessment of sleep hygiene using the Sleep Hygiene Index. *Journal of Behavioral Medicine, 29*(3), 223–227. https://doi.org/10.1007/s10865-006-9047-6

Medic, G., Wille, M., & Hemels, M. (2017). Short- and long-term health consequences of sleep disruption. *Nature and Science of Sleep, 9*, 151–161. https://doi.org/10.2147/NSS.S134864

Mesghina, A., Au Yeung, N., & Richland, L. E. (2022). Performing up to par? Performance pressure increases undergraduates' cognitive performance and effort. *Journal of Applied Research in Memory and Cognition, 11*(4), 554-568. https://doi.org/10.1037/mac0000023

Mollaoğlu, M. (2013). Trigger factors in migraine patients. *Journal of Health Psychology, 18*(7), 984–994. https://doi.org/10.1177/1359105312446773

Mollayeva, T., Thurairajah, P., Burton, K., Mollayeva, S., Shapiro, C. M., & Colantonio, A. (2016). The Pittsburgh sleep quality index as a screening tool for sleep dysfunction in clinical and non-clinical samples: A systematic review and meta-analysis. *Sleep Medicine Reviews, 25*, 52–73. https://doi.org/10.1016/j.smrv.2015.01.009

Moon, H.-J., Seo, J.-G., & Park, S.-P. (2017). Perceived stress in patients with migraine: A case-control study. *The Journal of Headache and Pain, 18*(1), 73. https://doi.org/10.1186/s10194-017-0780-8

Noseda, R., & Burstein, R. (2013). Migraine pathophysiology: Anatomy of the trigeminovascular pathway and associated neurological symptoms, cortical spreading depression, sensitization, and modulation of pain. *Pain, 154*(Supplement 1), S44–S53. https://doi.org/10.1016/j.pain.2013.07.021

Ohayon, M., Wickwire, E. M., Hirshkowitz, M., Albert, S. M., Avidan, A., Daly, F. J., Dauvilliers, Y., Ferri, R., Fung, C., Gozal, D., Hazen, N., Krystal, A., Lichstein, K., Mallampalli, M., Plazzi, G., Rawding, R., Scheer, F. A., Somers, V., & Vitiello, M. (2017). National Sleep Foundation's sleep quality recommendations: First report. *Sleep Health, 3*(1), 6–19. https://doi.org/10.1016/j.sleh.2016.11.006

Okun, M. (2011). Biological consequences of disturbed sleep: Important mediators of health? *Japanese Psychological Research, 53*(2), 163–176. https://doi.org/10.1111/j.1468-5884.2011.00463.x

Peres, M. F. P., Mercante, J. P. P., Tobo, P. R., Kamei, H., & Bigal, M. E. (2017). Anxiety and depression symptoms and migraine: A symptom-based approach research. *The Journal of Headache and Pain, 18*(1), 37. https://doi.org/10.1186/s10194-017-0742-1

Pérez, L. G., Abrams, M. P., López-Martínez, A. E., & Asmundson, G. J. G. (2012). Trauma exposure and health: The role of depressive and hyperarousal symptoms. *Journal of Traumatic Stress, 25*(6), 641–648. https://doi.org/10.1002/jts.21762

Pietrobon, D., & Moskowitz, M. A. (2013). Pathophysiology of migraine. *Annual Review of Physiology, 75*(1), 365–391. https://doi.org/10.1146/annurev-physiol-030212-183717

Price, A., Sumner, P., & Powell, G. (2021). Subjective sensory sensitivity and its relationship with anxiety in people with probable migraine. *Headache: The Journal of Head and Face Pain, 61*(9), 1342–1350. https://doi.org/10.1111/head.14219

Rains, J. C. (2018). Sleep and migraine: Assessment and treatment of comorbid sleep disorders. *Headache: The Journal of Head and Face Pain, 58*(7), 1074–1091. https://doi.org/10.1111/head.13357

Riemann, D., Spiegelhalder, K., Feige, B., Voderholzer, U., Berger, M., Perlis, M., & Nissen, C. (2010). The hyperarousal model of insomnia: A review of the concept and its evidence. *Sleep Medicine Reviews, 14*(1), 19–31. https://doi.org/10.1016/j.smrv.2009.04.002

Robert, C., Bourgeais, L., Arreto, C.-D., Condes-Lara, M., Noseda, R., Jay, T., & Villanueva, L. (2013). Paraventricular hypothalamic regulation of trigeminovascular mechanisms involved in headaches. *Journal of Neuroscience, 33*(20), 8827–8840. https://doi.org/10.1523/JNEUROSCI.0439-13.2013

Spector, J. T., Kahn, S. R., Jones, M. R., Jayakumar, M., Dalal, D., & Nazarian, S. (2010). Migraine headache and ischemic stroke risk: An updated meta-analysis. *The American Journal of Medicine, 123*(7), 612–624. https://doi.org/10.1016/j.amjmed.2009.12.021

Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder. *Archives of Internal Medicine, 166*(10), 1092. https://doi.org/10.1001/archinte.166.10.1092

Stewart, W. F., Lipton, R. B., Whyte, J., Dowson, A., Kolodner, K., Liberman, J. N., & Sawyer, J. (1999). An international study to assess reliability of the Migraine Disability Assessment (MIDAS) score. *Neurology, 53*(5), 988–988. https://doi.org/10.1212/WNL.53.5.988

Stewart, W., Lipton, R., Kolodner, K., Liberman, J., & Sawyer, J. (1999). Reliability of the Migraine Disability Assessment score in a population-based sample of headache sufferers. *Cephalalgia, 19*(2), 107–114. https://doi.org/10.1046/j.1468-2982.1999.019002107.x

Sullivan, D. P., & Martin, P. R. (2017). Sleep and headaches: Relationships between migraine and non-migraine headaches and sleep duration, sleep quality, chronotype, and obstructive sleep apnoea risk. *Australian Journal of Psychology, 69*(3), 210–217. https://doi.org/10.1111/ajpy.12143

Sutherland, H. G., Albury, C. L., & Griffiths, L. R. (2019). Advances in genetics of migraine. *The Journal of Headache and Pain, 20*(1), 72. https://doi.org/10.1186/s10194-019-1017-9

U.S. Department of Health and Human Services, National Insitutes of Health, National Institute of Neurological Disorders and Stroke. (2023). *Migraine*. Retrieved April 1st, 2023, from https://www.ninds.nih.gov/health-information/disorders/migraine

van Oosterhout, W., van Someren, E., Schoonman, G., Louter, M., Lammers, G., Ferrari, M., & Terwindt, G. (2018). Chronotypes and circadian timing in migraine. *Cephalalgia, 38*(4), 617–625. https://doi.org/10.1177/0333102417698953

Vetvik, K. G., & MacGregor, E. A. (2017). Sex differences in the epidemiology, clinical features, and pathophysiology of migraine. *The Lancet Neurology, 16*(1), 76–87. https://doi.org/10.1016/S1474-4422(16)30293-9

Walters, A. B., Hamer, J. D., & Smitherman, T. A. (2014). Sleep disturbance and affective comorbidity among episodic migraineurs. *Headache: The Journal of Head and Face Pain, 54*(1), 116–124. https://doi.org/10.1111/head.12168

Williams, N. (2014). The GAD-7 questionnaire. *Occupational Medicine, 64*(3), 224–224. https://doi.org/10.1093/occmed/kqt161

APPENDICES

APPENDIX A

IRB APPROVAL LETTER

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129
FWA: 00005331/IRB Regn.. 0003571

MIDDLE TENNESSEE STATE UNIVERSITY

IRBN007 – EXEMPTION DETERMINATION NOTICE

Wednesday, December 08, 2021

Protocol Title	***The MTSU undergraduate Sleep Quality Study***
Protocol ID	**22-1062 2q**
Principal Investigator	**Adam Dockery** (Student) *Faculty Advisor:* James Loveless
Co-Investigators	Stevie Nichole (sns6p)
Investigator Email(s)	*mhd2q@mtmail.mtsu.edu; james.loveless@mtsu.edu*
Department/Affiliation	Psychology

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU Institutional Review Board (IRB) through the **EXEMPT** review mechanism under 45 CFR 46.101(b)(2) within the research category ***(2) Educational Tests, surveys, interviews or observations of public behavior*** *(Qualtrics Survey)*. A summary of the IRB action and other particulars of this protocol are shown below:

IRB Action	**EXEMPT from further IRB Review** Exempt from further continuing review but other oversight requirements apply
Date of Expiration	**6/30/2023** *Date of Approval:* **12/8/21** *Recent Amendment:* **NONE**
Sample Size	500 (FIVE HUNDRED)
Participant Pool	**Healthy adults (18 or older) – MTSU SONA**
Exceptions	Online consent followed by internet-based survey using Qualtrics is permitted (Qualtrics links on file).
Type of Interaction	☐ Non-interventional or Data Analysis ☒ Virtual/Remote/Online Interview/survey ☐ In person or physical– Mandatory COVID-19 Management (refer next page)
Mandatory Restrictions	**1. All restrictions for exemption apply.** **2. The participants must be 18 years or older.** **3. Mandatory ACTIVE informed consent. Identifiable information including, names, addresses, voice/video data, must not be obtained.** **4. NOT approved for in-person data collection.**
Approved IRB Templates	*IRB Templates:* SONA Recruitment Script and Online Informed Consent *Non-MTSU Templates:* NONE
Research Inducement	SONA Credit
Comments	NONE

APPENDIX B

MIGRAINE SCREENING ITEM

Please select all symptoms that apply to you when experiencing a migraine attack.

- ☐ Eye Pain
- ☐ Sensitivity to light
- ☐ Sensitivity to smells
- ☐ Sensitivity to sound
- ☐ Nausea/vomiting
- ☐ Worse pain on one side of the head
- ☐ Pounding, pulsing, or throbbing pain
- ☐ None of these apply to me

APPENDIX C

DEMOGRAPHICS QUESTIONNAIRE

What is your age in years?

_____

What was your assigned sex at birth?

- o Female
- o Male
- o Intersex

What is your ethnicity?

- o African American/Black
- o Asian
- o Hispanic/Latina/o
- o Native American or Native Alaskan
- o Native Hawaiian or Pacific Islander
- o White/Caucasian
- o Other, please describe

_____

APPENDIX D

VALIDITY QUESTIONS

What does 20 – 7 equal?

- o 17
- o 15
- o 13
- o 27

True or False:

The sky is green, and the grass is blue.

- o True
- o False

APPENDIX E

INFORMED CONSENT

Information and Disclosure Section

The following information is provided to inform you about the research project in which you have been invited to participate. Please read this disclosure and feel free to ask any questions. The investigators must answer all of your questions and please save this page as a PDF for future reference.

- Your participation in this research study is voluntary.
- You are also free to withdraw from this study at any time without loss of any benefits.

For additional information on your rights as a participant in this study, please contact the Middle Tennessee State University (MTSU) Office of Compliance (Tel 615-494-8918 or send your emails to irb_information@mtsu.edu. (http://www.mtsu.edu/irb). Please read the following and respond to the consent questions in the bottom if you wish to enroll in this study.

1. Purpose: This research project is designed to help us evaluate the relationships between sleep quality and several different psychological and behavioral variables among a college student population.

2. Description: In this study, you will be asked to complete several surveys related to sleep and factors that are known to be related to sleep. You will also be asked to provide some information about your sleep environment as well as some demographic data.

3. IRB Approval Details:

    Protocol Title: The MTSU undergraduate sleep quality study

    Primary Investigator: James Loveless, Ph.D.

    PI Department & College: Department of Psychology; College of Behavioral & Health Sciences

    Protocol ID: 22-1062 2q Approval Date: 12.08.2021 Expiration Date: 06.30.2023

4. Duration: The whole activity should take about 30 minutes. The participants must take at least 10 minutes.

5. Here are your rights as a participant:

• Your participation in this research is voluntary.

• You may skip any item that you don't want to answer, and you may stop the experiment at any time (but see the note below)

• If you leave an item blank by either not clicking or entering a response, you may be warned that you missed one, just in case it was an accident. But you can continue the study without entering a response if you didn't want to answer any questions.

• Some items may require a response to accurately present the survey.

6. Risks & Discomforts: The risks or discomforts associated with participation in this study are thought to be no more than one might expect from daily life.

7. Benefits:

a. Benefits to you that you may not receive outside this research: There are no direct benefits to you.

b. Benefits to the field of science or the community: This work will help us to better appreciate the factors that are related to subjective sleep quality among college students.

8. Identifiable Information: You will NOT be asked to provide identifiable personal information.

9. Compensation: The participants will be compensated with: Class credit – Explain: 1 SONA Credit

Other Compensation Requirements: a) The qualifications to participate in this research are: A consenting adult, aged 18 years or older. If you do not meet these qualifications, you will not be included in the research and you will not be compensated.

10. Confidentiality: All efforts, within reason, will be made to keep your personal information private but total privacy cannot be promised. Your information may be shared with MTSU or the government, such as the Middle Tennessee State University Institutional Review Board, Federal Government Office for Human Research Protections, if you or someone else is in danger or if we are required to do so by law.

11. Contact Information: If you should have any questions about this research study or possible injury, please feel free to contact Dr. James Loveless by telephone (615-898-5288) or by email james.loveless@mtsu.edu. You can also contact the MTSU Office of compliance via telephone (615 494 8918) or by email (compliance@mtsu.edu). This contact information will be presented again at the end of the experiment. You are not required to do anything further if you decide not to enroll in this study. Just quit your browser. Please complete the response section on the next page if you wish to learn more or you wish to part take in this study.

APPENDIX F

DEBRIEFING

Thank you for your participation in this research.

Good sleep is of critical importance to our health and wellbeing, and there is much that we do not understand about sleep among college students. If you would like to learn more about sleep or what you can do to improve your sleep quality, please visit https://www.cdc.gov/sleep/index.html.

If you have any questions or concerns about this research, please feel free to reach out to Dr. James Loveless via telephone (615-898-5288) or via email (james.loveless@mtsu.edu). Thank you again!

To finish this study, please click the arrow below (this must be done to receive SONA credit)!