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Headache and Psychological Variables as Predictors of Disability in Individuals with Primary Headache Disorders

Halle McCracken

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HEADACHE AND PSYCHOLOGICAL VARIABLES AS PREDICTORS OF DISABILITY IN INDIVIDUALS WITH PRIMARY HEADACHE DISORDERS

A Thesis
presented in partial fulfillment of requirements
for the degree of Master of Arts
in the Department of Psychology
The University of Mississippi

by

HALLE T. MCCracken

May 2022
ABSTRACT

Headache disorders are among the most prevalent disorders of the nervous system, affecting more than half of the global population during the lifetime. Tension-type headache and migraine are disabling conditions, and their resulting symptoms negatively impact quality of life and reduce daily functioning. These conditions are often comorbid with psychiatric disorders such as depression and anxiety disorders, and headache-related disability is often compounded by these psychiatric symptoms as well as transdiagnostic factors, such as stress, fear of pain, and anxiety sensitivity. The present study aimed to explore the relative contributions of headache symptoms and psychological factors to headache-related disability and investigate the moderating role of headache diagnosis on these relationships. We hypothesized that psychiatric symptoms and transdiagnostic psychological factors would account for significant unique variance beyond headache variables in “predicting” headache-related disability. Additionally, we hypothesized that the aforementioned relationships would be stronger among those with migraine than tension-type headache. As predicted, both psychiatric and transdiagnostic symptoms accounted for unique variance in headache-related disability beyond headache symptoms (R-squared changes of 2.7% and 2.3%, respectively). Significant three-way interactions revealed the relationship between psychiatric symptoms and disability, and between transdiagnostic variables and disability, was strongest for individuals with a diagnosis of chronic tension-type headache. Results of the present study suggest psychiatric and transdiagnostic factors contribute uniquely to headache-related disability, which may be important for expanding assessment and targeting behavioral interventions.
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GBD</td>
<td>Global burden of disease</td>
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<tr>
<td>YLD</td>
<td>Years lived with disability</td>
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<tr>
<td>ICHD</td>
<td>International classification of headache disorders</td>
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<td>IHS</td>
<td>International Headache Society</td>
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<td>EM</td>
<td>Episodic migraine</td>
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<td>LFEM</td>
<td>Low frequency episodic migraine</td>
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<td>MFEM</td>
<td>Moderate frequency episodic migraine</td>
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<td>HFEM</td>
<td>High frequency episodic migraine</td>
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<td>CM</td>
<td>Chronic migraine</td>
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<td>TTH</td>
<td>Tension-type headache</td>
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<td>ETTH</td>
<td>Episodic tension-type headache</td>
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<td>CTTH</td>
<td>Chronic tension-type headache</td>
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<td>ED</td>
<td>Emergency department</td>
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<td>GAD</td>
<td>Generalized anxiety disorder</td>
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<td>OR</td>
<td>Odds ratio</td>
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<td>RR</td>
<td>Relative risk</td>
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<td>MOH</td>
<td>Medication overuse headache</td>
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<td>FAM</td>
<td>Fear avoidance model</td>
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<td>FOP</td>
<td>Fear of pain</td>
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<td>AS</td>
<td>Anxiety sensitivity</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>ii</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS AND SYMBOLS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>vii</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>HEADACHE</td>
<td>1</td>
</tr>
<tr>
<td>HEADACHE DIAGNOSES</td>
<td>1</td>
</tr>
<tr>
<td>Prevalence and Impact</td>
<td>2</td>
</tr>
<tr>
<td>PSYCHIATRIC COMORBIDITY</td>
<td>7</td>
</tr>
<tr>
<td>Depression</td>
<td>8</td>
</tr>
<tr>
<td>Anxiety</td>
<td>9</td>
</tr>
<tr>
<td>ASSOCIATED PSYCHOLOGICAL SEQUALE</td>
<td>12</td>
</tr>
<tr>
<td>Stress</td>
<td>12</td>
</tr>
<tr>
<td>Fear of Pain</td>
<td>14</td>
</tr>
<tr>
<td>Anxiety Sensitivity</td>
<td>15</td>
</tr>
<tr>
<td>GOALS OF THE PRESENT STUDY</td>
<td>17</td>
</tr>
<tr>
<td>HYPOTHESES</td>
<td>18</td>
</tr>
<tr>
<td>METHOD</td>
<td>19</td>
</tr>
<tr>
<td>PARTICIPANTS</td>
<td>19</td>
</tr>
<tr>
<td>MATERIALS</td>
<td>20</td>
</tr>
</tbody>
</table>
Demographics Questionnaire……………………………………………………………... 20
Structured Diagnostic Interview for Headache (SDIH-3)…………………………….. 20
Headache Impact Test (HIT-6)…………………………………………………………… 20
Depression, Anxiety, and Stress Scale (DASS-21)…………………………………….. 21
Pain Anxiety Symptom Scale (PASS-20)………………………………………………. 21
Anxiety Sensitivity Index (ASI-3)………………………………………………………. 21

PROCEDURE………………………………………………………………………………… 22

RESULTS…………………………………………………………………………………… 23

STATISTICAL ANALYSES……………………………………………………………….. 23

PARTICIPANT DEMOGRAPHICS………………………………………………………….. 24

DATA ANALYTIC ASSUMPTIONS……………………………………………………….. 24

CORRELATIONS AMONG VARIABLES OF INTEREST AND GROUP

DIFFERENCES………………………………………………………………………………… 25

REGRESSION ANALYSES……………………………………………………………….. 25

MODERATION ANALYSES………………………………………………………………. 26

DISCUSSION………………………………………………………………………………… 29

PSYCHIATRIC SYMPTOMS AND HEADACHE-RELATED DISABILITY………. 29

TRANSDIAGNOSTIC VARIABLES……………………………………………………… 31

MODERATION ANALYSES………………………………………………………………. 33

LIMITATIONS AND FUTURE DIRECTIONS………………………………………….. 34

REFERENCES……………………………………………………………………………….. 37
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDIX</td>
<td>61</td>
</tr>
<tr>
<td>TABLES AND FIGURES</td>
<td>62</td>
</tr>
<tr>
<td>VITA</td>
<td>80</td>
</tr>
</tbody>
</table>
LIST OF TABLES

1. Demographic Characteristics of the Sample................................................. 59
2a. Pearson Correlations Between Disability and Associated Headache Variables......... 60
2b. Pearson Correlations Between Disability and Associated Psych Variables............... 60
3. Group Differences Between Individuals with Migraine and TTH.......................... 61
4a. Regression Analysis Results................................................................. 62
4b. Regression Analysis Results.................................................................... 63
5a. Regression Results for Conditional Effect of Psychiatric Symptoms on Disability...... 64
5b. Regression Results for Conditional Effect of Transdiagnostic Factors on Disability..... 65
LIST OF FIGURES

1a. Conceptual Diagram of Moderation Analysis with Psychiatric Symptoms............... 66
1b. Conceptual Diagram of Moderation Analysis with Transdiagnostic Variables......... 66
2a. Analysis of Simple Slopes Using Psychiatric Symptoms..................................... 67
2b. Analysis of Simple Slopes Using Transdiagnostic Variable................................. 68
Headache

Headache is a common disorder of the nervous system, affecting an estimated three billion individuals (Global Burden of Disease Study Collaborators, 2018). Currently, the global age-standardized prevalence of tension-type headache is 26.1% and of migraine is 14.4% (GBD Study Collaborators, 2018). Women are disproportionately affected, such that 21% of women versus 10.7% of men in the United States experience migraine or severe headache (Burch et al., 2021). Further, though headache disorders are the third leading cause of years lived with disability (YLD) for all individuals, they represent the second leading cause of YLD for women ages 15-49 years (Steiner et al., 2020). Specific headache disorders are characterized based on pain quality, duration, and other associated features.

Headache Diagnoses

The International Classification of Headache Disorders, 3rd Edition (ICHD-3; International Headache Society [IHS], 2018) classifies “primary headache disorders” as headaches not attributable to another disorder. Central among these are migraine and tension-type headache. Migraine is characterized by throbbing moderate to severe head pain, typically affecting one side of the head, that is aggravated by routine physical activity. Migraine attacks usually last between 4 and 72 hours, if untreated, and are accompanied by at least one additional symptom of nausea, vomiting, or both photophobia (i.e., sensitivity to normal light levels) and phonophobia (i.e., sensitivity to conversational noise levels). Roughly 20-25% of individuals with migraine experience aura, which are temporary neurological symptoms that often precede
or accompany a migraine attack (Rothrock, 2009). The most common aura symptoms are visual (e.g., seeing zig-zag lines, experiencing blurred vision, or scintillation, etc.; IHS, 2018), which manifest among 90% of patients who experience migraine with aura. Additional aura symptoms may be sensory, motor, or retinal, or can affect the brainstem, speech, or language. Aura symptoms are fully reversible and spread gradually over five to sixty minutes prior to head pain onset (IHS, 2018). Additionally, migraine is dichotomized into episodic or chronic migraine. Episodic migraine (EM) is characterized by less than 15 attacks per month, whereas 15 or more attacks per month indicates chronic migraine (CM).

Compared to migraine, tension-type headache (TTH) is characterized by pressing head pain of mild to moderate intensity, usually occurring on both sides of the head, and lasting between 30 minutes to seven days (IHS, 2018). Unlike migraine, TTH is not worsened by physical activity, nor is it accompanied by nausea. Individuals with tension-type headache may experience photophobia or phonophobia, but not both. This headache disorder is also characterized as either episodic (ETTH) or chronic (CTTH) as a function of the 15 days-per-month threshold.

**Prevalence and Impact**

**Migraine.** Migraine is a common, disabling headache disorder. Current estimates of the global prevalence of migraine in adults range from 11.6% to 14.4% (GBD Study Collaborators, 2018; Woldeamanuel & Cowan, 2017). Yearly prevalence of migraine in the United States is 18% for women and 6% for men (Burch et al., 2019), and prevalence peaks among individuals between the ages of 35-39 years (GBD Study Collaborators, 2018). The American Migraine Prevalence and Prevention (AMPP) Study, a rigorous epidemiologic study of migraine, found that migraine was more common among lower income individuals and among white individuals
compared to black individuals (Buse et al., 2012). Given the high prevalence of migraine, a significant number of individuals experience impairment in their daily lives, contributing to increased healthcare burden.

Migraine ranked as the second leading global cause of years lived with disability (YLD) in 2016 (GBD Study Collaborators, 2018) and contributes to substantial direct and indirect costs. Direct healthcare costs extend to inpatient and outpatient care, emergency department (ED) visits, and pharmacy costs. The economic burden for individuals with migraine is sizeable, such that those with migraine incur $6,574 more in overall annual healthcare costs than individuals without migraine ($11,010 vs. $4,436; Bonafede et al., 2018). Annual headache-related medical costs are greater for individuals with chronic versus episodic migraine ($8243 vs. $2649, respectively; Messali et al., 2016). According to the 2009 National Hospital Ambulatory Medical Care Survey (NHAMCS), headache or head pain was the fifth leading cause of ED visits (Smitherman et al., 2013) and has consistently accounted for 3% of all ED visits in the United States in subsequent years (Burch et al., 2018).

Beyond costs attributed to health care burden, migraine also confers significant indirect costs via its negative impact on functioning and health-related quality of life. For example, the mean number of work hours lost due to migraine is 88 hours per year (Burton et al., 2009). Outside of work performance, those with migraine portend increased financial burden to employers, costing employers an estimated $2600 more per year than individuals without migraine, due mostly to migraine-related absenteeism (Hawkins et al., 2008). Individuals aged 18-44 years show markedly greater migraine burden likely because this stage of life is typically marked by increased work productivity and child-rearing (Burch et al., 2018). The indirect burden of migraine is further differentiated by sex, such that women who suffer from migraine
commonly report higher pain intensity and greater headache-related disability than men (Burch et al., 2019). To understand what makes migraine burdensome, it is important to explore the role of individual migraine symptoms on functional impairment.

The functional impairment that manifests during attacks (ictally; Buse et al., 2009) is attributable in large part to symptoms of migraine, including nausea, vomiting, and heightened sensitivity to environmental stimuli (Burch et al., 2019). Among a sample of adults, one study found that total headache frequency, frequency of severe headaches, and nausea demonstrated a strong association with increased disability (Ford et al., 2008). More specifically, the combination of headache symptoms (headache duration, severity, frequency, nausea, photophobia, phonophobia, vomiting), neck pain, and coping response accounted for 36% of variance in headache-related disability in the sample. Tkachuk and colleagues (2003) also found that photophobia and phonophobia were related to increased impairment among an adolescent sample, and the presence of nausea during a migraine attack significantly predicted a higher number of missed activities. More recently, results from the AMPP Study revealed that individuals with episodic migraine (EM) and high-frequency nausea (i.e., nausea during at least half of migraine attacks) experienced an 81% increase in disability scores as compared to individuals with EM without nausea (Lipton et al., 2013), indicating that nausea independently contributes to disability.

Migraine frequency and severity are also determinants of migraine-related disability. One study reported that 72.9% of people with CM experienced severe headache-related disability, compared to only 42.3% of individuals with EM (Buse et al., 2012). To examine the effects of increased headache frequency, Buse and colleagues (2020) split AMPP participants with migraine into groups of low-frequency episodic migraine (LFEM; 0-3 days per month),
moderate-frequency episodic migraine (MFEM; 4-7 days per month), high-frequency episodic migraine (HFEM; 8-14 days per month), and CM (≥ 15 days per month). They found that individuals with HFEM were twelve times more likely than those with L/MFEM to report severe disability (Buse et al., 2020), further supporting the idea that frequency of migraine is strongly related to greater disability. A similar positive association has been found between pain severity and disability (Magnusson & Becker, 2003). Among a multi-national sample of individuals with migraine, nearly 60% of the explained variance in disability scores was accounted for by average pain intensity scores (Stewart et al., 2003). Though migraine presents notable impact, TTH affects a greater proportion of the population and thus warrants unique consideration.

**Tension-type headache.** Tension-type headache is the most common primary headache disorder, affecting up to 78% of people during their lifetime (Rasmussen et al., 1991). Like migraine, TTH is more common among women than men, though not as disproportionately (ratio 5:4; Rasmussen et al., 1991). In both men and women, TTH increases with age, peaking in adulthood between 30 and 39 years, and subsequently declines (Rasmussen, 2001). The prevalence of TTH is significantly greater among white individuals than black individuals across both men (40.1% vs. 22.8%) and women (46.8% vs. 30.9%; Schwartz et al., 1998). CTTH is far less common than ETTH, with only 3% of adults experiencing CTTH as compared to 38% reporting ETTH (Crystal & Robbins, 2010).

Though migraine is more disabling at an individual level, TTH causes significant population-level disability largely because of its high prevalence (Stovner et al., 2007). TTH was estimated to have caused 7.2 million YLD in 2016 (GBD Study Collaborators, 2018), and the impact of TTH extends to both direct and indirect costs. In a study examining direct costs associated with TTH, individuals reported a total economic loss of $4,318 (Pop et al., 2009).
Roughly one in five (17%) patients with TTH has a history of at least one ED visit (Harpole et al., 2005), which are more common among individuals with CTTH (Giamberardino et al., 2020). However, the majority (92%) of the financial burden attributable to TTH comes from indirect costs (Linde et al., 2012).

Like migraine, TTH YLD peaks in individuals aged 35-39 years, likely due to heightened career and family demands during this period of life (GBD Study Collaborators, 2018). Among individuals with TTH, 44% of participants endorsed reduced workday effectiveness due to head pain (Schwartz et al., 1998), and nearly 40% reported reduced daily activities (Edmeads et al., 1993). Although less severe than migraine, TTH has been associated with lengthier absenteeism (Lenaerts, 2006), perhaps due to longer duration of headache.

As with migraine, symptoms of TTH contribute to functional impact. Attack frequency is positively associated with headache-related disability (Lenaerts, 2006), such that individuals with CTTH are more likely to miss work than those with ETTH (Simić et al., 2020) and report greater overall disability (Cassidy et al., 2003). In a study examining headache factors associated with disability, risk of severe headache-related disability was elevated in those with TTH who endorsed frequent headaches and moderate to severe pain intensity (OR: 20.89 for ≥ 15 days per month; OR: 3.15 for moderate pain; OR: 5.19 for severe pain). Further, the presence of phonophobia was associated with over 2.5 times greater odds of severe headache impact (Kim et al., 2015). Despite generally being less severe at an individual level than migraine, many with TTH still experience substantial symptom burden and functional impairment, particularly those with CTTH and more severe symptom profiles.

**Headache and disability.** In summary, both migraine and TTH are common pain conditions that negatively affect individual functioning. Prior research suggests that a substantial
portion of headache-related disability, particularly that which occurs during headache attacks, is driven by headache symptoms themselves. These symptoms include high headache frequency and those that are most characteristic of migraine (e.g., severe pain, nausea, photo/phonophobia). However, a meaningful proportion of unexplained variance in headache-related disability remains, and headache symptoms may be only minimally associated with interictal disability, or disability which occurs outside of the headache attack itself. A growing literature attests to the meaningful role of psychological variables in headache-related disability.

**Psychiatric Comorbidity**

Although headache is a neurological disorder, empirical studies suggest that headache is best approached from a biopsychosocial perspective, given both its strong relationship to psychosocial variables (e.g., stress, psychopathology, avoidance behavior) and the established efficacy of behavioral interventions (Lee et al., 2019; Penzien et al., 2015). Conceptualizing and treating headache from this framework yields improved outcomes in headache management (Henry et al., 2016; Holroyd et al., 2010; Powers et al., 2013).

Both migraine and TTH commonly present with psychiatric comorbidities, which compound both the pain experience itself and associated mental health symptoms while negatively impacting disability (Pearl et al., 2020). Studies suggest that there is a relationship between migraine frequency and intensity and psychological variables, such that increased frequency and intensity of migraine attacks is associated with increased symptoms of depression, anxiety, and pain catastrophizing (Seng et al., 2017; Magnusson & Becker, 2003). These symptoms are in turn associated with greater migraine-related disability (Pearl et al., 2020; Seng et al., 2017). Strikingly, in individuals with migraine or severe headache, physical and
psychiatric comorbidities account for the overwhelming majority of role disability (Saunders et al., 2008).

Though not especially frequent in ETTH, psychiatric comorbidities are relatively common among individuals with CTTH (Heckman & Holroyd, 2006; Solomon et al., 1994). For example, sleep, energy level, and emotional well-being are more adversely affected in individuals with CTTH than those without headache (Holroyd et al., 2000), suggesting that mental health and other psychological factors may also be important in understanding the effect of TTH on overall disability. Taken together, the literature confirms relationships between negative psychological states and primary headache disorders.

**Depression**

The association between headache disorders and depression is well-established (Breslau & Davis, 1992; Holroyd et al., 2000; Radat & Swendsen, 2005). Specifically, the relationship between migraine and depression is bidirectional in nature, such that individuals with a history of depression have a three-fold higher risk of migraine and individuals with migraine are up to five times more likely to develop major depression (Baskin et al., 2006; Breslau et al., 2003). Depression is particularly salient in those with CM. When compared to those with EM, individuals with CM are twice as likely to have depression (OR: 2.0; Buse et al., 2010), and depressive symptoms are a modifiable risk factor for progression to CM (Ashina et al., 2012). In one study, a major depressive episode was the most common psychiatric presentation as assessed by a structured diagnostic interview, affecting a quarter of patients (Beghi et al., 2010). Depression is also associated with headache frequency in TTH, such that an increase in attack frequency confers an increased risk of depression (Zwart et al., 2003). Comorbid depressive
symptoms often compound functional impairment for individuals with primary headache disorders.

In addition to high rates of comorbidity, depression is associated with increased migraine-related disability (Lanteri-Minet et al., 2005; Holroyd et al., 2007; Blumenfeld et al., 2011). Recently, the Chronic Migraine Epidemiology and Outcomes (CaMEO) study demonstrated that depression alone confers a 56% increased risk of moderate to severe migraine-related disability in individuals with migraine (RR: 1.56; Lipton et al., 2020), indicating that the burden these individuals experience is independent of headache symptoms. Even subthreshold symptoms of depression have been linked to increased susceptibility to migraine triggers and greater attack frequency (Baldacci et al., 2015). As with migraine, symptoms of depression also contribute to headache-related disability in individuals with CTTH. One study, which measured the emotional and physical burden of headache separately, found that depression and the emotional burden of headache mediates the relationship between pain and the physical burden of headache (Fuensalida-Novvo et al., 2017), suggesting that negative affect drives worsened disability in CTTH. Though the relationship between depression and primary headache disorders is well-established, anxiety disorders are in fact even more prevalent among those with both migraine (Smitherman et al., 2008) and TTH (Heckman & Holroyd, 2006).

Anxiety

As with depression, migraine shares a bidirectional relationship with anxiety disorders, such that either condition confers increased risk of onset of the other (Breslau et al., 2001; McWilliams et al., 2004). Headache patients are more likely than other neurological patients to suffer from anxiety disorders, such as Generalized Anxiety Disorder (GAD; Mehlsteibl et al., 2011). Among a small sample of individuals diagnosed with GAD, the lifetime odds for primary
headaches was more than seven times higher than those without psychiatric disorders (OR: 7.43), and individuals with GAD in turn experienced an increased likelihood of migraine (OR: 13.00; Mercante et al., 2011). In a much larger population-based study that controlled for sociodemographic variables, researchers replicated these findings but observed a lower odds ratio (OR: 2.46; Fuller-Thomson et al., 2017), confirming an increased likelihood of migraine in individuals with GAD. Similarly, migraine has a strong relationship with panic disorder (Smitherman et al., 2013), such that individuals with migraine are 2-10 times more likely than non-headache controls to have panic disorder (Breslau et al., 1998; 2001).

Increased prevalence of anxiety disorders also extends to TTH, such that prevalence of anxiety disorders is four times greater in those with CTTH and two times greater in ETTH compared to individuals without headache (Song et al., 2016). Some data suggest that anxiety disorders are even more common among those with TTH than among those with migraine (Lucchetti et al., 2013). For instance, a recent cross-sectional study reported that 70.6% of individuals with TTH had comorbid GAD (Ghogare & Patil, 2020). As with depression, anxiety has been associated with increased headache-related disability.

The high prevalence of comorbid anxiety compounds headache-related disability, such that individuals with comorbid anxiety are three and a half times more likely to report severe migraine-related disability than those without anxiety (Seng et al., 2017). Further supporting this notion, a recent study found that while controlling for sociodemographic and headache features, anxiety confers increased risk for moderate to severe migraine-related disability in individuals with migraine (RR: 1.39; Lipton et al., 2020). Similarly, anxiety appears to worsen the relationship between TTH and resulting disability. Monzani and colleagues (2018) found that state anxiety mediates the relationship between presence of TTH and workers’ productivity, such
that experiencing TTH leads to increased state anxiety symptoms, which subsequently reduces workplace productivity. Beyond functional impairment, heightened anxiety levels can also contribute to increased frequency of headache attacks in patients with either migraine or TTH (Song et al., 2016; Nicholson et al., 2007; Zwart et al., 2003). Overall, these findings underscore the additional burden experienced by individuals with comorbid psychiatric symptoms.

Current evidence supports the notion that comorbid depression and anxiety symptoms independently contribute to headache-related disability (Lipton et al., 2020). Perhaps this is because psychiatric comorbidities foster increased avoidance of stimuli believed to trigger a migraine attack (e.g., physical activity; Farris et al., 2019b), confer reduced response to migraine pharmacotherapy (Lanteri-Minet et al., 2005; Lucas et al., 2005; especially among those with CM; Smitherman et al., 2020), and contribute to medication nonadherence (Radat et al., 2005). A recent study provides theoretical support for how psychiatric symptoms may increase disability through avoidance (Seng et al., 2018). In this study, pain willingness and activity engagement sequentially mediated the relationship between depression/anxiety symptoms and severe headache-related disability. These findings suggest that individuals with comorbid psychopathology are less accepting of their pain and thus less engaged in valued activities and this avoidance compounds functional impairment. Another recent clinic-based study found that primary headache patients who met criteria for medication overuse headache (MOH) reported greater headache-related disability and more escape and avoidance behaviors related to their head pain (Peck et al., 2018). Both of the aforementioned studies suggest that comorbid psychopathology may play a role in increasing avoidance as a result of learned responses to pain, thus increasing disability. Further, both depression and anxiety symptoms are also associated with increased susceptibility to migraine triggers (Baldacci et al., 2015), such as stress,
dehydration, or irregular sleep, which may prompt not only more frequent headache attacks but contribute to further avoidance behavior. Psychiatric symptoms thus act to facilitate behavior that contributes to increased disability in individuals with primary headache disorders.

**Associated Psychological Sequelae**

Besides psychiatric symptoms, stress and other transdiagnostic variables that influence attacks, coping with triggers, and avoidance behavior are also associated with responses to primary headache disorders.

*Stress*

Stress is elicited by a situation in which perceived demands challenge perceived coping resources. As applied to headache, modern conceptualizations of stress view it within the context of an allostatic load model. Allostasis refers to the fluctuations in the physiological systems of the body in response to stressors (McEwen & Stellar, 1993), whereas allostatic load refers to the deterioration of such physiological systems by continued alterations in their structure and/or function (Borsook et al., 2012). In conceptualizing migraine as a disease of allostatic load, migraine is viewed as a dysregulation of physiological stability. As such, over time psychological stress contributes to neuronal dysregulation and central sensitization through increased neuroendocrine responses to sensory stimuli, which lower the pain threshold and increase risk for subsequent attacks (i.e., headache progression). Repeated headache attacks themselves come to function as chronic stressors that compound allostatic load (Borsook et al., 2012; Nash & Thebarge, 2006) and exacerbate poor coping. Viewing migraine through the lens of the allostatic load model underscores the role of chronic stress in migraine-related pathophysiology and disability.
Though most individuals experience stress in their daily lives, stress levels appear higher among individuals with migraine compared to non-headache controls (Wacogne et al., 2003). Indeed, stress is the most commonly reported migraine trigger (Walters-Pellegrino et al., 2018), and its role in the development and maintenance of migraine is relatively well established. For instance, in a daily diary study of individuals with CM and CTTH, high levels of stress for two consecutive days were associated with increased risk of subsequent headache attack (Houle et al., 2012). These findings are consistent with previous research among individuals with chronic primary headaches, which showed a relationship between exposure to increased stress prior to headache onset (De Benedittis et al., 1990). More recently, Houle and colleagues (2017) successfully forecasted future individual headache attacks in those with EM based on frequency and perceived intensity of stressful events (i.e., daily hassles). Although contradictory studies exist (Vives-Mestres et al., 2021), a reliable pattern of stressful events and subsequent attacks can offer individuals opportunities to respond to stress fluctuations in anticipation of an attack, providing a deeper understanding of an individual’s approach to their headaches.

In addition to precipitating individual headache attacks, stress plays a role in headache disorder progression. Stress independently contributes to headache chronicity while also affecting behavioral responses to headache, such as occasioning poor sleep or inconsistent daily routines (Nash & Thebarge, 2006) that indirectly drive disorder progression. Perceived stress is significantly higher in those with chronic migraine as compared to non-headache controls, even after controlling for anxiety and depression (Moon et al., 2017), indicating that the stress-headache relationship is independent of other psychiatric symptoms.

Early life stress has also been linked to de novo migraine disease onset, such that individuals who experienced early childhood stress are more likely to have migraine-associated
biomarkers of inflammation, coagulation, and oxidative stress (Tietjen et al., 2012) and thus at greater risk for developing migraine in adulthood. The odds of migraine increase by 51% among individuals with two or more early life stressors as compared to those without any early life stressors (Hammond & Colman, 2020). Given the numerous ways in which stress affects headache, stress likely compounds headache-related disability. Indeed, a recent study found that stress mediates the relationship between allodynia (perception of non-noxious stimuli as painful) and headache-related disability (Polk et al., 2020). The prior study is important as it suggests a psychological mechanism through which migraine-related pain sensitivity can affect disability. Though ample literature exists regarding the nature of depression, anxiety disorders, and stress in headache disorders, an emerging body of research aims to apply chronic pain models of reinjury fear to headache.

**Fear of Pain**

Prior to its application to headache, the fear avoidance model (FAM) was developed to help explain the differing psychosocial responses to musculoskeletal pain (Lethem et al., 1983). The model postulates that fear of pain (FOP), the fear of movement or activity due to presumed susceptibility to pain, prompts avoidance, rather than confrontation, of pain-related stimuli in susceptible individuals. That is, differential interpretations of pain, as either non-threatening (i.e., pain is temporary) or catastrophic (i.e., pain is a serious injury where one has little to no control; Crombez et al., 2012) influence subsequent responses to pain. For example, individuals responding to pain as non-threatening will eventually resume pre-injury activity levels. However, those with high fear of pain will avoid stimuli putatively associated with pain. When this avoidance behavior extends beyond the period of tissue damage and healing, the individual is at risk for physical deconditioning, social withdrawal, and negative psychological effects (Vlaeyen
& Linton, 2000; 2012). In support of this model, interventional studies suggest that reducing pain-related fear may result in an increase in daily life activities (Crombez et al., 2012).

Recently, researchers have applied the FAM to headache in an attempt to explicate a psychosocial pathway between headache and disability (Rogers et al., 2020; Ruscheweyh et al., 2019). For example, an individual with headache may perceive air travel as precipitating head pain. Resultingly, this individual avoids air travel out of fear that it will reliably elicit a pain experience. Over time, increasing avoidance of air travel may cause increased functional impairment via lack of connection with distant family and friends. In an earlier study of FOP in headache, Nash and colleagues (2006) found that pain-related anxiety accounted for a unique proportion of variance in headache-related disability, even after controlling for pain severity and other related psychosocial variables. More recently, Black and colleagues (2015) replicated these findings among individuals with migraine and TTH and showed that FOP’s role in headache-related disability was distinct from anxiety and depression symptoms. FOP accounted for more variance in disability than gender and these psychiatric symptoms combined, and FOP partially mediated the association between pain severity and disability (Black et al., 2015). These findings support the application of the FAM to headache and the role of FOP in headache-related disability among individuals suffering from primary headache disorders.

Anxiety Sensitivity

Another transdiagnostic cognitive variable of relevance to headache is anxiety sensitivity (AS). AS is the tendency to attend to, and be fearful of, arousal and/or bodily sensations (Farris et al., 2019a) associated with anxiety. Expectancy theory, which states that motivation to avoid a feared outcome is a function of both expectancy and sensitivity, asserts that AS is both a risk factor for and consequence of anxiety disorders (Reiss, 1991). When applied to headache,
expectancy theory suggests that individuals with headache may avoid headache triggers in part due to anticipation of resulting physical symptoms and a perceived sensitivity to those symptoms. AS may be conceptualized in the context of the FAM, such that excessive preoccupation with arousal-related bodily sensations of pain fosters interpretations of pain as catastrophic, thus increasing FOP and promoting further avoidance of painful stimuli (Vlaeyen & Linton, 2000). Supporting this relationship in individuals with recurrent headache, a structural equation modeling study showed that AS directly affects FOP, which in turn influences pain-related escape and avoidance (Norton & Asmundson, 2004). This finding indirectly suggests that interventions that target AS may be advantageous in mitigating pain-related escape and avoidance behaviors, which has been supported by clinical studies (Watt et al., 2006).

Research on AS in headache demonstrates a multifaceted relationship with headache onset, headache-related disability, and psychiatric distress (Farris et al., 2019a; Nicholson et al., 2007; Smitherman et al., 2015). AS may beget headache onset if an individual misinterprets innocuous bodily stimuli as dangerous (e.g., heart palpitations, light touch/pressure), which may trigger a sympathetic response that occasions headache (Nicholson et al., 2007). Smitherman and colleagues (2015) found that AS accounted for a significant proportion of variance in headache-related disability, beyond that of depression and anxiety combined. Notably, AS was most strongly associated with symptoms characteristic of migraine (e.g., phono/photophobia, worsening by activity, nausea) and as AS increased, the number of reported triggers increased. More recent data suggests that women with probable migraine are more likely to endorse clinically elevated levels of AS, and that AS specific to cognitive and social concerns is associated with greater average pain intensity and more severe psychiatric symptoms compared to women without probable migraine (Farris et al., 2019a). Additionally, Farris and colleagues
(2019a) found that the cognitive domain of AS was specifically linked to misuse of pain medication and avoidance, even after controlling for anxiety and depressive symptoms. These studies indirectly support the notion that AS is related to headache-related disability through its effects on avoidance behavior and sensitivity to headache triggers, consistent with FAM conceptualizations of headache.

**Goals of the Present Study**

Headache symptoms (i.e., pain severity, frequency of attacks, nausea, photophobia, phonophobia) have an established relationship with headache-related disability (Ford et al., 2008; Kim et al., 2015; Tkachuk et al., 2003). Likewise, psychiatric symptoms (i.e., depression, anxiety) and transdiagnostic psychological variables (i.e., stress, fear of pain, anxiety sensitivity) explain a significant proportion of unique variance in headache-related disability (Baskin & Smitherman, 2009; Black et al., 2015; Hamelsky & Lipton, 2006; Smitherman et al., 2015). However, to date, literature examining the relative contribution of headache symptoms and psychological factors to headache-related disability is lacking, which is the principle aim of the present study. Determining the relative contribution of these factors to headache-related disability may aid in enhancing assessment of important headache-related outcomes as well as inform the focus of clinical interventions. For instance, if psychological variables contribute to disability beyond headache variables, providers may opt to expand screening of transdiagnostic symptoms and comorbid psychiatric disorders or become more adept at recognizing patients in need of psychiatric referral. Additionally, adjunctive headache treatments, such as cognitive behavioral therapy, may be particularly indicated for intervening specifically on psychological factors that impact disability, though this is an empirical question. The following goals and related hypotheses are proposed.
Hypotheses

Study Goal 1: To explore the relative contributions of headache symptoms and psychological factors in headache-related disability.

- Hypothesis 1a: Psychiatric symptoms (i.e., depression, anxiety) and transdiagnostic psychological factors (i.e., stress, fear of pain, anxiety sensitivity) would account for significant unique variance in headache-related disability beyond headache symptoms (i.e., pain severity, frequency, nausea, photophobia, phonophobia), after controlling for sex. (Primary hypothesis)

Study Goal 2: To explore the moderating role of headache type and frequency on the relationships of psychiatric symptoms and psychological factors with headache-related disability.

- Hypothesis 2a: Headache type and frequency would moderate the observed relationship between the psychiatric symptoms (i.e., depression, anxiety) and disability, such that the relationship would be stronger among those with migraine than those with tension-type headache, and among those with chronic versus episodic headache.

- Hypothesis 2b: Headache type and frequency would moderate the observed relationship between the transdiagnostic psychological factors (i.e., stress, fear of pain, anxiety sensitivity) and disability, such that the relationship would be stronger among those with migraine than those with tension-type headache, and among those with chronic versus episodic headache.
II. METHOD

Participants

The current study consisted of an undergraduate student sample age 18 years or older who were enrolled in psychology courses at the University of Mississippi. Students completed a variety of computer-administered measures through SONA Systems across fall and spring semesters, from Spring 2017- Spring 2021. Individuals meeting ICHD-3 criteria for episodic tension-type headache (ETTH), chronic tension-type headache (CTTH), episodic migraine (EM), and chronic migraine (CM) were retained for the present study. As young adults with migraine often present with attacks lasting between 2 and 4 hours, if untreated, (Rains et al., 2001) the criterion for the length of migraine attacks was lowered for the present study to include individuals who endorsed symptoms characteristic of migraine with untreated attacks lasting a minimum of 2 hours. Individuals with or suspected of having another headache disorder (i.e., posttraumatic headache, medication overuse headache, or cluster headache) or those who did not meet criteria for a headache disorder were excluded. Additional exclusion criteria included participants exhibiting suspect effort, defined as completing the battery 90% faster than all participants (see Meade & Craig, 2012) or with incomplete survey batteries, defined as more than 5% of total missing data. For survey batteries with less than 5% missing data, the current analysis utilized data from all available cases. An a priori power analysis, based on a medium effect size among psychological variables and headache disability (Black et al., 2015; Seng et al., 2018), was conducted using G*Power 3.1 (Faul et al., 2009). Based on hypothesis 1a, a
minimum of 123 participants were needed for the current study to be adequately powered, assuming a medium effect size of \( f^2 = .15 \), power of .80, and statistical significance of \( p < .05 \).

**Materials**

**Demographics Questionnaire.** Participants completed a questionnaire that queries details about their race, ethnicity, sex, age, and other demographic information. See Appendix A for the complete questionnaire.

**Structured Diagnostic Interview for Headache-3 (SDIH-3).** The SDIH-3 (Smitherman et al., 2015) is an adapted version of the original computer-administered and well-validated SDIH (Andrew et al., 1992), revised to comport with International Classification of Headache Disorder—3rd Edition (ICHD-3) diagnostic criteria. The SDIH-3 is a 17-item diagnostic interview used for differential diagnosis of primary headache disorders by assessing headache symptoms, severity, frequency, and other diagnostic characteristics. Further, the SDIH-3 includes additional appendices with questions assessing for aura symptoms, cluster headache, medication overuse headache, and post-traumatic headache. See Appendix B.

**Headache Impact Test-6 (HIT-6).** The HIT-6 (Kosinski et al., 2003) is a 6-item self-report questionnaire that assesses the impact of headache on an individual’s functioning. Specifically, this measure assesses headache disability in the domains of social functioning, cognitive functioning, and psychological distress. Respondents report frequency of headache-related impairment over the past month on a 5-point Likert-type scale, with responses ranging from “never” to “always.” Total scores range from 36-78, with scores ≥ 60 indicating very severe impact of headache on functioning. The HIT-6 has good internal consistency, alternate forms, and test-retest reliability (\( \alpha = .89, .90, \) and .80, respectively), as well as good discriminant validity among diagnostic groups (Kosinski et al., 2003). See Appendix C.
**Depression, Anxiety, and Stress Scales (DASS-21).** The DASS-21 (Lovibond & Lovibond, 1995) is a 21-item self-report measure designed to assess the labeled negative affective states (depression, anxiety, and stress) over the past week. The DASS-21 is a brief version of the original 42-item DASS (Lovibond & Lovibond, 1993). Participants respond to seven items for each subscale using a 4-point Likert-type response, ranging from 0 (“does not apply”) to 3 (applies “very much or most of the time”). Items from each scale are summed and provide an indication of affective distress in each domain. The DASS-21 subscales have demonstrated strong convergent validity with related measures (Beck Depression Inventory [BDI] = 0.79, Beck Anxiety Inventory [BAI] = 0.85) and exhibit acceptable divergent validity. Subsequently, the DASS-21 displays high levels of internal consistency across studies (α = .82-.97; Antony et al., 1998; Henry & Crawford, 2005). For the present study, each subscale was utilized. See Appendix D.

**Pain Anxiety Symptom Scale (PASS-20).** The PASS-20 (McCracken & Dhingra, 2002) is an updated and condensed version of the original 40-item PASS (McCracken et al., 1992). The PASS-20 is a 20-item self-report measure that assesses fear of pain across four subdomains: cognitive anxiety, escape/avoidance, fearful appraisals, and physiological responses. Participants respond to each item using a 6-point Likert-type scale ranging from 0 (“never”) to 5 (“always”), with total scores ranging from 0-100. Compared to the original PASS, the PASS-20 preserves good internal consistency and construct validity and demonstrates good convergent and divergent validity with the original PASS subscales (McCracken & Dhingra, 2002). See Appendix E.

**Anxiety Sensitivity Index-3 (ASI-3).** The ASI-3 (Taylor et al., 2007) is a modified version of the ASI (Peterson & Reiss, 1992) and the ASI-R (Taylor & Cox, 1998a, 1998b). Compared to the original ASI, the ASI-3 shows improved reliability and validity (Taylor et al.,
The ASI-3 is an 18-item measure of anxiety sensitivity across three dimensions (physical, cognitive, and social concerns). Anxiety concerns are rated on a 5-point Likert-type scale with response agreements ranging from 0 (“very little”) to 4 (“very much”). Subscale scores range from 0-24 and total scores from 0-72. The ASI-3 has good internal consistency across samples from different cultures (physical concerns, $\alpha = .76-.86$, cognitive concerns, $\alpha = .79-.91$, social concerns, $\alpha = .73-.86$), as well as good convergent, discriminant, and criterion-related validity (Taylor et al., 2007). See Appendix F.

**Procedure**

The previously outlined measures were administered as part of a larger online survey battery through SONA systems. Students completed survey batteries over several semesters and received modest course credit for their participation.
III. RESULTS

Statistical Analyses

Statistical analyses were completed using IBM SPSS Version 25 (IBM, Inc., Chicago, IL, USA). The criterion for statistical significance was \( p < .05 \). Preliminary analyses included descriptive statistics of the sample and bivariate correlations between variables of interest using Pearson correlations. Both descriptive statistics and correlations between variables were summarized and distributions examined. The primary analyses were conducted in three steps. First, a hierarchical linear regression analysis was conducted to assess the relationship between headache symptoms (Step 2), psychiatric symptoms (Step 3), transdiagnostic variables (Step 4), and headache-related disability, after controlling for sex (Step 1). Second, to assess moderation, the effect psychiatric and transdiagnostic symptoms on headache-related disability was assessed given the condition of headache frequency (chronic vs. episodic) and type (migraine vs. TTH). Third, a three-way interaction was conducted to examine the differences in the interaction of headache type with psychiatric and transdiagnostic symptoms on headache-related disability among chronic vs. episodic headache. For these analyses, psychiatric symptoms were collapsed into a single variable, as were transdiagnostic psychological variables. Individual items representing the variables of interest were standardized and an average z-score of the standardized items calculated to represent the aggregated variable. Two moderator variables were dummy coded and dichotomized: headache type (migraine [1] vs TTH [0]) and headache frequency (episodic [<15 days/month; 0] vs chronic [≥15 days/month; 1]). Both moderation models were conducted using Hayes’ PROCESS macro for SPSS (model 3; Hayes, 2012), to
examine the effect of psychiatric and transdiagnostic variables on headache-related disability based on the condition of headache type and frequency.

**Participant Demographics**

A total of 6,007 students participated between Spring 2017 through Spring 2021. Of those, 446 (7.4% of the eligible sample) were excluded for exhibiting suspect effort, as defined previously. Additional exclusions included participants with > 5% missing data on headache-specific items necessary to determine a headache diagnosis (n = 229); those without headache (n = 1402); those who endorsed symptoms consistent with probable migraine (n = 978) or probable TTH (n = 718); or those who reported symptoms consistent with medication overuse headache (n = 7), cluster headache (n = 108), or headache attributed to head injury (n = 301).

Table 1 presents the demographic characteristics of the final sample with migraine or TTH. The retained sample consisted of 1,818 undergraduate students (74.6% female) with a mean age of 19.03 years (SD = 5.1). The majority of the sample identified as White (80.9%); 12.2% identified as Black, 2.2% were Asian/Pacific Islander, 1.7% were Hispanic/Latino, 0.3% were Native American/Alaskan Native/Native Hawaiian, and 2.8% identified as multi-racial. Of these, 848 (46.6%) met criteria for episodic migraine, 211 (11.6%) endorsed symptoms consistent with chronic migraine, 696 (38.3%) met criteria for episodic TTH, and 63 (3.5%) had chronic TTH. On average participants experienced 7.5 (SD = 5.73) headache days per month with moderate headache-related disability ($M = 54.7$, $SD = 8.7$). Participants reported “normal” levels of depression symptoms ($M = 8.4$, $SD = 9.1$) and stress ($M = 12.4$, $SD = 8.7$), and mild symptoms of anxiety ($M = 8.3$, $SD = 8.0$). On average, participants endorsed somewhat elevated FOP ($M = 31.2$, $SD = 16.5$) and low AS ($M = 16.3$, $SD = 13.4$).

**Data Analytic Assumptions**

24
Analytic assumptions for all variables of interest were found to be satisfactory after examining histograms and descriptives for skewness and kurtosis. Participants were examined for multivariate outliers using Mahalanobis distance prior to analyses, and no outliers were found.

**Correlations Among Variables of Interest and Group Differences**

Significant correlations were found between headache-related disability and the variables of interest (all \( ps < .01 \)). Table 2a presents correlations between disability and the headache variables, and Table 2b presents correlations between disability and the psychiatric and transdiagnostic variables. Headache-related disability exhibited a small positive relationship with phonophobia and all of the psychological variables; a small-to-moderate positive relationship with headache frequency, nausea, and photophobia; and a large positive relationship with severity (\( r = .59 \)).

Differences between individuals with migraine and TTH are presented in Table 3. Those with migraine reported significantly greater headache-related disability (\( M = 58.58 \) vs. \( M = 49.18 \)) and higher levels of all psychiatric (i.e., depression, anxiety) and transdiagnostic variables (stress, FOP, AS).

**Regression Analyses**

In order to assess the relationship between headache, psychiatric symptoms, psychological variables, and headache disability, hierarchical linear regression analyses were conducted. Complete results of the initial regression analysis are presented in Table 4a. Block 1, which included sex was significant, with sex accounting for 5.7% of variance in headache-related disability (\( p < .001 \)). After controlling for sex, Block 2, which included the headache variables of interest (i.e., pain severity, headache frequency, nausea, photophobia, phonophobia),
independently accounted for almost half of the variance in headache-related disability ($\Delta R^2 = .45$, $p < .001$). The psychiatric symptoms (i.e., depression [DASS depression], anxiety [DASS anxiety]) entered in Block 3 accounted for significant incremental variance in headache-related disability ($\Delta R^2 = .027$, $p < .001$). Finally, the transdiagnostic variables (i.e., stress [DASS stress], FOP [PASS-20 total score], AS [ASI-3 total score]) added in Block 4 significantly accounted for additional incremental variance in headache-related disability ($\Delta R^2 = .023$, $p < .001$; overall model $R^2 = .55$, $p < .001$). A comparison of the confidence intervals of the Block 4 standardized regression coefficients indicates that this incremental contribution was driven by fear of pain. In the final model, all variables significantly predicted disability except stress ($\beta = .04$, $p = .16$) and AS ($\beta = .02$, $p = .17$).

As the initial regression analysis only revealed a small proportion of variance in disability accounted for by psychiatric symptoms and transdiagnostic factors (2.7% and 2.3%, respectively), a second hierarchical regression analysis was conducted as a sensitivity analysis, in which the psychological variables were entered first. Complete results are presented in Table 4b. Controlling for sex, psychiatric symptoms accounted for 11.7% incremental variance in disability ($p < .001$), and transdiagnostic variables further increased the variance accounted for by 5.8% ($p < .001$). Together, psychiatric symptoms and transdiagnostic factors accounted for 17.5% of variance in disability, independent of headache-specific symptoms. Headache symptoms added in Block 4 accounted for an additional 32.4% ($p < .001$) of variance in disability.

**Moderation Analyses**

To examine the conditional effect of headache type and headache frequency on headache-related disability, two moderation analyses were performed. The first examined the relationship between psychiatric symptom variables and headache-related disability, while the second
moderation analysis examined the relationship between transdiagnostic variables and headache-related disability. Moderation results are presented in Tables 5a and 5b. Conceptual diagrams are presented in Figures 1a and 1b.

The first moderation examined the effect of diagnosis and frequency on disability when the standardized psychiatric variable was held constant. A three-way interaction was conducted to analyze the relationships between the psychiatric and two moderator variables. The total model was significant \( F(7, 1715) = 152.72, p < .001, R^2 = .38 \). Main effects revealed that psychiatric symptoms \( (b = 2.00, p < .001) \), headache type \( (b = 7.66, p < .001) \), and headache frequency \( (b = 4.52, p < .001) \) were each independently associated with disability. All two-way interactions were non-significant (psychiatric symptoms and headache type, psychiatric symptoms and headache frequency, headache type and frequency). A significant three-way interaction was found between psychiatric symptoms, headache type, and headache frequency \( (b = -3.16, p = .002) \), indicating that the interaction of headache type and psychiatric symptoms on disability differs significantly among individuals with chronic vs. episodic headache. The conditional effects of the psychiatric aggregate variable on disability at different levels of the moderators (ETTH, EM, CTTH, CM) were all significant.

Simple slopes of psychiatric symptoms by disability were tested at each level of the moderators (ETTH, CTTH, EM, CM). Simple slopes are presented in Figure 2a. Each simple slope test revealed significant positive associations between psychiatric symptoms and headache-related disability. Specifically, the relationship between psychiatric symptoms and disability was strongest for those with CTTH \( (b = 3.93, p < .001) \), then EM \( (b = 2.07, p < .001) \), ETTH \( (b = 1.80, p < .001) \), and weakest for those with CM \( (b = 1.04, p = .01) \).
The second moderation examined the effect of diagnosis and frequency on disability when the aggregated transdiagnostic variable was held constant. The overall model was significant \( F(1775) = 176.86, p < .001, R^2 = .41 \), and main effects demonstrated that transdiagnostic factors \( (b = 2.94, p < .001) \), headache type \( (b = 7.56, p < .001) \), and frequency \( (b = 4.97, p < .001) \) were all independently associated with disability.

Although the interaction between transdiagnostic factors and frequency was non-significant, the interaction between transdiagnostic factors and headache type was significant \( (b = -.99, p = .02) \), such that a diagnosis of TTH strengthens the relationship between transdiagnostic factors and headache-related disability. A significant three-way interaction revealed that the interaction of headache type and transdiagnostic factors on disability differs significantly among individuals with chronic vs. episodic headache \( (b = -2.37, p = .03) \).

Finally, simple slopes of transdiagnostic variables with disability were tested at each of the diagnostic types (ETTH, CTTH, EM, CM). See Figure 2b. Each simple slope test revealed significant positive associations (all \( ps < .001 \)) between transdiagnostic variables and headache-related disability. Specifically, similar to the results from the prior moderation analysis, the effect of the transdiagnostic variables on disability was strongest for individuals with CTTH \( (b = 4.62, p < .001) \), then ETTH \( (b = 3.33, p < .001) \), EM \( (b = 2.69, p < .001) \), and weakest for individuals with CM \( (b = 1.61, p = .001) \).
IV. DISCUSSION

Headache symptoms and psychological factors have been associated with increased headache-related disability in individuals with primary headache disorders. The present study sought to examine the relative contributions of these variables to headache-related disability.

**Psychiatric Symptoms and Headache-Related Disability**

Consistent with the primary hypothesis, psychiatric symptoms accounted for significant unique variance in headache-related disability beyond that attributable to headache symptoms. Though headache symptoms alone accounted for almost half of the variance in headache-related disability and are the primary target of contemporary headache interventions, the present findings underscore the notion that psychiatric symptoms influence disability independent of pain and other headache symptoms. Specifically, comorbid depression and anxiety symptoms were both associated with more severe headache-related disability. Though the incremental effect was small (2.7% unique variance), the correlation analyses showed that these symptoms had a medium-sized association with disability when considered without the headache symptoms (all $rs > .30$).

The finding that depression and anxiety symptoms independently contribute to headache-related disability is consistent with data from larger epidemiological studies among primarily middle-aged adults (Holroyd et al., 2000; Lipton et al., 2020) and extend them to a younger demographic at increased risk for developing migraine (Lipton et al., 2007). However, the contribution of psychiatric symptoms to headache-related disability in the present study was somewhat smaller than findings from prior studies. Lipton et al. (2020) found that depression and anxiety symptoms alone conferred a 56% and 39% increased risk for moderate to severe
headache-related disability, respectively, and a 79% increase in risk when considered together. Similarly, Saunders et al. (2008) reported that comorbid conditions, including psychiatric conditions, explained 65% of variance in role disability among their sample. Somewhat smaller associations may be a result of differences in assessment of disability or sample composition. The present study utilized the HIT-6, while the CaMEO study used the Migraine Disability Assessment Scale (MIDAS; Lipton et al., 2020), and Saunders et al. (2008) used the WHO Disability Assessment Schedule II. Although the MIDAS and HIT-6 have demonstrated a moderate, positive correlation (Sauro et al., 2010), the MIDAS emphasizes activity impairment exclusively, while the HIT-6 has been shown to be more strongly influenced by headache severity and thus may be more weighted toward headache (versus psychological) symptoms. The WHO Disability Assessment Schedule is not headache-specific and emphasizes broader functional disability, such that it may better capture the impact of psychological symptoms on functional impairment. Another possible explanation for somewhat smaller associations between psychiatric symptoms and headache-related disability in the present study could be the relatively low levels of psychiatric symptoms among the current sample. Participants in the current study reported relatively low levels of depression and anxiety whereas almost half of participants in the CaMEO study had clinically significant levels of depression and/or anxiety.

Given that psychiatric symptoms influence disability independently of headache symptoms, providers are encouraged to regularly screen for depression and anxiety among treatment-seeking headache patients (Begasse et al., 2018; Dresler et al., 2019; Smitherman et al., 2008). A small but growing body of literature has demonstrated improvements in psychiatric symptoms as a result of pharmacological and behavioral interventions for headache (Affatoto et al., 2021; Martin et al., 2015; Rampello et al., 2004; Seng & Holroyd, 2012; Smitherman et al.,
Few interventional studies have examined how psychiatric improvement in individuals with headache may affect disability (e.g., Seng & Holroyd, 2012), and in such cases disability is typically examined as a secondary outcome.

One RCT showed that a 12-week cognitive behavioral therapy intervention targeting headache and comorbid depression improved headache symptoms, depression, anxiety, and quality of life (Martin et al., 2015), while a pilot study demonstrated similar improvements in depressive symptoms, general functioning, and migraine-related disability following a one-day acceptance and commitment therapy intervention (Dindo et al., 2012). Notably, a more recent RCT compared mindfulness-based stress reduction (MBSR) versus headache education for migraine and found that both groups showed similar improvement in migraine frequency but only the MBSR group improved on measures of disability, quality of life, and psychological symptoms (i.e., self-efficacy, pain catastrophizing, and depression; Wells et al., 2021). Similarly, an RCT that compared a mindfulness-based cognitive therapy intervention for migraine patients (MBCT-M) to treatment as usual showed greater reductions in headache-related disability and attack-level migraine-related disability in the MBCT-M group (Seng et al., 2019). Due to the unique contribution of psychiatric symptoms to headache-related disability in the present study and support from previous clinical trials, it can be theorized that treating comorbid psychiatric symptoms may reduce disability, though this notion awaits further empirical study.

**Transdiagnostic Variables**

Beyond exploring the role of psychiatric symptoms, the present study is, to our knowledge, the first to examine the relative contribution of transdiagnostic variables to headache-related disability. Importantly, the transdiagnostic variables accounted for small but significant unique variance in headache-related disability after accounting for both headache
symptoms and psychiatric symptoms. Transdiagnostic factors are of importance because they are not commonly assessed in clinical settings and because they present independently of, and are risk factors for, psychiatric disorders. For instance, several studies have demonstrated that early childhood stress (Brietzke et al., 2012; Elsayed et al., 2019) and emotional reactivity to even mild daily life stressors (Vaessen et al., 2017) portend increased likelihood of developing psychopathology later in life. AS is a well-established risk factor for developing mood and anxiety disorders, such as panic disorder (PD) and posttraumatic stress disorder (PTSD; Olatunji & Wolitzky-Taylor, 2009). Transdiagnostic factors may contribute to functional impairment independently of their functioning as risk factors for psychopathology, however. For instance, cognitive concerns associated with AS are associated with avoidance of exercise and physical activity in women with migraine (Farris et al., 2019). Similarly, FOP may exacerbate deconditioning and disability through restriction of movement and social activities (Vlaeyen & Linton, 2000). The present study suggests that these transdiagnostic factors have a meaningful, but often overlooked, contribution to headache-related disability.

Relative to stress and AS, however, FOP seems to play a larger role in headache-related disability among the present sample, as the contribution of the transdiagnostic variables was driven by FOP. Previous research supports the importance of FOP in pain-related disability. In chronic pain more broadly, a hospital-based study among children and adolescents found that though AS and FOP were related, only FOP was associated with disability (Martin et al., 2007). In applying the FAM to headache specifically, Norton and Asmundson (2004) showed that AS indirectly influenced disability through its effects on FOP. These findings are consistent with a conceptualization of AS as a dispositional variable that exacerbates FOP (Vlaeyen & Linton, 2012). In more recent work, Black and colleagues (2015) found that FOP was associated with
increased headache pain and accounted for unique variance in headache-related disability after controlling for depression, anxiety, and sex differences. Similarly, a study of individuals seeking treatment for primary headache disorders found that FOP, high headache-related disability, and use of combination acute medications were the best predictors of MOH (Peck et al., 2018). These studies highlight the role of avoidance behavior, driven by FOP, as a potential mechanism for increased disability, and our findings suggest that FOP influences activity limitation and societal disengagement germane to migraine attacks.

In terms of treatment implications, targeting FOP (through repeated exposure to feared activities) may hold promise in improving functioning among individuals with headache. A novel RCT demonstrated that a behavioral headache intervention that taught participants to cope with their headache triggers through repeated exposure showed potential for reducing headache symptoms and decreasing medication consumption, as compared to the traditional advice to avoid triggers (Martin et al., 2014). A follow-up study showed reductions in headache attack frequency and severity maintained after one year (Martin et al., 2021). This work in headache has not been applied to avoided stimuli beyond triggers or yet replicated but is promising, considering the efficacy of exposure-based interventions for other chronic pain disorders (Hedman-Lagerlöf et al., 2018). Further research evaluating the utility of exposure-based interventions for reducing FOP and headache-related disability among individuals with headache is needed.

**Moderation Analyses**

A significant three-way interaction occurred consistently in both moderation analyses, indicating that headache type and frequency together strengthen the relationship between psychological symptoms and disability. The conditional effects at each level of the moderators
showed that, contrary to hypotheses, this relationship was strongest among those with CTTH and weakest among those with CM. Although the prior literature suggests that a diagnosis of migraine would strengthen the relationship (as migraine is more disabling), this was not observed in the present study. Perhaps psychological variables influence individuals with migraine and TTH differently. For example, one hospital-based study comparing stress-induced pain in individuals with migraine and TTH suggested that individuals with TTH may be more affected by widespread central sensitization as a result of more generalized pain response (Leistad et al., 2006). Similarly, Leistad et al. (2007) found that individuals with TTH experienced prolonged cortisol secretion during low-grade cognitive stress, while those with migraine experienced normal decreases. Unique activation of the hypothalamic-pituitary-adrenocortical (HPA) axis was also observed when individuals with TTH managed stress (Leistad et al., 2007).

Additionally, individuals with TTH may be more susceptible to the influence of psychological factors (psychiatric symptoms and transdiagnostic variables) as a function of disease severity. That is, because the symptoms of TTH are comparatively mild, perhaps psychological factors exert a greater influence on disability. Alternatively, disability among individuals with migraine may be confounded by the more severe symptoms inherent to migraine, which often preclude activity engagement regardless of psychological variables. The finding that the relationship is stronger for those with CTTH than those with ETTH is consistent with prior literature indicating that affective distress is positively associated with headache frequency in individuals with TTH, and that those with ETTH have psychological profiles similar to those without headache (Heckman & Holroyd, 2006). Future research could explore whether these moderating effects of headache diagnosis have meaningful clinical implications.

Limitations and Future Directions
The present study is strengthened by its large sample size, data collection across multiple years, and adherence to ICHD-3 diagnostic criteria. Despite these strengths, the current study has several limitations. First, the participants included in the sample were all college students, with overall low or subclinical psychiatric symptomatology and moderate headache-related disability. Utilizing a treatment-seeking sample would likely provide greater variability in psychological symptoms and may reveal an even stronger relationship between the psychological variables and headache-related disability. However, despite the younger and relatively healthy sample, current participants endorsed higher-than-typical headache frequency (7.5 days/month) as compared to the general population (Lipton et al., 2007), indicating that they experienced meaningful patterns of headache.

A second limitation of this study is that the way stress was operationalized in the current study is somewhat discrepant from how it has been operationalized in previous studies. For example, stress in the context of headache has been measured in relation to triggers (Walters-Pellegrino et al., 2018), early life stress (Hammond & Colman, 2020; Tietjen et al., 2012), and individual events or hassles (Houle et al., 2017). The present study utilized the DASS-21 to measure stress, which places more emphasis on physical symptoms of tension (e.g., agitation, feeling touchy). As stress can be conceptualized differently, generalization of null findings regarding stress may be limited. The present results should therefore be interpreted with this in mind.

As previously stated, individuals with EM, CM, ETTH, and CTTH may be affected differently by psychological symptoms. Future endeavors to examine and differentiate the influence of these and other transdiagnostic variables across headache diagnoses may aid in informing targeted assessment approaches and behavioral interventions to improve disability.
Inclusion of disability as a primary outcome variable in treatment studies focused on psychological symptoms would also advance this line of research. Future research should also strive to examine the effects on disability of targeting FOP in behavioral headache treatments. Such strategies may be beneficial in teaching individuals how to effectively manage their headaches and promote social and behavioral engagement despite headache.
LIST OF REFERENCES


Clinical Neurology and Neurosurgery, 132, 74-78.
https://doi.org/10.1016/j.clineuro.2015.02.017

https://doi.org/10.1007/s10072-009-0071-5


https://doi.org/10.1136/jnnp.2009.192492


https://doi.org/10.1016/S0025-6196(11)60561-2


https://doi.org/10.1046/j.1526-4610.2003.03106.x


https://doi.org/10.1016/0304-3959(90)91052-K

Behaviour Research and Therapy, 50(9), 537-543.

https://doi.org/10.1016/j.brat.2012.05.007


anxiety, depression, and headache severity in women with migraine. *Headache, 59*(8), 1212-1220. https://doi.org/10.1111/head.13568


https://doi.org/10.1023/A:1026119331193


https://doi.org/10.1016/j.pain.2005.09.010


https://doi.org/10.1016/0005-7967(83)90009-8


https://doi.org/10.1111/j.1468-1331.2011.03612.x

prevalence, disease burden, and the need for preventive therapy. *Neurology, 68*(5), 343-349. https://doi.org/10.1212/01.wnl.0000252808.97649.21


https://doi.org/10.1111/head.12755


https://doi.org/10.1111/j.1526-4610.2006.00580.x


https://doi.org/10.1016/j.pain.2004.06.018


https://doi.org/10.1037/a0017428


List of Appendices
### VI. TABLES AND FIGURES

**Table 1.** Demographic Characteristics of the Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>% or Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (% Female)</td>
<td>74.6</td>
</tr>
<tr>
<td>Mean Age (SD)</td>
<td>19.03 (5.1)</td>
</tr>
<tr>
<td>Race (% Caucasian)</td>
<td>80.9</td>
</tr>
<tr>
<td>Episodic Migraine %</td>
<td>46.6</td>
</tr>
<tr>
<td>Chronic Migraine %</td>
<td>11.6</td>
</tr>
<tr>
<td>Episodic TTH %</td>
<td>38.3</td>
</tr>
<tr>
<td>Chronic TTH %</td>
<td>3.5</td>
</tr>
<tr>
<td>Mean Headache Days per Month (SD)</td>
<td>7.54 (5.73)</td>
</tr>
<tr>
<td>Mean Headache Severity (SD)</td>
<td>4.94 (1.68)</td>
</tr>
<tr>
<td>Nausea (% yes)</td>
<td>33.2</td>
</tr>
<tr>
<td>Photophobia (% yes)</td>
<td>62.4</td>
</tr>
<tr>
<td>Phonophobia (% yes)</td>
<td>68.3</td>
</tr>
<tr>
<td>Mean Depression (SD)</td>
<td>8.4 (9.1)</td>
</tr>
<tr>
<td>Mean Anxiety (SD)</td>
<td>8.3 (8.0)</td>
</tr>
<tr>
<td>Mean Stress (SD)</td>
<td>12.4 (8.7)</td>
</tr>
<tr>
<td>Mean Anxiety Sensitivity (SD)</td>
<td>16.3 (13.4)</td>
</tr>
<tr>
<td>Mean Fear of Pain (SD)</td>
<td>31.2 (16.5)</td>
</tr>
<tr>
<td>Mean Disability (SD)</td>
<td>54.7 (8.7)</td>
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**Table 2a.** Pearson correlations between disability and associated headache variables

<table>
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<tr>
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<th>3</th>
<th>4</th>
<th>5</th>
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<tr>
<td>2. Frequency</td>
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<tr>
<td>3. Severity</td>
<td>.59**</td>
<td>.31**</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4. Nausea</td>
<td>.46**</td>
<td>.20**</td>
<td>.43**</td>
<td></td>
<td></td>
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<td>5. Photophobia</td>
<td>.47**</td>
<td>.18**</td>
<td>.45**</td>
<td>.38**</td>
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<td>6. Phonophobia</td>
<td>.38**</td>
<td>.15**</td>
<td>.35**</td>
<td>.30**</td>
<td>.42**</td>
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</table>

**p < .01**

**Table 2b.** Pearson correlations between disability and associated psych variables

<table>
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<th>4</th>
<th>5</th>
</tr>
</thead>
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<td>1. HIT-6</td>
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<tr>
<td>2. Depression</td>
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<td></td>
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<tr>
<td>3. Anxiety</td>
<td>.33**</td>
<td>.65**</td>
<td></td>
<td></td>
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<tr>
<td>4. Stress</td>
<td>.34**</td>
<td>.70**</td>
<td>.75**</td>
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<tr>
<td>5. ASI-3</td>
<td>.32**</td>
<td>.55**</td>
<td>.66**</td>
<td>.61**</td>
<td></td>
</tr>
<tr>
<td>6. PASS-20</td>
<td>.39**</td>
<td>.29**</td>
<td>.38**</td>
<td>.37**</td>
<td>.50**</td>
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**p < .01**
Table 3. Group differences between individuals with migraine and TTH.

<table>
<thead>
<tr>
<th></th>
<th>Migraine group mean (SD)</th>
<th>TTH group mean (SD)</th>
<th>t-tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIT-6</td>
<td>58.58 (7.33)</td>
<td>49.18 (7.41)</td>
<td>(t(1599) = 26.63^*)</td>
</tr>
<tr>
<td>Depression</td>
<td>9.49 (9.62)</td>
<td>6.92 (8.00)</td>
<td>(t(1726) = 6.10^*)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>9.81 (8.49)</td>
<td>6.29 (6.76)</td>
<td>(t(1766) = 9.78^*)</td>
</tr>
<tr>
<td>Stress</td>
<td>13.89 (8.91)</td>
<td>10.31 (8.05)</td>
<td>(t(1694) = 9.10^*)</td>
</tr>
<tr>
<td>Anxiety Sensitivity</td>
<td>18.43 (14.33)</td>
<td>13.35 (11.35)</td>
<td>(t(1740) = 8.27^*)</td>
</tr>
<tr>
<td>Fear of Pain</td>
<td>34.37 (16.87)</td>
<td>26.76 (14.87)</td>
<td>(t(1666) = 9.94^*)</td>
</tr>
</tbody>
</table>

\(* p < .001\)
Table 4a. Regression Analysis Results

<table>
<thead>
<tr>
<th>Block 1</th>
<th>β</th>
<th>95% CI for β</th>
<th>R²</th>
<th>ΔR²</th>
<th>P-value of ΔR²</th>
<th>P-value of Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>4.80</td>
<td>3.83 – 5.76</td>
<td>5.7%</td>
<td></td>
<td>&lt;.001</td>
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</table>

<table>
<thead>
<tr>
<th>Block 2</th>
<th>β</th>
<th>95% CI for β</th>
<th>R²</th>
<th>ΔR²</th>
<th>P-value of ΔR²</th>
<th>P-value of Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>0.39</td>
<td>0.34 – 0.45</td>
<td>50.1%</td>
<td>45%</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
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<tr>
<td>Severity</td>
<td>1.69</td>
<td>1.47 – 1.91</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nausea</td>
<td>2.94</td>
<td>2.20 – 3.69</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photophobia</td>
<td>2.98</td>
<td>2.22 – 3.75</td>
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<tr>
<td>Phonophobia</td>
<td>1.74</td>
<td>1.00 – 2.49</td>
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<table>
<thead>
<tr>
<th>Block 3</th>
<th>β</th>
<th>95% CI for β</th>
<th>R²</th>
<th>ΔR²</th>
<th>P-value of ΔR²</th>
<th>P-value of Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>DASSdepression</td>
<td>0.12</td>
<td>0.08 – 0.17</td>
<td>53.1%</td>
<td>2.7%</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
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<tr>
<td>DASSanxiety</td>
<td>0.07</td>
<td>0.02 – 0.12</td>
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</table>

<table>
<thead>
<tr>
<th>Block 4</th>
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<th>ΔR²</th>
<th>P-value of ΔR²</th>
<th>P-value of Model</th>
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</thead>
<tbody>
<tr>
<td>DASSstress</td>
<td>0.04</td>
<td>-0.02 – 0.10</td>
<td>55.3%</td>
<td>2.3%</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
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<tr>
<td>ASI-3</td>
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<td>-0.01 – 0.06</td>
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<td></td>
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<tr>
<td>PASS-20</td>
<td>0.08</td>
<td>0.06 – 0.10</td>
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CI = confidence interval
**Table 4b.** Regression Analysis Results

<table>
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<tr>
<th>Block</th>
<th>R²</th>
<th>∆R²</th>
<th>P-value of ∆R²</th>
<th>P-value of Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 1</td>
<td>5.7%</td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Sex</td>
<td>4.80</td>
<td>3.83 – 5.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 2</td>
<td>17.3%</td>
<td>11.7%</td>
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<td>&lt;.001</td>
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<tr>
<td>DASS depression</td>
<td>0.17</td>
<td>0.11 – 0.22</td>
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<td></td>
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<tr>
<td>DASS anxiety</td>
<td>0.23</td>
<td>0.17 – 0.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 3</td>
<td>23%</td>
<td>5.8%</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>DASS stress</td>
<td>0.08</td>
<td>0.001 – 0.15</td>
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</tr>
<tr>
<td>ASI-3</td>
<td>0.03</td>
<td>-0.02 – 0.07</td>
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</tr>
<tr>
<td>PASS-20</td>
<td>0.13</td>
<td>0.10 – 0.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 4</td>
<td>55.3%</td>
<td>32.4%</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Frequency</td>
<td>0.34</td>
<td>0.29 – 0.40</td>
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<tr>
<td>Severity</td>
<td>1.58</td>
<td>1.37 – 1.79</td>
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<td></td>
</tr>
<tr>
<td>Nausea</td>
<td>2.58</td>
<td>1.86 – 3.29</td>
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<td></td>
</tr>
<tr>
<td>Photophobia</td>
<td>2.61</td>
<td>1.89 – 3.34</td>
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<td></td>
</tr>
<tr>
<td>Phonophobia</td>
<td>1.48</td>
<td>0.77 – 2.18</td>
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<td></td>
</tr>
</tbody>
</table>

CI = confidence interval
### Table 5a. Regression Results for Conditional Effect of Psychiatric Symptoms on Disability

<table>
<thead>
<tr>
<th>Predictor</th>
<th>B</th>
<th>SE</th>
<th>t</th>
<th>p</th>
<th>LL</th>
<th>UL</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constants</td>
<td>54.68</td>
<td>.17</td>
<td>315.76</td>
<td>&lt;.001</td>
<td>54.34</td>
<td>55.02</td>
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<tr>
<td>Psych_agg</td>
<td>2.00</td>
<td>.18</td>
<td>11.28</td>
<td>&lt;.001</td>
<td>1.65</td>
<td>2.35</td>
<td></td>
</tr>
<tr>
<td>Migraine vs. TTH</td>
<td>8.22</td>
<td>.35</td>
<td>23.16</td>
<td>&lt;.001</td>
<td>7.52</td>
<td>8.92</td>
<td></td>
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<tr>
<td>psych_agg*headache type</td>
<td>-.19</td>
<td>.37</td>
<td>-.52</td>
<td>.61</td>
<td>-92</td>
<td>.54</td>
<td></td>
</tr>
<tr>
<td>Chronic vs. Episodic</td>
<td>4.98</td>
<td>.54</td>
<td>9.22</td>
<td>&lt;.001</td>
<td>3.92</td>
<td>6.04</td>
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</tr>
<tr>
<td>psych_agg<em>frequency Type</em>frequency</td>
<td>.29</td>
<td>.47</td>
<td>.61</td>
<td>.54</td>
<td>-.64</td>
<td>1.22</td>
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<tr>
<td>psych_agg<em>frequency Type</em>frequency</td>
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<td>1.16</td>
<td>-.44</td>
<td>.66</td>
<td>-2.78</td>
<td>1.77</td>
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<tr>
<td>psych_agg<em>frequency Type</em>frequency</td>
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<td>1.04</td>
<td>-3.05</td>
<td>.002</td>
<td>-5.19</td>
<td>-1.13</td>
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*Psych_agg: psychiatric symptom aggregate variable
### Table 5b. Regression Results for Conditional Effect of Transdiagnostic Factors on Disability

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<th>p</th>
<th>LL</th>
<th>UL</th>
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</thead>
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<td>Trans_agg</td>
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<td>.20</td>
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<td>&lt;.001</td>
<td>2.56</td>
<td>3.33</td>
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<td>Migraine vs.</td>
<td>7.56</td>
<td>.34</td>
<td>22.01</td>
<td>&lt;.001</td>
<td>6.89</td>
<td>8.23</td>
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<tr>
<td>TTH</td>
<td>trans_agg*</td>
<td>-0.99</td>
<td>.41</td>
<td>-2.42</td>
<td>.02</td>
<td>-1.79</td>
</tr>
<tr>
<td>Migraine vs.</td>
<td>7.56</td>
<td>.34</td>
<td>22.01</td>
<td>&lt;.001</td>
<td>6.89</td>
<td>8.23</td>
</tr>
<tr>
<td>TTH</td>
<td>trans_agg*</td>
<td>-0.99</td>
<td>.41</td>
<td>-2.42</td>
<td>.02</td>
<td>-1.79</td>
</tr>
<tr>
<td>Chronic vs. Episodic</td>
<td>4.97</td>
<td>.51</td>
<td>9.81</td>
<td>&lt;.001</td>
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<td>5.96</td>
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<tr>
<td>trans_agg*</td>
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<td>-0.17</td>
<td>.87</td>
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<td>.93</td>
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<tr>
<td>Type*</td>
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<td>1.08</td>
<td>-0.26</td>
<td>.79</td>
<td>-2.41</td>
<td>1.84</td>
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<tr>
<td>trans_agg*</td>
<td>-2.37</td>
<td>1.12</td>
<td>-2.12</td>
<td>.03</td>
<td>-4.56</td>
<td>-.18</td>
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</tbody>
</table>

*Trans_agg: transdiagnostic aggregate variable*
**Figure 1a.** Conceptual Diagram of Moderation Analysis with Psychiatric Symptoms

- Frequency (chronic vs. episodic)
- Headache Type (Migraine vs. TTH)

Psychiatric Symptom Cluster → Headache-related disability

**Figure 1b.** Conceptual Diagram of Moderation Analysis with Transdiagnostic Variables

- Frequency (chronic vs. episodic)
- Headache Type (Migraine vs. TTH)

Transdiagnostic Variable Cluster → Headache-related disability
Figure 2a. Analysis of Simple Slopes Using Psychiatric Symptoms
Figure 2b. Analysis of Simple Slopes Using Transdiagnostic Variables

![Graph showing analysis of simple slopes using transdiagnostic variables. The graph displays the relationship between HIT-6 scores and transdiagnostic aggression (Low Trans_Agg vs. High Trans_Agg) for different types of headache conditions: TTH Episodic, TTH Chronic, Mig Episodic, and Mig Chronic.]
APPENDIX A: DEMOGRAPHICS QUESTIONNAIRE

Demographic Information
Please answer the following questions.

1. Today’s Date _______
   Today’s Time _______

2. Sex:
   ☐ Male
   ☐ Female

3. Age: _______

4. What is your year in school?
   ☐ 1st year undergraduate
   ☐ 2nd year undergraduate
   ☐ 3rd year undergraduate
   ☐ 4th year undergraduate
   ☐ 5th year undergraduate
   ☐ Graduate or professional
   ☐ Non seeking a degree
   ☐ Other

5. What is your enrollment status?
   ☐ Full-time  ☐ Part-time  ☐ Other

6. How do you usually describe yourself?
   (Check all that apply)
   ☐ White, non Hispanic (includes Middle Eastern)
   ☐ Black, non Hispanic
   ☐ Hispanic or Latino/a
   ☐ Asian or Pacific Islander
   ☐ American Indian, Alaskan Native, or Native Hawaiian
   ☐ Biracial or Multiracial
   ☐ Other

7. Are you an international student?
   ☐ No  ☐ Yes

8. Where do you currently live?
   ☐ Campus residence hall
   ☐ Fraternity or sorority house
   ☐ Other college/university housing
   ☐ Parent/guardian’s home
   ☐ Other off-campus housing
   ☐ Other

9. How many hours a week do you volunteer?
   ☐ 0 hours  ☐ 30-90 hours
   ☐ 0-9 hours  ☐ 40 hours
   ☐ 10-19 hours  ☐ More than
   ☐ 20-29 hours  ☐ 40 hours

10. What is your approximate cumulative grade average? If you are a first year student or don’t know, select the gpa you think you’ll end this semester with.
    ☐ A ☐ B ☐ C ☐ D ☐ F

72
APPENDIX B: Structured Diagnostic Interview for Headache-3 (Brief Version)

1. Do you ever get headaches?
   a. Yes  b. No

2. On average, how many **DAYS** PER **MONTH** do you have a headache? *(enter one number between 0 and 30)*
   ____

3. If 0 is no pain, 5 is moderate pain, and 10 is the worst pain imaginable, what is the average pain intensity of these headaches? *(enter one number between 0 and 10)*
   ____

4. If left untreated or unsuccessfully treated, about how long would these headaches usually last?
   a. less than 30 minutes
   b. at least 30 minutes but less than 2 hours
   c. at least 2 hours but less than 4 hours
   d. between 4 hours and 3 days
   e. between 3 days and 7 days
   f. longer than 7 straight days

5. For approximately how long have you been having these headaches?
   a. Less than 3 months
   b. 3 months
   c. 4 months or more

6. About how many of these headaches have you had in your life?
   a. Less than 5
   b. 5 – 9
   c. 10 – 20
   d. More than 20

7. Which of the following best describes your pain?
   a. Pulsating/Throbbing  b. Tight pressure (non-pulsating)

8. Is the pain typically experienced on one side or both sides of your head?
   a. Typically one side  b. Typically both sides

9. Is the pain made worse by routine physical activities or cause you to avoid routine physical activities (like walking, bending over, or climbing stairs)?
   a. Yes  b. No

10. Do you often feel nauseous or sick to your stomach during these headaches?
    a. Yes  b. No
11. Do you often vomit or throw up during these headaches?
   a. Yes  b. No

12. Are you often sensitive to light during these headaches?
   a. Yes  b. No

13. Are you often sensitive to sound during these headaches?
   a. Yes  b. No

14. Do you often experience any symptoms shortly before the headache pain actually begins, such as changes in your vision (blurry vision, seeing spots or zigzag lines), changes in your sensation (numbness, tingling), or changes in your speech?
   a. Yes  b. No  *If “no” skip to #16

15. If you answered “Yes” to the previous question, how many times have you experienced these symptoms before having a headache?
   a. 1  
   b. 2 – 5  
   c. 6 – 10  
   d. More than 10

16. Do you use any medications to treat these headaches?
   a. Yes  b. No  *If “no” skip to #20

17. If you use medication, how many days per week do you use any type of medication to treat your headaches?
   a. Less than 1 day per week  
   b. 1-2 days per week  
   c. 3 days per week  
   d. 4 or more days per week

18. How long have you been using these medications at this frequency?
   a. 3 months or less  
   b. More than 3 months

19. Did your headache develop or get worse when you started using these medications at this frequency?
   a. Yes  
   b. No

20. Did this headache develop shortly after a head injury or head trauma?
   a. Yes  
   b. No
21. Have you ever been diagnosed with cluster headaches?
   a. Yes
   b. No

22. Do your headaches interfere with your work, school, or personal life?
   a. Yes
   b. No
APPENDIX C: Headache Impact Test-6

HIT-6™
(Versions 1.1)

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

   COLUMN 1 (6 points each)
   + COLUMN 2 (8 points each)
   + COLUMN 3 (10 points each)
   + COLUMN 4 (11 points each)
   + COLUMN 5 (13 points each)

To score, add points for answers in each column. Please share your HIT-6 results with your doctor.

Total Score

Higher scores indicate greater impact on your life.

Score range is 36-78.
APPENDIX D: Depression and Anxiety Stress Scale – 21 Item (DASS-21)

## DASS21

<table>
<thead>
<tr>
<th>Name:</th>
<th>Date:</th>
</tr>
</thead>
</table>

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all  
1 Applied to me to some degree, or some of the time  
2 Applied to me to a considerable degree or a good part of the time  
3 Applied to me very much or most of the time

<table>
<thead>
<tr>
<th>Item</th>
<th>Statement</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (a)</td>
<td>I found it hard to wind down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2 (a)</td>
<td>I was aware of dryness of my mouth</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3 (d)</td>
<td>I couldn’t seem to experience any positive feeling at all</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4 (a)</td>
<td>I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5 (d)</td>
<td>I found it difficult to work up the initiative to do things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6 (s)</td>
<td>I tended to over-react to situations</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7 (a)</td>
<td>I experienced trembling (e.g. in the hands)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8 (s)</td>
<td>I felt that I was using a lot of nervous energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9 (a)</td>
<td>I was worried about situations in which I might panic and make a fool of myself</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10 (d)</td>
<td>I felt that I had nothing to look forward to</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11 (a)</td>
<td>I found myself getting agitated</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12 (s)</td>
<td>I found it difficult to relax</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13 (d)</td>
<td>I felt down-hearted and blue</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14 (s)</td>
<td>I was intolerant of anything that kept me from getting on with what I was doing</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15 (a)</td>
<td>I felt I was close to panic</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>16 (d)</td>
<td>I was unable to become enthusiastic about anything</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17 (d)</td>
<td>I felt I wasn’t worth much as a person</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18 (s)</td>
<td>I felt that I was rather touchy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>19 (a)</td>
<td>I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20 (a)</td>
<td>I felt scared without any good reason</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>21 (d)</td>
<td>I felt that life was meaningless</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
APPENDIX E: Pain Anxiety Symptoms Scale – 20 (PASS-20)

Pain Anxiety Symptom Scale Short Form 20

*Please rate each item in terms of frequency, from 0 (Never) to 5 (Always).*

<table>
<thead>
<tr>
<th>Item Numbers</th>
<th>Never</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I can’t think straight when in pain</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>2. During painful episodes it is difficult for me to think of anything besides the pain</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>3. When I hurt I think about pain constantly</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>4. I find it hard to concentrate when I hurt</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>5. I worry when I am in pain</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>6. I go immediately to bed when I feel severe pain</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>7. I will stop any activity as soon as I sense pain coming on</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>8. As soon as pain comes on I take medication to reduce it</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>9. I avoid important activities when I hurt</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>10. I try to avoid activities that cause pain</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>11. I think that if my pain gets too severe it will never decrease</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>12. When I feel pain I am afraid that something terrible will happen</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>13. When I feel pain I think I might be seriously ill</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>14. Pain sensations are terrifying</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>15. When pain comes on strong I think that I might become paralyzed or more disabled</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>16. I begin trembling when engaged in activity that increases pain</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>17. Pain seems to cause my heart to pound or race</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>18. When I sense pain I feel dizzy or faint</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>19. Pain makes me nauseous</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>20. I find it difficult to calm my body down after periods of pain</td>
<td>0 1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

**Total Score**
APPENDIX F: Anxiety Sensitivity Index – 3 (ASI-3)

Please circle the number that best corresponds to how much you agree with each item. If any items concern something that you have never experienced (e.g., fainting in public), then answer on the basis of how you think you might feel if you had such an experience. Otherwise, answer all items on the basis of your own experience. Be careful to circle only one number for each item and please answer all items.

<table>
<thead>
<tr>
<th></th>
<th>Very little</th>
<th>A little</th>
<th>Some</th>
<th>Much</th>
<th>Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>It is important for me not to appear nervous.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>When I cannot keep my mind on a task, I worry that I might be going crazy.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>It scares me when my heart beats rapidly.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>When my stomach is upset, I worry that I might be seriously ill.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>It scares me when I am unable to keep my mind on a task.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>When I tremble in the presence of others, I fear what people might think of me.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>When my chest feels tight, I get scared that I won’t be able to breathe properly.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>When I feel pain in my chest, I worry that I’m going to have a heart attack.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>I worry that other people will notice my anxiety.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>When I feel “spacey” or spaced out I worry that I may be mentally ill.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>It scares me when I blush in front of people.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>When I notice my heart skipping a beat, I worry that there is something seriously wrong with me.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>When I begin to sweat in a social situation, I fear people will think negatively of me.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14</td>
<td>When my thoughts seem to speed up, I worry that I might be going crazy.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15</td>
<td>When my throat feels tight, I worry that I could choke to death.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>16</td>
<td>When I have trouble thinking clearly, I worry that there is something wrong with me.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17</td>
<td>I think it would be horrible for me to faint in public.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18</td>
<td>When my mind goes blank, I worry there is something terribly wrong with me.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Scoring: Physical concerns = sum of items 3, 4, 7, 8, 12, 15. Cognitive concerns = sum of items 2, 5, 10, 14, 16, 18. Social concerns = sum of items 1, 6, 9, 11, 13, 17.

EDUCATION

Bachelor of Science
University of Florida, Gainesville, Florida. Major: Psychology, Minor: Health Sciences. Date of completion: May 2018

RESEARCH INTERESTS

• Improving quality of life in patients with chronic illnesses through evidenced-based practices
• Psychological variables contributing to the development and progression of chronic illness

CLINICAL EXPERIENCE

St. Jude Children’s Research Hospital  July 2021-present
Clinical Neuropsychology Practicum Student, Memphis, TN
Supervisor: Jennifer Longoria, Ph.D., ABPP
• Administering, scoring, and interpreting neuropsychological test batteries in pediatric patients with sickle-cell disease (SCD) and pediatric patients who have received treatment for brain tumor, leukemia, have underwent bone-marrow transplant (BMT), or received CNS-directed therapies that are associated with neurocognitive late effects. Additional duties include medical chart review, test battery selection, report writing, and clinical interview. As well, receiving didactic training in pediatric clinical psychology, neuroanatomy, and related subspecialities.

The Baddour Center  July 2020-June 2021
Psychology Intern, Education and Behavior Services (EBS), Senatobia, MS
Supervisors: Deborah MacNamee, MA., BCBA & Josh Fulwiler, Ph.D.
• Providing individual cognitive-behavioral (CBT) and dialectical-behavioral (DBT) informed therapy interventions for individuals with developmental and intellectual disabilities living in a residential facility. Additionally, offering weekly social skills groups to all residents and administering assessments for tardive dyskinesia and dementia.

Psychological Services Center  July 2020-present
Graduate Therapist
University of Mississippi, University, MS
Supervisors: Danielle Maack, Ph.D., Alan Gross, Ph.D.
• Providing individual cognitive-behavioral therapy (CBT) interventions via in-person and telehealth services for university and community outpatient adolescents and adults. Specific experience treating individuals through a CBT and behavioral exposure framework.
Support Group Facilitator, LAMBDA  
University of Mississippi, University, MS  
Supervisor: Laura Johnson, Ph.D.

Co-leading in weekly group meetings that consist of several graduate student therapists and 10-20 undergraduate students who identify as LBGTQ+. Facilitating conversation about diverse topics relating to experiencing gender discrimination and offering a safe supportive environment for students to express concerns and develop positive coping strategies.

Clinical Practicum, Health and Behavior Team  
University of Mississippi, University, MS  
Supervisors: Aaron Lee, Ph.D., Danielle Maack, Ph.D., Alan Gross, Ph.D.

Attending weekly supervision meetings to review cases of students with patients at the campus clinic. Participating in discussion concerning evidence-based practice techniques.

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RESEARCH EXPERIENCE

Research Assistant, Migraine and Behavioral Health Lab  
Department of Psychology  
University of Mississippi, University, MS  
Supervisor: Todd Smitherman, Ph.D.

Training and supervising all undergraduate research assistants on projects within the lab. Working directly on an experimental project examining the relationship between the effects of social isolation on pain perception and tolerance in patients with and without migraine.

Research Assistant, PSICH Lab  
Department of Psychology  
University of Mississippi, University, MS  
Supervisor: Aaron Lee, Ph.D.

Observed and assisted with various experimental projects pertaining to psychological influences on chronic health conditions, among patients with obesity, asthma, COPD, and cardiovascular disease.

Research Coordinator, Psycho-Oncology Lab  
Department of Clinical and Health Psychology  
University of Florida, Gainesville, FL  
Supervisor: Deidre Pereira, Ph.D.

Coordinated all functions of clinical intervention RO1 grant study: Feasibility, Acceptability, and Efficacy of a Yoga Intervention for Distress in Women with Gynecologic, Gastrointestinal, and Thoracic cancer. Duties included active involvement in screening, recruitment, enrollment, monitoring interventions, tracking adverse events, and collecting and preparing data for analysis.

Senior Research Assistant, Pediatric Neuropsychology Lab  
Department of Clinical and Health Psychology  
University of Florida, Gainesville, FL  
Supervisor: Shelley Heaton, Ph.D.
Entered and analyzed data in RedCap spreadsheet for patients enrolled in a study examining cognitive and behavioral outcomes after pediatric traumatic brain injury. Scored, interpreted, and administered clinical assessments such as the MVP, TOMM, Conners CPT-2, and the CATA to pediatric patients under the supervision of a licensed clinical neuropsychologist.

TEACHING EXPERIENCE

Teaching Assistant, Social Psychology (PSY 321) August 2021-December 2021
University of Mississippi, University, MS
Supervisor: Marilyn Mendolia, Ph.D.
Assisted with grading virtual class assignments and providing feedback to students regarding assignment and test information.

Teaching Assistant, Introduction to Psychology (PSY 201) May 2020-July 2020
University of Mississippi, University, MS
Supervisor: Melinda Redding, Ph.D.
Assisted with virtual class assignments and communicated with students regarding lecture and assignment information.

Teaching Assistant, Developmental Psychology (PSY 301) August 2019-December 2019
University of Mississippi, University, MS
Supervisor: Lucy Leslie, Ph.D.
Assisted with in-class activities and administered examinations to students through disability services. In addition, communicated with students regarding lecture and class activity information.

Peer Tutor, Statistics Lab June 2021-June 2021
University of Mississippi, University, MS
Peer Supervisor: Adam Beam, M.A.
Provided support to undergraduate students seeking tutoring help with psychology statistics courses.

SERVICE

Graduate Peer Mentor August 2020-present
University of Mississippi Psychology Department
Meet with first-year graduate students in the psychology department to provide support and assistance with adjusting to the program and offer guidance on various academic opportunities.

Graduate Student Panelist, Diversifying Psychology April 2022
University of Mississippi Psychology Department
Provided insight on applying to graduate school as a first-generation college student and answered questions related to my unique experiences as a graduate student to undergraduate students who identified as diverse students and who were seeking a future in graduate psychology programs.
Phone Counselor, Crisis Center  
Alachua County Crisis Center, Gainesville, FL  
Supervisors: Ali Martinez, Ph.D., Janet Greene, Ed.S., LMHC, Ashley Bobroff, B.A.

Completed a 60-hour rigorous training program that provided skills on counseling patients in crisis and offering emergency support services. Answered phone to callers in crisis and used advanced psychotherapy techniques to address, assess, and assist in fostering solutions to clients as well as information on other supportive services in the area. Employed emergency services when necessary to clients in need.

I. Award of Excellence, Alachua County Crisis Center, 2017-2018

Student Volunteer, UF Health Shands Hospital  
Orthopedic and Sports Medicine Institute, Gainesville, FL  
Assisted with the organization and inventory of medical supplies and braces. Administered therapeutic machines to patients, such as the GameReady machine. Observed physical therapists and interacted with patients while they were receiving treatment.

PEER-REVIEWED PUBLICATIONS & PROFESSIONAL PRESENTATIONS
*denotes mentorship of undergraduate students

Book Chapters


Oral Presentations


Poster Presentations


Also presented at the Annual Colloquium of the Big Apple Health Psychology Conference (2022, March), New York City, NY, United States.

PROFESSIONAL ASSOCIATION MEMBERSHIPS

American Psychological Association (APA), Student Affiliate since 2018
   I.  Division 38: Health Psychology, Member

American Academy of Clinical Neuropsychology (AACN), Student Member since 2021
   I.  AACN Student Mentorship Program, Mentee

Society of Behavioral Medicine (SBM), Student Member since 2021

PROFESSIONAL DEVELOPMENT

American Psychological Association’s Telepsychology Best Practice 101 4-Part Series
Completed: March 2020
8 credit hours

University of Mississippi Psychology Department’s ALLIES Training
Completed: October 2020

Board of Examiners in Psychology’s Certified Psychological Assistant
Anticipated Completion: June 2022

EDITING AND REVIEWING EXPERIENCE

Ad-Hoc Reviewing
Headache: The Journal of Head and Face Pain
Neurology