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Examining the sleep hygiene behaviors of migraineurs in a university setting

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EXAMINING THE SLEEP HYGIENE BEHAVIORS OF MIGRAINEURS IN A UNIVERSITY SETTING

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ABSTRACT

Migraine is a commonly-occurring primary headache disorder that is often comorbid with many conditions, including depression, anxiety, and sleep disorders. Previous research has shown that sleep problems are common among migraineurs, with insomnia being the most prevalent. Insomnia in migraineurs has many possible causes, including inadequate sleep hygiene, or participating in behaviors that are not conducive to sleep. Modifying sleep hygiene behavior has been shown to be effective in reducing migraine intensity and frequency, but research characterizing the specific sleep hygiene behaviors of migraineurs is limited. The present study sought to identify problematic sleep behaviors and their association with episodic migraine so as to inform the development and refinement of behavioral sleep interventions to reduce migraine frequency, intensity, and disability. The present study also explored anxiety and depression and their relation to migraine, sleep hygiene, and insomnia among college students, a population of interest because of their high rates of migraine, sleep disturbance, and psychological comorbidities.

The sample consisted of 323 college students with a mean age of 19.28 years (SD = 3.38), with 84 (26%) meeting ICHD-II criteria for episodic migraine and 8 (2.5%) for chronic migraine. Episodic migraineurs reported significantly poorer overall sleep hygiene compared to controls (Sleep Hygiene Index M = 38.24 [SD = 6.71] v. 36.54 [SD = 6.06], $p < .05$). After controlling for symptoms of insomnia, anxiety, and depression, which were significantly higher among migraineurs, however, these differences were rendered nonsignificant. Among episodic migraineurs, linear regression analyses showed that poorer sleep hygiene significantly predicted

headache-related disability but not migraine severity or frequency. An argument is presented that sleep hygiene is less important among episodic than chronic migraineurs, and directions for future research are discussed.

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Introduction

Migraine Diagnosis

Migraine is a commonly-occurring primary headache disorder that can be extremely disabling and can have a major impact on many areas of an individual's life. Migraine has a lifetime prevalence of 12% among the general population and 18-20% among women (Fukui et al., 2008; Jette, Patten, Williams, Becker, & Wiebe, 2008). Many studies have shown that migraine is up to four times more common among women than among men (Jelinski et al., 2006; Lyngberg, Rasmussen, Jorgensen, & Jensen, 2005; Stewart, Lipton, Celentano, & Reed, 1992) and is most prominent between the ages of 25 and 44 years (Lipton et al., 2002; Pryse-Phillips et al., 1992). The World Health Organization has ranked migraine as number 19 among all diseases worldwide that cause disability (Leonardi, Musicco, & Nappi, 1998).

Diagnostic criteria for migraine and other headache disorders are outlined in the *International Classification of Headache Disorders, 2nd Edition* (ICHD-II; Headache Classification Subcommittee of the International Headache Society [IHS], 2004). Migraine is defined as "a recurrent headache disorder manifesting in attacks lasting 4-72 hours" either untreated or unsuccessfully treated (IHS, 2004, p. 24). Typical characteristics of migraine attacks are "unilateral location, pulsating/throbbing quality, moderate or severe intensity, aggravation by routine physical activity, and association with nausea and/or vomiting and/or photophobia and

phonophobia" (IHS, 2004, p. 24-25). Migraine can be divided into two major sub-types: migraine without aura (1.1) and migraine with aura (1.2). Though less common than migraine without aura, migraine with aura is distinctively characterized by neurological symptoms (aura) that are usually visual innature and precede or sometimes accompany the other features of migraine. Typical aura (1.2.1) consists of at least one of the following: "fully reversible visual symptoms including positive features (e.g. flickering lights, spots or lines) and/or negative features (i.e. loss of vision), fully reversible sensory symptoms including positive features (i.e. pins and needles) and/or negative features (i.e. numbness), or fully reversible dysphasic speech disturbance" (IHS, 2004, p. 26-27).

Comorbidity of Migraine

The prevalence of co-occurring psychological disorders (i.e., psychological comorbidity) in migraineurs has been explored frequently. Migraine is comorbid with disorders such as major depressive disorder, generalized anxiety disorder, panic disorder, bipolar disorder, and social phobia (Breslau & Davis, 1992, 1993; Breslau, Davis, Schultz, & Peterson, 1994; Breslau, Lipton, Stewart, Schultz, & Welch, 2003; Breslau, Shultz, Stewart, Lipton, & Welch, 2001; Ettinger, Reed, Goldberg, & Hirschfeld, 2005; Lipton, Hamelsky, Kolodner, Steiner, & Stewart, 2000; McIntyre et al., 2006; Stewart, Breslau, & Keck, 1994). Conflicting findings exist pertaining to the comorbidity of substance use disorders with migraine (Jette et al., 2008; Saunders, Merikangas, Low, Von Korff, & Kessler, 2008; Swartz, Pratt, Armenian, Lee, & Eaton, 2000). The most common classes of psychological disorders that are comorbid with migraine are depressive and anxiety disorders (Lanteri-Minet, Radat, Chautard, & Lucas, 2005; Oedegaard et al., 2006). Several large-scale population-based studies have shown that migraineurs are two to four times more likely to suffer from depression and anxiety disorders

than are individuals in the general population without migraine (Boardman, Thomas, Millson, & Croft, 2005; Breslau et al., 1994, 2003; Jette et al., 2008; Merikangas, Angst, & Isler, 1990; Ohayon, 2004), with panic disorder and phobias being the most common comorbid anxiety disorders (Breslau & Davis, 1992; Breslau et al., 2001; Radat & Swendsen, 2005; Stewart et al., 1994).

A bidirectional relationship has been implicated for migraine and depression, suggesting that each disorder increases risk for onset of the other and arguing against the traditional notion that depression is merely a response to living with disabling migraines (Breslau et al., 1994, 2003). A bidirectional relationship has also been implicated between migraine and panic disorder (Breslau et al., 2001), although further research is needed to clarify the temporal relationship between anxiety disorders and migraine. These findings suggest that psychological comorbidities may share etiological pathways with migraine. As one example, reduced serotonergic transmission is common in both migraine and anxiety/depression (Breslau et al., 1994; Panconesi, 2008), and both conditions respond favorably to medications that increase serotonergic activity.

Psychological comorbidities in migraineurs have become an increasing concern since the World Health Organization has ranked both migraine and major depressive disorder as leading causes of disability worldwide (Jette et al., 2008; Simon, 2003; Ustun & Kessler, 2002), with anxiety disorders also ranked as highly disabling among psychological disorders (Kessler, Chiu, Demler, & Walters, 2005). Studies have already shown that migraine (with and without psychological comorbidity) causes a significant reduction in quality of life, loss of productivity, and increased health care costs, among other practical liabilities (Hu, Markson, Lipton, Stewart, & Berger, 1999; Lipton et al., 2000; Von Korff, Stewart, Simon, & Lipton, 1998; Baskin &

Smitherman, 2009). Furthermore, it is important to identify psychological comorbidities in migraineurs because these comorbidities may complicate the diagnosis and treatment of migraine, affect treatment adherence, or alter the course of migraine (Baskin, Lipchik, & Smitherman, 2006; Baskin & Smitherman, 2009).

Role of Sleep Dysfunction in Migraine

In addition to research on affective comorbidities, headache researchers have begun to look at other comorbidities (Peres, Young, Kaup, Zukerman, & Silberstein, 2001; Peres, Zukerman, Young, & Silberstein, 2002). Some of the most common other comorbidities that accompany migraine are sleep disorders. Sleep disorders that are comorbid with migraine and other headache include circadian rhythm disorders (Ohayon, 2005), chronic snoring (Jennum, Hein, Suadicani, & Gyntelberg, 1994), sleep apnea (Ulfberg, Carter, Talback, & Eding, 1996) and other sleep-related breathing disorders (Olson, King, Hensley, & Saunders, 1995), parasomnias (Goder et al., 2003), and hypersomnia (Goder et al., 2003). The most common sleep disorder in migraineurs, however, is insomnia (Maizels & Burchette, 2004; Ohayon, 2004; Paiva, Martins, Batista, Esperanca, & Martins, 1994; Rains & Poceta, 2006; Rothrock, Patel, Lyden, & Jackson, 1996).

Early research on headache and sleep was unclear as to whether sleep disturbance consistently accompanies migraine in the absence of other psychological comorbidities or whether sleep disturbance is a complication of co-occurring psychological disorders (Wright, 1871). However, current research has shown that a disproportionate prevalence of sleep disturbances in migraine persists even after controlling for psychological comorbidities such as anxiety and depression (Vgontzas, Cui, & Merikangas, 2008) and is thus not merely a consequence of affective comorbidities. Not only has migraine been implicated to precede sleep

disturbance (Inamorato, Minatti-Hannuch, & Zukerman, 1993; Marcus, 2006), but insomnia and the aforementioned sleep disturbances also often function as "triggers" for migraine (Fukui et al., 2008; Kelman, 2007; Spierings, Ranke, & Honkoop, 2001).

A migraine trigger is an environmental or physiological event that produces (or predisposes an individual to) a migraine attack. Many studies have examined the different types of migraine triggers, though most of them rely on retrospective recall rather than prospective data. Kelman (2007) found that 75.9% of migraineurs reported experiencing triggers, with 35.5% reporting that they occurred at least frequently and 94.6% reporting that they occurred at least occasionally. Sixty-one percent of patients reported having between four and nine triggers (M = 6.7; Mdn = 7.7). The most common triggers reported were stress, hormonal changes (in women), not eating, weather changes, and sleep disturbances, all of which were present in roughly 50% of the migraine sample. Another study by Fukui et al. (2008) found that dietary factors, sleep disturbance, environmental factors, and stress were among the most common migraine triggers. Marcus (2003) found that 26% of approximately 300 headache patients reported changes in sleep as a trigger for migraine. Similarly, Jerusalimschy and Moreira-Filho (2002) found that 49% of headache patients reported sleep disturbance as a trigger for their headache. More specifically, Spierings et al. (2001) found that 74% reported sleeplessness as a headache trigger. Taken together, and despite large variability in estimates, these studies provide strong support for the notion that sleep disturbances are common among migraineurs and function frequently as migraine triggers (for ¼ to ¾ of migraineurs).

The rate at which sleep disturbances co-occur with migraine (even when controlling for other comorbidities) is suggestive of a potential shared etiology between these conditions. It has been suggested that migraine can occur because of circadian changes in levels of serotonin,

melatonin, and magnesium (Dodick, Eross, & Parish, 2003; Marcus, 2006). At night, circulating tryptophan is converted to serotonin in the pineal gland, which is then converted to melatonin. Serotonin and melatonin released from the pineal gland influence activity of the trigeminovascular system (Marcus, 2006; Toglia, 2001). Altered neuronal activity in the trigeminovascular system (specifically the trigeminal nerve, spinal trigeminal nucleus, and thalamus) elicits migraine through nociceptive afferents to the brain and meningeal blood vessels, which causes the perception of pain (Messlinger, 2009). Although evidence is growing that sleep and migraine share common pathophysiology, further research is needed to clarify the mechanisms that underpin this relationship.

Insomnia in Migraine

Insomnia is typically defined in research studies as a sleep disturbance characterized by getting ≤ 6 hours of continuous sleep, difficulty falling asleep or staying asleep, early morning awakening or non-restorative sleep, and daytime consequences such as sleepiness. The International Classification of Sleep Disorders- 2nd edition (ICSD-2; AASM, 2005) classifies insomnia by its severity: mild, moderate, or severe. With mild insomnia there is little to no evidence of impairment in functioning, with moderate insomnia there is mild to moderate evidence of impairment in social or occupational functioning, and with severe insomnia there is obvious and severe impairment in functioning. All severities are associated with feelings of restlessness, irritability, mild anxiety, daytime fatigue, and tiredness (AASM, 2005).

Insomnia or insomnia-like symptoms are often present in migraineurs. Fukui et al. (2008) found that among reported sleep disturbances, lack of sleep occurred in 61.5% of migraineurs. More specifically, in one of the largest samples of migraineurs studied to date (Kelman & Rains, 2005), 38% of 1,283 migraineurs suffered from insomnia-like symptoms (sleeping no more than

6 hours per night), compared with 10% of the general population (AASM, 2005). Thirty-one percent of migraineurs reported problems falling asleep and 39% reported problems staying asleep. In this study, greater frequency of migraine was related to shorter sleep episodes, in that patients with chronic migraine reported shorter sleep episodes than those with episodic migraine. Gori et al. (2005) also found that poor sleep was reported by 64% of migraineurs compared to 33% of controls. The most commonly reported sleep disturbance was inability to fall asleep. Although the range of these percentages is large, it is clear that migraineurs are significantly more likely to suffer from insomnia-like symptoms than are those without migraine. Indeed, the finding of insomnia as the most commonly reported sleep disturbance is consistent throughout the migraine literature (Blau, 1990; Calhoun & Ford, 2007; Calhoun, Ford, Finkel, Kahn, & Mann, 2006; Inamorato et al., 1993; Rains & Poceta, 2006). Specifically, odds ratios of having insomnia for a migraineur versus nonmigraineur have been reported as 2.1 (Ohayon, 2004), 2.9 (Rasmussen, 1993), and 2.5 (Vgontzas et al., 2008).

Insomnia can be precipitated by many factors. These may include substance or stimulant use, a comorbid anxiety or mood disorder, pain or another medical condition, being in an environment that is not conducive to sleep, or by engaging in behaviors that are not conducive to sleep (Calhoun et al., 2006). Most of these environmental factors and behaviors that are not conducive to sleep can be classified as inadequate sleep hygiene.

Inadequate Sleep Hygiene

Inadequate sleep hygiene (ISH) is defined in the ICSD-R (AASM, 2001) as a "sleep disorder due to the performance of daily living activities that are inconsistent with the maintenance of good quality sleep and full daytime alertness" (AASM, 2001, p. 73). The newest version of the ICSD, the ICSD-2 (AASM, 2005), describes ISH as one of eleven disorders that

contributes to insomnia. At least one of the following behaviors must be present in order qualify for a diagnosis of ISH (however, many are often present):

> 1) Daytime napping at least two times each week, 2) variable wake-up times or bedtimes, 3) frequent periods (two to three times per week) of extended amounts of time spent in bed, 4) routine use of products containing alcohol, tobacco, or caffeine in the period preceding bedtime, 5) scheduling exercise too close to bedtime, 6) engaging in exciting or emotionally upsetting activities too close to bedtime, 7) frequent use of the bed for non-sleep-related activities (e.g., television watching, reading, studying, snacking, etc.), 8) sleeping on an uncomfortable bed (poor mattress, inadequate blankets, etc.), 9) allowing the bedroom to be too bright, too stuffy, too cluttered, too hot, too cold, or in some way not conducive to sleep, 10) performing activities demanding high levels of concentration shortly before bed, or 11) allowing mental activities, such as thinking, planning, reminiscing, etc., to occur in bed (AASM, 2001, p. 76).

Complaints of insomnia or excessive sleepiness, or abnormal polysomnography findings, are also required to receive a formal diagnosis of ISH. ISH is present in approximately 2% of the general population and in 5-10% of sleep clinic samples (AASM, 2005).

Many of the aforementioned behaviors disturb sleep (Riedel, 2000; Stepanski & Wyatt, 2003) and there is a significant association between poor global sleep hygiene and poor sleep quality (Brown, Buboltz, & Soper, 2002; Gallasch & Gradisar, 2007; Lacks & Rotert, 1986; Mastin, Bryson, & Corwyn, 2006). For example, Brown et al. (2002) found that variable sleep schedules, going to bed thirsty, environmental noise, and worrying while falling asleep contributed most to reported poor sleep quality. Other studies have reported similar findings (Jefferson et al., 2005; Yang, Lin, Hsu, & Cheng, 2010). Inadequate sleep hygiene is sometimes

hard to identify because it is often confused with environmental sleep disorder (because of symptom overlap) (AASM, 2005) or is often ignored as a cause for the primary diagnosis of insomnia (Buysse et al., 1994). A DSM-IV (APA, 1994) field trial conducted by the American Psychological Association/National Institute of Mental Health showed that only 6.2% of patients in sleep clinics with a presenting complaint of insomnia were given a primary diagnosis of ISH (Buysse et al., 1994). However, when secondary diagnoses were included, 34.2% of the patients held a diagnosis of ISH.

Research is relatively consistent, however, in finding that ISH behaviors (regardless of formal diagnosis) are associated with poor sleep. An early survey using the Sleep Hygiene Awareness and Practice Scale (Lacks & Rotert, 1986) found that insomnia patients engaged in more unhealthy sleep habits than those who slept well (Lacks & Rotert, 1986). A more recent study using the same scale reported similar results, with poorer sleep hygiene practices in both primary insomnia patients and those with insomnia-like symptoms resulting from a psychological disorder (Kohn & Espie, 2005). Another study compared insomnia patients with non-insomnia controls and found that insomniacs engaged in more maladaptive sleep hygiene practices, including cigarette smoking, alcohol use, napping, and having more variable sleep-wake schedules (Jefferson et al., 2005). In another study (Yang et al., 2010), arousal-related behaviors such as watching TV in bed, worrying before going to sleep, or doing important work before bedtime were found to be significantly different between insomniacs and controls. Taken together, these studies suggest that poor sleep hygiene is a significant factor in insomnia and related sleep complaints, even though ISH often remains undiagnosed in individuals who suffer from insomnia (Gellis & Lichstein, 2009).

Sleep Hygiene Treatment

Good sleep hygiene may be described as practicing behaviors that facilitate sleep and avoiding behaviors that interfere with sleep. Sleep hygiene is usually assessed by the self-report of nighttime behaviors and environmental variables thought to be nonconducive to sleep. Test-retest reliability analysis analyses suggest that these sleep hygiene behaviors are relatively stable over time (Mastin et al., 2006). A study by Brown et al. (2002) surveyed university students and found that the practice of proper sleep habits was related positively to good sleep quality, confirming that sleep hygiene behaviors are valid predictors of other important sleep-related variables. Because of their importance in sleep disorders, modifying sleep hygiene behaviors has become an integral part of interventions designed to improve sleep. Hauri first introduced sleep hygiene as a treatment for insomnia in 1977. Today, sleep hygiene treatment is often subsumed as a component of other behavioral sleep interventions such as stimulus control therapy, sleep hygiene education, or behavioral sleep modification (Calhoun & Ford, 2007; Edinger et al., 2009; Morin et al., 2006). Although the treatment strategies have evolved over the years and sometimes vary from study to study, the underlying principles are the same. The basic principles involve psychoeducation about the role of behavior in sleep, training in basic behavioral strategies to facilitate sleep, training in environmental modification, and instructions to self-monitor and practice these behaviors on a daily basis (Calhoun & Ford, 2007; Edinger et al., 2009; Morin et al., 2006; Vincent & Lewycky, 2009). Sample sleep hygiene strategies might include avoiding caffeine and alcohol in the evening, avoiding daytime naps, avoiding large meals prior to bedtime, and arranging a sleep environment that is conducive to sleep (e.g., not too hot or cold).

A study by Vincent and Lewycky (2009) found that sleep hygiene and stimulus control therapy were effective treatments for insomnia. In fact, a review by Morin et al. (2006) included stimulus control therapy and cognitive behavioral therapy (CBT; with sleep hygiene as a major component) as empirically supported treatments for insomnia. Like CBT, most other insomnia treatment programs have incorporated sleep hygiene as one facet of a multicomponent approach to treatment that typically includes relaxation training, cognitive therapy, stimulus control, and/or sleep restriction therapy (Morin et al., 2006). A study by Scholcket, Bertelson, and Lacks (1988) evaluated meditation, stimulus control therapy, and sleep hygiene as treatments for insomnia. They found that sleep hygiene was effective in treating insomnia, as were the other treatments, but this study had no control group for comparison. Friedman et al. (2000) compared sleep hygiene to other behavioral sleep interventions and found that sleep hygiene treatment alone was just as effective as combined sleep hygiene/sleep restriction therapy and combined nap modification (of sleep restriction therapy)/sleep hygiene. On the other hand, a study by Edinger et al. (2009) showed that sleep hygiene was not as effective as CBT at treating insomnia, the latter which included sleep hygiene education and stimulus control therapy in combination with sleep restriction. These studies in combination suggest that sleep hygiene, often as part of a larger treatment module, is effective in treating insomnia.

Sleep Hygiene in Migraineurs

Despite the role of insomnia and sleep disorders in migraine (both as triggers and comorbidities), the utility of using sleep hygiene interventions to reduce migraine has been explored only recently. In one of the only migraine-specific studies to date, Calhoun and Ford (2007) hypothesized that behavioral sleep modification (BSM) would be associated with improvement in headache frequency and intensity in a group of treatment-seeking females with

chronic migraine. They randomly assigned 43 women to receive either one session of BSM instructions or one session of 'sham' instructions. BSM consisted of providing participants a set of five sleep hygiene instructions including: 1) scheduling a consistent bedtime allowing eight hours in bed, 2) eliminating TV watching, reading, and music in bed, 3) using visualization techniques prior to sleep, 4) eating dinner at least four hours prior to bed and limiting fluids within two hours of bedtime, and 5) discontinuing naps. All participants received usual medical care in addition to either the behavioral intervention or the sham/placebo intervention.

Compared to the placebo group, the BSM group experienced significantly greater reductions in headache frequency and intensity at six-week follow-up. Thirty-five percent of chronic migraineurs reverted to episodic migraine within this time period, compared to none of the patients in the placebo group. Once the blind was broken and participants were followed for another six weeks, 48% had reverted to episodic migraine. Compliance with the BSM intervention was positively correlated with improvement, such that participants adhering to all five instructions reported the most improvement. On the other hand, participants who adhered to less than three instructions did not see a significant reduction in headache frequency or intensity. This study showed that a brief behavioral intervention including sleep hygiene is effective in reducing the frequency and intensity of migraine among those with chronic migraine. Another study by Bruni, Galli, and Guidetti (1999) also found sleep hygiene modification effective at reducing migraine frequency and duration among children and adolescents with migraine, but the specific treatment instructions were not clearly outlined in the publication of this study.

Whereas other studies (Gellis & Lichstein, 2009; Jefferson et al. 2005) have examined specific sleep behaviors characteristic of insomniacs, research on the specific sleep behaviors common to migraineurs is sparse. Only one study has examined sleep behaviors common to

adult migraineurs. Calhoun et al. (2006) surveyed females with transformed (chronic) migraine presenting to a headache center. They found that chronic migraineurs consistently engaged in a number of maladaptive sleep behaviors, such as watching TV or reading in bed (78.9%), nocturia (70.1%; i.e., due to eating or drinking prior to bedtime), taking naps (63.3%), and spending too much (≥ 9.5 hours; 18.5%) or too little (≤ 6.5 hours; 18.5%) time in bed. Further, a significant minority reported drinking alcohol during the week (0-1 drinks per week, 79.5%; 2-4 drinks, 15.6%). However, this study did not contain a migraine-free control group for comparison and did not consider sleeping to relieve migraine as napping. This study also did not include men or individuals with episodic migraine. Another study by Bruni et al. (1997, 1999) examined specific sleep behaviors in children and adolescent migraineurs. They found that the migraine participants consistently fell asleep later (after 11 p.m.- 16.0% v. 7.0%, $p < .001$), woke up later (after 8 a.m.- 3.5% v. 0.2%, $p < .0001$), napped more during the day (7.4% v. 3.3%, $p < .005$), and had a more varied bedtime (10.6% v. 5.8%, $p < .05$) and waking time (9.2% v. 1.7%, $p < .0001$) than did the nonmigraineurs. This study selected and treated only the most sleep-disturbed migraineurs and used only some of the AASM (2001, 2005) criteria to characterize poor sleep hygiene. The criteria included: bedtime later than 11 p.m., waking time later than 8 a.m., napping during the day, irregular schedule (bedtime and wake time varying by more than one hour on school days), caffeine in the late afternoon or evening, and the need to drink fluids or take drugs to facilitate sleep. The study required that at least two of these criteria be met in order to be characterized as poor sleep hygiene. Thus, while the existing literature has provided some preliminary evidence that modifying sleep hygiene behaviors is effective in reducing migraine frequency, evidence is lacking regarding which specific sleep hygiene behaviors are common and problematic among adult episodic migraineurs in community samples.

Goals and Hypotheses of the Present Study

The aims of the present study were to identify the specific maladaptive sleep behaviors that distinguish migraineurs from individuals without migraine, assess relations between sleep hygiene and migraine variables, and assess the roles of depression and anxiety in sleep hygiene practices. Unlike the Calhoun et al. (2006) study that lacked a control group, the current study used individuals without migraine as a control group. The current study also included men and individuals with episodic migraine. College students served as participants in the current study in order to elucidate the relationship between migraine and specific problematic sleep behaviors in a non-treatment-seeking community sample.

College students were recruited as participants due to their inconsistent sleep patterns and maladaptive sleep behaviors, and because there is a paucity of research in this area despite the high prevalence of both sleep problems and migraine among college students. Approximately 25% of college students suffer from migraine (Bigal, Bigal, Betti, Bordini, & Speciali, 2001), and the prevalence of migraine rises dramatically during the college years (late teens to mid-twenties; Lipton, Bigal, Hamelsky, & Scher, 2008). Further, at least two-thirds of college students report occasional sleep disturbances, and about one-third of these report severe sleep difficulties (Coren, 1994; Lack, 1986). The large majority of college students have moderate to severe sleep complaints, and only 11% of students report good sleep quality (Brown et al., 2002; Buboltz, Brown, & Soper, 2001). Because of the high prevalence of sleep problems among college students, their use as a sample for this study is of particular relevance. College life likely contributes to maladaptive sleep patterns, which in turn places students at risk for onset of migraine and subsequent disability (Brown et al., 2002; Rains & Poceta, 2006). In essence, the sleep disturbances that occur during the college years may function as etiological factors in the

subsequent development of migraine. The present study thus endeavored to identify problematic sleep behaviors and their association with migraine so as to inform the development and refinement of subsequent behavioral sleep interventions to reduce migraine frequency, intensity, and disability.

The following specific goals and hypotheses were proposed:

Study Goal 1: To determine if migraineurs engage in poorer sleep hygiene than do nonmigraineurs.

Hypothesis 1a: Poor sleep hygiene will differentiate migraineurs from controls.

Hypothesis 1b: Migraineurs will engage in poorer sleep hygiene than nonmigraineurs even after controlling for comorbid depression/anxiety and/or insomnia symptoms.

Study Goal 2: To identify specific patterns of problematic sleep hygiene behaviors that characterize migraineurs.

Hypothesis 2: Migraineurs will differ from controls on specific sleep hygiene behaviors (e.g., not having a consistent sleep/wake schedule, more frequent napping, spending more time in bed, and going to bed physically or emotionally aroused).

Study Goal 3: To determine if migraineurs' poor sleep hygiene is predictive of migraine-related variables.

Hypothesis 3: The severity of poor sleep hygiene will be a significant predictor of migraine frequency, migraine severity, and migraine-related disability.

Methods

Participants

Participants were undergraduate students at the University of Mississippi who received modest course credit for their participation. Participants included those who suffered from migraine headaches and healthy controls who did not suffer from any type of primary headache other than episodic tension-type headache. Participants who screened positive for migraine were administered a structured headache interview to confirm the migraine diagnosis. Those verified as migraineurs comprised the migraine group. Controls were those who denied experiencing problematic headaches. Assuming a small to moderate effect size ($f^2 = 0.08$), a power level of 0.80, and an alpha level of 0.05, a total sample size of 236 participants was required.

Measures

Demographic Questionnaire. The Demographic Questionnaire consisted of a number of questions that assess for basic information such as age and gender, and other more specific questions related to general disability and other headache/migraine variables and symptoms. This questionnaire can be found in Appendix A.

ID Migraine. The ID Migraine (Lipton et al., 2003) is a three-item self-administered measure used to screen for migraine in the primary care setting. The three items assess for migraine-related disability and the symptoms of nausea and light sensitivity, which are uniquely characteristic of migraine. The endorsement of two or more items is considered a positive screen for migraine (Lipton et al., 2003). The ID Migraine is one of the briefest but most valid and

reliable screeners of migraine currently used in research. Construct validity of ID Migraine scores was established in the original study by comparing positive screens on the measure to migraine diagnoses made by headache specialists in a large primary care setting (Lipton et al., 2003). Validity of ID Migraine scores was further established in a separate study by comparing the measure to the Brief Headache Screen (Maizels & Houle, 2007). The two measures showed 82.6% agreement (kappa = 0.79). Criterion validity of the measure was also established in the original study. The final three items (out of nine original diagnostic screening questions) showed a sensitivity of 0.81 and a specificity of 0.75 (positive predictive value = 0.93). Test-retest reliability was also high (kappa = 0.68; Lipton et al., 2003). This measure can be found in Appendix B.

Brief Headache Screen. The Brief Headache Screen (BHS; Maizels & Burchette, 2003) is a seven-item measure that was designed to screen for migraine and drug-rebound headache, as well as assess for satisfaction with current medication and desire for preventative medication. The diagnostic portion of the BHS consists of three questions specifically assessing the frequency of severe (disabling) headache, mild headache, and medication use. A score of 1-3 on the first and second items signifies episodic migraine. Four of the seven questions require the rater to rate each item on a four point Likert-type scale (0 = *almost never*, 4 = *daily or near daily*), while the other three questions require a yes or no response. As mentioned above, BHS scores showed high reliability and validity when compared to the ID Migraine (Maizels & Houle, 2007) and in the original study (93% specificity for migraine based on responses to Question 1; Maizels & Burchette, 2003). This measure can be found in Appendix C.

Sleep Hygiene Index. The Sleep Hygiene Index (SHI; Mastin et al., 2006) is a 13-item self-report measure used to assess the presence of behaviors that comprise the criteria for ISH as

classified by the ICSD-R (AASM, 2001). The SHI assesses how frequently the respondent engages in specific sleep behaviors, using a five point Likert-type scale ranging from *always* to *never*. Scores range from 13-65 with higher summed scores on the index indicating more maladaptive sleep behaviors. SHI scores have adequate test-retest reliability ($r = 0.71$) and internal consistency ($\alpha = 0.66$) that is superior to that of scores of previously published sleep hygiene instruments (Mastin et al., 2006). SHI scores have shown good validity as evidenced by significant correlations ($p < .01$) with the Epworth Sleepiness Scale ($r = 0.244$; Johns, 1991) and the Pittsburgh Sleep Quality Index ($r = 0.481$; Buysse, Reynolds, Monk, Berman, & Kupfer, 1988), indices that have shown to be related to the construct of sleep hygiene (Mastin, Peszka, Poling, Phillips, & Duke, 2005). The current study examined both the total SHI score as well as group differences on individual sleep behaviors (items). This measure can be found in Appendix D.

Migraine Disability Assessment Questionnaire. The Migraine Disability Assessment Questionnaire (MIDAS; Stewart, Lipton, Dowson, & Sawyer, 2001) is a seven-item measure that assesses headache-related disability. The MIDAS requires the migraine sufferer to answer five questions, counting the number of days in the past three months that migraine has limited his/her activities at school/work, at home, and in social activities. The first five items are summed, resulting in a global disability score with scores 0-5 indicating little or no disability, 6-10 indicating mild disability, 11-20 indicating moderate disability, and ≥ 21 indicating severe disability. The final two questions on the measure ask the individual to notate the frequency and intensity of his/her headaches. The internal consistency, test–retest reliability, and validity of MIDAS scores have been established in many different populations ($\alpha = 0.73$-0.76; Stewart et al., 1999; Stewart, Lipton, & Sawyer, 1999). Validity of MIDAS scores was also established by

comparing the measure to a 90-day headache diary in migraineurs (Stewart et al., 2000) and by comparing the measure in migraineurs and controls (Bigal, Rapoport, Lipton, Tepper, & Sheftell, 2003). This measure can be found in Appendix E.

Headache Impact Test-6. The Headache Impact Test-6 (HIT-6; Kosinski et al., 2003) is a six-item self-report measure of headache-related disability. This measure requires the individual to rate each item on a five point Likert-type scale from *never* to *always*. Scores range from 36-78, with ≤ 49 characterized as little to no impact on life, 50-55 as some impact, 56-59 as substantial impact, and ≥ 60 as severe impact. HIT-6 scores have shown to be a reliable and valid measure of headache-related disability in the general population (with internal consistency = 0.89, alternate forms reliability = 0.90, and test-retest reliability = 0.80; Kosinski et al., 2003) and in treatment-seeking individuals (α = 0.87; Kawata et al., 2005). This measure can be found in Appendix F.

Pittsburgh Sleep Quality Index. The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1988) is a 24-item measure that assesses sleep disturbance on seven dimensions: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction (Buysse et al., 1988). Scores from these seven areas are summed resulting in a global score ranging from 0-21. Internal homogeneity, internal consistency, and test-retest reliability were established in the original study by Buysse et al. (1988) in a clinical sample of individuals with depression and sleep disorders. They found that global PSQI scores > 5 showed 89.6% sensitivity and 86.5% specificity for detecting "good" and "poor" sleepers. These statistics have since been replicated in a non-clinical sample of adults (Grandner, Kripke, Yoon, & Youngstedt, 2006) and insomniacs (sensitivity of 98.7, specificity of 84.4, and α = 0.85; Backhaus, Junghanns, Broocks, Riemann, & Hohagen, 2002). This

measure can be found in Appendix G.

Epworth Sleepiness Scale. The Epworth Sleepiness Scale (ESS; Johns, 1991) is a self-administered eight-item measure of daytime sleepiness in adults. Respondents rate items pertaining to the likelihood of dozing during various activities on a four point Likert-type scale, ranging from 0 (*would never doze*) to 3 (*high chance of dozing*). Ratings on the ESS are summed with a score < 10 considered normal (although < 5 is desirable), 10-15 considered as moderate sleepiness, and 16-24 as severe sleepiness. The ESS is one of the most widely used paper-pencil measures of daytime sleepiness in adults (Rains & Poceta, 2006) and has been validated against polysomnographic recordings of an individual's tendency to fall asleep (Johns, 1991). Reliability and internal consistency of ESS scores also has been established in a study comparing healthy medical students to individuals with obstructive sleep apnea ($\alpha = 0.88$) (Johns, 1992). This measure can be found in Appendix H.

Patient Health Questionnaire-9. The Patient Health Questionnaire-9 (PHQ-9; Spitzer, Kroenke, & Williams, 1999) is a self-administered measure of depression that is commonly used for the purpose of screening for depression among medical patients (Kroenke, Spitzer, & Williams, 2001). The PHQ-9 assesses the nine diagnostic criteria for a major depressive episode according to the Diagnostic and Statistical Manual of Mental Disorders (APA, 2000). Scores range from 0-27 with scores of 5, 10, 15, and 20 reflecting mild, moderate, moderately severe, and severe depression, respectively. The PHQ-9 is one of the most commonly used and validated brief measures of depression in use today among medical patients (Fann et al., 2005; Huang, Chung, Kroenke, Delucchi, & Spitzer, 2006; Kroenke & Spitzer, 2002; Lowe, Kroenke, Herzog, & Grafe, 2004; Martin, Rief, Klaiberg, & Braehler, 2006; Pinto-Meza, Serrano-Blanco, Penarrubia, Blanco, & Haro, 2005) and has strong psychometric properties. Construct validity

was established by comparing the PHQ-9 to the 20-item Short-Form General Health Survey, self-reported sick days and doctor's visits, and symptom-related disability (Spitzer, William, & Kroenke, 2000). Criterion validity was established by comparing the PHQ-9 against an independently structured mental health professional interview in a sample of 580 people (Kroenke et al., 2001). Specifically, a PHQ-9 score ≥ 10 was shown to have a sensitivity of 88% and a specificity of 88% for identifying major depression (Kroenke et al., 2001). This measure can be found in Appendix I.

GAD-7. The GAD-7 (Spitzer, Kroenke, Williams, & Lowe, 2006) is a self-report measure used to screen for Generalized Anxiety Disorder (GAD). The GAD-7 consists of seven items that reflect the DSM-IV-TR (APA, 2000) diagnostic criteria for Generalized Anxiety Disorder. Each item requires the respondent to indicate the frequency of each symptom over the past two weeks. Each item is rated on a 4-point Likert-type scale ranging from 0 (*not at all*) to 3 (*nearly every day*). GAD-7 scores range from 0-21 with scores ≥ 5 indicating mild anxiety, scores ≥ 10 indicating moderate anxiety, and scores ≥ 15 indicating severe anxiety (Spitzer et al., 2006).

The GAD-7 is one of the most commonly used, easily accessible, and validated brief measures of anxiety used in medical research today (Hallgren & Morton, 2007; Lowe et al., 2008). Initial use of the measure by Spitzer et al. (2006) showed that GAD-7 scores had excellent internal consistency ($\alpha = 0.92$), test-retest (procedural) reliability (intraclass correlation = 0.83), good reliability and good criterion, construct, factorial, and procedural validity in primary care patients. Scores ≥ 10 also showed high sensitivity (89%) and specificity (82%) for diagnosing GAD (Spitzer et al., 2006). GAD-7 scores were also shown to be reliable and valid in a study of more than 5000 subjects in the general population (Lowe et al., 2008). Most recently, the GAD-7

has also been shown to be effective at detecting other anxiety disorders such as panic disorder, social phobia, and posttraumatic stress disorder (Kroenke, Spitzer, Williams, Monahan, & Lowe, 2007). This measure can be found in Appendix J.

Structured Diagnostic Interview for Headache – Revised (Brief Version). The Structured Diagnostic Interview for Headache-Revised (SDIH-R; Penzien, Bartley, Rhudy, & Rains, 2007) consists of 17 questions assessing migraine and contains appendices for assessing aura symptoms, cluster headache symptoms, medication over-use symptoms, and post-traumatic headache symptoms. The majority of questions assess migraine pain location, headache intensity, pain features, frequency, history, duration, and other migraine symptoms. Responses to this interview allow for determination of a migraine diagnosis based on criteria of the ICHD-II (IHS, 2004). In the current study, migraine participants were defined as those who met ICHD-II diagnostic criteria for migraine (ICHD code 1.1), typical migraine with aura (1.2.1), or chronic migraine (1.5.1). This measure can be found in Appendix K.

Procedures

After providing written informed consent, participants completed a packet of questionnaires including the aforementioned measures. Those who screened positive for migraine based on their responses to the ID-Migraine were scheduled to meet individually with a trained headache researcher for administration of the SDIH-R, in order to confirm their diagnostic status. Those who met diagnostic criteria for migraine were assigned to the migraine group. Those denying problematic headaches on the demographic questionnaire, ID-Migraine, and Brief Headache Screen comprised the control group and were not administered the SDIH-R. Participants who screened positive for migraine on the ID-Migraine but did not meet diagnostic criteria for migraine based on the structured interview were assigned to the control group.

(Although not a specific focus of this thesis, individuals who met diagnostic criteria for migraine were asked to engage in two weeks of self-monitoring of their sleep behaviors and migraine patterns as part of an ancillary study. Participants also completed a computerized pain attentional bias task as part of another ancillary study.)

Statistical Analyses

In order to test the main hypothesis, which sought to examine whether episodic migraineurs and controls differed on a global score of sleep hygiene, an independent samples t-test was conducted. Subsequently, a series of univariate ANCOVAs were used to determine if the significant difference in global sleep hygiene persisted after individually controlling for symptoms of depression (PHQ-9), anxiety (GAD-7), and insomnia (PSQI and ESS). A MANOVA was conducted in order to test the second hypothesis, which sought to compare the groups on specific sleep hygiene behaviors as indexed by the 13 SHI items while controlling for family-wise Type I error rates given the number of dependent variables assessed. Univariate follow-up ANOVAs of individual items were conducted as appropriate. In addition to examining specific sleep hygiene behaviors, the current study also sought to predict migraine frequency, severity, and headache-related disability using global sleep hygiene scores. Linear regression analyses were conducted in order to determine the amount of variance predicted by global sleep hygiene in these migraine variables. To further explore psychological symptoms comorbid with migraine and sleep disturbance, a MANOVA was performed to determine if the groups differed on insomnia, anxiety, and depression, with follow-up univariate ANOVAs as appropriate. Finally, a chi-square analysis was conducted in order to determine if there were any clinically significant differences between groups on proportions with elevated scores on each psychological variable.

Results

Participant Demographics and Migraine Prevalence

The sample consisted of 323 college students (70.9% female) with a mean age of 19.28 years (*SD* = 3.38). The majority (62.8%) of the sample was Caucasian, 29.1% was African American, 3.1% was Asian, 0.9% was Hispanic/Latino, 1.2% was Native American/Pacific Islander, and 2.8% were of other ethnicities. With regard to migraine, 92 participants (28.5%) met ICHD-II diagnostic criteria for migraine: 84 (26%) with episodic migraine and eight (2.5%) with chronic migraine. Because the present study focused on episodic migraine, chronic migraineurs were excluded from subsequent analyses. Nearly three-quarters (73.8%) of episodic migraineurs were female, and 27.4% experienced aura. Average headache frequency for episodic migraineurs was 5.11 days/month (*SD* = 3.80). They reported an average headache-related disability score of 17.07 (*SD* = 19.15) on the MIDAS and an average score of 60.89 (*SD* = 5.09) on the HIT-6. Although half were classified as having minimal or mild migraine-related disability, 53% of episodic migraineurs endorsed moderate to severe disability on the MIDAS, compared to 84.3% endorsing substantial to severe impact on the HIT-6.

Data Analytic Assumptions

Histograms, Q-Q plots, and descriptive statistics data (i.e., skewness, kurtosis) were used to assess data analytic assumptions for the main total scores of interest (SHI, ESS, PSQI, PHQ-9, GAD-7) to be compared between episodic migraineurs and controls and found satisfactory. Levene's test of equality of error variances confirmed that homogeneity of variance was met for

all main criterion variables. Episodic migraineurs and control participants were then assessed for multivariate outliers on the main total scores of interest by group using Mahalanobis distance; one multivariate outlier was found using a conservative $p < .001$ cutoff (control participant) and was thus removed from subsequent analyses.

Sleep Hygiene and Its Associations

Regarding sleep hygiene, over half of the entire sample (episodic migraineurs and controls) endorsed *frequently* or *always* engaging in poor sleep hygiene behaviors such as going to bed at different times each day (56.7%); doing something mentally stimulating before bedtime (58.9%); using the bed for things other than sleep and sex (61.8%); doing important work before bedtime (56.5%); and thinking, planning, or worrying when in bed (56.7%) (see Table 1). Episodic migraineurs obtained significantly higher total scores on the SHI than controls (M = 38.24 [SD = 6.71] v. 36.54 [SD = 6.06], $p < .05$), indicating that they evidenced poorer overall sleep hygiene. After controlling for symptoms of insomnia, anxiety, and depression using separate ANCOVAs, however, these differences were rendered nonsignificant: PSQI overall model: $F(1,284) = .076$, $p = .783$, partial $\eta^2 = .000$; ESS overall model: $F(1,305) = 2.45$, $p = .119$, partial $\eta^2 = .008$; PHQ-9 overall model: $F(1,311) = .116$, $p = .733$, partial $\eta^2 = .000$; GAD-7 overall model: $F(1,310) = .518$, $p = .472$, partial $\eta^2 = .002$. Notably, the corresponding covariate effect size values (η^2) ranged from .093 (ESS) to .242 (PHQ-9); the effect size of insomnia as measured by the PSQI was higher than that of the ESS (.175 vs. .093, respectively).

The overall MANOVA comparing groups on the 13 SHI items was nonsignificant, $F(13,295) = 1.076$, $p = .379$, partial $\eta^2 = .045$. Although the MANOVA was nonsignificant, because the overall sleep hygiene score differed significantly between the groups, an ANOVA was performed on individual items to aid in interpretation. Of all the items, only the variable of

"going to bed feeling stressed, angry, upset, or nervous" differed significantly between groups, $F(1,312) = 6.46$; $p = .012$, partial $\eta^2 = .020$. However, applying a Bonferroni correction to this result (requiring a $p < .004$, given the non-significant MANOVA) would not retain statistical significance. There was no difference in sleep hygiene between episodic migraineurs with and without aura ($M = 39.00$ [$SD = 7.08$] v. 36.22 [$SD = 5.23$], $p = .09$).

Headache-Related Disability

Among episodic migraineurs, linear regression analyses confirmed that poorer sleep hygiene significantly predicted headache-related disability as measured by both the MIDAS and HIT-6, accounting for 11.0% and 7.7% of variance in headache disability, respectively (see Table 2). Despite its relationship with insomnia though, sleep hygiene did not predict migraine severity or frequency as obtained from SDIH-R responses. Insomnia (as measured by the PSQI), conversely, significantly predicted headache-related disability as measured by the MIDAS ($R^2 =$ 18.2%) and HIT-6 ($R^2 = 6.8\%$), as well as migraine frequency ($R^2 = 14.8\%$), but not headache severity. No significant differences emerged between episodic migraineurs with and without aura in headache-related disability or migraine frequency or severity (see Table 3).

Psychological Variables

Bivariate correlational analyses showed that global sleep hygiene scores were significantly correlated with psychological variables including insomnia (PSQI: $r = .432$, $p <$ .001; ESS: $r = .315$, $p < .001$), depression ($r = .503$, $p < .001$), and anxiety ($r = .447$, $p < .001$) for the entire sample. In comparing episodic migraineurs and controls on these variables using a MANOVA, the Wilks' lambda multivariate criterion for overall group differences was significant, $F(4,276) = 7.756$, $p < .0001$ (partial $\eta^2 = .101$), indicating that episodic migraine and nonmigraine participants differed on the combination of variables relevant to the psychological

impact of migraine. No significant differences emerged between episodic migraineurs with and without aura on any of the assessed psychological variables (see Table 4). Subsequent univariate ANOVAs revealed that episodic migraineurs reported statistically higher levels of insomnia (as measured by the PSQI), depression, and anxiety than did controls (see Table 5). The difference between daytime sleepiness approached significance, though the majority of participants in both groups reported clinically significant elevations on this variable (ESS ≥ 10 indicating disordered sleep) (see Table 6).

Efforts to quantify clinically significant differences involved comparing the proportion of each group achieving an elevated score on the psychological variables of interest (i.e., PSQI > 5; ESS, PHQ-9, and GAD-7 ≥ 10). As is evident from Table 6, a large proportion of both groups endorsed clinically significant problems with sleep pertaining to daytime sleepiness (44.8% of sample) and insomnia (68.3% of sample), as well as elevated levels of depression (25.5%) and anxiety (23.0%). However, a significantly higher proportion of migraineurs than controls achieved clinically significant elevations on insomnia, depression, and anxiety scores. No differences in daytime sleepiness were observed, consistent with results of nonsignificant findings on the univariate ANOVA between groups.

Discussion

The present study sought to identify associations between problematic sleep hygiene behaviors and episodic migraine so as to inform the development and refinement of subsequent behavioral sleep interventions to reduce migraine symptomatology. The present study also explored psychological disorders such as anxiety and depression and their relation to migraine, sleep hygiene, and insomnia in college students, a population of interest because of their high rates of migraine (Bigal et al., 2001; Lipton et al., 2008), sleep disturbances (Brown et al., 2002; Coren, 1994; Lack, 1986), and psychological comorbidities (Kessler et al., 2005; Smitherman, McDermott, & Buchanan, 2011). Conclusions from the current study are strengthened by the fact that many of our observations were consistent with previous studies on this population of interest.

First, the observed prevalence of episodic migraine was consistent with previous studies on college students. The current study observed a prevalence of 28.5% while both Bigal et al. (2001) and Smitherman et al. (2011) observed a prevalence approximating 25%. Secondly, the observed prevalence of sleep disturbance was also consistent with previous studies among this population (Buboltz et al., 2001). In the current study, 68.3% of the total sample (85.9% of migraineurs, 61.7% of controls) reported poor sleep quality (PSQI > 5), while 73% of students in the study by Buboltz et al. endorsed at least occasional sleep problems. More direct comparisons between these two studies are difficult because different measures of sleep quality were used. Rates of elevated psychological symptomatology among college migraineurs were generally

consistent with, though slightly higher than, those observed in previous studies. For instance, in the current study significant symptoms of depression and anxiety were reported by 39.3% and 34.5% of migraineurs, respectively, compared to 27.2% and 23.9% of migraineurs, respectively in Smitherman et al. In addition, Kessler et al. (2005) reported the lifetime of prevalence of experiencing an anxiety or mood disorder between the ages of 18 and 29 to be 21.4% (depression) and 30.2% (anxiety). Finally, the presence of episodic migraine was associated with significant headache-related disability for a sizeable proportion of participants, although mean disability scores were higher than those from previous studies (Smitherman et al.).

Sleep Hygiene

As was the main focus of this study, sleep hygiene was found to be poorer among migraineurs than controls. This is consistent with previous findings by Calhoun et al. (2006) and Bruni et al. (1997, 1999) that migraineurs consistently engage in behaviors that are nonconducive to sleep, such as watching TV or reading in bed (78.9% of migraineurs); eating or drinking prior to bedtime (70.1%); taking naps (63.3%); spending too much or little time in bed (37%); and having more variable sleep/wake schedules. Although insomnia symptoms and poor sleep hygiene were more prevalent in the migraine group, only one sleep hygiene variable, going to bed feeling stressed, angry, upset, or nervous, was different between the migraine and control groups. However, because the overall analysis of sleep hygiene items was nonsignificant, and because this finding was nonsignificant after Bonferroni correction, the single item is likely not of particular importance in informing the current study. Despite research from previous studies indicating that both adolescent migraineurs (Bruni et al.) and women with transformed migraine (Calhoun et al.) exhibit poor sleep hygiene behaviors (e.g., frequent napping, variable sleep/wake schedules), the current study did not reflect these previously-reported group differences.

Our adherence to the a priori sample size calculation rules out inadequate sample size as a contributing factor to the null differences on multiple sleep hygiene components. One explanation for the present results is that the control group also exhibited poor sleep habits (Buboltz et al., 2001; Coren, 1994). This argument is supported by the finding that over half of the student sample endorsed frequently or always going to bed at different times from day to day; doing something mentally stimulating or important work before bedtime; using the bed for things other than sleep and sex; and thinking, planning, or worrying in bed. A large proportion of both groups also endorsed clinically significant sleep problems pertaining to insomnia and daytime sleepiness, and thus any potential differences might be better elucidated using a control group with less disturbed sleep. However, another possible explanation for our failure to observe group differences is that sleep hygiene behaviors are not as important among episodic migraineurs as they are among chronic migraineurs. Kelman and Rains (2005) found that chronic migraineurs reported shorter sleep episodes and were more likely to complain of difficulty falling asleep than were episodic migraineurs. Ohayon (2005) also described a strong relationship between sleep difficulties and chronic headaches as did Calhoun et al. (2006), who found that 83.7% of chronic migraineurs stated that they usually awakened tired compared to only 38.1% of episodic migraineurs. Considering our null findings in conjunction with existing studies of adults with chronic migraine, the role of poor sleep hygiene does not appear to be as strong among episodic migraineurs. However, future studies are warranted to confirm this latter hypothesis.

Comorbid Psychological Symptoms

Although migraineurs and controls differed on a score of global sleep hygiene, this difference was attributable principally to differences in co-occurring symptoms of insomnia, anxiety, and depression. Consistent with numerous previous studies (Lanteri-Minet et al., 2005;

Oedegaard et al., 2006; Paiva et al., 1994; Rains & Poceta, 2006; Smitherman et al., 2011), episodic migraineurs reported greater symptoms of depression, anxiety, and insomnia than did nonmigraineurs. However, our results are contrary to those of Vgontzas et al. (2008), who found that sleep disturbance persisted even after controlling for depression and anxiety disorders. The results of the aforementioned study and the current study likely conflict because Vgontzas et al. controlled for lifetime and current rates of all anxiety disorders (instead of GAD symptoms only). They also compared migraineurs and nonmigraineurs on more general sleep complaints, such as difficulty falling and staying asleep, instead of specific sleep hygiene behaviors, as did the current study. Again, these findings strengthen the idea that, although closely related (Buysse et al., 1994), general symptoms of insomnia have a greater influence on migraine and comorbid psychological disorders than do sleep hygiene behaviors in isolation.

Treatment Implications of the Current Study

Although directly modifying sleep hygiene behaviors has shown promise in treating chronic migraine (Calhoun & Ford, 2007), sleep hygiene treatment is not usually offered in isolation for insomnia specifically because its effects on insomnia are less potent than those of stimulus control and sleep restriction, as confirmed by systematic reviews (Morin et al., 2006), practice parameters (Morganthaler et al., 2006), and clinical guidelines (Schutte-Rodin et al., 2008). Another reason that sleep hygiene treatment is not often offered in isolation is because sleep hygiene only targets specific sleep habits and does not address other factors that contribute to insomnia (e.g., environmental cue stimuli, psychological comorbidities). As such, broad-based insomnia treatment packages tend to include modifying sleep behaviors, restricting sleep, and altering environmental stimuli, as well as directly targeting other psychological symptoms related to comorbid depression and anxiety.

Based on the current findings that poorer sleep hygiene and insomnia symptoms significantly predicted migraine-related disability, a rigorous sleep hygiene protocol might beneficially impact headache-related disability among episodic migraineurs; however, this notion awaits empirical verification. Although the present study did not find associations between sleep hygiene and migraine frequency or severity, previous research has indicated that various sleep disturbances (e.g., hypnic jerks, nightmares) are related to headache severity (Bruni et al., 1999). In light of this evidence and the potency of more comprehensive sleep interventions, perhaps the most effective means of improving sleep and migraine is a treatment package that addresses insomnia symptoms (i.e., sleep restriction, stimulus control), modifies sleep hygiene behaviors, and manages comorbid psychological symptoms (Edinger et al., 2009; Friedman et al., 2000; Scholcket et al., 1988; Vincent & Lewycky, 2009).

Limitations and Future Directions

While this study is unique because of its large sample size, focus on episodic migraineurs, and adherence to ICHD-II diagnostic criteria, limitations exist. One limitation of this study is that alcohol use/abuse was not assessed, despite the fact that it is often comorbid with and influences sleep problems (Johnson & Breslau, 2001) and is disproportionately prevalent among college populations (O'Malley & Johnston, 2002). Another limitation is reliance on survey-based instruments to assess the sleep and psychological variables. While adherence to a structured diagnostic headache interview and ICHD-II diagnostic criteria are strengths of the headache data, daily diary data on sleep and structured interview diagnoses of affective disorders would have further strengthened the present study. The aforementioned ancillary study will use self-monitoring data to extend the present findings and test additional hypotheses related to sleep disturbance and migraine using time-series analyses.

As mentioned above, studies are needed comparing the role of sleep hygiene (versus other insomnia variables) in episodic and chronic migraineurs, and in validating the efficacy of more broad-based sleep interventions among episodic migraineurs with comorbid psychological disorders. In light of limitations of the present study, future studies should assess relations between alcohol use and insomnia/sleep hygiene among college migraineurs. Such studies could use a design similar to the present study but with the addition of prospective self-monitoring data for alcohol, sleep, and migraine variables and in using interactions between alcohol and sleep to predict headache occurrence and disability. Given the significant headache-related disability observed among this sample, broad-based university education and intervention efforts should focus on identifying college migraineurs with significant headache-related disability and offering validated pharmacological or behavioral migraine interventions.

Although a large proportion of treatment studies have focused on chronic migraineurs, outcome studies should explore means of targeting headache-related disability among episodic migraineurs given their evidenced high rates of functional impairment. Specifically, treatment studies could focus on assessing and comparing the efficacy of sleep hygiene interventions that have shown promise with chronic migraineurs (Calhoun & Ford, 2007) with more comprehensive sleep modification interventions that have strong research support for insomnia more broadly (e.g., stimulus control and sleep restriction). Although there is evidence for the efficacy of these treatments, the exact mechanisms of action still remain largely unclear, particularly as they relate to beneficial impact on migraine symptoms. Dismantling studies are warranted to determine the most essential therapeutic mechanisms that underlie improvements in migraine stemming from improvements in sleep. Furthermore, given the paucity of data regarding the effects of treating comorbid psychological disorders on migraine, a strong need

remains for treatment studies that assess the effects of treating comorbid depression or anxiety on both sleep and headache symptoms. Because availability of effective behavioral therapies remains a barrier to broader treatment access, further research is needed also on promoting dissemination of empirically-supported behavioral interventions, which are both efficacious (Rains, Penzien, McCrory, & Gray, 2005) and cost-effective (Schafer et al., 2011) in comparison to pharmacologic management. Cumulatively, such studies will help further the growing literature pertaining to the role of sleep and related variables in perpetuating migraine.

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Table 1

Group Differences on Sleep Hygiene Index Items

	Episodic Migraineurs *M* (*SD*)	**Controls *M* (*SD*)**	***P* value**	**% of controls endorsing frequently or always**	**% of migraineurs endorsing frequently or always**	***P* value**
1. I take daytime naps lasting two or more hours.	2.75 (1.02)	2.52 (1.07)	.088	18.26	25.00	.281
2. I go to bed at different times from day to day.	3.68 (1.08)	3.57 (1.04)	.443	55.65	59.52	.803
3. I get out of bed at different times from day to day.	3.02 (1.25)	2.92 (1.10)	.469	30.57	38.10	.254
4. I exercise to the point of sweating within one hour of bedtime.	1.73 (0.87)	1.72 (0.81)	.934	3.49	2.38	.077
5. I stay in bed longer than I should two or three times a week.	2.76 (1.19)	2.49 (1.14)	.064	21.93	26.19	.209
6. I use alcohol, tobacco, or caffeine within four hours of going to bed or after going to bed.	2.37 (1.31)	2.12 (1.14)	.091	14.35	19.05	.083
7. I do something that may wake me up before bedtime (e.g., watch TV, read, eat, or study).	3.55 (1.12)	3.60 (1.09)	.746	58.26	60.71	.353
8. I go to bed feeling stressed, angry, upset, or nervous.	3.02 (0.93)	2.71 (0.97)	.012*	19.57	23.81	.010**
9. I use my bed for things other than sleeping or sex (e.g., watch TV, read, eat, or study).	3.63 (1.06)	3.57 (1.28)	.830	63.04	58.33	.037*
10. I sleep on an uncomfortable bed (e.g., poor mattress or pillow, too many or not enough blankets).	2.13 (1.19)	2.00 (1.10)	.329	12.17	15.48	.876
11. I sleep in an	2.42 (1.16)	2.19 (1.16)	.150	14.35	21.43	.137

11. I sleep in an uncomfortable bedroom (e.g., too bright, too stuffy, too hot, too cold, too noisy).	2.42 (1.16)	2.19 (1.16)	.150	14.35	21.43	.137
12. I do important work before bedtime (e.g., pay bills, schedule, or study).	3.55 (0.97)	3.60 (0.96)	.722	57.21	54.76	.987
13. I think, plan, or worry when I am in	3.63 (1.08)	3.56 (1.08)	.517	55.65	59.52	.978

** $p < .05$. ** $p < .01$*

Table 2

Sleep Hygiene and Insomnia as Predictors of Migraine Variables

	Sleep hygiene as predictor			Insomnia (PSQI) as predictor		
	***F* value**	***P* value**	**R^2**	***F* value**	***P* value**	**R^2**
MIDAS	10.02	.002**	.110	16.65	.000**	.182
HIT-6	6.71	.011*	.077	5.47	.022*	.068
Severity	1.52	.221	.018	1.41	.239	.018
Frequency	1.00	.320	.013	12.50	.001**	.148

** $p < .05$. ** $p < .01$*

Table 3

Differences on Migraine Variables Between Migraineurs With and Without Aura

	Migraineurs without aura ***M*** **(*SD*)** **N = 61**	**Migraineurs with aura** ***M*** **(*SD*)** **N = 23**	***P*** **value**
HIT-6	60.28 (4.59)	62.48 (6.02)	.078
MIDAS	16.50 (19.05)	18.54 (19.78)	.666
Frequency	5.16 (3.95)	4.98 (3.46)	.853
Severity	6.62 (1.40)	7.13 (2.58)	.243

Table 4

Differences on Psychological Variables Between Migraineurs With and Without Aura

	Migraineurs without aura ***M*** **(*SD*)** **N = 61**	**Migraineurs with aura** ***M*** **(*SD*)** **N = 23**	***P*** **value**
PSQI (insomnia)	8.89 (3.65)	8.90 (2.63)	.991
GAD-7 (anxiety)	7.87 (5.05)	7.78 (4.23)	.942
PHQ-9 (depression)	8.46 (5.08)	9.00 (4.63)	.657
ESS (insomnia)	10.44 (3.10)	9.30 (4.42)	.192

Table 5

Group Differences on Psychological Variables

	Episodic Migraineurs *M (SD)*	**Controls** *M (SD)*	***F* Value**	***P* Value**	**partial η^2**
ESS (insomnia)	10.12 (3.53)	9.19 (3.79)	3.77	.053	.012
PSQI (insomnia)	8.90 (3.39)	6.60 (3.05)	30.23	.000**	.096
PHQ-9 (depression)	8.61 (4.94)	6.39 (4.57)	13.85	.000**	.043
GAD-7 (anxiety)	7.85 (4.81)	5.76 (4.75)	11.72	.001**	.036

** $p < .05$. ** $p < .01$*

Table 6

Percent of Sample Reaching Clinical Significance on Psychological Variables

	% of episodic migraineurs reaching clinical significance	% of controls reaching clinical significance	*P* Value of Chi-square
ESS (insomnia)	54.9	41.2	.287
PSQI (insomnia)	85.9	61.7	.001**
PHQ-9 (depression)	39.3	20.4	.001**
GAD-7 (anxiety)	34.5	18.8	.044*

** $p < .05$. ** $p < .01$*

APPENDIX

Appendix A

Demographic Questionnaire

Age: _____

Gender (circle one): Male Female Transgender

Race (circle one): Caucasian African American Asian Hispanic/Latino

Native American/Pacific Islander Other: _____

What is your approximate height and weight? _____ inches _____ pounds

Do you snore (check one)**?** _____ Usually ____ Sometimes _____ No

Have a doctor ever diagnosed you with migraines? _____Yes _____No

What year of school are you currently in (circle one)**?**

Freshman Sophomore Junior Senior Graduate Student N/A

In the past 3 months, how many days of school have you missed?
_____ days

In the past 3 months, how many days were you unable to carry on your usual function at home?
_____ days

In the past 3 months, about how many medical visits have you made (include visits to your regular doctor, specialists, and Urgent Care or Emergency room)?
_____ visits

In the past 3 months, how many days did your health interfere with your ability to study?
_____ days

Have you had one or more problem headaches within the past year (Do NOT count headaches occurring during a hangover or sinus infection)**?**

_____Yes _____No

If YES, how many of these headaches do you have per month, on average?

_____ headaches per month

On average how severe are these headaches (*circle one number*)?

0	1	2	3	4	5	6	7	8	9	10
No Pain			Mild Pain		Moderate Pain			Very Painful		Extremely Painful

Which of the following that are typical features of these headaches (*check all that apply*)?

_____ Occurs on one side of head

_____ Pulsing/throbbing pain

_____ Nausea or vomiting

_____ Sensitivity to light

_____ Sensitivity to sound

_____ Visual or sensory symptoms that occur BEFORE the headache begins

Appendix B

ID Migraine

Check one answer for each question below.

1. Has a headache limited your activities for a day or more in the last three months?

   _____ Yes _____ No

2. Are you nauseated or sick to your stomach when you have a headache?

   _____ Yes _____ No

3. Does light bother you when you have a headache?

   _____ Yes _____ No

From Lipton et al., 2003, in the public domain.

Appendix C

Brief Headache Screen

Please answer the following questions about your headaches. Check the best answer for each question below.

1. How often do you get *severe* headaches (difficult or unable to continue normal function)?

   _____ Daily or near daily
   _____ 3-4 days per week
   _____ Between 2 days per week and 2 days per month
   _____ Once a month or less
   _____ Almost never

2. How often do you get mild or less severe headaches?

   _____ Daily or near daily
   _____ 3-4 days per week
   _____ Between 2 days per week and 2 days per month
   _____ Once a month or less
   _____ Almost never

3. How often do you take pain relievers, or any medication to relieve headache symptoms?

   _____ Daily or near daily
   _____ 3-4 days per week
   _____ Between 2 days per week and 2 days per month
   _____ Once a month or less
   _____ Almost never

4. How often do you miss some work or leisure time because of headache?

   _____ Daily or near daily
   _____ 3-4 days per week
   _____ Between 2 days per week and 2 days per month
   _____ Once a month or less
   _____ Almost never

5. Are you satisfied with the current medication you use to relieve your headaches?

   _____ Yes _____ No

6. Are you taking daily prescription medication to prevent headaches?

   _____ Yes _____ No

7. If no, do your headaches trouble you enough to take daily preventive medication?

   _____ Yes _____ No

Appendix D

Sleep Hygiene Index

Indicate how frequently you engage in each of the following behaviors.

1=Never 2=Rarely 3=Sometimes 4=Frequently 5=Always

1. I take daytime naps lasting two or more hours.
   1 2 3 4 5

2. I go to bed at different times from day to day.
   1 2 3 4 5

3. I get out of bed at different times from day to day.
   1 2 3 4 5

4. I exercise to the point of sweating within 1 hour of going to bed.
   1 2 3 4 5

5. I stay in bed longer than I should two or three times a week.
   1 2 3 4 5

6. I use alcohol, tobacco, or caffeine within 4 hours of going to bed or after going to bed.
   1 2 3 4 5

7. I do something that may wake me up before bedtime (for example: play video games, use the internet, or clean).
   1 2 3 4 5

8. I go to bed feeling stressed, angry, upset, or nervous.
   1 2 3 4 5

9. I use my bed for things other than sleeping or sex (for example: watch television, read, eat, or study).
   1 2 3 4 5

10. I sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets).
    1 2 3 4 5

11. I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy).
    1 2 3 4 5

12. I do important work before bedtime (for example: pay bills, schedule, or study).
    1 2 3 4 5

13. I think, plan, or worry when I am in bed.
    1 2 3 4 5

Appendix E

MIDAS

Please answer the following questions about ALL your headaches you have had over the last 3 months. Write in your answer for each question below.

1. On how many days in the last 3 months did you miss work or school because of your headaches?

_____ days

2. How many days in the last 3 months was your productivity at work or school reduced by half or more because of your headaches?
(Do not include days you counted in question 1 where you missed work or school.)

_____ days

3. On how many days in the last 3 months did you NOT do household work because of your headaches?

_____ days

4. How many days in the last 3 months was your productivity in household work reduced by half of more because of your headaches?
(Do not include days you counted in question 3 where you did not do household work.)

_____ days

5. On how many days in the last 3 months did you miss family, social or leisure activities because of your headaches?

_____ days

6. On how many days in the last 3 months did you have any headache?
(If a headache lasted more than 1 day, count each day)

_____ days

7. On a scale of 0 - 10, on average how painful were these headaches?
(where 0 = no pain at all and 10 = pain as bad as it can be)

_____ days

Appendix F

HIT-6

This questionnaire was designed to help you describe and communicate the way you feel and what you cannot do because of headaches.

To complete, please circle one answer for each question.

1) When you have headaches, how often is the pain severe?

Never Rarely Sometimes Very Often Always

2) How often do headaches limit your ability to do usual daily activities including household work, work, school, or social activities?

Never Rarely Sometimes Very Often Always

3) When you have a headache, how often do you wish you could lie down?

Never Rarely Sometimes Very Often Always

4) In the past 4 weeks, how often have you felt too tired to do work or daily activities because of your headaches?

Never Rarely Sometimes Very Often Always

5) In the past 4 weeks, how often have you felt fed up or irritated because of your headaches?

Never Rarely Sometimes Very Often Always

6) In the past 4 weeks, how often did headaches limit your ability to concentrate on work or daily activities?

Never Rarely Sometimes Very Often Always

From Kosinski et al., 2003, in the public domain.

Appendix G

Name:_____ Date: _____

Pittsburgh Sleep Quality Index (PSQI)

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. **Please answer all questions.**

1. During the past month, what time have you usually gone to bed at night? _____
2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night? _____
3. During the past month, what time have you usually gotten up in the morning? _____
4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.) _____

5. During the past month, how often have you had trouble sleeping because you…	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				
j. Other reason(s), please describe:				
6. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
8. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?				
	Very good	Fairly good	Fairly bad	Very bad
9. During the past month, how would you rate your sleep quality overall?				

From Buysse et al., 1988, in the public domain.

Appendix H

Epworth Sleepiness Scale

How likely are you to doze off or fall asleep in the following situations, in contrast to just feeling tired?

These questions are about your usual way of life in recent times. Even if you have not done some of these things recently, try to work out how they would have affected you.

Use the following scale to choose the most appropriate number for each situation:

0 - Would never doze
1 - Slight chance of dozing
2 - Moderate chance of dozing
3 - High chance of dozing

Activity & Chance of Dozing

Sitting and reading _____
Watching TV _____
Sitting inactive in a public place (meeting, theater, etc) _____
As a passenger in a car for 1 hour without a break _____
Lying down in the afternoon when circumstances permit _____
Sitting and talking to someone _____
Sitting quietly after lunch without alcohol _____
In a car, while stopped for a few minutes in traffic _____

Total _____

Epworth sleepiness scale. Each question is answered with a number from 0 (not at all likely to fall asleep) to 3 (very likely to fall asleep). This yields a total of 0 (minimum) to 24 (maximum). Scores above 10 warrant investigation.

SOURCE: JOHNS MW. A NEW METHOD OF MEASURING SLEEPINESS: THE EPWORTH SLEEPINESS SCALE. SLEEP 1991; 14:540-54

Appendix I

PHQ-9

Over the last **two weeks**, how often have you been bothered by any of the following problems**:**
(*circle the number that applies to you*)

	Not at all	**Several days**	**More than half the days**	**Nearly every day**
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself—or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed. Or the opposite—being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead, or of hurting yourself in some way	0	1	2	3
If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?	*Not difficult at all*	*Somewhat difficult*	*Very difficult*	*Extremely Difficult*
Total (For health professionals only) = _____				

Appendix J

GAD-7

Over the last **two weeks**, how often have you been bothered by the following problems**:** (*circle the number that applies to you*)

	Not at all	**Several days**	**More than half the days**	**Nearly every day**
1. Feeling nervous, anxious or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3
If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?	*Not difficult at all*	*Somewhat difficult*	*Very difficult*	*Extremely Difficult*
Total (For health professionals only) = _____				

Structured Diagnostic Interview for Headache – Revised (Brief Version)

Patient Name:	Age:	Sex: M F
Patient ID:	Interviewer:	Date: / /

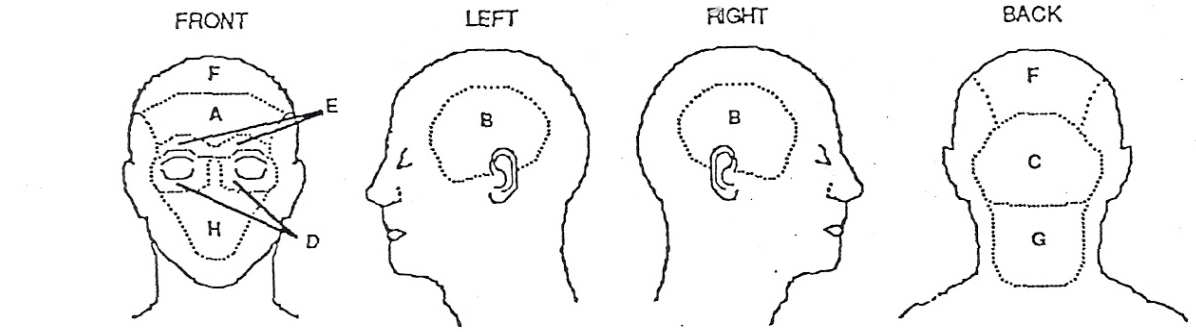
The following items are selected from the long version of the Structured Diagnostic Interview for Headache (SDIH). The SDIH is part of the Headache Evaluation and Diagnostic System (HEDS) which includes software for data entry and diagnostic decision-making. These materials are intended to facilitate diagnosis of selected recurrent, benign headaches according to both IHS (2004) and Ad Hoc Committee (1962) diagnostic criteria. Optimal use of this interview requires expertise with the diagnostic classifications and familiarity with the computer software and manual that accompany the interview.

1. Does the patient get more than one type of headache? ☐ Yes ☐ No
   (Complete a separate brief interview form for each type of headache) Headache #1 #2 #3

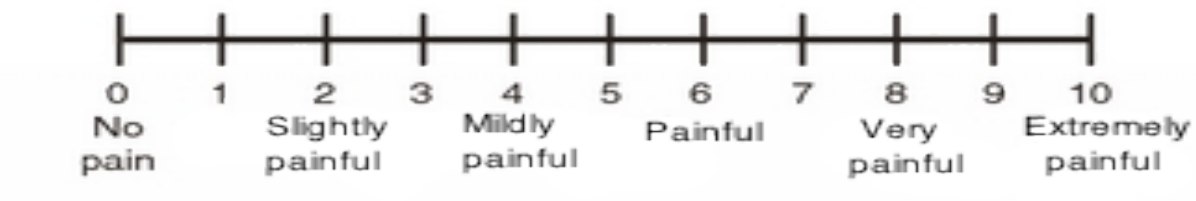
2. Select all pain locations that apply to this type of headache: ***(You must check at least one)***

   ☐ frontal (A) ☐ temporal (B) ☐ occipital (C) ☐ orbital (D) ☐ supraorbital (E)

3. Select all that apply: ☐ top of head (F) ☐ base of neck (G) ☐ nasal/facial (H)



4. What is the intensity of pain that the patient experiences with a typical headache? ____ ***(Indicate rating from 0-10)***



5. Which of the following symptoms are a "predominant feature" of this headache type (presume that the headache is untreated)?

   Pain Location ***(Select only one)***: ☐ Unilateral ☐ Not Unilateral

   Pain Features ***(Select only one)***: ☐ Pulsating ☐ Pressing/Tightening (non-pulsating) ☐ Other:_____

6. How often does the patient experience this type of headache pain? ____ d w m y ***(Indicate frequency in x per day, week, month, or year)***

7. How long have these headaches been occurring at this rate? ____ Months Years

8. What is the total number of this type of headache ever experienced: ☐ 1 ☐ 2-4 ☐ 5-9 ☐ ≥10 ____ ***(Indicate total number experienced)***

9. How long does this headache last if untreated or unsuccessfully treated? (If patient falls asleep and wakes up without headache, duration of attack is until waking up. Check unremitting if patient reports never experiencing headache less than 7 days in duration). ***(Indicate duration in minutes, hours, or days)***

   ☐ Unremitting **OR**

   ____ m h d Typical Average ____ m h d Typical Minimum ____ m h d Typical Maximum

10. Has anything about this headache (except freq.) changed in the last 6 months? ☐ Yes ☐ No
    If **YES**, explain: _____

---

11. Is the patient's typical headache pain aggravated by routine physical activities (i.e., walking, lifting, bending, etc.)? ☐ Yes ☐ No

12. Do any of the following symptoms occur with this headache?

    ☐ Loss of appetite/Anorexia
    ☐ Headache worsened by conversational noise levels (phonophobia)
    ☐ Headache worsened by normal light (photophobia)
    ☐ Nausea ***(Indicate intensity)*** ☐ Mild ☐ Moderate ☐ Severe
    ☐ Vomiting ***(Indicate intensity)*** ☐ Mild ☐ Moderate ☐ Severe

13. Does the patient ever experience symptoms before this headache pain begins? ☐ Yes ☐ No
    If **YES**, and if any of the reported symptoms provide evidence of focal cerebral cortical, and/or brainstem dysfunction, complete **Appendix 1**
    If **NO**, skip to #14

14. Does this headache have severe unilateral orbital, supraorbital, and/or temporal pain, and/or does the interviewer suspect a cluster-type headache? ☐ Yes ☐ No
    If **YES**, complete **Appendix 2**
    If **NO**, skip to #15

15. Does the patient use any medications to relieve headache pain? ☐ Yes ☐ No
    If **YES**, complete #15a, #15b, #15c
    If **NO**, skip to #16

    15a. How long has the patient been using the medication(s) to relieve headache pain? ____ d w m y ***(Indicate duration in days, weeks, months, or years)***

    15b. What is the frequency of medication use? ____ days per week ____ days per month ____ times per day

    15c. Did this headache develop or markedly worsen during medication overuse? ☐ Yes ☐ No

If **YES**, complete **Appendix 3**
If **NO**, skip to #16

16. Is this headache related to any head injury or trauma? ☐ Yes ☐ No
If **YES**, complete **Appendix 4**
If **NO**, skip to #17

17. Is this headache suspected to be attributed to a physical or other neurological disorder? ☐ Yes ☐ No

APPENDIX 1 — Migraine Aura Symptoms

1. How many aura attacks has the patient experienced? ____

2. What best describes the aura symptoms? ***(Select all that apply)***
- ☐ At least one aura symptom develops gradually over more than 4 minutes, **AND/OR** 2 or more symptoms occur in succession over 4 minutes
- ☐ Each aura symptom lasts longer than 4 minutes but less than 60 minutes
- ☐ Headache begins during aura **OR** follows aura with a headache-free interval of less than 60 minutes

3. Indicate which of the following aura symptoms are present during this type of headache: ***(Select all that apply)***

X	SYMPTOM	X	SYMPTOM
☐	Partial loss of sight (scotoma)	☐	Uncoordinated movements (ataxia)
☐	Scintillation	☐	Dizziness (vertigo)
☐	Blurred vision	☐	Ringing in ears (tinnitus)
☐	Fortification spectra (zig-zag lines)	☐	Decreased hearing acuity
☐	Double vision	☐	Decreased level of consciousness
☐	Tingling or numbness (paresthesias)	☐	Aphasia or unclassifiable speech
☐	Weakness (paresis)	☐	Poorly articulated speech (dysarthria)
☐	Other:	☐	Other:

APPENDIX 2 — Cluster Headache Symptoms

1. Have the headaches occurred in cluster periods? ☐ Yes ☐ No
   If **YES**, complete #1a
   If **NO**, skip to #2

   1a. What is the total number of cluster periods experienced? ____

   1b. What is the duration of cluster periods? ____ d w m y ***(Indicate duration in days, weeks, months, or years)***

2. Are the headaches separated by remission periods? ☐ Yes ☐ No
   If **YES**, complete #2a
   If **NO**, skip to #3

   2a. What is the duration of remission periods? ____ d w m y ***(Indicate duration in days, weeks, months, or years)***

3. Indicate which of the following symptoms are present, as well as side affected, during this type of headache: ***(Select all that apply)***

X	SYMPTOM	SIDE	X	SYMPTOM	SIDE
☐	Red eyes (conjunctival injection)	R L	☐	Forehead and facial sweating	R L
☐	Tearing of the eyes (lacrimation)	R L	☐	Pupillary constriction (miosis)	R L
☐	Nasal congestion	R L	☐	Drooping eyelids (ptosis)	R L
☐	Runny nose (rhinorrhoea)	R L	☐	Eyelid swelling (oedema)	R L
☐	Restlessness or agitation		☐	Other:	

APPENDIX 3 Medication-Overuse Headache Symptoms

1. Has the patient withdrawn from the overused medication? ☐ Yes ☐ No
   If **YES**, complete #1a and #1b
   If **NO**, skip to #2

   1a. Did headache resolve or revert to its previous pattern within 2 months after discontinuation of overused medication?
   ☐ Yes ☐ No

   1b. Has medication overuse ceased within the last 2 months, but headache has not resolved or reverted back to its previous pattern? ☐ Yes ☐ No

2. Has intake of ergotamine, triptan, opioid **OR** combination of ergotamine, triptan, opioid, or analgesic occurred on 2 or more days per week, for 10 or more days per month, for greater than 3 months ***(Must not have combination overuse of any single class alone)***? ☐ Yes ☐ No
   If **YES**, indicate drug(s): ☐ ergotamine ☐ triptan ☐ opioid ☐ analgesic
   _____

3. Has the patient's intake of analgesic occurred on 2 or more days per week, for 15 or more days per month, for greater than 3 months? ☐ Yes ☐ No
   If **YES**, indicate drug: _____

4. Has the patient's intake of combination analgesics occurred on 2 or more days per week, for 10 or more days per month, for greater than 3 months? ☐ Yes ☐ No
   If **YES**, indicate drugs:
_____

5. Has the patient's intake of medication other than ergotamine, triptan, analgesic, or opioid occurred on a regular basis for greater than 3 months? ☐Yes ☐ No
   If **YES**, indicate drug: _____

APPENDIX 4 Post-Traumatic Headache Symptoms

1. Was there a loss of consciousness associated with head trauma? ☐ Yes ☐ No
   If **YES**, complete #1a
   If **NO**, skip to #2

   1a. What was the duration of unconsciousness? ____ m h d ***(Indicate duration in minutes, hours, or days)***

2. Is head injury attributed to whiplash? ☐ Yes ☐ No
   If **YES**, skip #5 through #8
   If **NO**, complete #3 through #8

3. Did headache develop within 7 days after head trauma (or after regaining consciousness)? ☐ Yes ☐ No

4. How long has the headache continued? ***(Select most representative category)***
   ☐ Resolves within 3 months after head trauma
   ☐ Persists for greater than 3 months after head trauma
   ☐ Persists but 3 months have not passed since head trauma

5. Did coma develop? ☐ Yes ☐ No
   If **YES**, indicate severity on Glasgow Coma Scale: ☐ GCS <13 *[moderate/severe]* ☐ GCS ≥13 *[mild]*

6. Did post-traumatic amnesia develop and continue for longer than 48 hours? ☐ Yes ☐ No

7. Did symptoms/signs develop diagnostic of a concussion? ☐ Yes ☐ No

8. Were abnormal neuroimaging results attained suggestive of a traumatic brain lesion? ☐ Yes ☐ No

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PROFESSIONAL MEMBERSHIPS

American Headache Society (AHS) — 2011-present
AHS Behavioral Issues Special Interest Section
Association for Behavioral and Cognitive Therapies (ABCT) — 2010-present
American Psychological Association (APA) — 2009-present

SELECTED HONORS AND AWARDS

Phi Kappa Phi Honor Society — 2006-2008
Psi Chi Honor Society — 2006-2008
Alpha Kappa Delta Honor Society — 2006-2008
Psi Chi Regional Research Award — 2007
SEPA Conference, New Orleans, LA
All-Conference Research Team Award — 2007
Big SURS Conference, Myrtle Beach, SC
Winthrop Undergraduate Research Scholar — 2007
Psychology Department Outstanding Researcher Award — 2007

PUBLICATIONS AND PRESENTATIONS

Publications in Peer-Reviewed Journals

Smitherman, T. A., **Walters, A. B.**, Maizels, M., & Penzien, D. B. (2011). The use of antidepressants for headache prophylaxis. *CNS Neuroscience & Therapeutics, 17,* 462-469.

Published Abstracts (all presented as posters at national conferences)

Smitherman, T. A., Maizels, M., **Walters, A. B.**, Henley, M. Bounds, L. B., Presley, E., et al. (2009). Negative impact of episodic migraine on a college population: Psychiatric comorbidity, functional impairment, and school interference. [Published abstract]. *Cephalalgia*, *29* (Suppl. 1), S148.

Poster Presentations

Walters, A. B., Davis, R. E., Hamer, J. D., Townsend, E. A., Blann, K. R., Schulenberg, S. E., & Smitherman, T. A. (2011, November). *Relations between migraine, psychological variables, and meaning in life in a college population.* Poster presented at the annual convention of the Association for Behavioral and Cognitive Therapies, Toronto, Canada.

Campbell, S. W., **Walters, A. B.**, Baczwaski, B. J., Schulenberg, S. E., Drescher, C. F. & Smith, C. V. (2011, August). *Disaster-Related Research and Consultation: Lessons Learned from Two Events*. Poster presented at the annual convention of the American Psychological Association, Washington, D.C.

Walters, A. B., Smitherman, T. A., Davis, R. E., Townsend, E. A., Hamer, J. D., & Blann, K. R. (2011, June). *Sleep hygiene and psychiatric comorbidity in episodic migraineurs.* Poster presented at the annual convention of the American Headache Society, Washington, D.C.

Walters, A. B., Baskin, B. L., McDermott, M. J., & Smitherman, T. A. (2010, November). *Chronic daily headache in a college population: Psychiatric comorbidity and functional impairment*. Poster presented at the annual convention of the Association for Behavioral and Cognitive Therapies, San Francisco, CA.

McDermott, M. J., **Walters, A. B.,** Smitherman, T. A., Gratz, K. L., & Tull, M. T. (2010, November). *The Role of Anxiety Sensitivity and Migraine Symptoms in Posttraumatic Stress Disorder among Individuals in Residential Substance Abuse Treatment*. Poster presented at the annual convention of the Association for Behavioral and Cognitive Therapies, San Francisco, CA.

Smitherman, T. A., Maizels, M., **Walters, A. B.**, Kirkland, K. & Penzien, D. (2009, November). *Development and validation of the Mood, Anxiety, and Physical Symptoms Scale: A brief measure for assessing depression and anxiety symptoms among medical patients.* Poster

presented at the annual convention of the Association for Behavioral and Cognitive Therapies, New York, NY.

Walters, B., Nunnally, B., & Sinn, J. (2007, March). *Political Conservatism as a Predictor of Ecological Attitudes: Socially Motivated Cognition and the Issues of Global Warming and Species Extinction.* Poster presented at the Big South Undergraduate Research Symposium, Myrtle Beach, SC.

Woods, A., **Walters, A. B.**, & Sleigh, M. J. (2007, February). *The Big Five Personality Traits and Young Adults' Perceptions of Workplace Romance.* Poster presented at the South Eastern Psychological Association conference, New Orleans, LA.

EDITING AND REVIEWING

Ad Hoc Reviewing

Annals of Behavioral Medicine
Headache
JAMA
Pain
Book Chapters for Sattler, J.

Consulted Reviewing

Book Chapter on Introduction to Research Methods

Practicum and Research Experience

Efficacy of Behavioral Insomnia Treatment for Chronic Migraine 2011-present
Research grant comparing migraine treatments
University of Mississippi, *Oxford, MS*

Clinical Disaster Research Center 2010-present
Disaster Research and Consulting
University of Mississippi, *Oxford, MS*

Delta Autumn Consulting
Social Security assessments 2011
Cleveland, MS

The Baddour Center 2009-2011
Residential facility for adults with Developmental/Intellectual Disabilities
Senatobia, MS