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# Thwarted Interpersonal Needs, Depression, and Sleep Disturbances in Primary Care: Does Gratitude Help You Sleep?

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ABSTRACT

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Sleep disturbances are prevalent in primary care patients and can be exacerbated by interpersonal dysfunction and depression. As well, thwarted interpersonal needs (TIN), including thwarted belongingness and perceived burdensomeness, contribute to depression. However, the presence of gratitude, a cognitive-emotional protective factor, may improve symptoms. We longitudinally examined the mediating role of depressive symptoms on the relation between TIN and sleep disturbances, and the moderating role of gratitude on the TIN-sleep disturbances and depression-sleep disturbances linkages. Our primary care patient sample ($N = 223$) completed self-report surveys at baseline (T1) and at a one-year follow-up (T2; $n = 97$). Patients with greater TIN reported more depressive symptoms (T1) and, in turn, increased sleep disturbances (T2). Gratitude did not moderate the belongingness model but, in the burdensomeness model, buffered the linkage between burdensomeness and sleep disturbances and strengthened the relation between depressive symptoms and sleep disturbances. Clinical implications and future research directions are discussed.

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# CHAPTER 1

# INTRODUCTION

Sleep disturbances are highly prevalent in the United States, with 18% of the general population complaining of sleep problems and 22% reporting daytime fatigue (Grandner, Jackson, Pak, & Gehrman, 2012), and are associated with increased risk for an array of comorbid medical and psychological disorders, such as hypertension, obesity, diabetes, and schizophrenia (Reeve, Sheaves, & Freeman, 2015; Xi, He, Zhang, Xue, & Zhou, 2014). Yet, although widespread and transdiagnostically deleterious, sleep disturbances are rarely assessed or treated during primary care office visits (Almeneessier et al., 2018; Senthilvel, Auckley, & Dasarathy, 2011).

The extant research on sleep pathology focuses not only on the impact of physiology (e.g., overactive hypothalamic-pituitary-adrenal axis, inflammatory cytokine release, heart conditions) on sleep problems (Kraus & Rabin, 2012), but also on psychosocial risk factors for sleep disturbances including, but not limited to, unemployment, socioeconomic status (Fitelson & McGibbon, 2016), and interpersonal dysfunction (Cho et al., 2018; Matthews et al., 2017; McHugh & Lawlor, 2013; Yu, Steptoe, Niu, Ku, & Chen, 2018). Interpersonal and intrapersonal predictors of sleep disturbances, such as cognitive biases, psychopathology, transient mood states, and social interactions, are contributing factors that tend to be more clinically pliable than biological influences and represent a growing area of focus for basic and interventional research (Rogojanski, Carney, & Monson, 2013).

One such risk factor that may contribute to both sleep difficulties and psychological functioning, including depression and suicidality, is thwarted interpersonal needs (Van Orden et al., 2010). Comprised of perceived burdensomeness, or the unfulfilled need for social

competence, usefulness and reciprocality, and thwarted belongingness, conceptualized as the unmet need to connect to others and feelings of social isolation (Nsamenang, Webb, Cukrowicz, & Hirsch, 2013; Van Orden, Cukrowicz, Witte, & Joiner, 2012), thwarted interpersonal needs are associated with poor mental and physical health outcomes, including depression and insomnia (Chu et al., 2017; Khazem, Jahn, Cukrowicz, & Anestis, 2017). Further, the association between depression and sleep disturbances is well-established in the literature (Bouwmans, Conradi, Bos, Oldehinkel, & De Jonge, 2017; Yang et al., 2011), yet no previous research has examined the interrelations between thwarted interpersonal needs, depression, and sleep disruption. Thus, in our study, we assess the mediating role of depressive symptoms in the association between thwarted interpersonal needs and sleep disturbances.

It must be noted, however, that not all patients who experience thwarted interpersonal needs or depressive symptoms develop sleep disturbances, perhaps due to the buffering effects of individual-level protective factors, such as gratitude. Conceptualized as the acknowledgement and appreciation of positive characteristics in one's life, and of gifts or benefits bestowed on the individual, gratitude is recognized as a positive psychological trait that can be cultivated and harnessed to promote psychological and physical health (Wood, Froh, & Geraghty, 2010). For example, in past research, gratitude is beneficially associated with depression in young adults and persons with a trauma history (Van Dusen, Tiamiyu, Kashdan, & Elhai, 2015; Wood, Maltby, Gillett, Linley, & Joseph, 2008), interpersonal dysfunction among undergraduates (Wood et al., 2010), physical health outcomes among populations with and without chronic illnesses (Lavelock et al., 2016), and health-related quality of life in persons with arthritis, chronic obstructive pulmonary disease, and diabetes (Eaton, Bradley, & Morrissey, 2014). Few studies, however, have examined the linkage between gratitude and sleep disturbances, and none

have investigated the potentially protective effect of gratitude on the interrelations between thwarted interpersonal needs, psychopathology, and sleep health. As such, in our study, we examine the longitudinal association between thwarted interpersonal needs and sleep disruption, along with the potential mediating role of depression and moderating role of gratitude. Specifically, we investigate the buffering effect of gratitude on the associations between depressive symptoms and sleep disturbances, and between thwarted interpersonal needs and sleep disruption. In the following sections, we will discuss the epidemiology and etiology of sleep dysfunction, including the influence of maladaptive interpersonal functioning and psychopathology, and the potential health benefits of gratitude.

## Sleep Disturbances

The recommended daily amount of sleep for adults is seven hours per night (Watson et al., 2015), and most individuals spend about one-third of their lives in bed, sleeping or attempting to sleep (Kitamura et al., 2016). While adequate and restful sleep is beneficially associated with health (Irwin & Opp, 2017), sleep problems transdiagnostically amplify risk for a broad range of psychological and physical conditions (Jank, Gallee, Boeckle, Fiegl, & Pieh, 2017; Murphy, Wulff, Catmur, & Bird, 2018), including impairment of working memory, learning, performance, attention, and ability to complete activities of daily living (Friedman, 2016; Naismith & Mowszowski, 2018; Rosekind & Gregory, 2010). Further, not meeting recommended guidelines for sleep, including undersleeping and oversleeping, is associated with depression, heart disease, diabetes, obesity, autoimmune disease, and mortality (Bootzin & Epstein, 2011; Kanagasabai & Chaput, 2017; Young et al., 2018), as well as exacerbation of neurodegenerative, musculoskeletal, cardiac, and respiratory disease (Gerhart et al., 2017; Grimm & Koehler, 2014; Shorofsky et al., 2019; Videnovic & Abbott, 2016).

Criteria for sleep-wake disorders are outlined in the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013), and comprise ten categories: breathing-related sleep disorders, insomnia disorder, hypersomnolence disorder, narcolepsy, circadian rhythm sleep-wake disorders, non-rapid eye movement (NREM) sleep arousal disorders, nightmare disorder, rapid eye movement (REM) sleep behavior disorder, restless legs syndrome, and substance/medication-induced sleep disorder. All sleep-wake disorders result in daytime impairment and distress, and typically involve issues with timing, duration, and quality of sleep. Importantly, sleep disturbances, particularly insomnia and excessive sleepiness, can signal the early development of a mental disorder and are often comorbid with psychopathology, including depression and anxiety (APA, 2013).

Sleep quality, as assessed by the Sleep Scale from the Medical Outcomes Study (MOS) (Hays & Stewart, 1992; Tarlov et al., 1989), consists of numerous dimensions, including: initiation, maintenance, quantity, perceived adequacy, somnolence, and respiratory impairments. Problems with initiation, or the time it takes to fall asleep, and maintenance, or staying asleep, are characteristics of insomnia and are the most commonly reported sleep disturbances, including among, but not limited to, persons with depression (Murphy & Peterson, 2015), anxiety (Simon, Berki, Gettys, & Vedak, 2016), cardiac disease (Javaheri & Redline, 2017), cancer (Fiorentino & Ancoli-Israel, 2010), and chronic pain (Mathias, Cant, & Burke, 2018). Each of the other characteristics of sleep are also associated with psychopathology and pathophysiology including, for instance, the relations between perceived sleep adequacy, or the satisfaction with sleep amount and feeling rested, and schizophrenia, paranoia (Wee et al., 2019), and depression (Zhai, Zhang, & Zhang, 2015), which are supported in several systematic reviews. Associations

between somnolence, or excessive daytime sleepiness, and neurological, endocrine, and metabolic disorders were found in a longitudinal study of community-dwelling adults (Jaussent, Morin, Ivers, & Dauvilliers, 2017). Further, respiratory impairments, including snoring and shortness of breath, are related to depression in primary care patients (Shoib, Malik, & Masoodi, 2017), and systematic and meta-analytic reviews indicate that sleep apnea is related to hypertension (Hou et al., 2018), stroke (King & Cuellar, 2016), and Alzheimer's dementia (Emamian et al., 2016). In summary, sleep disturbances are prevalent disorders contributing to, and arising from, a wide array of mental and physical health conditions. Thus, it is imperative to elucidate the mechanisms contributing both risk and protection for sleep disturbances so that malleable risk factors can be targeted for intervention. To begin, in the following sections, we will discuss the epidemiology and etiology of sleep disturbances.

**Epidemiology of Sleep Disturbances**

Sleep disturbances are common. For example, insomnia symptoms are present in one-third of the U.S. general population, 8.5% to 13% of whom have daytime impairments, and 6% to 15% of whom meet criteria for insomnia disorder, which is the most prevalent of the sleep disorders (Ohayon, 2011). In primary care settings, the prevalence of insomnia symptoms is approximately 33% (Léger, Partinen, Hirshkowitz, Chokroverty, & Hedner, 2010) and, in the general population, insomnia is more prevalent in females than males (1.4:1) (Mallampalli & Carter, 2014). Further, 30 to 48% of older adults report insomnia complaints (Patel, Steinberg, & Patel, 2018).

Hypersomnolence, or excessive sleepiness during the day despite sleeping at least seven hours, is diagnosed in about 14% of those with a major depressive episode (Geoffroy et al., 2018) and 30% of those with bipolar disorder (Grigolon et al., 2019). In a study of approximately

16,000 adults in fifteen U.S. states, 27.8% endorsed excessive daytime sleepiness, with 4.7% experiencing frequency of sleepiness at least three times per week over a three-month period, and 1.5% meeting the criteria for hypersomnia (Ohayon, Dauvilliers, & Reynolds, 2012). Idiopathic hypersomnia, in which the cause of the hypersomnolence is unknown and specific objective markers are observed in formal polysomnographic testing, is rare, with prevalence estimates of 0.002% to 0.010% in the general population (Sowa, 2016). Circadian rhythm sleep-wake disorders (CRSWD), which occur when one's circadian rhythm is out of sync with their environment, can contribute to insomnia or hypersomnia, or both. The prevalence of the most common CRSWD, delayed sleep phase disorder (i.e., consistent delay in one's sleep period relative to the desired sleep time), is 0.17% in the general population and 7 to 16% in adolescents (Zhu & Zee, 2012).

Another disorder for which the primary symptom is excessive daytime sleepiness is narcolepsy, with a prevalence of 19 to 56 per 100,000 people in the general population and a 10- to 40-fold higher risk among first-degree relatives (Faraco & Mignot, 2011; Hale, Guan, & Emanuele, 2016). Individuals with narcolepsy repeatedly lapse into uncontrollable sleep and commonly experience hypersomnia, abnormal REM sleep, hallucinations when falling asleep or awakening, and sleep paralysis, while 60 to 80% report episodes of cataplexy, or loss of muscle tone while remaining awake (Hale et al., 2016). Notably, individuals with narcolepsy are 3.8 to 4.9 times more likely to be diagnosed with depression and 3.4 to 4.7 times more likely to have any psychiatric diagnosis than persons without narcolepsy (Cohen, Mandrekar, St. Louis, Silber, & Kotagal, 2018).

Regarding breathing-related sleep disorders, there are two types of sleep apnea: obstructive (OSA), characterized by obstruction of the respiratory passages during sleep which

leads to arousal and loss of oxygen in the blood, and central (CSA), in which the brain periodically fails to generate a breath, usually as a result of heart failure or opioid use (Javaheri et al., 2017). The prevalence of persons with OSA worldwide who experience at least 5 breathing disturbances per hour is 9 to 38% (Senaratna et al., 2017). In primary care settings, the prevalence of OSA in U.S. diabetes patients is 18% (Heffner, Rozenfeld, Kai, Stephens, & Brown, 2012) and, among Japanese patients with hypertension, the prevalence is 65% (Hamano & Tokuda, 2019). Rates of depression in individuals with OSA range from 5% to 63% (Khawaja et al., 2016). Regarding CSA, the prevalence ranges from 18 to 37% in patients with heart failure (Randerath et al., 2017) and is 24% in persons prescribed chronic opioids (Correa et al., 2015).

The overall prevalence of NREM sleep arousal disorders in the general population varies by type; 29 to 62% of children and 1 to 12% of adults experience the sleepwalking type, while 15 to 56% of children and 1 to 2.6% of adults have the sleep terror type (Irfan, Schenck, & Howell, 2017). Regarding nightmare disorder, 5% of adults experience occasional nightmares and 1.75 to 5.1% have nightmares once per week, as assessed in large-scale representative samples in the U.S. and Europe (Schredl, 2018) and, among individuals with psychiatric conditions, the prevalence of nightmare disorder is 30% (Swart, van Schagen, Lancee, & van den Bout, 2013). In a population-based sample of middle-aged and older adults in Switzerland ($N$ = 1,997), the prevalence of REM sleep behavior disorder (i.e., performing complex movements or vocalizations during sleep) was 1% (Haba-Rubio et al., 2018). Within primary care settings, 11 to 25% of patients meet basic criteria for restless legs syndrome, compared with 5 to 14.3% of the general population, and 3.4 to 9% of primary care patients versus 1.02 to 4.2% of the general population report symptoms twice or more per week accompanied by moderate to severe distress (Ohayon, O'Hara, & Vitiello, 2012). Finally, substance/medication-induced sleep disorder is

diagnosed when any of the above conditions are caused by substances or medications, such as alcohol, caffeine, opioids, and psychotropic medications, and has four types: insomnia, daytime sleepiness, parasomnia, and mixed (APA, 2013).

Overall, our review of the epidemiological characteristics of sleep-wake disorders suggests that sleep disturbances affect a significant proportion of individuals in primary and specialty care settings, and in the general population. Further, the epidemiological correlates of sleep disturbances, spanning both physical and mental health factors, indicate that contributors to the development and maintenance of sleep problems are diverse and complex, which we discuss below.

**Etiology of Sleep Disturbances**

The causes of sleep disturbances can be attributed to a multitude of physiological, genetic, environmental, and psychosocial factors. Medical and genetic contributors to sleep disturbances include heart failure, chronic obstructive pulmonary disease (COPD), diabetes, gastroesophageal reflux (Fitelson & McGibbon, 2016; Utge et al., 2010), cancer (Sharma et al., 2012), neurodevelopmental disorders such as autism (Reynolds & Malow, 2011), and neurologic diseases such as stroke, Alzheimer's disease, multi-infarct dementia, and Parkinson's disease (Dyken, Afifi, & Lin-Dyken, 2012), among others. For example, over 50% of individuals with heart failure experience central sleep apnea and a characteristic breathing difficulty known as Hunter-Cheyne-Stokes respiration, which is a periodic, erratic breathing that causes individuals to awaken as they are falling asleep and periodically throughout the night (Randerath & Javaheri, 2016). As another example, persons with Parkinson's disease often experience frequent awakenings as a result of involuntary movements, temperature sensations, tremors, pain, and other symptoms related to neurodegeneration, leading to an insomnia diagnosis in approximately

37% of patients (Loddo et al., 2017).

Specific physiological factors may also influence the development of sleep disturbances. For example, cognitive hyperarousal, a characteristic in which individuals engage in excessive cognitive processing during intended sleep periods (e.g., worried thinking when trying to go to sleep), is a robust contributor to insomnia and has been measured with functional neuroimaging studies performed on patients with insomnia; subcortical brain areas increased in activity prior to and during sleep, whereas prefrontal cortex activation decreased while awake (Bootzin & Epstein, 2011). This combination of overactive brain activity during sleep and underactive functioning during the day is congruent with the sleep initiation, sleep maintenance, and excessive daytime fatigue complaints of individuals with insomnia. Other pathophysiological factors contributing to the etiology of sleep disturbances include inflammation (Ali, 2013), heredity of specific sleep disorders (Barclay & Gregory, 2013), mutation of circadian clock genes (Patke et al., 2017), and neurotransmitter abnormalities (Alvaro, Roberts, & Harris, 2013).

Environmental factors may confer risk for sleep disturbances, such as shift work, unemployment, low socioeconomic status (SES), low education level, low physical activity level, stress, female gender, older age, and substance use (Fitelson & McGibbon, 2016; Kang, Lee, Jang, Kim, & Sunwoo, 2013). For example, individuals in low SES groups are more likely to endorse room temperature complaints, health-related worries, and neighborhood noise as factors that disturbed their sleep, and tend to report lower physical activity and heightened negative affect (Mezick et al., 2008). Also, in a systematic review of 30 retrospective and prospective studies conducted globally, adverse childhood experiences (ACES) were associated with the development of sleep disorders in adulthood (Kajeepeta, Gelaye, Jackson, & Williams, 2015). Additional environmental factors, such as using the bed for non-sleep related activities,

smoking or engaging in arousing activities near bedtime, irregular sleep schedule, and light or noise disturbance were associated with current and future insomnia in a longitudinal study of Swedish adults ($N$ = 1,638; Jansson-Fröjmark, Evander, & Alfonsson, 2019).

Finally, psychosocial risk factors, at both the intrapersonal and interpersonal levels, are robust contributors to the development and course of sleep disturbances and are the focus of our current study. For example, in primary care patients, between 31 and 50% of patients with depression also report insomnia (Arroll et al., 2012; Simon & VonKorff, 1997; Zailinawati, Mazza, & Teng, 2012). Panic disorder, separation anxiety disorder, social anxiety disorder, ADHD, and substance use disorders also increase risk for insomnia and other sleep-related problems, such as daytime sleepiness, short sleep duration, generally poor sleep quality, and worse daytime functioning, in clinical and non-clinical populations (Khurshid, 2018). Further, in a systematic review and meta-analysis, the prevalence of obstructive sleep apnea in clinical samples compared with non-clinical samples, respectively, was 36.3% and 19.8% in individuals with major depressive disorder, 24.5% and 6.9% in patients with bipolar disorder, and 15.4% and 4.5% in patients with schizophrenia, while increasing body mass index and age predicted higher OSA rates (Stubbs et al., 2016). Additionally, in another systematic review, depressed mood was a consistent risk factor for future sleep disturbances in older adults (Smagula, Stone, Fabio, & Cauley, 2016) and, among undergraduates ($N$ = 1,599), exposure to a potentially traumatic interpersonal event, such as physical or sexual assault, was associated with PTSD symptoms and, in turn, to sleep disturbances (Lind et al., 2017). Other interpersonal dynamics, such as sexual activity, social rhythms, psychological abuse, and marital functioning, are associated with changes in sleep quality via a range of intrapersonal and physiological mediators (e.g., depression, anxiety, delta wave sleep percentages, stress, circadian rhythms; Rauer, Kelly,

Buckhalt, & El-Sheikh, 2010; Rogojanski et al., 2013).

In our study, we focus on etiological influences of sleep disturbances that are clinically adaptable and malleable. For example, interpersonal functioning, including the need for social connections with others and feelings of burdensomeness, is associated with sleep disturbances and may be amenable to therapeutic intervention (e.g. see Cacioppo, Grippo, London, Goossens, & Cacioppo, 2015; Dour et al, 2014). In one study, for instance, increases in diary-recorded social connection during the day predicted longer sleep at night, as measured by wrist actigraphy, for undergraduates high in trait loneliness, indicating that fostering social connection may improve sleep for lonely individuals (Sladek & Doane, 2015). Further, individuals who experienced greater social connection, regardless of trait loneliness levels, had an increase in cortisol levels after awakening the next day, a natural response that reduces daytime fatigue. Similarly, individuals with greater loneliness had significantly higher sleep fragmentation, among a sample of adults who wore wrist actigraphs for a week (Kurina et al., 2011). Finally, in a study of older adults ($N$ = 736), psychological distress, low emotional and social support, and negative social interactions were related to sleep disturbances (Steptoe, O'Donnell, Marmot, & Wardle, 2008).

Such patterns of effects suggest that relationship-based stressors and a lack of social interaction and support are robust contributors to sleep disturbances. In the following section, we will discuss a similar psychosocial construct, thwarted interpersonal needs, which has traditionally been examined in relation to suicide, but which has implications for broader mental and physical health functioning and is also amenable to clinical intervention (Allan, Boffa, Raines, & Schmidt, 2018).

## Interpersonal Needs and Health Outcomes

The construct of thwarted interpersonal needs, as operationalized by Joiner's Interpersonal-Psychological Theory of Suicide (IPTS; Joiner, 2005), is comprised of perceived burdensomeness and thwarted belongingness (Van Orden, Cukrowicz, et al., 2012). Van Orden, Cukrowicz, and colleagues (2012) describe thwarted belongingness as a distressing mental state, encompassing feelings of social isolation and characterized by an unfulfilled need to belong or feel connected to others. Thwarted belongingness (Joiner, 2005) was conceptualized from the construct of social isolation, a component of social connectedness (Berkman, Glass, Brissette, & Seeman, 2000). Social isolation includes several facets, such as social withdrawal, living alone, low social support, and loneliness, all of which are indices of thwarted belongingness (Van Orden et al., 2010), and each of which signal that the need to belong, described by Baumeister and Leary (1995), is unmet. Baumeister and Leary's (1995) belonging hypothesis states that humans have an innate drive to seek out and maintain positive, close interpersonal relationships (i.e., a need to belong), and that belongingness explains much of human social behavior.

Perceived burdensomeness, another type of thwarted interpersonal need, is conceptualized as the cognitive-emotional perception that one is burden and may stem from an unfulfilled need for social competence or to be skillful and valuable in one's social network (Nsamenang et al, 2013). The idea that individuals endorsing perceived burdensomeness feel like a liability to significant others was broadened from Sabbath's (1969) theory that adolescent suicide arises from perceptions of being a burden to one's family. For persons with chronic illness, perceived burdensomeness may be exacerbated by, among other factors, functional impairment, illness-related unemployment, and family discord during the illness experience (Khazem, 2018; Wilson et al., 2017).

Thwarted interpersonal needs, as operationalized by the IPTS, are robustly related to

suicidal outcomes and have only occasionally been examined in the context of additional physical and mental health outcomes (Bell, Rieger, & Hirsch, 2019; Hirsch et al., 2019; Roberts et al., 2019; Stanley et al., 2019). However, much previous research has examined the linkage between constructs closely related to thwarted interpersonal needs (e.g., belonging, self-perceived burden) and physical health outcomes. For instance, minimal social support, living alone, and loneliness have been consistently linked to poor health outcomes (Ong, Uchino, & Wethington, 2018; Uchino et al., 2018). These and similar markers of interpersonal functioning, such as chronic interpersonal difficulties, social isolation, and social belonging, are associated with immune function (Miller, Rohleder, & Cole, 2009), cardiovascular disease (Christiansen, Larsen, & Lasgaard, 2016; Valtorta, Kanaan, Gilbody, & Hanratty, 2018; Valtorta, Kanaan, Gilbody, Ronzi, & Hanratty, 2016), cancer (Jaremka & Nadzan, 2018), stroke (Valtorta et al., 2016; Valtorta et al., 2018), diabetes (Christiansen et al., 2016), general health (Cohen & Janicki-Deverts, 2009; Walton & Cohen, 2011), and mortality (Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Holwerda et al., 2012). Finally, in a study by Tomaka, Thompson, and Palacios (2006), belongingness support, or perceived social support from friends and social groups, was negatively related to hypertension, diabetes, arthritis, and emphysema in a random sample of elderly Caucasian and Hispanic New Mexico residents. In sum, thwarted interpersonal needs and associated variables have been consistently linked to disruptions in physical health. Yet, we know of no other studies that have examined the association between thwarted interpersonal needs, as operationalized by the IPTS, and our outcome of sleep disturbances, which we discuss in the following section.

**Interpersonal Needs and Sleep Disturbances**

In the fledgling research linking thwarted interpersonal needs to health outcomes, no

studies have examined the influence of thwarted belongingness and perceived burdensomeness on sleep disturbances, although several studies have examined insomnia as a predictor of unmet interpersonal needs and unmet interpersonal needs as a mediator of insomnia and suicidality, in an attempt to elucidate the mechanisms by which sleep disorders confer risk for suicide (Nadorff, Anestis, Nazem, Harris, & Winer, 2014). For example, in a multi-sample study of undergraduate students, firefighters, psychiatric outpatients, and primary care patients, and, in another study of veterans and military service members, thwarted belongingness mediated the association between insomnia symptoms and suicide-related behaviors (Chu et al., 2017; Hom, Chu et al., 2017). These findings were not multi-directional; insomnia did not explain the association between thwarted belongingness and suicidal behaviors. Similarly, in a sample of sexual and gender minority participants, both thwarted belongingness and perceived burdensomeness, independently and in parallel, mediated the relation between sleep disturbances and suicide risk (Chu, Hom, Hirsch, & Joiner, 2018). Finally, in a quasi-experimental study using a social exclusion game, although insomnia and thwarted belongingness were not related, insomnia severity predicted heightened feelings of perceived burdensomeness and attenuated desire for emotional support, controlling for baseline thwarted interpersonal needs levels, desire for social support, and symptoms of depression and social anxiety (Chu, Hom, Gallyer, Hammock, & Joiner, 2019).

It must be noted that, although these findings are premised on the assertion that sleep problems predict thwarted interpersonal needs, there is evidence for a bidirectional association, when indices of thwarted interpersonal needs are considered. For example, in a study of 2,232 English and Welch young adult twins, loneliness, which is a contributor to thwarted belongingness (Van Orden, Cukrowicz, et al., 2012), was associated with poor sleep quality

(Matthews et al., 2017). Similarly, emotional loneliness, mediated by perceived stress, predicted sleep problems in older adults in England (McHugh & Lawlor, 2013) and social isolation predicted poor sleep quality in a longitudinal study of older adults from Taiwan (Yu et al., 2018). Finally, in a large ($N$ = 2,541), random sample of older adults residing in Los Angeles, CA, subjective social isolation, more than objective social isolation (i.e., size of social network), was associated with sleep disturbances, fatigue, and depression (Cho et al., 2018), highlighting the importance of personal perceptions of the degree to which interpersonal needs are met.

Previous theory and research investigating markers of, and contributors to, thwarted interpersonal needs, such as social isolation and loneliness, as predictors of sleep problems in non-suicidal populations provide support for our current study, which focuses on the association between thwarted interpersonal needs and sleep disturbances. For example, from a cognitive perspective, loneliness may trigger feelings of vulnerability, producing thoughts, emotions, and behavioral changes that increase vigilance to protect against potential threats, consequently impairing sleep and, further, loneliness and social isolation are linked to depression, anxiety, and other forms of psychopathology that may negatively impact sleep (Matthews et al., 2017). Finally, individuals who have fewer positive relationships are less likely to engage in healthy behaviors, including adaptive sleep hygiene (Hom, Hames, et al., 2017). In our study, we examine these associations in a comprehensive model, assessing the premise that thwarted interpersonal needs are directly associated with sleep disturbances.

**Interpersonal Needs and Depressive Symptoms**

In addition to a direct linkage between thwarted interpersonal needs and health, including sleep-related well-being, perceived burdensomeness and thwarted belongingness may indirectly impact sleep via their deleterious impact on psychological functioning, including exacerbation of

depression. Both theory and research support this connection. Baumeister and Leary (1995), for instance, conceptualized belonging as a basic motivation, positing that lack of social inclusion and acceptance, which parallel the construct of thwarted belongingness, contribute to depression. Furthermore, from a cognitive perspective, perceived burdensomeness may contribute to thoughts of purposelessness and irrelevance, and to negative existential rumination (e.g., that others would be better off without them; Van Orden, Cukrowicz, et al., 2012), thereby facilitating depression (Tang et al., 2016).

Several studies have examined the association between thwarted interpersonal needs and psychopathology, including in primary care. To begin, in a longitudinal study of Asian Americans ($N$ = 605) by Carrera and Wei (2017), thwarted belongingness and perceived burdensomeness predicted future depression, and similar patterns have been found among sexual minority youth experiencing minority stress (Baams, Dubas, Russell, Buikema, & van Aken, 2018; Baams, Grossman, & Russell, 2015), individuals with hoarding tendencies (Raines et al., 2016), inflammatory bowel disease patients facing illness stigma (Roberts et al., 2019), and university students with attachment anxiety (Øverup, McLean, Brunson, & Coffman, 2017) and hopelessness (Nalipay & Ku, 2019).

Such associations may be particularly relevant for health-focused research and health-compromised populations. For example, in a study of community adults, number of physical impairments and health conditions was associated with suicidal ideation via the serial mediating effects of perceived burdensomeness and depressive symptoms, and this model was not significant when depression preceded burdensomeness (Khazem et al., 2017). According to Khazem et al. (2017), physical limitations due to health conditions may prompt feelings of burdensomeness, perhaps because assistance with daily activities is often required, contributing

to depressive symptomology. Further supporting this position, among individuals with movement disorders, burdensomeness mediated the effects of functional impairment on depressive symptoms (Dempsey, Karver, Labouliere, Zesiewicz, & De Nadai, 2012). Finally, in a study of primary care patients, less future orientation was associated with greater depressive symptoms, and thwarted belongingness and perceived burdensomeness mediated this association (Chang, Batra, Premkumar, Chang, & Hirsch, 2018). Also, thwarted belongingness mediated the effect of domestic abuse on depressive symptoms among female primary care patients (Chang, Kahle, & Hirsch, 2015).

Overall, the extant research suggests that thwarted interpersonal needs adversely impact mental health, particularly depressive symptoms, across both non-clinical and clinical populations. This insight may be particularly important when considering the influence of depression on sleep disturbances and given that these conditions are highly comorbid and prevalent in the primary care population.

## Depressive Symptoms and Sleep Disturbances

Sleep disturbances, typically in the form of insomnia or hypersomnia, are a key diagnostic criterion for most mood disorders, including major depressive disorder (APA, 2013), and are frequent complaints of primary care patients (Fujieda et al., 2017). Sleep disturbances are present in approximately 70% of individuals with depression and those with remitted depression often continue to experience sleep disturbances; as well, persons with insomnia are twice as likely to develop depression (Bouwmans et al., 2017).

Sleep disturbances are transdiagnostic in nature and may both contribute to, and result from, psychopathology. Some research, for instance, suggests that difficulties with sleep can exacerbate depressive symptoms (Zhai et al., 2015). Indeed, in a study of community adults from

Finland and the U.S., causal estimates indicated that sleep disturbances were related to depression at a greater magnitude than the opposing predictive association between depression and sleep (Rosenström et al., 2012). Yet, much research suggests that this association is bidirectional (Alvaro et al., 2013; Bao et al., 2017), including in a longitudinal study of primary care patients (Bouwmans et al., 2017). For example, depressed mood emerged as a robust risk factor for sleep disturbances in a systematic review of older adults (Smagula et al., 2016), in adults with chronic pain (Kim, Lee, Yoon, An, & Yoon, 2015), and in middle-aged women (Ham, Kim, Lee, & Choi, 2017).

Despite directionality, there is a well-established association between sleep disturbances and depressive symptoms across medical samples, including primary care patients (Kang et al., 2013; Rutledge, Guardia, & Bluestein, 2013). For example, heightened inflammation, a contributor to depression, is common in cancer survivors and exacerbated by sleep problems, which are also highly prevalent in cancer patients and survivors (Irwin, Olmstead, Ganz, & Haque, 2013). Individuals with chronic pain that develop sleep problems are 3.5 times more likely to experience a new depressive period 3 years later (Campbell et al., 2013), and ulcerative colitis patients report high rates of sleep problems, which are strongly linked to depressive symptoms (Hood et al., 2018). Sleep disturbances and depressive symptoms are also significantly associated among samples of older adults (Becker, Jesus, João, Viseu, & Martins, 2017) and healthy adults (Horne, Watts, & Norbury, 2019). This relation may be due, in part, to common circadian clock genes, which control the production of proteins necessary to regulate the body's circadian rhythm and contribute to both faulty sleep regulation and depression; specifically, certain gene polymorphisms are associated with early morning awakening, daytime fatigue, sleep duration, seasonal mood changes, social activity, energy level, and depression

(Utge et al., 2010). Other proposed biological mechanisms for this association include mesolimbic dopamine system dysfunction (Finan & Smith, 2013), hyperarousal of the hypothalamic–pituitary–adrenal (HPA) axis and the autonomic nervous system (Staner, 2010), heightened inflammatory cytokines (Fang, Tu, Sheng, & Shao, 2019), and a variation in the serotonin transporter gene-linked polymorphic region (van Dalfsen & Markus, 2019).

A wide array of environmental and psychosocial factors also contributes to depression and sleep disturbances. For example, in a longitudinal study of 5,172 adults, living alone, relative poverty, smoking, and female sex predicted greater sleep problems and depressive symptoms (Poole & Jackowska, 2018). Among a sample of college students, room temperature and noise and light disturbances from roommates disrupted sleep, while daytime naps and pre-bedtime excessive physical activity, emotional upset, and media use predicted both depressive symptoms and sleep problems (Peltz & Rogge, 2016). Additionally, workplace dissatisfaction or stress, strained family relationships, and inadequate emotional support are social factors that lead to restlessness and impaired sleep quality, as well as depressed mood (Ailshire & Burgard, 2012; Burgard & Ailshire, 2009).

Finally, several cognitive-emotional mechanisms have been proposed to explain how depression may influence sleep quality. For example, in a sample of primary care patients, depression significantly predicted reduction in self-efficacy for sleep, or the belief in one's ability to engage in sleep hygiene behaviors (Rutledge et al., 2013). In university students with moderate to severe depression, pre-sleep rumination predicted significantly longer sleep onset latency on objective and self-report measures (Pillai, Steenburg, Ciesla, Roth, & Drake, 2014). Of note, the perseverative cognition hypothesis states that rumination can generate consistent physiological and psychological arousal, disturbing sleep (Brosschot, Gerin, & Thayer, 2006).

Supporting this premise, in a young adult sample, the associations between loneliness and depressed mood, and between loneliness and sleep quality, were mediated by rumination (Zawadzki, Graham, & Gerin, 2013) and, in another sample of young adults, rumination mediated the association between depressed mood and sleep quality at a two-month follow-up (Slavish & Graham-Engeland, 2015). As depressive symptoms and sleep disturbances frequently co-occur across diverse populations and share multiple common risk factors, many of which cannot be altered, it is important to identify potentially malleable contributors, such as cognitive-emotional characteristics, that can be clinically addressed.

**Interpersonal Needs, Depressive Symptoms, and Sleep Disturbances**

In our study, we explore the interpersonal and cognitive-emotional risk factor of thwarted interpersonal needs as a predictor of sleep disturbances, and the potential mediating role of depressive symptoms. Only one study to date has examined the linkages among sleep problems, depressive symptoms, and Joiner's (2005) conceptualization of thwarted interpersonal needs, investigating sleep disturbances as a transdiagnostic risk factor. In a meta-analysis of six cross-sectional and prospective studies, including samples of military personnel, undergraduates, adults with depression and/or history of suicidal behavior, psychiatric outpatients, and young adults in acute suicidal crisis presenting to a medical center, insomnia was positively associated with greater feelings of thwarted belongingness and loneliness, and depression mediated this linkage (Hom, Hames, et al., 2017).

In contrast, several studies offer support for our hypothesis that dysfunctional interpersonal and psychosocial factors can exert disruptive downstream effects on sleep well-being. Among persons with HIV, loneliness and depressive symptoms serially mediated the effect of internalized stigma on global sleep quality (Fekete, Williams, & Skinta, 2018).

Similarly, in a multinational longitudinal study of adults, stronger identification with one's family was negatively associated with loneliness, which predicted lower levels of depressive symptoms and, in turn, better sleep quality (Wakefield, Bowe, Kellezi, Butcher, & Groeger, 2020).

The serial pathway of effects noted by Wakefield et al. (2020) is based on the social cure perspective (Jetten, Haslam, & Haslam, 2012), which posits that social groups are important to an individual's well-being, including to reduced loneliness and depression, but only if they feel a sense of belonging and group identification. Broadly, the benefits of belongingness for mental and physical health have been substantiated in diverse populations, including individuals with medical conditions such as multiple sclerosis and stroke (Haslam et al., 2008; Wakefield, Bickley, & Sani, 2013). On the other hand, from an evolutionary perspective, loneliness may exacerbate perceptions of social threat, contributing to hypervigilance and associated physiological responses, such as enhanced cortisol production, that facilitate disrupted sleep (Wakefield et al., 2020). Such patterns of effects, theoretically framed by the social cure perspective and an evolutionary perspective, offer a paradigm for understanding our hypotheses for the current project.

Our review of the literature indicates well-established bidirectional associations between social dysfunction and sleep problems, between thwarted interpersonal needs and depressive symptoms, and between depression and sleep disturbances, across studies. Yet, previous theory and research support our proposition that thwarted belongingness and perceived burdensomeness contribute to depressive symptoms and, in turn, to sleep problems. To summarize, the basic human drive for belonging is unmet in individuals who are lonely and socially isolated (Baumeister & Leary, 1995), which can lead to depression (Cacioppo, Hawkley, & Thisted,

2010). Similarly, perceptions of burdensomeness may cause an individual to lose their sense of purpose and belief in their value to others (Van Orden, Cukrowicz, et al., 2012), thereby propagating depressive symptoms of worthlessness and hopelessness. In turn, depression can diminish self-efficacy for sleep hygiene (Rutledge et al., 2013) and increase rumination (Koster, De Lissnyder, Derakshan, & De Raedt, 2011), ultimately impacting sleep quality (Thorsteinsson, Brown, & Owens, 2019). However, not all patients who experience thwarted interpersonal needs or depression also experience sleep disturbances, perhaps due to the presence of individual-level protective characteristics, such as gratitude.

## Gratitude as a Moderator

Considered a prosocial characteristic, the concept of gratitude has a long history of prominence in our understanding of interpersonal relationships, but also in religious and spiritual traditions. Monotheistic religions, such as Christianity, Judaism, and Islam, identify gratitude as a central component of worshipping God, through the process of expressing appreciation for God's gifts and benevolence (Emmons & Crumpler, 2000). As examples, the concluding daily prayer in Judaism, the *Alenu*, expresses gratitude toward God for the Jewish people's destiny, and fasting during Ramadhan is performed to foster gratitude in Islam (Emmons & Crumpler, 2000). Further, nontheistic religions, such as Buddhism, place high importance on gratitude; for instance, Theravada Buddhists value knowledge of the generous past deeds of others and appreciate how these actions directly benefit people in the present (Berkwitz, 2003). Hinduism, a polytheistic religion, also holds the experience of gratitude in high regard (Wirtz, Gordon, & Stalls, 2014). From a non-religious perspective, gratitude may have a spiritual focus, in which thankfulness is directed toward the universe, broadly, with recognition that each person is connected to one another and to the cosmos in a transcendent manner (Emmons, 2004).

Since the turn of the century and the advent of the positive psychology movement, theoretical exploration of, and empirical research on, gratitude has burgeoned (Elosúa, 2015). Conceptualized as a general focus on positive experiences and appreciation for the positive features of one's environment, including interpersonal relationships and material possessions (Wood, Joseph, & Maltby, 2009; Wood, Maltby, Stewart, & Joseph, 2008), gratitude is most often characterized as an affective trait (McCullough, Emmons, & Tsang, 2002). Gratitude may also encompass frequent feelings of awe for nature and beauty, appreciation for positive aspects of the present moment, feeling thankful for one's life in comparison to others or for one's sense of abundance, and understanding that life is not permanent (Wood, Maltby, Stewart, & Joseph, 2008). According to McCullough et al. (2002), for individuals to be considered high in gratitude, they should possess four co-occurring elements, or facets. Dispositionally grateful persons feel gratitude: more intensely after a positive occurrence (intensity); often throughout the day, even in the setting of simple positive acts (frequency); for a higher number of life circumstances simultaneously (span); and toward more people when experiencing a single positive event (density; McCullough et al., 2002).

Previous research has also investigated the way gratitude predicts, causes, interacts with, or arises from positive affect (Emmons & McCullough, 2003). Generally, gratitude is thought to emerge from an interpersonal context (Algoe & Stanton, 2012), as grateful individuals tend to attribute positive occurrences to external factors, such as received altruism, and thus, feel valued and supported by other people (McCullough et al., 2002). According to Watkins (2014), an individual's emotional response of gratitude arises from four general cognitive appraisals. First, an individual must recognize the gift, or take notice of the occurrence of a particular benefit. Second, the value and goodness of the gift should be understood. Third, it is important for the

individual to believe that the giver of the gift was motivated by altruism, rather than the receipt of personal benefit in return. Last, one is more likely to experience gratitude if the nature of the gift exceeds their expectations of the benefactor. The interpersonal nature of gratitude has led some researchers and philosophers to characterize it as a moral emotion, functioning as a motivator and reinforcer of virtuous, prosocial behavior for the recipient of a benefactor's moral actions (Harpham, 2004; McCullough, Kilpatrick, Emmons, & Larson, 2001). Further, the socially oriented perception of gratitude may help to deter perceptions of loneliness (Wood, Maltby, Gillett, et al., 2008) and promote relationship formation (Algoe, Haidt, & Gable, 2008).

According to theory, there are four mechanisms through which gratitude is hypothesized to relate to well-being (Wood et al., 2010). First, the schematic hypothesis states that grateful individuals possess a general perception of help from others as altruistic, costly to the giver, and valuable, whereas ungrateful individuals might rationalize that these three conditions did not exist; in other words, their schematic processing influences their interpretation of such events (Wood, Maltby, Stewart, et al., 2008). The second mechanism is the coping hypothesis, which proposes that grateful individuals are less likely to suffer from stress because they utilize positive coping strategies (e.g., social support, planning), whereas those who are ungrateful use maladaptive coping strategies (e.g., self-blame, behavioral disengagement; Wood, Joseph, & Linley, 2007). Third, the positive affect hypothesis suggests that gratitude, as a positive, pleasant experience, may generate additional positive emotions, which consequently lead to heightened life satisfaction and well-being (Wood et al., 2010). Finally, the broaden-and-build theory proposes that positive emotions serve an evolutionary benefit, to build personal resources, such as social support and health, over time, by gradually broadening the automatic thoughts and behaviors that occur when experiencing such emotions (Fredrickson, 2001). Gratitude, which

generates positive emotions and is also frequently conceptualized as a positive emotion itself, may facilitate adaptive behaviors and cognitions, helping to develop skills and relationships that may be beneficial during stressful times, thereby improving well-being (Fredrickson, 2004; Wood et al., 2010).

Supporting the broaden-and-build hypothesis, gratitude is both directly and indirectly associated with health (e.g., Deichert, Prairie Chicken, & Hodgman, 2019; Krause, 2006; Nezlek, Krejtz, Rusanowska, & Holas, 2019; Wood, Maltby, Gillett, et al., 2008), in part due to its role in the promotion of adaptive heath behaviors and the amelioration of stress (Wood et al., 2010). In a recent review, for example, Lavelock et al. (2016) posited that the beneficial linkage between gratitude and physical health is due to improvements in health behaviors, mental health, and interpersonal relationships. This premise was supported in a sample of Swiss adults ($N$ = 962), in which gratitude was associated with better self-reported physical health, via the mediating effects of nutritious eating, exercise, and treatment-seeking (Hill, Allemand, & Roberts, 2013). Finally, the effects of gratitude on markers of stress and health are evident from a therapeutic perspective. For example, in patients with stage B asymptomatic heart failure, gratitude journaling was related to improvements in indicators of cardiovascular pathophysiology, inflammatory biomarkers, and parasympathetic heart rate variability (Redwine et al., 2016).

In sum, previous theory and research indicate that gratitude can exert a beneficial influence on interpersonal, physical, and mental health functioning and, in our current study, we extend this work by investigating the potential buffering role of gratitude on the deleterious associations between thwarted interpersonal needs and sleep disturbances, and between depressive symptoms and sleep disturbances. In the following sections, we review and discuss the extant research documenting the protective influence of gratitude on interpersonal

relationships, mental health, and sleep well-being.

**Gratitude and Interpersonal Needs**

As we have noted, gratitude both originates from and facilitates positive social relationships, at a broad level (Elosúa, 2015; Lavelock et al., 2016; Wood et al., 2010). Overall, high-gratitude individuals tend to have more frequent interpersonal interactions than low-gratitude individuals and are more likely to both perceive and solicit social support, contributing to less loneliness (Ni, Yang, Zhang, & Dong, 2015). However, research examining gratitude's influence on perceptions of interpersonal circumstances (e.g., thwarted belongingness, perceived burdensomeness) is still in its infancy.

The prosocial effects of gratitude are, perhaps, best explained according to the broaden-and-build theory (Fredrickson, 2001). Frederickson (2004) conceptualized gratitude as a positive emotion that broadens and builds, generating the urge to act prosocially toward one's benefactor or toward others. This tendency does not serve to repay the benefactor as a result of indebtedness but, instead, broadens to spark a variety of prosocial behaviors, such as providing support and guidance to those in need, making a creative gift for a friend, or donating time and personal resources to one's community and, over time, these actions strengthen friendships and social relationships (Frederickson, 2004).

To our knowledge, four studies have sought to investigate gratitude within the broaden-and-build theoretical framework and support a beneficial linkage between gratitude and interpersonal perceptions and interactions. First, in an experimental study with undergraduates, Chang, Lin, and Chen (2012) postulated, based on the broaden-and-build theory and supported using social network analysis, that gratitude would broaden participants' current perspectives in a socially oriented manner, increasing each individual's tendency to assist associates and, finally,

that these altruistic actions would replicate and eventually circulate goodwill in a larger social network. Second, in a study with students from nine Taiwanese universities, Lin (2015a) found that gratitude contributed to the development of personal resources (i.e., perceived social support) and positive emotions, and fewer negative emotions, although this study was cross-sectional and causation cannot be inferred. Third, in a longitudinal study of university students ($N$ = 1,102), increased gratitude at a 3-month follow-up was associated with greater social connectedness and meaning in life and, in turn, to better subjective well-being (Liao & Weng, 2018). According to Liao and Weng (2018), their findings support the broaden-and-build theory because gratefulness was responsible for building social and cognitive resources that contributed to subjective well-being. Finally, support for the theory was found in a cross-sectional study of undergraduates ($N$ = 913); perceived quality of social support and social interaction independently mediated the relation between gratitude and suicidal behavior (Kaniuka et al., in press).

Overall, the extant research indicates that gratitude is associated with enhanced interpersonal abilities, connectivity, and warmth (Jans-Beken et al., 2019). For example, in a sample of Chinese students attending six universities, the association between gratitude and loneliness was mediated by social support (Ni et al., 2015). Additionally, in a longitudinal study of married couples, mutual gratitude was predictive of greater levels of marital satisfaction (McNulty & Dugas, 2019) and, broadly, individuals who feel appreciated by their partner engage in more behaviors that maintain their relationship, express their own feelings of gratitude more frequently, and respond to their partner's needs (Algoe & Zhaoyang, 2016; Gordon, Impett, Kogan, Oveis, & Keltner, 2012; Kubacka, Finkenauer, Rusbult, & Keijsers, 2011).

These prosocial effects are also evident in treatment studies, offering therapeutic

implications. For example, in a study of college students, those assigned to a gratitude intervention experienced higher positive affect and were more likely to have provided emotional support or helped someone with a problem in the two weeks following the intervention, than participants in other experimental conditions (Emmons & McCullough, 2003). Additionally, in a four-week gratitude diary intervention with schoolchildren, gratitude and school belongingness increased, compared to a control group (Diebel, Woodcock, Cooper, & Brignell, 2016). Finally, from an applied perspective, gratitude is associated with improved perceptions of social support in patients with chronic illness. For example, in a study of women with metastatic breast cancer, those who responded to altruistic actions of others in a grateful manner experienced an increase in perceived social support at a 3-month follow-up (Algoe & Stanton, 2012).

In sum, gratitude is associated with connectivity and prosocial behavior across samples and studies. The broaden-and-build theory provides a conceptual framework for gratitude in which grateful responses to altruistic deeds perpetuate supportive behaviors that serve to strengthen social ties in a broader network and enhance well-being, including attenuation of interpersonal and psychological distress.

**Gratitude and Depressive Symptoms**

Extensive research examining the role of gratitude in mitigating psychopathology, including depressive symptoms, has been conducted. For example, in an undergraduate sample, gratitude was associated with reduced depression, over and above the effects of positive and negative affect (Simon, 2016). Similarly, in a large sample of undergraduates ($N$ = 814), gratitude was inversely associated with depression and suicidal ideation, and depression and self-esteem mediated the relation between gratitude and suicidal ideation (Lin, 2015b). Supporting gratitude's role as a potential moderator, in a study by Kleiman, Adams, Kashdan and Riskind

(2013), gratitude weakened the association between depression and hopelessness and suicide ideation. Finally, in individuals exposed to trauma, gratitude was negatively associated with poor mood and cognitive symptoms of PTSD (McNulty & Dugas, 2019).

Similar outcomes are evident in experimental investigations of treatment effects. For example, in an internet-based randomized controlled trial with adults by Seligman, Steen, Park, and Peterson (2005), participants' depressive symptoms and happiness improved and were maintained at a one-month follow-up after completing a gratitude intervention (i.e., writing and delivering a letter expressing gratitude to an important person). Similarly, in a longitudinal study of the effects of keeping a gratitude diary, stress and depressive symptoms were reduced in a sample of health care practitioners (Cheng, Tsui, & Lam, 2015).

Importantly, recent research has investigated the psychological benefits of gratitude for individuals with chronic illnesses. For example, in a longitudinal study by Sirois and Wood (2017), higher levels of gratitude were associated with lower depression at a six-month follow-up in patients with arthritis and inflammatory bowel disease. Additionally, in a sample of patients with cancer, thankful prayer (i.e., conveying gratitude for life circumstances) was associated with lower depressive symptoms, and this linkage was mediated by rumination, suggesting that gratitude may contribute to improvements in depression in this population (Pérez et al., 2011).

Numerous studies have investigated the mechanisms of action (e.g., improvement of mood and social support) for the beneficial effect of gratitude on psychopathology, including depression. In a sample of Chinese undergraduate students, gratitude was associated with reduced depression, and this linkage was mediated by increased peace of mind (i.e., a peaceful and emotionally balanced cognitive-emotional state) and decreased rumination (Liang et al., 2018). Similarly, in a study of undergraduates ($N$ = 352) by Bryan, Young, Lucas, and Quist

(2018), gratitude beneficially moderated the association between ambivalence over emotional expression (AEE), or refraining from emotion expression due to fear of negative social consequences, and depressive symptoms, by facilitating positive cognitive reappraisals (i.e., reframing thoughts to reduce emotional reactions). In a longitudinal study of adults from 43 countries ($N$ = 797), gratitude and meaningfulness were associated with increases in self-reported positive life events and, in turn, to diminished levels of depression (Disabato, Kashdan, Short, & Jarden, 2017). In two longitudinal studies of college students, the association between gratitude and stress and depression was mediated by social support, suggesting that gratitude improves social functioning and, in turn, reduces psychopathology (Wood, Maltby, Gillett, et al., 2008). Finally, Kaniuka et al. (in press) supported one of the mechanisms described by Wood et al. (2010), the positive affect hypothesis, finding that gratitude mitigated negative emotions (e.g., depressive symptoms), in the context of suicidality.

In both cross-sectional and longitudinal studies, gratitude is consistently linked to reductions in depression, and interventions to foster gratitude can reduce depressive symptoms, with sustained effects over time. This beneficial effect may occur, in part, due to the ability of gratitude to reduce rumination, calm the mind, and promote recognition of positive events, thereby ameliorating depressive symptoms in a self-soothing process that may also enhance sleep well-being.

**Gratitude and Sleep Disturbances**

Unlike the association between gratitude and depressive symptoms, few studies have investigated the direct relation between gratitude and sleep disturbances. In a recent systematic review examining the association between positive affect and sleep, higher levels of positive affective states and traits, including gratitude, were related to better sleep quality (Ong, Kim,

Young, & Steptoe, 2017). In a study using a community sample ($N$ = 401), which was included in the aforementioned review, gratitude was associated with fewer sleep problems, including improved sleep latency, duration, and quality, and less daytime dysfunction, and this linkage was mediated by improved pre-sleep cognitions (Wood, Joseph, Lloyd, & Atkins, 2009). Similarly, in a treatment study utilizing a sample of undergraduates, a gratitude intervention resulted in reduced pre-sleep worry and sleep disturbances (Digdon & Koble, 2011).

Such beneficial effects may occur because, as Wood, Joseph, et al. (2009) found, grateful individuals are more likely to think positive thoughts before bedtime (e.g., perspectives on social relationships and situations, evaluations of life circumstances) and less likely to have negative thoughts (e.g., troubling life situations, tragic world events). Gratitude may also help individuals to improve awareness of the positive aspects of one's life and counteract attention directed toward negative life events, thereby reducing worry and somatic and cognitive arousal before falling asleep (Digdon & Koble, 2011).

On a broad level, like stress, sleep is considered an important mechanism of action for the linkage between gratitude and health (Lavelock et al., 2016; Wood et al., 2010), given the transdiagnostic contributory nature of sleep disturbances to the onset and progression of many physiological and psychological conditions, such as diabetes mellitus, cardiovascular diseases, obesity, major depression, and PTSD (Goldstein & Walker, 2014; Itani, Jike, Watanabe, & Kaneita, 2017). Further, although the empirical support beneficially linking gratitude to sleep is promising, additional work is needed to explicate gratitude's utility for mitigating risk factors, for instance the potential buffering effect of gratitude on the association between psychosocial risk factors and sleep disturbances. In our final sections, we will discuss the extant research linking gratitude to the associations between depression and sleep disturbances, and between

thwarted interpersonal needs and sleep disturbances.

**Gratitude, Interpersonal Needs, and Sleep Disturbances**

Gratitude appears to exert a positive effect on interpersonal functioning which may, in turn, help to mitigate sleep disturbances. For example, in an international sample of adults ($N$ = 118), gratitude was associated with fewer physical health problems, including sleep disturbances, and loneliness mediated this linkage (O'Connell, O'Shea, & Gallagher, 2016). Similarly, in a study of adolescents, the relation between gratitude and recent physical symptoms (e.g., headache, runny nose, sore muscles) was mediated by relational fulfillment, suggesting that gratitude contributes to feelings of relational satisfaction and support and, in turn, to less physical symptomology (Froh, Yurkewicz, & Kashdan, 2009). Finally, in a longitudinal study of acute care nurses that focused on the effects of being a recipient of gratitude rather than on personal levels of gratitude, those who were thanked more often for their work were more satisfied with the care they provided to others, which predicted later improvements in sleep quality and adequacy (Starkey, Mohr, Cadiz, & Sinclair, 2019).

Although interpersonal variables explained, in part, the effects of gratitude on sleep problems in each of these studies, none of the studies specifically assessed thwarted interpersonal needs as conceptualized by Joiner (2005). Based on these well-established linkages between gratitude and interpersonal functioning, including associations with closely related variables such as loneliness and social support, we examine whether gratitude weakens the effects of thwarted belongingness and perceived burdensomeness on sleep disturbances.

**Gratitude, Depressive Symptoms, and Sleep Disturbances**

Previous research also supports another set of linkages within our model, among gratitude, depressive symptoms, and sleep disturbances. To begin, across three studies by

Emmons and McCullough (2003), engaging in gratitude interventions resulted in greater life satisfaction, optimism, positive affect and exercise, and fewer physical complaints and less negative affect in undergraduates, and improved positive affect and sleep quality and quantity in a clinical sample of patients with neuromuscular disease. Although depressive symptoms were not specifically measured, Emmons and McCullough (2003) indicated that if daily gratitude rituals improved positive and negative affect, they may also alleviate milder depressive symptomology. Similarly, in a study of Spanish undergraduates, engagement in a gratitude intervention resulted in increased positive affect but not improved sleep quality (Martínez-Martí, Avia, & Hernández-Lloreda, 2010). Martínez-Martí et al. (2010) posited that the brief 2-week duration of the gratitude intervention may have accounted for the lack of benefit for physical well-being variables or may indicate, perhaps, that gratitude does not directly affect physical well-being.

Regarding mental health, individuals with self-reported depression, anxiety, and sleep difficulties reported improvements in symptoms after engaging in a gratitude diary intervention, although these effects did not persist at a three-week follow-up (Southwell & Gould, 2017). Similarly, in a randomized controlled experiment of females with emotional and sleep disturbances ($N$ = 119), engaging in a gratitude intervention improved sleep quality, optimism, and hedonic well-being, and reduced diastolic blood pressure (Jackowska, Brown, Ronaldson, & Steptoe, 2016). Finally, in a sample of 18- to 29-year-olds, depressive symptoms mediated the relation between gratitude and self-reported sleep quality (Alkozei, Smith, Kotzin, Waugaman, & Killgore, 2017).

The beneficial effects of gratitude for mental and physical health, including sleep, also extend to persons with chronic illness. For example, in a sample of cardiac patients, gratitude

was associated with less depressive mood, fewer inflammatory biomarkers, and better sleep quality and, further, gratitude mediated the relation between spiritual well-being and depressed mood, and between spiritual well-being and sleep quality (Mills et al., 2015). Similarly, in a study of patients with chronic pain, gratitude was associated with better sleep quality and less depression (Ng & Wong, 2013).

Overall, prior research suggests that gratitude is associated with reductions in depressive symptoms and sleep problems across samples, including adults, college students, and individuals with chronic illnesses. In our current project, we expand upon these studies, employing a two-wave longitudinal design with primary care patients, to evaluate the potential protective role of gratitude for depressive symptoms and sleep disturbances.

**Gratitude, Interpersonal Needs, Depression, and Sleep Disturbances**

Finally, to our knowledge, only one study has investigated the interrelations among gratitude, depression, sleep problems, and an interpersonal construct, although it did not specifically examine perceived burdensomeness or thwarted belongingness. In a couple-based mind-body intervention study of patients with metastatic non-small cell lung cancer and their partners by Milbury and colleagues (2018), engaging in activities intended to foster interpersonal connection, gratitude, purpose, and mindfulness resulted in improvements in depression and sleep disturbances for both patients and their partners.

Currently, there is a dearth of research relating the constructs of perceived burdensomeness and thwarted belongingness, from Joiner's IPTS (Joiner, 2005), to other health outcomes, such as sleep disturbances. However, thwarted interpersonal needs have been repeatedly linked to depression (Carrera & Wei, 2017; Raines et al., 2016; Roberts et al., 2019), and gratitude is widely considered to arise from and perpetuate interpersonal connection (Algoe

& Stanton, 2012; Fredrickson, 2004). Further, depression is a significant predictor of sleep disturbances (Kang et al., 2013) and gratitude improves depressive symptoms (Cheng et al., 2015).

## Statement of the Problem

In sum, our review of the literature indicates that both depression and interpersonal dysfunction, including thwarted interpersonal needs, deleteriously impact the quantity and quality of sleep, warranting investigation of potential protective factors, such as gratitude, that may assuage psychopathology and interpersonal deficits in the service of sleep improvement. Yet, these associations have not been previously examined in an integrated model nor in primary care patients. As such, in our current study, we examine whether unmet interpersonal needs, including both perceived burdensomeness and thwarted belongingness, are associated with sleep disturbances, whether depressive symptoms mediate this association, and whether gratitude moderates the deleterious linkages between depression and sleep disturbances, and between thwarted interpersonal needs and sleep disturbances.

### Hypotheses

1) At the bivariate level, we hypothesized that thwarted interpersonal needs, including both perceived burdensomeness and thwarted belongingness, would be positively associated with depressive symptoms and sleep disturbances, and that all these variables would be negatively related to gratitude.
2) At the multivariate level, we hypothesized that depressive symptoms would mediate the relations between perceived burdensomeness and sleep disturbances, and between thwarted belongingness and sleep disturbances, such that greater levels of thwarted interpersonal needs would be associated with higher levels of depressive symptoms

and, in turn, to greater sleep disturbances.

3) Finally, we hypothesized that gratitude would moderate the relations among thwarted interpersonal needs, depressive symptoms, and sleep disturbances on two pathways of our model, including between depressive symptoms and sleep disturbances, and between thwarted interpersonal needs and sleep disturbances, such that higher levels of gratitude would weaken these linkages.

# CHAPTER 2

# METHOD

## Procedure

Data for the current project were previously collected as part of a larger Institutional Review Board-approved study conducted by the Laboratory of Resilience in Psychological and Physical Health in the Department of Psychology at East Tennessee State University. Participants were recruited in-person, over a one-year time period, from a rural primary care clinic in Southern Appalachia. Inclusion criteria required participants to possess the capability to give consent and complete self-report measures, to be English-speaking, and to be age 18 or older. Participants responded to a battery of questionnaires, either in person or online, after providing informed consent and received $20 in compensation for completion. All participants were invited to complete a second battery of surveys after approximately one year and, again, received $20 remuneration upon completion.

## Participants

Participants at Time 1 ($N$ = 223) were 61.2% female ($n$ = 137), 36.6% male ($n$ = 82), and 0.4% transgender ($n$ = 1), ranging from 19 to 79 years of age ($M$ = 44.07, $SD$ = 12.33). Racial and ethnic composition was primarily White ($n$ = 193; 86.2%), followed by Black ($n$ = 16; 7.1%), Hispanic ($n$ = 7; 3.1%), other race ($n$ = 3; 1.4%), American Indian/Alaskan Native ($n$ = 2; 0.9%), and Asian ($n$ = 1; 0.4%). Most participants reported income between $0 and $9,999 ($n$ = 148; 66.2%), followed by income between $10,000 and $19,999 ($n$ = 46; 20.5%), $20,000 and $29,999 ($n$ = 16; 7.1%), $30,000 to $39,999 ($n$ = 7; 3.1%), and over 40,000 ($n$ = 6; 2.7%). Most participants ($n$ = 152; 68%) reported having no health insurance, and 31.4% ($n$ = 70) reported having insurance.

One-hundred twenty-three participants were lost to follow-up at Time 2 and, further, three participants were dropped from analyses due to missing data at Time 1. At Time 2, the remaining participants ($n$ = 97) consisted of 62 females (63.9%) and 35 males (36.1%) and ranged in age from 20 to 80 years old ($M$ = 47.85, $SD$ = 11.97). Regarding race/ethnicity, Time 2 participants were primarily White ($n$ = 85; 87.6%), followed by Black ($n$ = 7; 7.2%), Hispanic ($n$ = 2; 2.1%), American Indian/Alaskan Native ($n$ = 2; 2.1%), and other race ($n$ = 1; 1.0%). Most respondents reported an income between $0 and $9,999 ($n$ = 58; 59.8%), followed by income between $10,000 and $19,999 ($n$ = 20; 20.6%), $20,000 and $29,999 ($n$ = 10; 10.3%), $30,000 to $39,999 ($n$ = 3; 3.1%), and over 40,000 ($n$ = 5; 5.2%). Finally, most respondents ($n$ = 58; 59.8%) had no health insurance, whereas 36 participants (37.1%) reported having insurance.

## Measures

In addition to assessment of the primary study variables of thwarted interpersonal needs, depressive symptoms, gratitude, and sleep disturbances, participants completed a comprehensive demographic survey at each time point that evaluated age, race and ethnicity, sex, income, and health insurance status, among other variables. This information was collected to provide descriptive statistics for our sample and to serve as potential covariates.

**Sleep Disturbances.** Sleep disturbances were assessed, at Time 2, using the Sleep Problems Index 2 (SPI2) of the Medical Outcomes Study Sleep Scale (MOS-Sleep; Hays & Stewart, 1992). The MOS-Sleep is a twelve-item scale consisting of 11 Likert-type questions and one open-ended response assessing sleep quantity. Ten of the questions assess how often respondents have experienced certain sleep issues in the past 4 weeks, using a six-point Likert scale ranging from 1 (“all of the time”) to 6 (“none of the time”). Examples of items include “Get enough sleep to feel rested upon waking in the morning?” and “Feel drowsy or sleepy

during the day?" Respondents also indicate how long it has taken them to fall asleep, in the past 4 weeks, using a 5-point Likert-type scale, ranging from 1 ("0-15 minutes") to 5 ("more than 60 minutes"). MOS-Sleep items are used to compute 6 domains, including daytime somnolence, sleep adequacy, sleep disturbances, sleep quantity, snoring, and awaken short of breath or with headache, and two composite subscales, Sleep Problems Index 1 (SPI1) and Sleep Problems Index 2 (SPI2). All item scores are converted to a 0 to 100 scale so that each score represents a percentage of the total score (e.g., on a 6-point scale, a score of 5 equates to 80, or 80% of the highest possible score), and can be reverse-scored so that higher scores reflect greater levels of sleep disturbances. For our study, we utilized the SPI2 composite score, which uses 9 items and provides a broader assessment of sleep disturbances as compared to the SPI1, which only utilizes 6 items.

The MOS-Sleep has exhibited sound psychometric properties in several studies, including among individuals with restless legs syndrome, fibromyalgia, diabetic peripheral neuropathy, and overactive bladder (Allen, Kosinski, Hill-Zabala, & Calloway, 2009; Cappelleri et al., 2009; Kim et al., 2013; Lau, Morlock, & Hill, 2006). In the initial psychometric validation, using a nationally representative sample of 1,011 U.S. adults and a sample of 173 adult patients with neuropathic pain enrolled in a clinical drug trial (Hays, Martin, Sesti, & Spritzer, 2005), internal consistency (Cronbach's alpha; α) of the SPI2 was good in the non-clinical sample (α = .83) and acceptable in the clinical sample (α = .78). In a clinical trial conducted in six countries with 396 diabetic neuropathy patients, internal consistency of the SPI2 was good (α = .81) and the SPI2 was moderately correlated ($-0.40 \leq r < -0.70$) with the bodily pain, mental health, vitality, social functioning, and physical functioning subscales of the MOS 36-Item Short Form Health Survey (SF-36; Viala-Danten, Martin, Guillemin, & Hays, 2008). More recently, the

MOS-Sleep was validated in a sample of Spanish postmenopausal women; the SPI2 exhibited good test-retest reliability ($r = 0.84$) and internal consistency ($\alpha = 0.82$), and was moderately correlated ($r = 0.64$) with the Pittsburgh Sleep Quality Index (PSQI; Zagalaz-Anula, Hita-Contreras, Martínez-Amat, Cruz-Díaz, & Lomas-Vega, 2017). In our study, internal consistency of the SPI2 is good ($\alpha = .86$).

**Thwarted Interpersonal Needs.** Thwarted interpersonal needs were measured, at Time 1, using the Interpersonal Needs Questionnaire (INQ; Van Orden, Cukrowicz, et al., 2012), which is composed of 15 items assessing the constructs of thwarted belongingness (INQ-TB; 9 items) and perceived burdensomeness (INQ-PB; 6 items). The INQ-TB subscale evaluates perceived social isolation and integration and perceived ability to develop and maintain interpersonal connections, and includes items such as "These days, other people care about me" and "These days, I am close to other people" (Van Orden, Cukrowicz, et al., 2012). The INQ-PB assesses self-perception of liability to others, contribution to other individuals' well-being, and feeling that others would benefit from one's permanent absence, through items such as "These days, I think I am a burden on society" and "These days, the people in my life would be happier without me" (Van Orden, Cukrowicz, et al., 2012). Responses are indicated on a 7-point Likert scale ranging from 1 ("not at all true for me") to 7 ("very true for me"). Six items in the INQ are reverse-scored to indicate greater levels of thwarted belongingness or perceived burdensomeness. Total scores for INQ-TB (range = 9 to 63) and INQ-PB (range = 6 to 42) are created by summing the item responses for each subscale, with higher scores indicating greater thwarted belongingness or perceived burdensomeness, respectively.

In both clinical and non-clinical samples, the INQ has exhibited strong psychometric properties, including measurement invariance across five samples of undergraduates, adult

outpatient mental health clients, and older adults, most of whom were primary care patients ($n$ = 208) (Van Orden, Cukrowicz, et al., 2012). Convergent validity is also evident. For example, Van Orden, Cukrowicz, et al. (2012) also found that social support ($r$ = -.76) and loneliness ($r$ = .91) were highly correlated with thwarted belongingness, and death ideation ($r$ = .60) and low perceived social worth ($r$ = .47) were positively related to perceived burdensomeness. Similarly, in three additional samples of older (age 60 to 93 years) and younger (age 18 to 30 years) adults, respectively, the INQ-PB was positively correlated with depression ($r$ = .32, .66), suicidality ($r$ = .44, .47), and hopelessness ($r$ = .61, .66) (Lutz & Fiske, 2017).

Further, in a representative sample of German individuals ($N$ = 2,513), internal consistency was good for the INQ-TB (α = .89) and excellent for the INQ-PB (α = .94), and both scales showed convergent validity with depression and suicidality (Hallensleben, Spangenberg, Kapusta, Forkmann, & Glaesmer, 2016). Similarly, in a sample of young male adults in Singapore, internal consistency for INQ-TB was good (α = .89), and was excellent for INQ-PB (α = .95) (Teo, Suárez, & Oei, 2018). In two samples of undergraduates ($N$ = 449 and 218) and a sample of adolescent psychiatric inpatients ($N$ = 114), internal consistency was good for INQ-TB (α =.81-.87), and good to excellent for INQ-PB (α = .85-.90); (Hill et al., 2015). Finally, among two primary care samples, the INQ-TB exhibited good reliability (α = 0.84, 0.82) and the INQ-PB showed acceptable reliability (α = 0.74, 0.74) (Cukrowicz, Jahn, Graham, Poindexter, & Williams, 2013; Jahn, Poindexter, & Cukrowicz, 2015). In our primary care sample, internal consistency is excellent for both the INQ-TB (α = 0.90) and INQ-PB (α = 0.94) subscales.

**Depressive Symptoms.** The Patient Health Questionnaire-9 (PHQ-9) was utilized, at Time 1, to evaluate depressive symptoms (Kroenke, Spitzer, & Williams, 2001), and is comprised of 9 items that were validated in two large studies, with 3,000 obstetrics-gynecology

patients in seven clinics, and with 3,000 primary care patients in eight clinics (Spitzer, Kroenke, & Williams, 1999; Spitzer, Williams, Kroenke, Hornyak, & McMurray, 2000). The sensitivity and specificity of the PHQ-9 in detecting depressive symptoms is comparable to diagnostic interviews and validated measures such as the Hamilton Rating Scale for Depression (HAM-D; Hamilton, 1960; Kroenke et al., 2001; Spitzer et al., 1999), and the PHQ-9 is the most commonly-used measure to assess depressive symptoms in primary care patients (Levis et al., 2019).

Respondents indicate the frequency of depressive symptoms (e.g., "poor appetite or overeating" and "thoughts that you would be better off dead or of hurting yourself in some way") over the previous two weeks, using a four-point Likert scale which ranges from 0 ("not at all") to 3 ("nearly every day)." Summed total scores range from 0 to 27, with higher scores indicating more severe depressive symptomology.

In the PRIME-MD studies, the internal consistency reliability of the PHQ-9 was good in both the obstetrics-gynecology ($\alpha = .86$) and primary care samples ($\alpha = .89$) and test-retest reliability was also good ($r = .84$) after 48 hours (Kroenke et al., 2001). Convergent and concurrent validity were also supported in these samples. For example, PHQ-9 scores were negatively correlated with all SF-20 (20-Item Short Form Health Survey) subscales, were positively correlated with symptom-related difficulty and number of days of disability and physician visits, and distinguished patients with major depressive disorder (MDD; Kroenke et al., 2001).

In the past 20 years, studies have continued to substantiate the strong psychometric properties of the PHQ-9 in the primary care population. For example, the PHQ-9 demonstrated measurement invariance across marital status, education level, employment status, sex, and age

over a 3-month timeframe among patients from 22 primary care centers in Spain ($N = 836$) (González-Blanch et al., 2018). Further, among primary care samples in the United States, Malaysia, China, Ethiopia, Taiwan, Thailand, Singapore, Japan, the Netherlands (El-Den, Chen, Gan, Wong, & O'Reilly, 2018), Latvia (Vrublevska, Trapencieris, & Rancans, 2018), and India (Indu et al., 2018), internal consistency (Cronbach's alpha) of the PHQ-9 ranged from 0.67 to 0.92, with 10 of the 13 studies falling within the good to excellent range. In these samples, PHQ-9 scores were significantly positively related to other validated depression measures (range: $r$ = 0.54 to 0.73), such as the HAM-D (Hamilton, 1960) and Quick Inventory of Depressive Symptomology- Self Report (Rush et al., 2003), supporting the PHQ-9's convergent validity. Sensitivity for detecting clinical levels of major depression ranged from 61% to 95% and specificity from 61% to 98%, and test-retest reliability was acceptable to excellent (range: $r$ = 0.73 to 0.94). In our sample, internal consistency of the PHQ-9 was excellent ($\alpha = .90$).

**Gratitude.** Gratitude was assessed, at Time 2, using the Gratitude Questionnaire-Six Item Form (GQ-6; McCullough et al., 2002). The questionnaire is comprised of six statements (e.g., "I have so much in life to be thankful for;" "I am grateful to a wide variety of people") that are rated on a 7-point Likert-type scale, ranging from 1 ("strongly disagree") to 7 ("strongly agree"). Two items are reverse-scored and responses are summed (range = 6 to 42), with higher scores indicating greater gratitude.

The GQ-6 has displayed sound psychometric qualities in both domestic and international samples. For example, in a meta-analysis of internal consistency estimates from 57 studies collapsed into geographic regions, the GQ-6 had a Cronbach's alpha of 0.81 in the U.S., United Kingdom, Australia, and Asia, and an acceptable alpha of .75 in Europe (Card, 2019). Further, measurement invariance across sexes and criterion validity with life satisfaction and affective

well-being were found in a sample of Chinese adults ($N$ = 1,151) (Kong, You, & Zhao, 2017). Among Japanese college students, test-retest reliability for the GQ-6 was good ($r$ = .86), and the GQ-6 was distinguishable from life satisfaction, positive and negative affect, and psychosocial flourishing, supporting its discriminant validity (Sumi, 2017). Similarly, in the original validation study of U.S. community adults by McCullough et al. (2002), internal consistency of the GQ-6 was good (α = .82) and, further, it was distinguishable from satisfaction with life, hope, optimism, vitality, and happiness. In our sample, internal consistency is good (α = .88).

## Statistical Analyses

**Bivariate Analyses.** All analyses were performed using RStudio Version 1.2.1335 (RStudio Team, 2018). Pearson's product-moment correlation coefficients were calculated to evaluate the independence of, and associations between, study variables. Any associations with coefficients greater than 0.80, indicating multicollinearity, would have been excluded from our analytic model (Field, 2009); however, none of our bivariate correlations reached this cutoff.

**Multiple Linear Regression Analyses.** Four longitudinal multiple linear regression models were analyzed using ordinary least squares (OLS) path analysis (Gelman & Hill, 2007) to assess the potential mediating effect of depressive symptoms on the association between thwarted interpersonal needs and sleep disturbances, and the potential moderating of gratitude on the linkages between thwarted interpersonal needs and sleep disturbances, and between depressive symptoms and sleep disturbances. Gratitude was not examined as a moderator between thwarted interpersonal needs and depressive symptoms because it was measured at Time 2 and, thus, could not function as a predictor of depressive symptoms at Time 1.

Prior to conducting analyses, the data was reviewed visually and statistically to detect outliers and verify that the assumptions of multiple linear regression were met. The presence of

skewness, kurtosis, and heteroscedasticity were evaluated, and logarithmic or polynomial transformations of the data were performed when appropriate. Both mediation and moderated mediation analyses were conducted using the stats package in R (RStudio Team, 2018), which can compute effects for combinations of linear and nonlinear associations. To verify the absence of multicollinearity within each model, each coefficient's variance inflation factor (VIF) was calculated during analysis, using the car R package (Fox & Wiesberg, 2019), to confirm that values were less than 5 (Hair, Risher, Sarstedt, & Ringle, 2019). The VIF for a predictor, which indicates the extent to which its variance is increased by correlations among other predictor variables in the model (i.e., multicollinearity), is derived by regressing the predictor of interest on the remaining predictors of the model; a VIF near 1 is ideal (Akinwande, Dikko, & Samson, 2015).

**Mediation.** Two simple mediation analyses were conducted to investigate the potential mediating role of depressive symptoms (T1) in the association between thwarted interpersonal needs (T1) and sleep disturbances (T2). In mediation analysis, the mediated effect, or indirect effect, can be calculated by multiplying the effects of the *a* and *b* pathways, or by subtracting the direct effect (*c′*), which is the uninterrupted relation between the predictor and outcome variables, from the total effect (*c*), defined as the effect of the predictor on the outcome accounting for the mediator. Nonparametric bootstrapping, a repeated sampling with replacement technique (i.e., 10,000 bootstrapped samples) that estimates sampling distribution (e.g., sample mean) and provides 95% confidence intervals (CI) of the mediation effects, was conducted using the boot R package (Canty & Ripley, 2019).

**Moderated mediation (conditional indirect effects).** Moderated mediation models were utilized to evaluate potential moderating effects of gratitude on the relation between depressive

symptoms and sleep problems (*b* pathway), and between perceived burdensomeness/thwarted belongingness and sleep problems (*c′* pathway). That is, we assessed whether the indirect effect of our simple mediation models was conditional on varying levels of the moderator variable. Each model utilized 10,000 bootstrapped samples and generated 95% confidence intervals for each indirect effect. Predictor, mediator, and moderator variables were mean-centered prior to analysis to ease interpretability of effects and to reduce multicollinearity (Jaccard & Turrisi, 2003). Finally, Johnson-Neyman analyses were conducted to determine at which levels of the moderator (i.e., gratitude) the predictor (i.e., perceived burdensomeness, thwarted belongingness, or depressive symptoms) exerted a significant effect on the outcome variable (i.e., sleep disturbances), and plots were produced to illustrate the effects (Johnson & Fay, 1950; Johnson & Neyman, 1936; Long, 2019).

**Covariates.** Potential confounders of our analyses, such as sex, age, race and ethnicity, income, and insurance status, were included as covariates. Each covariate was collected at both time points; thus, Time 1 variables were entered as covariates of the *a* pathway and Time 2 variables were entered for the *b* and *c′* pathways. Sleep disturbances at Time 1 were also entered as a covariate for the *b* and *c′* pathways. Any non-significant covariates were removed using backward stepwise selection to preserve analytic power, unless they improved the overall fit of the model (Faraway, 2015).

To begin, biological sex was included as a covariate, given its associated with numerous of our study variables. As an example, in previous research, women benefit more from cultivating and expressing gratitude than men; higher gratitude was positively associated with belonging and autonomy for women but, for men, the opposite effect was observed, and receiving a gift evoked a sense of obligation and burden (Kashdan, Mishra, Breen, & Froh,

2009). Regarding psychopathology, both the 12-month and lifetime prevalence of major depression is 2 times higher for women than men (Hasin et al., 2018). Similarly, women have higher rates of insomnia (40% higher), restless legs syndrome (100% higher) and idiopathic hypersomnia (80% higher) and, although the risk of obstructive sleep apnea is twice as high in men, it is more strongly associated with depression in women (Odds Ratio 5.2 compared to 3.4; Mallampalli & Carter, 2014). Given the high comorbidity of psychiatric disorders with insomnia, females are at significantly greater risk of experiencing both sleep disturbances and depressive symptoms (Poole & Jackowska, 2018).

Sleep disturbances, and their risk and protective factors, are also influenced by age. For example, the prevalence of major depression is highest among adults 18 to 25 years old, affecting approximately 4.6 million (13.8%) young adults and resulting in severe impairment in 3 million (8.9%) (Substance Abuse and Mental Health Services Administration, 2019), whereas insomnia is more common among middle-age and older adults, with a 12-month prevalence of 21 to 24% in cohorts aged 45 years and older (Ford, Cunningham, Giles, & Croft, 2015). Further, rates of obstructive sleep apnea increase with advancing age (Senaratna et al., 2017). Regarding thwarted interpersonal needs, perceived burdensomeness was more highly correlated with depressive symptoms in younger adults than in older adults (Lutz & Fiske, 2017), although perceived burdensomeness tends to be more prevalent in older adults as a result of declining health and physical functioning (Jahn, Van Orden, & Cukrowicz, 2013). However, older adults have significantly higher levels of gratitude than younger and middle-aged adults (Chopik, Newton, Ryan, Kashdan, & Jarden, 2019).

In previous research, race and ethnicity are also associated with our variables of interest. White individuals, as compared to non-Whites, experience increased prevalence of depression

(McGuire & Miranda, 2008). For example, among 16% of individuals in a large U.S. sample (*n* = 17,249) who met criteria for MDD, 34% were White, 25% were Black, 20% were Hispanic, 13% were Asian, and 8% were Afro-Caribbean (Budhwani, Hearld, & Chavez-Yenter, 2015). However, depression is often underreported in racial and ethnic minorities, particularly Black individuals, despite disparities including, but not limited to, lower income, inadequate healthcare, and reduced access to services (Sohail, Bailey, & Richie, 2014). In a recent study, Latino Americans and European Americans had higher levels of gratitude than East Asian Americans, and the interaction between gratitude and ethnicity predicted fewer depressive symptoms and less loneliness (Corona et al., 2020). Regarding sleep disturbances, Black individuals are 32% more likely than Whites to sleep six or fewer hours per night (Sheehan, Frochen, Walsemann, & Ailshire, 2019) and are significantly more likely to have lower sleep efficiency, more sleep fragmentation, more time spent awake after sleep onset, lower sleep quality, and more daytime sleepiness than White, Hispanic, and Asian individuals (Carnethon et al., 2016).

Low-income individuals also experience greater sleep disturbances (Grandner et al., 2010). For example, individuals below the poverty threshold were 2.8 times more likely to report poor sleep quality than those above the threshold in a sample of 9,714 U.S. adults (Patel, Grandner, Xie, Branas, & Gooneratne, 2010). Similarly, individuals making less than $20,000 per year are 1.44 times more likely to have major depression in their lifetime, compared to those making $70,000 or more (Sareen, Afifi, McMillan, & Asmundson, 2011), and undergraduates with lower income report higher levels of perceived burdensomeness and thwarted belongingness (Davidson, Wingate, Grant, Judah, & Mills, 2011). Among adults endorsing low gratitude levels, those with higher income have lower levels of the inflammatory marker interleukin-6 than adults with lower income, irrespective of demographic, personal, and health

factors, while income levels have similar effects among individuals with high gratitude levels (Hartanto, Lee, & Yong 2019), warranting its inclusion as a covariate.

Individuals without insurance coverage have limited access to health care and are more likely than those with insurance to experience undiagnosed or untreated psychopathology and poorer physical health (Jones, Lebrun-Harris, Sripipatana, & Ngo-Metzger, 2014; Kamimura, Christensen, Tabler, Ashby, & Olson, 2013). For instance, with the expansion of Medicaid in Oregon, which provided insurance to the previously uninsured, the prevalence of undiagnosed depression declined by 50%, while untreated depression declined by 60% (Baicker, Allen, Wright, Taubman, & Finkelstein, 2018).

Persons at the intersectionality of these covariates may experience higher rates of sleep disturbances or depression. For example, impoverished older adults are more likely to experience difficulties falling asleep and longer sleep duration (i.e., nonoptimal sleep duration, or sleep duration that is too long) on weekends, particularly those who have been exposed to poverty for at least five years (Chen, 2019). Further, Blacks, Asians, and Hispanics/Latinos have shorter sleep duration and poorer sleep quality than non-Hispanic Whites (Johnson, Jackson, Williams, & Alcántara, 2019). Women with a higher household income have lower rates of depression than men and White women with higher incomes have lower rates of depression than White men and Black individuals, while high income is a risk factor for African American men (Assari, 2017). Research indicates that Black women tend to have lower risk for depressive symptoms than expected based on the additive effects of belonging to two disadvantaged groups, while Native American women are at greater risk than expected (Fagrell Trygg, Gustafsson, & Månsdotter, 2019). Among older adults, social support from relatives and friends has been linked to lower rates of depression in White women and slightly higher rates of depression in Black women,

while social ties had no effect on depression rates in Black men and these rates were significantly higher than those of White men (Mair, 2010).

Finally, sleep disturbances at Time 1 were also included as a covariate of the *b* and *c′* pathways to account for any variance in our models explained by prior sleep issues. As the MOS-Sleep was not administered at Time 1, we utilized item 3 of the PHQ-9, which inquires how often, on a scale of 0 (“not at all”) to 3 (“nearly every day”), the individual had “Trouble falling or staying asleep, or sleeping too much” (Kroenke et al., 2001). In order to match the scale of the MOS-Sleep, the responses were converted to a 0 to 100 scale so that each number represented a percentage of the maximum score for the item. This item was also mean-centered prior to analysis.

# CHAPTER 3

# RESULTS

## Descriptive Statistics

Ninety-seven of the original 223 participants, from Time 1, completed the study, representing an overall response rate of 43% at Time 2. Most participants were divorced (33%; *n* = 32), 31% were married and living with their spouse (*n* = 30), 18% were single (*n* = 17), 9% were married and not living with their spouse (*n* = 9), and 8% were widowed (*n* = 8). Regarding employment status, 37% were unemployed (*n* = 36), 20% were employed part time (*n* = 19), 18% were employed full time (*n* = 17), 19% received disability (*n* = 18), and 6% were retired (*n* = 6). Of the 37% of respondents with health insurance (*n* = 36), 78% had public (i.e., government supplied) insurance (*n* = 28), 17% had private health insurance (*n* = 6), and 3% had Veterans Administration insurance (*n* = 1).

In paired samples *t*-tests, no statistically significantly differences in study variables between Time 1 and Time 2 emerged (See Table 1). Chi-square tests were conducted to assess the categorical variables of health insurance status (McNemar test) and income over time (McNemar-Bowker test; see Table 2). Income groups with too few responses to conduct a reliable test were combined (i.e., annual incomes of $20,000 or more). Participants' income did not significantly change from baseline to follow-up. However, there was a statistically significant difference in insurance coverage between the two time points; nine patients lost health insurance coverage from Time 1 to Time 2.

We also compared responses between T2 study completers and non-completers (See Table 3). In independent samples *t*-tests, patients who did not complete the study were younger and had a significantly higher level of thwarted belongingness. No other significant differences

were noted between completers and non-completers, including for categorical variables assessed by chi-square analyses (See Table 4).

## Bivariate Correlations

Pearson's product moment correlation analyses were employed to test our first hypothesis, which was supported (See Table 5). Thwarted belongingness was significantly positively related to perceived burdensomeness ($r = .70$, $p < .001$), depressive symptoms ($r = .66$, $p < .001$), and sleep disturbances ($r = .38$, $p < .001$) and negatively related to gratitude ($r = -.55$, $p < .001$). Similarly, perceived burdensomeness was significantly positively related to depressive symptoms ($r = .63$, $p < .001$) and sleep disturbances ($r = .45$, $p < .001$), and negatively related to gratitude ($r = -.57$, $p < .001$). Depressive symptoms were positively related to sleep disturbances ($r = .39$, $p < .001$) and negatively related to gratitude ($r = -.58$, $p < .001$). Finally, sleep disturbances were negatively related to gratitude ($r = -.46$, $p < .001$). Correlations are also provided for continuous (i.e., sleep disturbances at Time 1) and interval (i.e., income at T1 and T2) covariates in Table 5.

## Mediation Analyses

Prior to conducting simple mediation models, the continuous predictors of each model were plotted against the outcome variable (i.e., sleep disturbances at Time 2) to assess the linearity of each association, using the ggplot2 R package (Wickham, 2016). Functional forms of each association were compared using the Akaike Information Criterion (AIC; Akaike, 1974) and all were linear, except between perceived burdensomeness and depressive symptoms, for which a logarithmic functional form provided the best fit for the data ($r^2 = .498$; $r^2_{Adjusted} = .493$, $p < .001$). Thus, perceived burdensomeness was transformed to a logarithmic scale in the *a* pathway formula. Variance inflation factors for each model were all less than 5 (see Table 6).

**Simple Mediation Analyses**

Longitudinal multiple linear regression models, investigating thwarted belongingness and perceived burdensomeness as predictors without covariates, were significant, supporting hypotheses. The direct effect of thwarted belongingness on sleep disturbances dropped out of significance after depressive symptoms were included in the model, indicating mediation ($c$ = .63[.31, .94], $SE$ =.16, $p < .001$; $c'$ = -.03[-.40, .34], $SE$ = .19, $p$ = .87). The bootstrapped bias corrected and accelerated (BCa) mediation effect ($ab$ = .66[.38, .97], $SE$ = .15) was significant. Similarly, the direct effect of perceived burdensomeness on sleep disturbances dropped out of significance after including depressive symptoms, indicating mediation ($c$ = .94[.56, 1.33], $SE$ =.19, $p < .001$; $c'$ = .21[-.26, .68], $SE$ = .24, $p$ = .37). The bootstrapped bias corrected (BCa) mediation effect ($ab$ = 12.37[6.77, 18.33], $SE$ = 2.91) was significant. Refer to Figure 1 for pathway coefficients.

As a second step, we re-analyzed our hypothesized models with the inclusion of covariates. In our model examining the mediating role of depressive symptoms on the relation between thwarted belongingness and sleep disturbances, hypotheses were supported. Using backward stepwise selection, sex emerged as a significant covariate of the $a$ pathway, age and sex as covariates of the $b$ pathway, and age, sex, and Time 1 sleep disturbances as covariates of the $c$ pathway. Thwarted belongingness was not significantly associated with greater sleep disturbances ($c$ = .25, $SE$ = .17, $p$ = .14), and the direct effect of thwarted belongingness on sleep disturbances remained nonsignificant after accounting for the mediating effect of depressive symptoms ($c'$ = .03[-.33, .39], $SE$ = .18, $p$ = .86). However, higher levels of thwarted belongingness were significantly related to greater depressive symptoms ($a$ = .33, $SE$ = .04, $p <$ .001) and, in turn, depressive symptoms were significantly positively associated with sleep

disturbances ($b$ = 1.29, $SE$ = .47, $p$ < .01), indicating an "indirect only" effect (BCa bootstrap interval was significant; $ab$ = .42[.15, .76], $SE$ = .16). Our model accounted for approximately 41% of the indirect effect variance ($R^2$ = .41, $r^2_{Adjusted}$ = .38, $p$ < .001). Individuals who reported higher levels of thwarted belongingness reported greater depressive symptoms and, in turn, more sleep disturbances (See Table 7; Figure 2).

In our perceived burdensomeness model, using backward stepwise selection, sex emerged as a significant covariate of the $a$ pathway, age and sex as covariates of the $b$ pathway, and age, sex, and Time 1 sleep disturbances as covariates of the $c$ pathway. Supporting our hypothesis, higher perceived burdensomeness was significantly related to greater depressive symptoms ($a$ = 7.10, $SE$ = .77, $p$ < .001), and to heightened sleep disturbances ($c$ = .56, $SE$ = .20, $p$ < .01). Additionally, depressive symptoms were positively associated with sleep disturbances ($b$ = 1.51, SE = .35, $p$ < .001). The direct effect of perceived burdensomeness on sleep disturbances dropped out of significance ($c'$ = .30[-.15, .76], $SE$ = .23, $p$ = .19) upon inclusion of depressive symptoms, indicating mediation (See Table 7; Figure 2). The bootstrapped bias corrected (BCa) mediation effect ($ab$ = 10.74[5.60, 16.38], $SE$ = 2.76) was significant. Our model accounted for approximately 41% of the of the indirect effect variance ($R^2$ = .41, $r^2_{Adjusted}$ = .39, $p$ < .001).

**Conditional Indirect Effect Analyses**

In a moderated mediation model investigating gratitude as potential moderator of the $b$ and $c'$ pathways of the thwarted belongingness mediation model, hypotheses were not supported. Sex emerged as a significant covariate of the $a$ and $b$ pathways, and age, sex, and Time 1 sleep disturbances as covariates of the $c'$ pathway. Gratitude did not significantly moderate the relation between depressive symptoms and sleep disturbances ($b$ path; b = .06, $SE$ = .04, $t$(87) = 1.52, $p$ = .13), or between thwarted belongingness and sleep disturbances ($c'$ path; b = -.01, $SE$ = .02, $t$(87)

= -.43, $p$ = .67) (See Table 8; Figure 3).

In our perceived burdensomeness model, the same covariates emerged as significant contributors, and our hypotheses were partially supported. Gratitude significantly moderated the relation between depressive symptoms and sleep disturbances (*b* path; b = .13, *SE* = .04, $t(88)$ = 3.32, $p < .01$), and between perceived burdensomeness and sleep disturbances (*c′* path; b = -.07, *SE* = .03, $t(88) = -2.66$, $p < .01$). On the *b* path of the model, the positive coefficient indicates that gratitude and depressive symptoms interact synergistically to increase sleep disturbances whereas, on the *c′* path, gratitude operates as a protective factor, weakening the association between perceived burdensomeness and sleep disturbances (See Table 8; Figure 3).

Johnson-Neyman intervals and plots were generated for each moderated mediation pathway to test the conditional effects of gratitude. Low gratitude scores were not associated with any change in the effect of depressive symptoms on sleep disturbances. However, when gratitude reached moderately low levels (i.e., 6.32 points below the mean), and above, the effect of depressive symptoms on sleep disturbances proportionately increased. Higher levels of gratitude strengthened the detrimental effect of depressive symptoms on sleep (See Figure 4). Conversely, as gratitude levels increased from the lowest score, the adverse effects of perceived burdensomeness on sleep lessened; gratitude weakened the perceived burdensomeness-sleep relation (See Figure 5). However, gratitude exerted no buffering effect on this linkage when gratitude increased to moderately low levels and above (i.e., 7.06 points below the mean through the highest score).

# CHAPTER 4

# DISCUSSION

In our sample of primary care patients, we examined the longitudinal association between thwarted interpersonal needs and sleep disturbances, and the potential mediating role of depressive symptoms. Further, we investigated the potential moderating role of gratitude on two of the mediated linkages, including between depressive symptoms and sleep disturbances, and between thwarted interpersonal needs (i.e., perceived burdensomeness and thwarted belongingness) and sleep disturbances. Thwarted interpersonal needs were related to greater depressive symptoms and subsequent sleep disturbances, as predicted; however, partially supporting hypotheses, gratitude moderated both of the longitudinal pathways for only the perceived burdensomeness model. In the subsequent sections, we discuss our findings in greater detail, including bivariate and multivariate results and possible explanations for nonsignificant effects.

## Bivariate Analyses

At the bivariate level, all study variables were associated in anticipated directions, supporting our hypotheses. To begin, greater levels of thwarted belongingness and perceived burdensomeness were associated with sleep disturbances, substantiating previous research (Chu et al., 2019; Hom et al., 2019). Loneliness, a subconstruct of thwarted belongingness, may contribute to hypervigilance when attempting to fall asleep, sleep fragmentation at night, and daytime impairment (Hawkley, Preacher, & Cacioppo, 2010; Kurina et al., 2011; Sladek & Doane, 2015), while those who feel like a burden may experience physical symptoms (e.g., dyspnea, pain) and psychological distress (e.g., hopelessness, loss of dignity and control; McPherson, Wilson, Chyurlia, & Leclerc, 2010; Wilson, Curran, & McPherson, 2005), which are

known contributors to sleep disturbances (Grandner, 2019; Mystakidou et al., 2009). We also found that depressive symptoms were positively related to sleep disturbances, consistent with prior findings (Becker et al., 2017; Kim et al., 2015); depression predicts heightened pre-sleep rumination and reduced belief in ability to practice healthy sleep hygiene behaviors (Guastella, & Moulds, 2007; Rutledge et al., 2013). In a sample of primary care patients with insomnia, greater depression was associated with lower self-efficacy for sleep indicating, for example, less confidence in ability to fall asleep and less mental relaxation while lying in bed (Rutledge et al., 2013).

Our hypothesis that thwarted belongingness and perceived burdensomeness would be positively related to depressive symptoms was supported, as in previous studies (Campos & Holden, 2015; Gaskin-Wasson, Walker, Shin, & Kaslow, 2018; Hains, Janackovski, Deane, & Rankin, 2018). As we have noted, the absence of belonging, an innate human need, may contribute to depression, in part, because it elicits feelings of purposelessness, exasperation, and grief (Baumeister & Leary, 1995). Perceived burdensomeness may also promote depression, by evoking thoughts that one is inconsequential, a liability to others, and has no purpose (Tang et al., 2016; Van Orden, Cukrowicz, et al., 2012). The association between thwarted interpersonal needs and depressive symptoms has been observed across samples. In primary care patients, perceived burdensomeness and thwarted belongingness were positively related to depressive symptoms (Chang et al., 2018) and, among female primary care patients experiencing domestic abuse, thwarted belongingness was significantly related to depression (Chang et al., 2015). Further, among individuals reporting health conditions or physical disabilities, perceived burdensomeness is associated with higher levels of depression (Khazem et al., 2017) and, for those with stigmatizing medical conditions, such as inflammatory bowel disease, thwarted

belongingness is also related to depression (Roberts et al., 2019).

The positive psychological factor of gratitude was inversely related to perceived burdensomeness and thwarted belongingness, congruent with previous theory and research indicating its beneficial effect on interpersonal connectivity (Krysinska, 2018). Being the beneficiary of an altruistic act contributes to feeling supported by others and, in turn, to engagement in prosocial behavior (McCullough et al., 2002). Per the broaden-and-build theory, gratitude expands cognitive-emotional and behavioral repertoires, facilitating an urge to provide support and resources to others and bolstering relationships over time (Fredrickson, 2004). Accordingly, gratitude is positively associated with social affiliation, warmth, and social support in past research (Ni et al., 2015; Williams & Bartlett, 2015), including among persons with medical conditions, such as HIV/AIDS (Coursaris & Liu, 2009) and cancer (Algoe & Stanton, 2012).

As hypothesized, gratitude was also negatively related to depressive symptoms. This salutary association may occur because gratitude improves peace of mind, reduces rumination about negative events (Liang et al., 2018), and facilitates positive life events via prosocial behavior (Disabato et al., 2017). Additionally, gratitude may benefit depression via the amelioration of self-criticism and self-punishment and by fostering self-reassurance (Petrocchi & Couyoumdjian, 2016). In our study, gratitude was also linked to fewer sleep disturbances, and similar explanatory mechanisms have been proposed. For example, individuals with higher levels of gratitude tend to focus their thoughts on positive occurrences, rather than ruminating about negative events that may promote arousal and worry before sleep (Digdon & Koble, 2011). These positive cognitions include, among others, remembering enjoyable aspects of the past few days, good things happening in the world, and positive characteristics of relationships with

friends and family, and are associated with better subjective sleep quality, efficiency, duration, and latency (Wood, Joseph, et al., 2009).

Notably, completers' incomes from Time 1 to Time 2 were only moderately correlated ($r = .59$, $p < .001$). Nineteen (20%) participants shifted from one incremental income category to another, with 12 (12%) moving to a lower income bracket. Eight of these 12 (8% of sample) were earning between $40,000 and $49,999 at Time 1 and less than $20,000 by Time 2. The unstable nature of employment in rural Appalachia and the 1-year time lag between surveys may account for these trends. Given the minimal number of participants in higher income brackets, income categories were collapsed into three groups (i.e., 0-9,999, 10,000-19,999, and 20,000 or more) to assess changes from Time 1 to Time 2. The overall number of individuals making below $10,000 per year did not change, but 6 (6%) individuals shifted from the $10,000 to $19,999 category to making $20,000 or more (See Table 2); however, this change in income between T1 and T2 was not significant, per the McNemar-Bowker chi-square test of symmetry.

In sum, our bivariate hypotheses were supported and were consistent with extant research. Thwarted interpersonal needs, depressive symptoms, and sleep disturbances were positively associated, and gratitude was negatively related to each of these. In the following section, we will discuss the results of our mediation and moderated-mediation analyses.

## Multivariate Analyses

### Mediation Models

In multivariate analyses, supporting hypotheses, depressive symptoms mediated the relations between perceived burdensomeness and sleep disturbances, and between thwarted belongingness and sleep disturbances, such that greater levels of thwarted interpersonal needs were associated with increased depressive symptoms and, in turn, to more sleep disturbances. In

our model examining thwarted belongingness, neither the total nor direct effects were significant, indicating an "indirect only" effect in which the influence of thwarted belongingness on sleep is transmitted primarily through depressive symptoms. The total effect of perceived burdensomeness on sleep disturbance was, however, significant. Prior research documents the direct relation between sleep disturbances and consequent thwarted interpersonal needs (Chu et al., 2017; Hom, Chu et al., 2017), and between related interpersonal constructs and consequent sleep disturbances; however, our findings extend this literature by examining thwarted interpersonal needs as a predictor of sleep disturbances, rather than an outcome, and by documenting the role of depressive symptoms as a potential mechanism of action for this association. In the following sections, we discuss each of the linkages of our model, including the association between thwarted interpersonal needs and sleep disturbances, between thwarted interpersonal needs and depression, and between depression and sleep disturbances.

**Interpersonal Needs and Sleep Disturbances.** Neither thwarted belongingness nor perceived burdensomeness, as conceptualized by Joiner (2005), have been previously examined as predictors of sleep disturbances but, rather, have been assessed as mediators of sleep disturbances in the context of suicidality (Chu et al., 2018, 2019; Nadorff et al., 2014). However, constructs with similarity to thwarted interpersonal needs, such as loneliness, are inversely associated with physical health, including sleep (Luanaigh & Lawlor, 2008), perhaps due to their exacerbation of a sense of social threat and increased physiological arousal (Cacioppo & Cacioppo, 2018).

According to Cacioppo and Cacioppo's (2018) evolutionary theory of loneliness (ETL), loneliness, or perceived social isolation, is an innate biological mechanism that facilitates survival by increasing restlessness and fragmentation of sleep to protect against predatory

threats. Per the ETL, loneliness primes the HPA axis to activate more quickly in response to possible stressors, inducing arousal through the periodic release of cortisol during the sleep cycle. In a study of college students, by Cacioppo and colleagues (2002), loneliness was associated with more microawakenings, both at home and in a sleep lab, and higher levels of daytime fatigue. The association between loneliness and poor sleep has been supported repeatedly across samples (e.g., Hayley et al., 2017; Segrin & Burke, 2015; Zawadzki et al., 2013). For example, in a prospective study of a population-based sample of adults, daily fluctuations in loneliness predicted subsequent daytime dysfunction (i.e., low energy, fatigue, sleepiness), including when depression was covaried (Hawkley et al., 2010). In a longitudinal twin study, past violence or child maltreatment exposure exacerbated the effect of loneliness on sleep quality, supporting the hypothesis that heightened vigilance for threats to safety contributes to sleep disturbances (Matthews et al., 2017).

Further, social isolation is hypothesized to disrupt social cues that help to regulate sleep-wake activity (Cho et al., 2018). Healthy relationship functioning within a home tends to promote daily activities and social rhythms (e.g., meals, sleep and wake times, relaxation, exercise) that coincide with circadian *zeitgebers* (e.g., light exposure, noise), while distressed relationships may disrupt exposure to circadian cues in the environment, for example, as a result of changing social rhythms to avoid one's partner (Rogojanski et al., 2013). Broadly, however, living with one's partner, as opposed to alone, is linked to better sleep efficiency, less daytime fatigue, shorter sleep onset latency, and healthier sleep beliefs (Troxel, Robles, Hall, & Buysse, 2007). For instance, among older adults in China ($N = 15{,}638$), living with a spouse or relative increased the probability of good sleep quality by 11%, in comparison to individuals living alone (Gu, Sautter, Pipkin, & Zeng, 2010). Low social participation and dysfunctional marriages also

predicted poor sleep among older adults, as measured by actigraphy and self-report surveys (Chen, Lauderdale, & Waite, 2016; Chen, Waite, & Lauderdale, 2015).

Thwarted belongingness can trigger internalizing cognitive-emotional reactions, such as feeling unwanted, rejected, worthless, neglected, and misunderstood (Richman & Leary, 2009), characteristics that often arise independently in depressed individuals. Further, as noted above, disruptive interpersonal circumstances (e.g., abuse history, relationships problems, living alone) may contribute to unmet belonging needs, thereby eliciting depressive symptoms. Indeed, in a study of adult outpatients, depressive disorders had a stronger predictive association with thwarted belongingness than perceived burdensomeness (Silva, Ribeiro, & Joiner, 2015). Such findings suggest depression may be more robustly associated with thwarted belongingness, than with perceived burdensomeness and, in our study, may help to explain its requisite linkage in the prediction of sleep health. Further, across samples, insomnia was related to heightened thwarted belongingness (Hom, Hames, et al., 2017), with the authors speculating that insomnia may be intrinsically "lonely" and isolating due to the time spent lying awake alone or sleeping when others are awake. It is plausible, therefore, that if insomnia is necessarily a lonely condition, then thwarted belongingness may contribute little additional variance as a separate risk factor. However, given our small sample size, it is also possible that inadequate power contributed to the lack of a total effect for our thwarted belongingness model (Kenny & Judd, 2014).

In contrast, perceived burdensomeness is often impacted by variables we did not assess in our study, including psychological factors, such as guilt or shame (Rogers, Kelliher-Rabon, Hagan, Hirsch, & Joiner, 2017), and physiological factors, such as illness-related pain and functional impairment (Geng et al., 2017; Van Orden et al., 2010), which can directly affect sleep in the absence of depression (Grandner, 2017). Although comprehensive future research is

warranted to assess such models, insight about potential latent risk factors may be gained from the extant literature. From a psychological perspective, for example, greater perceived or anticipated rejection strengthened the mediating effect of perceived burdensomeness on the relation between sexual orientation and suicidal ideation among sexual minorities (Hill & Pettit, 2012) and, in a sample of patients with eating disorders, body dissatisfaction, which elicits low self-esteem, shame, and self-hatred, was associated with greater perceived burdensomeness and consequent suicidal ideation (Forrest et al., 2016). Notably, in a recent study of adolescents, perceived burdensomeness was operationalized as shame, given the status of shame as a robust indicator of perceived burdensomeness, worthlessness, and suicidality (Dyer, Goodman, & Hardy, 2020).

Physiological factors are also linked to perceived burdensomeness in primary care and chronic disease samples. Among older primary care patients, higher perceived burdensomeness levels were related to greater functional impairment (e.g., activities of daily living, cognition, mobility), while thwarted belongingness was linked to social impairment (Mournet, Bower, & Van Orden, 2020). Of note, functional impairment is robustly associated with sleep disturbances, above and beyond the effects of comorbid mental and physical health conditions and sociodemographic variables (Stein, Belik, Jacobi, & Sareen, 2008). Another potential latent risk factor, among persons with chronic illness, is progression of disease; feelings of burdensomeness, and not depression, increased with disease progression in a longitudinal study of patients with amyotrophic lateral sclerosis (Mora, Salas, Fajardo, Ivanez, & Rodriguez-Santos, 2013). The worsening symptomatology inherent in the progression of many medical conditions (e.g., increasing pain, deteriorating mobility, respiratory impairment) may independently disrupt sleep (Gjerstad, Wentzel-Larsen, Aarsland, & Larsen, 2006; Gore et al., 2005).

Burdensomeness itself is also directly related to sleep disturbances. For example, in a sample of patients with congestive heart failure, greater perceived burden was associated with poorer sleep quality and daytime sleepiness (Shen, Song, & Song, 2018). According to self-determination theory, failure to meet the basic psychological needs of autonomy (i.e., desire for freely executed actions to coincide with one's sense of self), competence (i.e., need to feel effective in one's social environment), and relatedness (i.e., desire for meaningful social connection) compromises health and well-being (Deci & Ryan, 2000). Perceived burdensomeness stems from an unfulfilled need for autonomy and competence, while thwarted belongingness emerges when the need for relatedness is unmet (Van Orden, Cukrowicz, et al., 2012). Broadly, insufficient satisfaction of basic psychological needs is associated with poor sleep quality in HIV patients (Campbell et al., 2019), and with lower sleep quantity, poor overall sleep quality, and daytime sleepiness and fatigue in adults (Campbell et al., 2015). Such effects may be due, in part, to the deleterious impact of burdensomeness, and the thwarting of other psychological needs, on cognitive-emotional functioning and, in turn, on sleep health. In a polysomnography study of persons with chronic fatigue, stress (e.g., physiological hyperarousal, irritability) and negative sleep cognitions (e.g., rumination about lack of sleep) were mechanisms of action linking basic psychological need frustration and both subjective and objective sleep deficits (Campbell et al., 2017). Similarly, in a longitudinal study of college students, stress mediated the deleterious effect of need frustration on daytime dysfunction and sleep quantity and quality (Campbell et al., 2015). The extant research, thus, suggests that frustration of psychological needs produces stress and rumination (Quested et al., 2011; Van der Kaap-Deeder, Vansteenkiste, Van Petegem, Raes, & Soenens, 2016), which are known contributors to sleep

disturbances (Digdon & Koble, 2011; Valerio, Kim, & Sexton-Radek, 2016; Wood, Joseph, et al., 2009).

Examining the processes by which the latent factors comprising perceived burdensomeness (i.e., thwarted autonomy and competence needs) confer these downstream effects may also yield important insights for treatment development and health promotion. For example, thwarted competence inhibits flexible coping and enables stress incursion during difficult situations (e.g., requiring high demand or energy), leading to maladaptive health behaviors and poorer health (Weinstein & Ryan, 2011). Similarly, thwarted autonomy contributes to frustration and anxiety during stressful tasks, attenuates ability to fully process emotions associated with stressors, undermines goal setting that may result in less stress, and reduces vitality, thereby constraining coping capacity when faced with stressors (Weinstein & Ryan, 2011). Stress-generated emotional dysregulation and rumination regarding stressors may, in turn, permeate cognitions prior to falling asleep, resulting in disruptions to sleep quality and quantity (Campbell et al., 2017; Guastella & Moulds, 2007).

In sum, available evidence, and our current findings, indicates a direct linkage between thwarted interpersonal needs, including thwarted belongingness and perceived burdensomeness, and sleep disturbances, and suggests numerous potential psychosocial pathways of action to explain these associations. Maladaptive coping and psychopathological reactions, including depression, may help to explain the TIN-sleep association. Indeed, in addition to their robust relations to sleep, higher perceived stress levels and negative pre-sleep rumination may both exacerbate and originate from depression (Pillai & Drake, 2015; Vogt, Waeldin, Hellhammer, & Meinlschmidt, 2016), thereby cyclically worsening sleep via depression. Of note, perceived burdensomeness is associated with greater depressive symptoms among individuals with medical

conditions, over and above the potential effects of physical impairment (Khazem et al., 2017). Despite differential patterns of effects, both types of thwarted interpersonal needs are linked to sleep through depression, suggesting a critical connection, which we discuss in greater detail in the following section.

**Interpersonal Needs and Depressive Symptoms.** As acknowledged above, across both of our models, thwarted interpersonal needs were associated with depressive symptoms, supporting our hypotheses and substantiating previous research (Baams et al., 2018; Carrera & Wei, 2017). According to the social cure perspective, group belongingness is beneficial for well-being (Wakefield, Bowe, Kellezi, McNamara, & Stevenson, 2019). For example, in a longitudinal intervention study, perceived group belongingness predicted recovery from depression in both community recreation and clinical psychotherapy groups (Cruwys et al., 2014). In a longitudinal population-based study ($N$ = 5,055), belonging to a greater number of groups prevented the development of depression in non-depressed individuals and alleviated depressive symptoms among initially depressed persons (Cruwys et al., 2013).

Leary and Baumeister's (2000) sociometer theory describes a mechanism through which interpersonal needs may influence depressive symptoms. When belongingness, a basic human need, is threatened and one feels devalued by others, an internal "sociometer," self-esteem, generates emotional distress. This response can include generalized negative affect, such as depression, and serves as a warning signal that promotes behaviors serving to restore one's sense of value to others, such as those that convey competence and agreeableness (Leary & Baumeister, 2000). Supporting sociometer theory, self-esteem mediated the effects of perceived friendship support and family cohesion on depressed mood, among Japanese and American samples of undergraduates (Abe, 2004).

Constructs similar to, or indices of, thwarted belongingness, such as loneliness, are also independent risk factors for depression (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006; Teo, Choi, & Valenstein, 2013). Cacioppo et al. (2006) theorized that loneliness confers unique risk for depressive symptomology because pleasant interpersonal connections are particularly important to well-being; the loss or absence of a satisfying relationship can generate loneliness and subsequent depression. In longitudinal studies, loneliness consistently predicts depressive symptoms beyond initial depressive symptomology (e.g., Heikkinen & Kauppinen, 2004; Wei, Russell, & Zakalik, 2005), over and above the effects of perceived stress, dispositional negativity, objective social isolation, and social support (Cacioppo et al., 2010). Moreover, in a population-based longitudinal study, Vanderweele, Hawkley, Thisted, and Cacioppo (2011) determined that successfully intervening to alleviate loneliness would affect a proportionate reduction in depressive symptoms 1 and 2 years later, on average.

Our other independent variable, perceived burdensomeness, may contribute to depression by fostering beliefs that one is of little value to significant others, or that others would be better off if one were dead (Hames, Hagan, & Joiner, 2013; Van Orden, Cukrowicz, et al., 2012). Often, when a person is unable to reciprocally contribute to a relationship, perhaps due to old age, disease or impairment, they may feel like a burden, with accompanying loss of meaning in life, reduced self-esteem and self-worth, and concern regarding negative consequences to relationships, that produces or exacerbates depressive symptoms (Tang et al., 2016; Van Orden, Bamonti, King & Duberstein, 2012).

The linkage between feelings of burdensomeness and depression is supported by previous research. Self-perceived burdensomeness among older adults and persons with chronic illness may arise when one feels like a burden to a caregiver and encompasses reactions such as guilt,

anger, frustration, helplessness, dependence, loss of control, and indebtedness (Cousineau, McDowell, Hotz, & Hébert, 2003). As examples, among persons with medical conditions that detrimentally impact autonomy and competence, including amyotrophic lateral sclerosis (Gauthier et al., 2007), cancer (Libert et al., 2017), stroke (McPherson et al., 2010), and hemodialysis (Arechabala, Catoni, Palma, & Barrios, 2011) patients, feeling like a burden is associated with depressive symptoms. In a study of terminal cancer patients by Tang and colleagues (2016), depressive symptoms were greater among those reporting high self-perceived burden, functional dependence, and distress from illness symptoms, and lower when positive social interactions and affectionate social support were endorsed.

Finally, other research has demonstrated the simultaneous detrimental influence of thwarted belongingness and perceived burdensomeness on depressive symptoms. For example, both interpersonal needs constructs, mediated by hopelessness, were associated with heightened depressive symptoms in college students (Nalipay & Ku, 2019). Similarly, thwarted interpersonal needs predict future depression across diverse groups, including persons with hoarding behaviors (Raines et al., 2016), attachment anxiety (Øverup et al., 2017), movement disorders (Dempsey et al., 2012), and sexual minority youth (Baams et al., 2015). In a study of hospitalized older adults, the latent components of thwarted belongingness (i.e., unmet need for relatedness) and perceived burdensomeness (i.e., low autonomy and competence) were associated with severity of depressive symptoms (Souesme, Martinent, & Ferrand, 2016). Similarly, in a longitudinal study of depressed patients without comorbid medical conditions, fulfillment of autonomy, competence, and relatedness was associated with significant symptom reduction, over and above the effects of dysfunctional attitudes, cognitive errors, and time (Quitasol, Fournier, Di Domenico, Bagby, & Quilty, 2018). Our study contributes to this

growing body of research establishing interpersonal deficits as risk factors for depressive symptoms, and this awareness is particularly valuable when considering the robust connection between depression and sleep disturbances.

**Depressive Symptoms and Sleep Disturbances.** Depression is highly comorbid with sleep disorders, and between 54 to 85% of individuals with depression have sleep disturbances (Conradi, Ormel, & de Jonge, 2011). Depressed mood is strongly predictive of sleep disturbances in clinical samples, such as among hemodialysis (Pai et al., 2007), rheumatoid arthritis (Nicassio et al., 2012), and breast cancer (Palesh et al., 2007) patients, and in non-clinical populations (Ham et al., 2017; Smagula et al., 2016). A range of biological mechanisms link depression to sleep disturbances (Slavich & Irwin, 2014; Staner, 2010). For example, hyperarousal of the autonomic nervous system and hypothalamic–pituitary–adrenal (HPA) axis contributes to slow wave sleep deficit and sleep maintenance issues in both depression and insomnia (Staner, 2010). Heightened proinflammatory cytokines (Ji et al., 2017) and blunted reward processing (Burani et al., 2019; Pizza, Magnani, Indrio, & Plazzi, 2014) also contribute to the onset and maintenance of sleep disturbances and depressive symptoms.

Further, shared genetic risk factors include an allelic variation that reduces serotonergic binding sites (van Dalfsen & Markus, 2018), polymorphisms of circadian clock genes that generate circadian rhythm disruptions (Satyanarayanan et al. 2020), and an overlap in genetic coding for major depression and multiple sleep quality indicators, including insomnia, napping, daytime dozing, daytime sleepiness, and tiredness (Jansen et al., 2019; Wray et al., 2018). Gene-environment interactions must also be considered when assessing the linkage between these disorders. For example, among a large sample of adult twins ($N$ = 1,788), high heritability of depression was associated with sleep durations that were chronically too short or long, while

non-shared environment played a significantly larger role than genetics in the pathogenesis of depression among participants who habitually slept a normal, healthy duration (Watson et al., 2014).

Psychosocial (e.g., poverty), environmental (e.g., vocational stress), and cognitive-emotional factors (e.g., rumination) are also robust contributors to depression and sleep disturbances (Poole & Jackowska, 2018; Takano & Tanno, 2009; Zwerenz et al., 2017). For example, individuals living in neighborhoods high in crime may experience depressive symptoms, which can dysregulate the HPA axis and heighten arousal, reducing sleep quality (Hirotsu, Tufik, & Andersen, 2015). In couples recruited from primary care, depression, female sex, and spouse's low sleep quality significantly predicted sleep disorders (Kang et al., 2013). Similarly, among primary care patients from 10 countries, female sex, older age, noisy environment, urbanicity, depressive symptoms, and employment were associated with having sleep disturbances, while moderate to severe depressive symptoms were associated with all types of sleep disturbances simultaneously (Léger et al., 2010). In another primary care sample, comorbid depression, low self-efficacy for engaging in sleep-related behavioral change (e.g., belief in ability to fall asleep within 30 minutes, to go back to sleep within 15 minutes), and dysfunctional beliefs about sleep (e.g., beliefs that one should stay in bed and try harder to sleep, that one has minimal control over sleep) were significant predictors of insomnia severity (Bluestein, Rutledge, & Healey, 2010). Finally, in a sample of female obstetric primary care patients, 36% of respondents with insomnia who reported high nocturnal rumination screened positive for depression, while only 4% of patients with insomnia endorsing low rumination were depressed (Kalmbach et al., 2020). Such patterns of findings are in line with the perseverative

cognition hypothesis, which implicates rumination as a causal factor in persistent physiological and psychological arousal that disrupts sleep (Brosschot et al., 2006).

In sum, depressive symptoms and sleep disturbances share a multitude of risk factors, including physiological and environmental predictors that are unalterable. Our study, however, sought to identify malleable cognitive-emotional characteristics that can be clinically targeted in primary care settings. As predicted, thwarted interpersonal needs appear to exert disruptive downstream effects on depression and sleep. However, not all persons who experience interpersonal dysfunction also experience depression and sleep disturbances, perhaps due to the presence of individual-level cognitive-emotional protective factors, such as gratitude. In the following sections, we discuss the potential role of gratitude as a buffer of the detrimental effects of thwarted interpersonal needs and depressive symptoms on sleep quality.

**Moderated Mediation Models**

**Thwarted Belongingness Model.** In our moderated mediation model examining thwarted belongingness as the predictor, contrary to hypotheses, gratitude did not significantly moderate the relation between depressive symptoms and sleep disturbances, nor the association between thwarted belongingness and sleep disturbances. The main effect of gratitude, however, was significant and negative, indicating that higher levels of gratitude were associated with lower levels of sleep disturbances.

Gratitude often arises after an individual recognizes the goodness of an altruistic deed (Watkins, 2014) and, consequently, feels supported and valued by others (McCullough et al., 2002), thereby promoting engagement in prosocial behaviors, fostering relationship formation and preservation (Algoe et al., 2008; Lambert & Fincham, 2011) and deterring loneliness (Ni et al., 2015). Thus, our findings seem in opposition to the extant literature suggesting that gratitude

is protective against the effects of perceived social isolation and depression.

However, in a series of experimental studies with undergraduates and online respondents, MacKenzie and Baumeister (2019) found that social exclusion stimulates a desire to belong, increasing gratitude through heightened perceptions of a subsequent benefactor's warmth. Thus, it may be the case that gratitude emerges from a lack of belonging, rather than interacting with belongingness to influence health. It is also possible that gratitude's lack of moderation of both the belongingness-sleep and depression-sleep linkages can be attributed to differential influences of gratitude that may negate beneficial effects. For example, according to Wood et al. (2016), gratitude can exert a number of harmful effects on well-being, depending on the situation, such as among individuals with maladaptive personality characteristics, including those with: self-sacrificing schemas, who believe they must put the needs of others before their own; dependency schemas, who lack a belief in their own autonomy; and, subjugation schemas, who believe their needs should not be expressed. Thus, for our sample, it is possible that some individuals endorsing thwarted belongingness and depressive symptoms also possess maladaptive gratitude, in which they yield to others.

Moreover, in a recent meta-analysis, the benefits of gratitude interventions, regardless of type, for individuals with depression, were relatively modest, with small effect sizes at post-test and follow-up compared to control interventions, and medium effect sizes in comparison to no intervention (Cregg & Cheavens, 2020). No consistent moderators were identified, but Cregg and Cheavens posited that the efficacy of gratitude interventions may vary as a function of levels of self-criticism and emotional neediness. Indeed, in a study by Sergeant and Mongrain (2011), self-critics benefitted from a gratitude intervention (i.e., improved physical symptoms, but not depression), while the intervention was either detrimental or ineffective for emotionally needy

individuals. Needing close, meaningful bonds with others as a requisite for well-being characterizes neediness (Sergeant & Mongrain, 2011), which is a personality dimension linked to dependency and synonymous with thwarted belongingness (Davidson et al., 2011), while self-criticism is linked to feelings of incompetence (Blatt, 2004; Sergeant & Mongrain, 2011), which can generate perceived burdensomeness (Van Orden, Cukrowicz, et al., 2012).

Thus, Sergeant and Mongrain's (2011) finding, that a gratitude intervention was not beneficial for those with greater levels of neediness (i.e., thwarted belongingness), but was for those high in self-criticism (i.e., a precursor to perceived burdensomeness), is consistent with our own finding that gratitude did not exert an effect in our belongingness model but did moderate our burdensomeness model. Further, Wood and colleagues (2016) explained that gratitude is not protective for individuals possessing maladaptive interpersonal styles, including self-sacrificing, subjugatory, and dependent schematic types, which are markers of thwarted belongingness. Finally, it is possible that thwarted belongingness produces, rather than interacts with, gratitude, by triggering perceptions of a benefactor's intentions as warmer, due to an enhanced desire for connection (MacKenzie & Baumeister, 2019). In sum, our findings, and previous research, indicate that gratitude, as an interpersonal construct, may be dependent on the presence and quality of interpersonal relationships which, when thwarted or absent, do not allow facilitation of gratitude or the translational application of its effects. Such patterns provide a possible explanation for the lack of effects for our thwarted belongingness model.

**Perceived Burdensomeness Model.** In our moderated mediation model examining perceived burdensomeness as a predictor, hypotheses were partially supported. On the one hand, gratitude significantly moderated the association between perceived burdensomeness and sleep disturbances, weakening this linkage and supporting hypotheses whereas, on the other hand,

gratitude exacerbated the linkage between depressive symptoms and sleep disturbances. The main effect of gratitude was nonsignificant, indicating that gratitude exerts an influence only when interacting with perceived burdensomeness or depressive symptoms.

In post hoc analyses of the association between perceived burdensomeness and sleep disturbances, gratitude buffered this linkage. The lowest level of gratitude was associated with the highest levels of perceived burdensomeness and sleep disturbances, and as gratitude levels increased, the detrimental effect of perceived burdensomeness on sleep declined, exerting a weakening effect. High levels of gratitude had no significant effect on the relation between perceived burdensomeness and sleep disturbances. Although no prior research has investigated the specific linkage between gratitude and perceived burdensomeness, we can infer details about this ameliorative process by examining the impact of gratitude on related constructs, and of related constructs on sleep.

Self-determination theory, for example, asserts that competence, autonomy, and relatedness are basic psychological needs that, when fulfilled, predict well-being (Ryan & Deci, 2000, 2001). Given that perceived burdensomeness often arises from unfulfilled autonomy and competence (Van Orden, Cukrowicz, et al., 2012), it may be that gratitude has an ameliorative effect on such risk factors (e.g., thankfulness for positive experiences, rather than distress about lack of choice) or may help to facilitate satisfaction of these needs (e.g., thankfulness for abilities, rather than distress about perceived ineffectiveness; Jans-Beken et al., 2019; Wood, Maltby, Stewart, et al., 2008). For example, in a study of undergraduates, gratitude was associated with greater satisfaction of basic psychological needs, including autonomy, competence and relatedness and, in turn, to lower levels of depression and suicidality (Lin, 2019). In two additional undergraduate samples, greater gratitude was associated with fulfillment

of basic psychological needs and, in turn, to better subjective well-being (Wang, 2020; Yang & Ye, 2014).

In a longitudinal study of undergraduates, predicated on the broaden-and-build (Fredrickson, 2004) and self-determination theories (Deci & Ryan, 2000), Lee, Tong, and Sim (2015) found that gratitude was associated with fulfillment of the basic psychological needs of autonomy and relatedness and, in turn, to generativity of more gratitude. Although gratitude did not predict changes in competence, it served as a mediator of the linkage between baseline and follow-up competence. Such findings provide support for gratitude's potential beneficial influence on perceived burdensomeness, via the promotion of motivational "nutriments" that can facilitate a sense of efficacy and interpersonal value. This protective effect may also ameliorate the deleterious impact of thwarted interpersonal and basic psychological needs on sleep quality, given that the extant literature indicates a linkage between unfulfilled basic psychological needs in poor sleep. For instance, among individuals with chronic fatigue, frustration of basic psychological needs predicted poorer subjective and objective sleep quality, mediated by stress and sleep-related cognitions (Campbell et al., 2017). Similarly, satisfaction of basic psychological needs was negatively related to impairments in sleep quality, sleep quantity, and daytime functioning among university students (Campbell, Soenens, Beyers, & Vansteenkiste, 2018). Thus, it is feasible that gratitude may exert a beneficial downstream effect on sleep health, via its influence on need fulfillment linked to interpersonal functioning, including satisfaction of the needs for relatedness (e.g., resolving thwarted belongingness), autonomy, and competence (e.g., volitional choices and personal efficacy that overcome feelings of burdensomeness).

In contrast, in our post hoc analyses, gratitude exacerbated the association between depressive symptoms and sleep disturbances. At low levels of gratitude, no interaction occurred;

however, as gratitude increased, the association between depressive symptoms and sleep disturbances became more pronounced. Although inconsistent with our hypothesis, our results are congruent with previous research. For example, in a large study of adults ($N$ = 1,007), those with heightened depression were more likely to experience adverse effects (e.g., guilt, indebtedness) from engagement in a gratitude induction exercise, than those with lower levels of depression (Siegel & Thomson, 2017). Among depressed individuals, a four-week gratitude letter writing intervention led to diminished well-being, including reductions in satisfaction with life, happiness, and positive affect, perhaps because persons with depression have difficulty identifying experiences to be grateful for, found the task frustrating and difficult, or felt that they were failing at it (Sin, Della Porta, & Lyubomirsky, 2011). Further, this effect persisted at a three-week follow-up for participants who had low expectations of success for the intervention, suggesting that maladaptive cognitive (e.g., failure expectations) and emotional (e.g., depression) characteristics may interact to negate potential benefits from gratitude.

Indeed, Wood and colleagues (2016) asserted that largely unexplored moderators may determine the efficacy of gratitude interventions, and called for future research to investigate individual characteristics, intervention types, and delivery methods to determine when and how gratitude interventions should be prescribed. Considering that the adverse effects of gratitude interventions in these studies included guilt, reduced positive affect, low life satisfaction, and rumination, which are all symptoms or correlates of depression and independent predictors of sleep disturbances (Dedert et al., 2019; Ong et al., 2017; Pillai et al., 2014; Steptoe et al., 2008), it is plausible that gratitude may have exerted a similar effect in our study, interacting with depression to disrupt sleep.

## Limitations and Directions for Future Research

Our novel findings must be interpreted within the context of limitations. First, although longitudinal designs, including our two-wave modeling, are more robust than cross-sectional methodologies, our ability to infer causality remains limited (Caruana, Roman, Hernández-Sánchez, & Solli, 2015). While two-phase panel studies can indicate change scores over time, they are limited in their ability to highlight potential non-linear growth curves of processes of interest (De Lange, Taris, Kompier, Houtman, & Bongers, 2003) and, in future research, it is recommended that data be collected across at least three timepoints, allowing the independent variable, mediators and moderators, and dependent variable, to be assessed independently.

Relatedly, because we cannot infer causality, bidirectionality of our study variables is a possibility (Hom, Hames, et al., 2017; Lau, Hui, Cheung, & Lam, 2015; Zhai et al., 2015). To begin, the association between depression and sleep is generally considered to be bidirectional, due to common physiological and environmental risk factors (Fang et al., 2019). In a 3-year study with primary care patients, depressive symptoms were positively associated with next-week sleep problems and negatively related to remission of sleep disturbances, while sleep disturbances predicted the development and remission of depressive symptoms (Bouwmans et al., 2017). Similarly, in a recent meta-analysis of 23 older adult cohort studies, chronic sleep disturbances heightened risk for the onset, worsening, and recurrence of depression, and depression predicted the onset and worsening of sleep disturbances (Bao et al., 2017).

Other linkages in our models may also be bidirectional. For example, in a sample of working community adults, reduced general belongingness, as assessed by the Sense of Belonging Instrument, and conceptualized as a diminished "perception of others' appraisal and support" resulting from criticism or rejection, was associated with depressive symptoms at baseline which, cyclically, were related to reduced belongingness at a 3-month follow-up

(Cockshaw, Shochet, & Obst, 2014). According to the social-cognitive interpersonal process model (Sacco & Vaughan, 2006), reciprocal paths of reinforcement exist between depressive symptoms and belongingness, and this association may be further impacted by reactions from others. That is, manifestation of depressive symptoms may decrease perceptions of belongingness via avoidance behaviors, self-deprecation, extreme reassurance-seeking, and withdrawal, which are characteristics that often elicit negative reactions from others, thereby perpetuating the reciprocality between depression and perceptions of decreased belongingness.

Finally, among a large sample of older adults ($N$ = 2,541), not only was the association between depression and subjective social isolation bidirectional, subjective social isolation was also reciprocally related to sleep disturbances (Cho et al., 2018). Further, additional studies have found evidence that sleep disturbances predict thwarted interpersonal needs. Insomnia was associated with thwarted belongingness among six populations, including primary care patients, and the findings were not bidirectional (Chu et al., 2017; Hom, Chu et al., 2017). As well, sleep disturbances predicted both thwarted belongingness and perceived burdensomeness in sexual and gender minorities (Chu et al., 2018), and insomnia severity was related to perceived burdensomeness and desire for social support in a quasi-experimental study (Chu et al., 2019).

Given the considerable research support for reciprocal effects among our variables, implementing fully longitudinal designs as previously recommended may clarify directionality. For example, the social-cognitive interpersonal process model (Sacco & Vaughan, 2006) might be tested by analyzing depressive symptoms at Time 1 as the predictor, thwarted belongingness at Time 2 as the mediator, and sleep disturbances at Time 3 as the outcome variable. Further, bidirectionality between sleep disturbances and depressive symptoms, and between sleep disturbances and thwarted interpersonal needs, could be assessed by evaluating sleep

disturbances at Time 1 and depressive symptoms or thwarted interpersonal needs at Time 3. Ideally, randomized controlled trials testing interventions that manipulate each variable should be implemented so that support for causality can be obtained (Hariton & Locascio, 2018).

Another limitation of our study is attrition of subjects to follow-up, given that 57% of our baseline sample did not complete Time 2 assessments. Our comparison of completers versus non-completers indicates that non-completers were younger and endorsed greater levels of thwarted belongingness than completers. Younger, compared to older, adults experience greater instability in employment, finances, housing, and romantic relationships and have a higher 12-month prevalence of psychiatric disorders (Arnett, Žukauskienė, & Sugimura, 2014), which may influence attrition rates. For instance, in a longitudinal study of a very large sample of Australian women ($N$ = 40,000), younger women had the highest attrition rate, and 20% of these participants could not be reached by phone (Young, Powers, & Bell, 2006). Further, those who could not be contacted reported more stress, worse physical health, and were in a romantic relationship, compared to respondents of the same age cohort, while participants that formally withdrew had less social support and education, and tended to be single. Finally, in a study examining factors associated with attrition in longitudinal research with vulnerable populations, individuals with unmet belonging needs, as conceptualized by Maslow (i.e., sense of belonging to a family or group, having social support and affectionate relationships), were significantly more likely to attrite (Ginn, Mughal, Syed, Storteboom, & Benzies, 2017). Participants with unfulfilled belonging needs had caregiver-child relationship difficulties and were single parents, and their associated financial, parenting, and logistical struggles impeded continued study participation.

As well, we utilized self-report survey measures, for which the external validity of the

data is limited by the degree of personal insight, honesty, mood, and response biases (i.e., the tendency for a given individual to respond with more affirmative or negative answers regardless of question) of our respondents (Demetriou, Ozer, & Essau, 2015; Huprich, Bornstein, & Schmitt, 2011). Despite this limitation, we administered "gold standard" assessments that have been well-validated in a variety of populations, including in samples of adults (Card, 2019; Hallensleben et al., 2016), college students (Sumi, 2017), individuals with medical conditions (Allen et al., 2009; Hays et al., 2005; Hill et al., 2015), and primary care patients (Kim et al., 2013; Spitzer et al., 1999; Van Orden, Cukrowicz, et al., 2012). To improve validity, future research could employ ecological momentary assessment and actigraphy to evaluate our study variables in real-time, rather than retrospectively (Armey, Schatten, Haradhvala, & Miller, 2015), and objective measures (e.g., medical records) could be used to substantiate self-report assessments.

Our participants were not randomly selected, were recruited from a rural primary care clinic in Southern Appalachia, and were predominantly White and female, which may limit generalizability. Our study variables are known to differ across demographic groups, including sex (Hasin et al., 2018; Kashdan et al., 2009), age (Ford et al., 2015; Lutz & Fiske, 2017), race (McGuire & Miranda, 2008; Sheehan et al., 2019), health insurance status (Baicker et al., 2018; Jones et al., 2014), and income (Patel et al., 2010). For instance, individuals in poverty experience increased rates of interpersonal problems and depressive symptoms (Santiago, Wadsworth, & Stump, 2011) and, similarly, women, adolescents and young adults, and White individuals have higher rates of depression (Weinberger et al., 2018). Higher levels of gratitude are associated with being female, older, Latino American, and European American (Chopik et al., 2019; Corona et al., 2020; Kashdan et al., 2009); yet, in another study, Hispanic/Latino

children had lower levels of gratitude than children of other races (Reckart, Huebner, Hills, & Valois, 2017). In a comparative study, gratitude was desired and expressed less frequently by East Asian Americans, than by European Americans and Latino Americans (Corona et al., 2020). However, according to a systematic review, non-White racial and ethnic groups are underrepresented in positive psychological research, and the concerns of both racial and ethnic minorities and non-Western cultures have only been examined superficially from a positive psychology perspective (Rao & Donaldson, 2015). Given the infancy of such research, ethnocultural differences in positive psychological manifestation and effects should be interpreted with caution. Finally, women have higher rates of restless legs syndrome and insomnia and lower rates of obstructive sleep apnea; younger adults have lower rates of sleep apnea and restless legs syndrome; and, Black individuals have the most unfavorable sleep duration and latency compared to other races (Ram, Seirawan, Kumar, & Clark, 2010).

After covarying each of these factors, age and sex emerged as significant covariates. In all models, on all pathways, female sex was significantly associated with increased depressive symptoms and sleep disturbances. This finding is consistent with prior research indicating that women have a higher prevalence of depression (Hasin et al., 2018), insomnia, idiopathic hypersomnia, and restless legs syndrome, than men (Mallampalli & Carter, 2014). Age was a significant covariate on the depression-sleep and interpersonal needs-sleep pathways for all models, except for the depression-sleep linkage in our thwarted belongingness moderated mediation model ($p > .05$). Age was negatively associated with sleep disturbances, a finding that is incongruent with some prior research indicating that sleep disturbances worsen with age (e.g., Ford et al., 2015; Senaratna et al., 2017). However, the age-related rates for insomnia, which comprises the most frequent constellation of sleep symptoms, vary by study (Patel et al., 2018;

Ram et al., 2010). Given such mixed findings linking age and sleep quality, prospective research designs utilizing objective (e.g., medical records) or physiological (e.g., actigraphy or polysomnography) assessments, may clarify this association.

Additionally, in repeated-measures models, it is important to control for baseline levels of the outcome variable (i.e., sleep disturbances), to ensure that any effects cannot be attributed to initial incidence (Streeter et al., 2017). We found that the baseline level of sleep disturbances was a significant covariate for the total effect pathway linking thwarted interpersonal needs to sleep disturbances at follow-up, yet baseline sleep disturbances did not contribute to the depression-sleep linkage. This pattern of effects indicates that depressive symptoms accounted for the effect of baseline sleep disturbances observed in the total effect pathway; that is, baseline sleep disturbances were related to sleep disturbances at follow-up, but this effect dropped out of significance when accounting for depressive symptoms. Our findings suggest that, in future research assessing associations between cognitive-emotional functioning and sleep disturbances, the effects of depression should be accounted for, to insure accurate estimation of the contribution of predictors.

Finally, our sample consisted primarily of individuals in poverty, with 60% of the sample earning less than $10,000 a year, whereas the average rate of poverty in the United states ranges from 7 to 20 percent (Laird, Parolin, Waldfogel, & Wimer, 2018). Greater poverty in our sample may limit the generalizability of our findings, as levels of sleep disturbances (Grandner et al., 2010), depression (Sareen et al., 2011), thwarted belongingness, and perceived burdensomeness (Davidson et al., 2011) tend to be higher among those with low income. As well, gratitude and income may interact to influence health outcomes. For example, individuals with low gratitude and income, compared to those with low gratitude and higher income, have increased levels of

inflammatory biomarkers (Hartanto et al., 2019), which may exacerbate depressive symptoms and sleep disturbances (Irwin & Opp, 2017). Our sample was also more depressed than is typical (i.e., 51.5% of our patients reported moderate to severe depressive symptoms); for instance, in an U.S. national sample of adults ($N$ = 36,309), the 12-month prevalence of depression was 10.4% (Hasin et al., 2018). Thus, caution must be taken when applying these findings to populations with higher incomes and lower rates of depression.

Of note, nine of our respondents (9%) lost health insurance from Time 1 to Time 2, reducing the insured coverage rate from 37.1% to 27.8%. When individuals are impoverished and uninsured, they tend to forgo needed medical treatment, tests, and medications due to cost and have significantly less access to treatment for psychological disorders (Dickman, Himmelstein, & Woolhandler, 2017). Such lack of care can exacerbate psychological and physical conditions and heighten risk for development of comorbidities (Guixiang, Okoro, Hsia, Town, & Zhao, 2018). Thus, understanding the impact of being underinsured or uninsured on interpersonal, psychological, and sleep health may be an important focal area for future research, including the influence of socioeconomic factors, such as access to care, on the protective efficacy of gratitude and other positive psychological factors. Further, considering the demographic homogeneity of our sample (e.g., income, insurance coverage, sex, and race), future studies utilizing random sampling and a control group, in diverse clinical and non-clinical populations, are necessary to improve generalizability and substantiate our findings.

In conclusion, despite limitations of our novel study, we identified interpersonal (i.e., thwarted interpersonal needs) and cognitive-emotional factors (e.g., gratitude) that, if clinically targeted, may improve depression and sleep disturbances. Yet, continued rigorous research is needed, including across disease groups (e.g., rheumatological and musculoskeletal,

cardiovascular) and health outcomes (e.g., quality of life, functional impairment), to substantiate and expand our findings. Similarly, translationally examining our hypothesized models in the context of specific types of sleep disturbances or disorders would add clinical utility to our findings (e.g., by recruiting patients diagnosed with insomnia, narcolepsy, or sleep apnea and implementing a gratitude intervention). Finally, although our models are theoretically-based and empirically-supported, it will be important to explore additional potential mechanisms (e.g., rumination; autonomic and psychological arousal) linking interpersonal dysfunction to sleep problems (Staner, 2010; Zawadzki et al., 2013), to better inform the development of targeted interventions to improve mental and physical health functioning.

**Implications**

Although preliminary in nature, our findings may have implications for the development of targeted interventions to improve psychosocial and sleep functioning in primary care patients. Broadly, we suggest that interventions to improve sleep in primary care patients may be enhanced, to the extent that they 1) target thwarted interpersonal needs, 2) improve screening and treatment of depression, 3) bolster gratitude, and/or 4) directly improve sleep.

To begin, psychoeducational and therapeutic interventions to improve interpersonal functioning, may have beneficial downstream effects on psychopathology and sleep disturbances. For example, perceived burdensomeness and thwarted belongingness can be directly addressed using cognitive bias modification and psychoeducation (Allan et al., 2018; Short, Stentz, Raines, Boffa, & Schmidt, 2019), both of which can be delivered via a computerized format (Short, Boffa, Raudales, & Schmidt, 2020). Patients can also be referred to illness support groups, in their community or online, which may help to foster meaningful interpersonal relationships and a sense of belonging (Lehardy & Fowers, 2018).

To identify patients who may be experiencing depressive symptoms, healthcare providers can administer a brief screener, such as the PHQ-9 (Kroenke et al., 2001), which was specifically developed for use in primary care settings. Of note, evidence-based interventions for depression, such as behavioral activation therapy (e.g., purposefully scheduling enjoyable and meaningful activities), cognitive behavioral therapy (e.g., targeting thoughts and behaviors to change emotions), and acceptance and commitment therapy (e.g., cultivating values-driven behavior and mindful, nonjudgmental awareness of the present) can be implemented in an integrated primary care setting (Hayes, Strosahl, & Wilson, 2003; Hopko, Robertson, & Carvalho, 2009; Kroenke et al., 2001). Behavioral activation that involves interpersonal contact with family and friends may be particularly well-suited for the improvement of both symptoms of depression and thwarted interpersonal needs (Solomonov et al., 2019).

Therapeutic promotion of gratitude may also benefit interpersonal functioning, psychopathology, and sleep health. Strategies such as gratitude journaling (Emmons & McCullough, 2003), gratitude letters (Bono, Krakauer, & Froh, 2015), and daily gratitude lists (Seligman et al., 2005), may reduce pre-sleep arousal and worry, improving overall sleep (Digdon & Koble, 2011). For example, gratitude journaling predicted an increase in school belonging in children (Diebel et al., 2016), and heightened positive affect and likelihood of helping and supporting others among undergraduates (Emmons & McCullough, 2003). Similarly, writing and delivering a gratitude letter improved depressive symptoms in adults (Seligman et al., 2005), and gratitude journaling led to a reduction in depressive symptoms and stress in healthcare workers (Cheng et al., 2015). Such psychological and prosocial effects of gratitude may be vital to the satisfaction of interpersonal needs, considering that gratitude broadens and builds cognitive, emotional, and behavioral repertoires that strengthen social

connections, and improve resiliency, over time (Fredrickson, 2004).

Finally, there are several effective psychosocial interventions to address sleep disturbances directly. First, cognitive behavioral therapy for insomnia is highly effective and commonly used with primary care patients (Karlin, Trockel, Taylor, Gimeno, & Manber, 2013; Vitiello et al., 2013). Broadly, cognitive behavioral approaches involve modifying sleep hygiene behaviors, and addressing maladaptive beliefs, to promote self-efficacy and motivation to engage in sleep-improving behavior (Morin, 2006). A systematic review of cognitive behavioral therapy for insomnia among primary care patients found that medium to large effects were observed within 4-6 sessions, which sustained for 3-12 months after treatment completion (Davidson, Dickson, & Han, 2019). Guided imagery, progressive muscle relaxation (Charalambous, Giannakopoulou, Bozas, & Paikousis, 2015), and stimulus control therapy (van Straten et al., 2018) are also well-suited to primary care settings (Dautovich, McNamara, Williams, Cross, & McCrae, 2010). In a systematic review, in 60% of studies ($n$ = 67), mind-body interventions, including relaxation, guided imagery, meditation, and movement interventions (e.g., yoga, tai chi), were effective for improving sleep (Neuendorf et al., 2015). Finally, in an intervention study among primary care patients ($N$ = 517) with chronic insomnia, stimulus control therapy, sleep restriction therapy, and multiple component therapy (i.e., stimulus control, sleep restriction, and sleep education and hygiene therapies in conjunction) were moderately effective in improving sleep and ameliorating perceived insomnia severity (Sidani, Epstein, Fox, & Collins, 2019). Of therapeutic importance, each of these psychosocial interventions can be implemented in a medical setting, including within the context of a primary care office visit, or assigned as a between-session treatment to bolster skills learned in the office.

## Conclusion

In our sample of primary care patients, we found that depressive symptoms mediated the relations between thwarted belongingness and sleep disturbances, and between perceived burdensomeness and sleep disturbances. Further, we found that gratitude moderated the association between perceived burdensomeness and sleep disturbances, weakening the linkage, and between perceived burdensomeness and depressive symptoms, strengthening the linkage. Future longitudinal research, with diverse samples, across additional time points, and utilizing objective assessments, is needed to substantiate our results. However, despite limitations, our findings may inform the development and implementation of therapeutic strategies to improve psychopathology, interpersonal functioning, and sleep health in primary care patients.

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Appendix

Table 1

*Descriptive Statistics and Paired T-tests for Continuous Study Variables by Time*

| Variable | Time | | | | | | 95% CI for Mean Difference | | |
|---|---|---|---|---|---|---|---|---|---|
| | Time 1 | | | Time 2 | | | | | |
| | *M* | *SD* | *n* | *M* | *SD* | *n* | | *t* | *df* |
| Thwarted Belongingness | 27.45 | 13.80 | 97 | 27.31 | 13.36 | 96 | [-2.17, 2.44] | .12 | 95 |
| Perceived Burdensomeness | 15.03 | 10.69 | 97 | 14.17 | 10.35 | 96 | [-.98, 2.71] | .93 | 95 |
| Depressive Symptoms | 10.41 | 7.26 | 97 | 11.36 | 7.75 | 97 | [-2.32, .12] | -1.80 | 96 |
| Sleep Disturbances | 49.47 | 22.80 | 97 | 55.18 | 37.10 | 97 | [-.76, 11.81] | 1.75 | 96 |

*Note*: Thwarted Belongingness = Thwarted Belongingness - Interpersonal Needs Questionnaire; Perceived Burdensomeness = Perceived Burdensomeness - Interpersonal Needs Questionnaire; Depressive Symptoms = Patient Health Questionnaire - 9; Sleep Disturbances = T1: Patient Health Questionnaire – 9 Item 3, Scaled / T2: Medical Outcomes Study Sleep Scale - Sleep Problems Index 2. No significant mean differences for study variables exist between T1 and T2.

Table 2

*Descriptive Statistics and Chi-Square Tests for Categorical Study Variables by Time*

| Variable | Time | | | | | |
|---|---|---|---|---|---|---|
| | Time 1 | | Time 2 | | | |
| | *n* | % | *n* | % | $\chi^2$ | *df* |
| Health Insurance | 97 | | 97 | | 5.82* | 1 |
| Yes | 36 | 37.1 | 27 | 27.8 | | |
| No | 61 | 62.9 | 70 | 72.2 | | |
| Income | 97 | | 97 | | 4.02 | 3 |
| 0-9,999 | 58 | 59.8 | 58 | 59.8 | | |
| 10,000-19,999 | 27 | 27.8 | 21 | 21.6 | | |
| 20,000 or more | 12 | 12.4 | 18 | 18.6 | | |

*Note:* A significant difference for health insurance coverage exists between T1 and T2; participants were less likely to have health insurance coverage at T2. * $p < .05$.

Table 3

*Descriptive Statistics and T-tests for Continuous Study Variables, Comparing Non-completers to Completers*

| Variable | Time | | | | | | 95% CI for Mean Difference | | |
|---|---|---|---|---|---|---|---|---|---|
| | Non-completers | | | Completers | | | | | |
| | *M* | *SD* | *n* | *M* | *SD* | *n* | | *t* | *df* |
| Thwarted Belongingness | 34.62 | 13.76 | 123 | 27.54 | 13.75 | 97 | [2.88, 10.19] | 3.52# | 206.2 |
| Perceived Burdensomeness | 16.62 | 10.83 | 123 | 15.25 | 10.84 | 97 | [-1.68, 4.09] | .82 | 206.3 |
| Depressive Symptoms | 12.05 | 7.60 | 123 | 10.39 | 7.23 | 97 | [-.30, 3.64] | 1.67 | 211.8 |
| Sleep Disturbances | 58.30 | 39.84 | 122 | 55.30 | 36.92 | 97 | [-7.66, 12.72] | .49 | 213.1 |
| Age | 42.23 | 12.19 | 118 | 46.85 | 11.97 | 97 | [-7.88, -1.43] | -2.85* | 206.2 |

*Note:* Thwarted Belongingness = Thwarted Belongingness - Interpersonal Needs Questionnaire; Perceived Burdensomeness = Perceived Burdensomeness - Interpersonal Needs Questionnaire; Depressive Symptoms = Patient Health Questionnaire - 9; Sleep Disturbances = T1: Patient Health Questionnaire – 9, Item 3, Scaled / T2: Medical Outcomes Study Sleep Scale - Sleep Problems Index 2. A significant mean difference for thwarted belongingness and age exists between those who completed the study (completers) and those who did not (non-completers); participants who completed the study had lower levels of thwarted belongingness and were older.
* $p < .01$, # $p < .001$.

Table 4

*Descriptive Statistics and Chi-Square Tests for Categorical Study Variables, Comparing Non-completers to Completers*

| Variable | Time | | | | | |
|---|---|---|---|---|---|---|
| | Non-completers | | Completers | | | |
| | *n* | % | *n* | % | $\chi^2$ | *df* |
| Health Insurance | 123 | | 97 | | .73 | 1 |
| Yes | 42 | 34.1 | 27 | 27.8 | | |
| No | 81 | 65.9 | 70 | 72.2 | | |
| Income | 123 | | 97 | | 5.13 | 2 |
| 0-9,999 | 88 | 71.5 | 58 | 59.8 | | |
| 10,000-19,999 | 19 | 15.4 | 27 | 27.8 | | |
| 20,000 or more | 16 | 13.0 | 12 | 4.1 | | |
| Sex | 122 | | 97 | | .40 | 1 |
| Female | 73 | 59.8 | 63 | 64.9 | | |
| Male | 49 | 40.2 | 34 | 35.1 | | |
| Race | 122 | | 97 | | .80 | 2 |
| White | 103 | 84.4 | 85 | 87.6 | | |
| Black | 9 | 7.4 | 7 | 7.2 | | |
| Other | 10 | 8.2 | 5 | 5.2 | | |

*Note:* No significant differences exist for the categorical study variables between individuals who completed the study (completers) and those who did not (non-completers).

Table 5

*Bivariate Correlations of Study Variables*

| | TB (T1) | PB (T1) | DS (T1) | Sleep (T2) | Gratitude (T2) | Sleep (T1) | Income (T1) |
|---|---|---|---|---|---|---|---|
| PB (T1) | .70^ | | | | | | |
| DS (T1) | .66^ | .67^ | | | | | |
| Sleep (T2) | .38^ | .45^ | .59^ | | | | |
| Gratitude (T2) | -.55^ | -.57^ | -.58^ | -.46^ | | | |
| Sleep (T1) | .56^ | .50^ | .79^ | .54^ | -.42^ | | |
| Income (T1) | -.18 | -.15 | -.27# | -.20* | .28# | -.26* | |
| Income (T2) | -.21* | -.19 | -.29# | -.13 | .34^ | -.26# | .59^ |

*Note*: TB = Thwarted Belongingness - Interpersonal Needs Questionnaire; PB = Perceived Burdensomeness - Interpersonal Needs Questionnaire; DS = Depressive Symptoms: Patient Health Questionnaire - 9; Gratitude = Gratitude Questionnaire - 6; Sleep (T1) = Sleep Disturbances T1: PHQ - 9 Item 3, Scaled. * $p < .05$, # $p < .01$, ^ $p < .001$.

Table 6

*Variance Inflation Factors for All Models*

| Path | TB | PB | DS | SD (T1) | Age | Sex | HI | Gratitude | Int. B | Int. C |
|---|---|---|---|---|---|---|---|---|---|---|
| *TB Mediation* | | | | | | | | | | |
| *b* (DS → SD) | 1.78 | -- | 1.78 | -- | -- | -- | -- | -- | -- | -- |
| *PB Mediation* | | | | | | | | | | |
| *b* (DS → SD) | -- | 1.81 | 1.81 | -- | -- | -- | -- | -- | -- | -- |
| *TB Mediation with Covariates* | | | | | | | | | | |
| *c* (TB → SD) | 1.49 | -- | 1.50 | -- | 1.05 | 1.05 | -- | -- | -- | -- |
| *a* (TB → DS) | 1.06 | -- | -- | -- | -- | 1.01 | 1.05 | -- | -- | -- |
| *b* (DS → SD) | 1.84 | -- | 3.37 | 2.73 | 1.05 | 1.07 | -- | -- | -- | -- |
| *PB Mediation with Covariates* | | | | | | | | | | |
| *c* (PB → SD) | -- | 1.35 | -- | 1.37 | 1.04 | 1.05 | -- | -- | -- | -- |
| *a* (PB → SD) | -- | 1.05 | -- | -- | -- | 1.01 | 1.04 | -- | -- | -- |
| *b* (DS → SD) | -- | 1.84 | 1.88 | -- | 1.04 | 1.06 | -- | -- | -- | -- |
| *TB: Mod. Med.* | | | | | | | | | | |
| *b/c′* (DS x Gratitude → SD) | 2.03 | -- | 2.10 | -- | -- | -- | -- | 1.65 | 1.97 | 1.92 |
| *PB: Mod. Med.* | | | | | | | | | | |
| *b/c′* (DS x Gratitude → SD) | 2.21 | -- | 2.19 | -- | -- | -- | -- | 1.76 | 2.46 | 2.78 |
| *TB: Mod. Med. with Covariates* | | | | | | | | | | |
| *c* (TB → SD) | 1.49 | -- | -- | 1.50 | 1.05 | 1.05 | -- | -- | -- | -- |
| *a* (TB → DS) | 1.06 | -- | -- | -- | -- | 1.01 | 1.05 | -- | -- | -- |
| *b/c′* (DS x Gratitude → SD) | 2.11 | -- | 4.04 | -- | 1.07 | 1.09 | -- | 1.69 | 2.03 | 1.93 |
| *PB: Mod. Med. with Covariates* | | | | | | | | | | |
| *c* (PB → SD) | -- | 1.35 | -- | 1.37 | 1.04 | 1.05 | -- | -- | -- | -- |
| *a* (PB → DS) | -- | 1.05 | -- | -- | -- | 1.01 | 1.04 | -- | -- | -- |
| *b/c′* (DS x Gratitude → SD) | -- | 2.26 | 2.27 | -- | 1.06 | 1.08 | -- | 1.78 | 2.51 | 2.80 |

*Note*: TB = Thwarted Belongingness - Interpersonal Needs Questionnaire; PB = Perceived Burdensomeness - Interpersonal Needs Questionnaire; DS = Depressive Symptoms: Patient Health Questionnaire - 9; SD = Medical Outcomes Study Sleep Scale - Sleep Problems Index 2; Mod. Med.= Moderated Mediation; Gratitude = Gratitude Questionnaire - 6; SD (T1) = Sleep Disturbances T1: PHQ- 9 Item 3, Scaled; HI = Health Insurance; Int. B = Interaction on *b* pathway; Int. C = Interaction on *c′* pathway.

Table 7

*Direct and Indirect Associations between Thwarted Interpersonal Needs, Depressive Symptoms, and Sleep Disturbances, with Covariates*

| Path | Estimate (*SE*) | Bias corrected and accelerated (BCa) 95% Confidence Interval |
|---|---|---|
| *Thwarted Belongingness* | | |
| *c* (TB → Sleep Disturbances) | .25 (.17) | [-.33, .39] |
| *a* (TB → Depressive Symptoms) | .32 (.04)^ | [.24, .41] |
| *b* (Depressive Symptoms → Sleep Disturbances) | 1.29 (.47)# | [.37, 2.22] |
| *c'* | .03 (.18) | [-.08, .59] |
| *ab* | .42 (.16)* | [.15, .76] |
| *Perceived Burdensomeness* | | |
| *c* (PB → Sleep Disturbances) | .56 (.20)# | [.17, .96] |
| *a* (PB → Depressive Symptoms) | 7.10 (.78)^ | [5.56, 8.64] |
| *b* (Depressive Symptoms → Sleep Disturbances) | 1.51 (.35)^ | [.82, 2.20] |
| *c'* | .30 (.23) | [-.15, .76] |
| *ab* | 10.74 (2.76)* | [5.60, 16.38] |

*Note*: Sleep Disturbances = Medical Outcomes Study Sleep Scale - Sleep Problems Index 2; Depressive Symptoms = Patient Health Questionnaire - 9; TB = Thwarted Belongingness - Interpersonal Needs Questionnaire; PB = Perceived Burdensomeness - Interpersonal Needs Questionnaire. Unstandardized regression coefficients are reported. Bootstrap sample size = 10,000. * $p < .05$, # $p < .01$, ^ $p < .001$.

Table 8

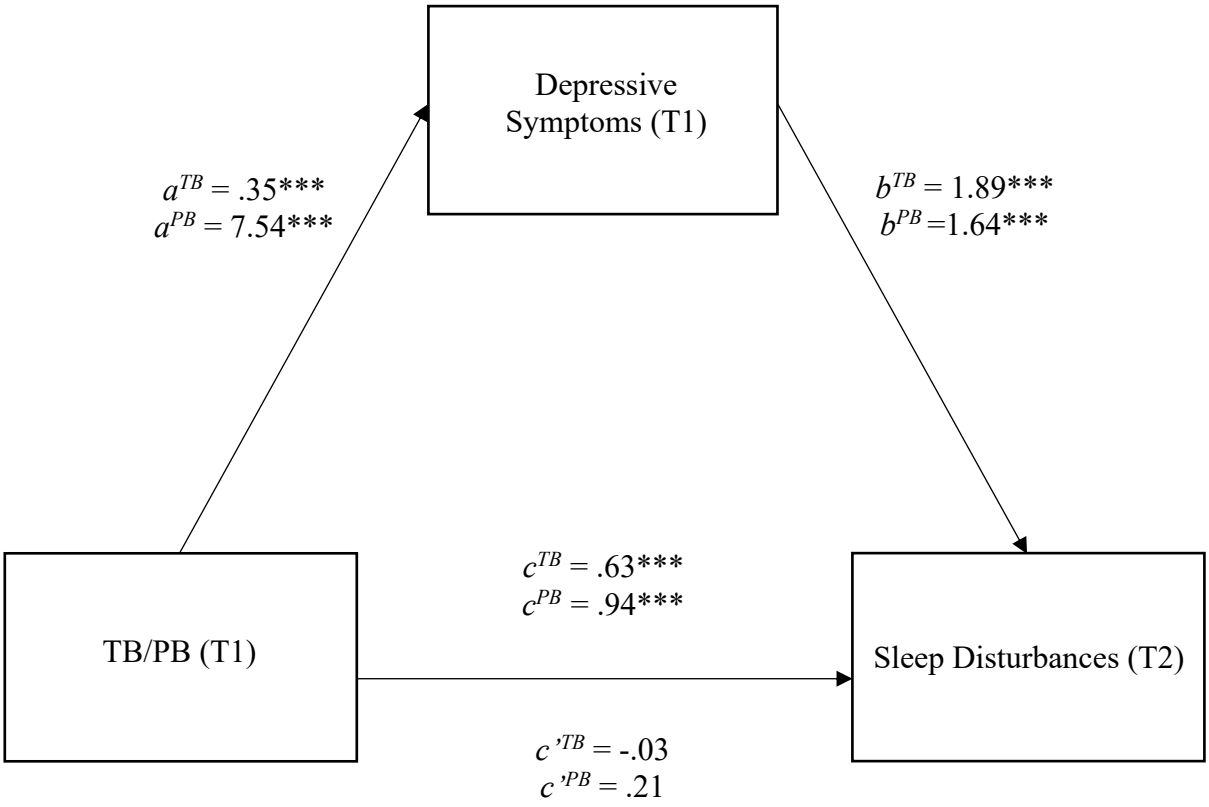
*Conditional Indirect Effects of Gratitude: Thwarted Belongingness and Perceived Burdensomeness Models*

| Path | b (*SE*) | *t* | Bias corrected and accelerated (BCa) 95% Confidence Interval |
|---|---|---|---|
| *Thwarted Belongingness* | | | |
| *b* (Depressive Symptoms x Gratitude → Sleep Disturbances) | .06 (.04) | 1.52 | [-.02, .13] |
| *c′* (Thwarted Belongingness x Gratitude → Sleep Disturbances) | -.01 (.02) | -.43 | [-.05, -.03] |
| *Perceived Burdensomeness* | | | |
| *b* (Depressive Symptoms x Gratitude → Sleep Disturbances) | .13 (.04) | 3.32* | [.05, .21] |
| *c′* (Perceived Burdensomeness x Gratitude → Sleep Disturbances) | -.07 (.03) | -2.66* | [-.12, -.02] |

*Note*: Sleep Disturbances = Medical Outcomes Study Sleep Scale - Sleep Problems Index 2; Depressive Symptoms = Patient Health Questionnaire - 9; Thwarted Belongingness = Thwarted Belongingness - Interpersonal Needs Questionnaire; Perceived Burdensomeness = Perceived Burdensomeness - Interpersonal Needs Questionnaire; Gratitude = Gratitude Questionnaire - 6. Regression coefficients reflect mean-centered predictors. Unstandardized regression coefficients are reported. Bootstrap sample size = 10,000. * $p < .01$.

Figure 1

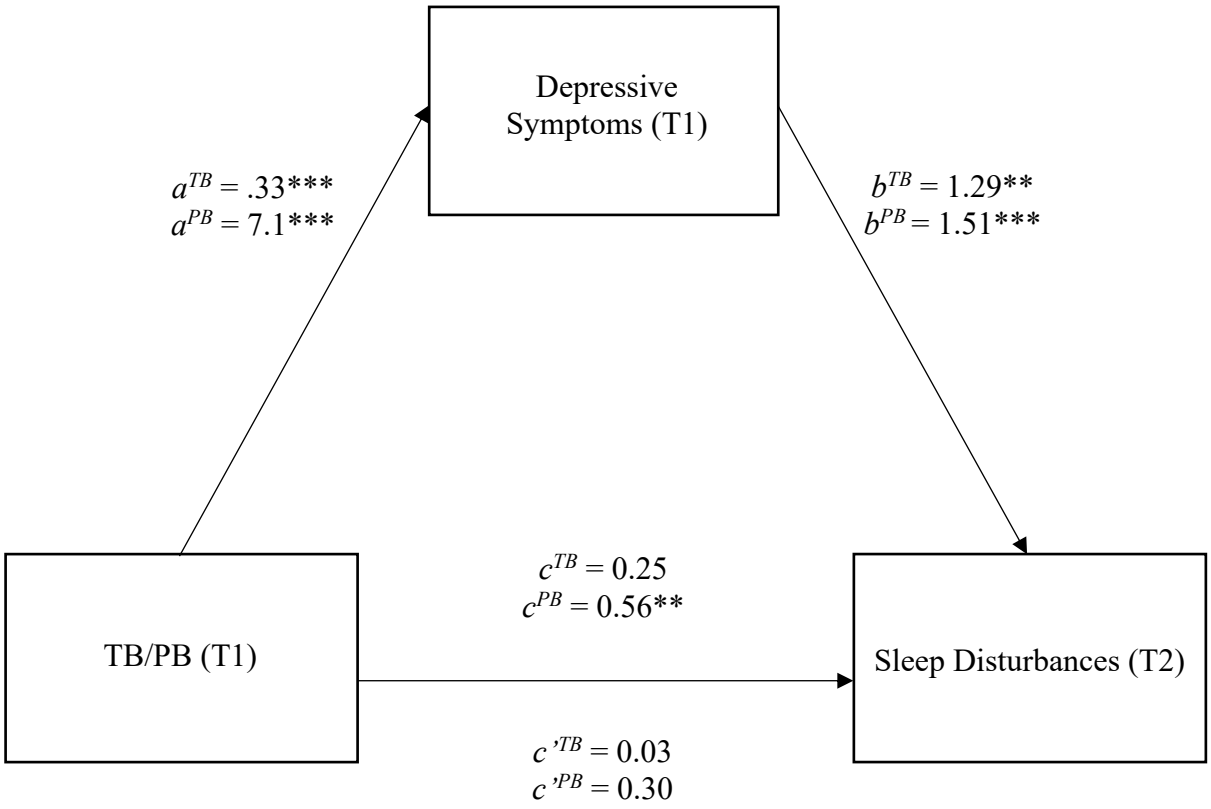
*Thwarted Interpersonal Needs and Sleep Disturbances: Simple Indirect Effect of Depressive Symptoms, without Covariates*




*Note:* $c^{TB}$ / $c^{PB}$ = total effect (thwarted belongingness / perceived burdensomeness related to sleep disturbances), $ab^{TB}$ / $ab^{PB}$ = indirect effect (thwarted belongingness / perceived burdensomeness related to sleep disturbances through depressive symptoms), $c'^{TB}$ / $c'^{PB}$ = direct effect (thwarted belongingness / perceived burdensomeness related to sleep disturbances accounting for depressive symptoms). ***$p < .001$.

Figure 2

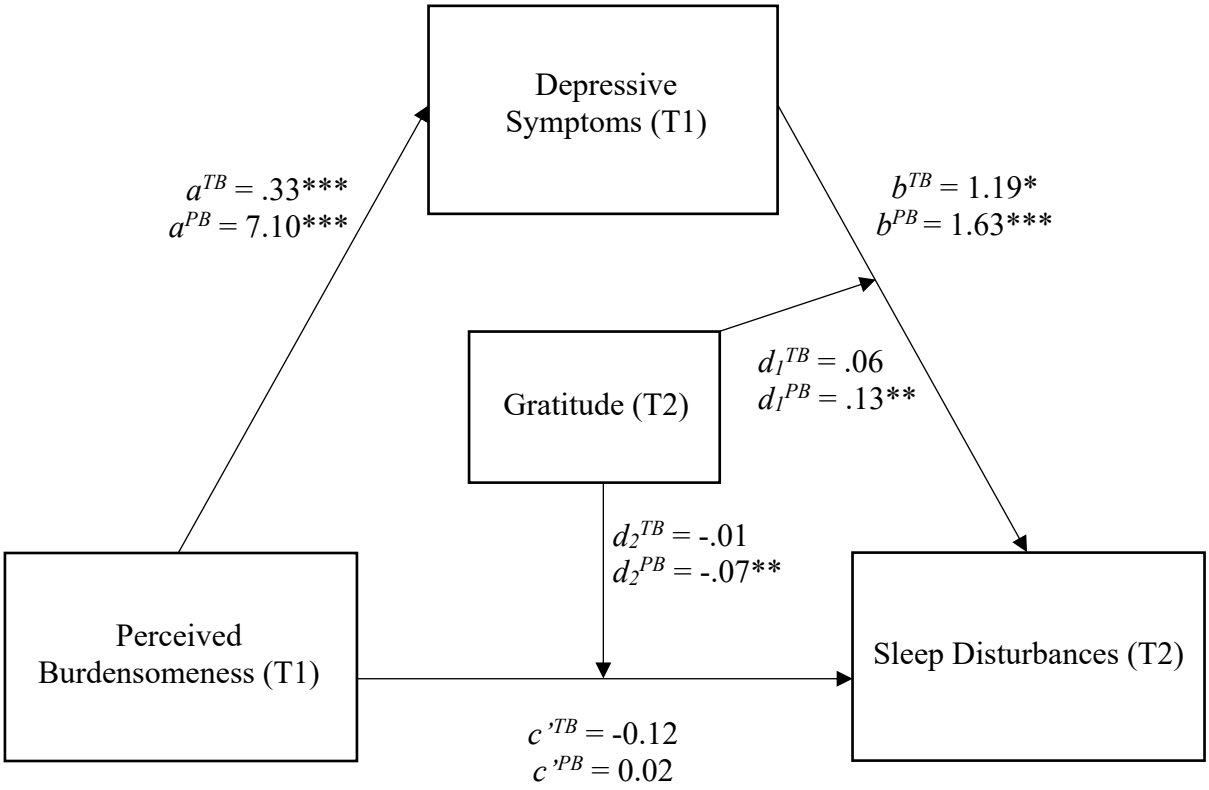
*Thwarted Interpersonal Needs and Sleep Disturbances: Simple Indirect Effect of Depressive Symptoms, with Covariates*




*Note:* $c^{TB}$ / $c^{PB}$ = total effect (thwarted belongingness / perceived burdensomeness related to sleep disturbances), $ab^{TB}$ / $ab^{PB}$ = indirect effect (thwarted belongingness / perceived burdensomeness related to sleep disturbances through depressive symptoms), $c'^{TB}$ / $c'^{PB}$ = direct effect (thwarted belongingness / perceived burdensomeness related to sleep disturbances accounting for depressive symptoms). **$p$ < .01, ***$p$ < .001.

Figure 3

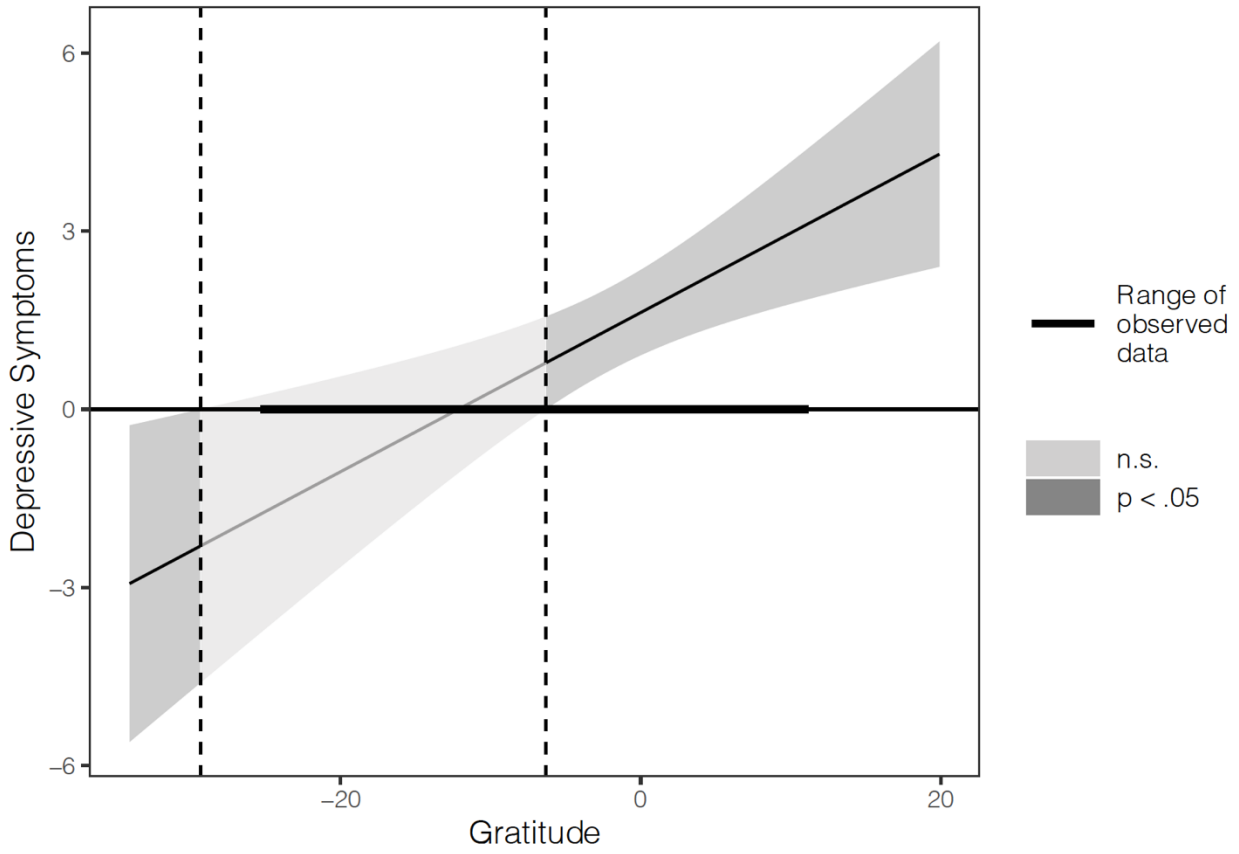
*Perceived Burdensomeness and Sleep Disturbances: Conditional Indirect Effects of Depressive Symptoms and Gratitude*




*Note*: $a$ = path coefficient (perceived burdensomeness related to depressive symptoms), $b$ = path coefficient (depressive symptoms related to sleep disturbances), $d_1$ = conditional effect (gratitude on the relation between depressive symptoms and sleep disturbances), $d_2$ = conditional effect (gratitude on the relation between perceived burdensomeness and sleep disturbances), $c'$ = direct effect (perceived burdensomeness related to sleep disturbances accounting for depressive symptoms). *$p$ < .05, **$p$ < .01, ***$p$ < .001.

Figure 4

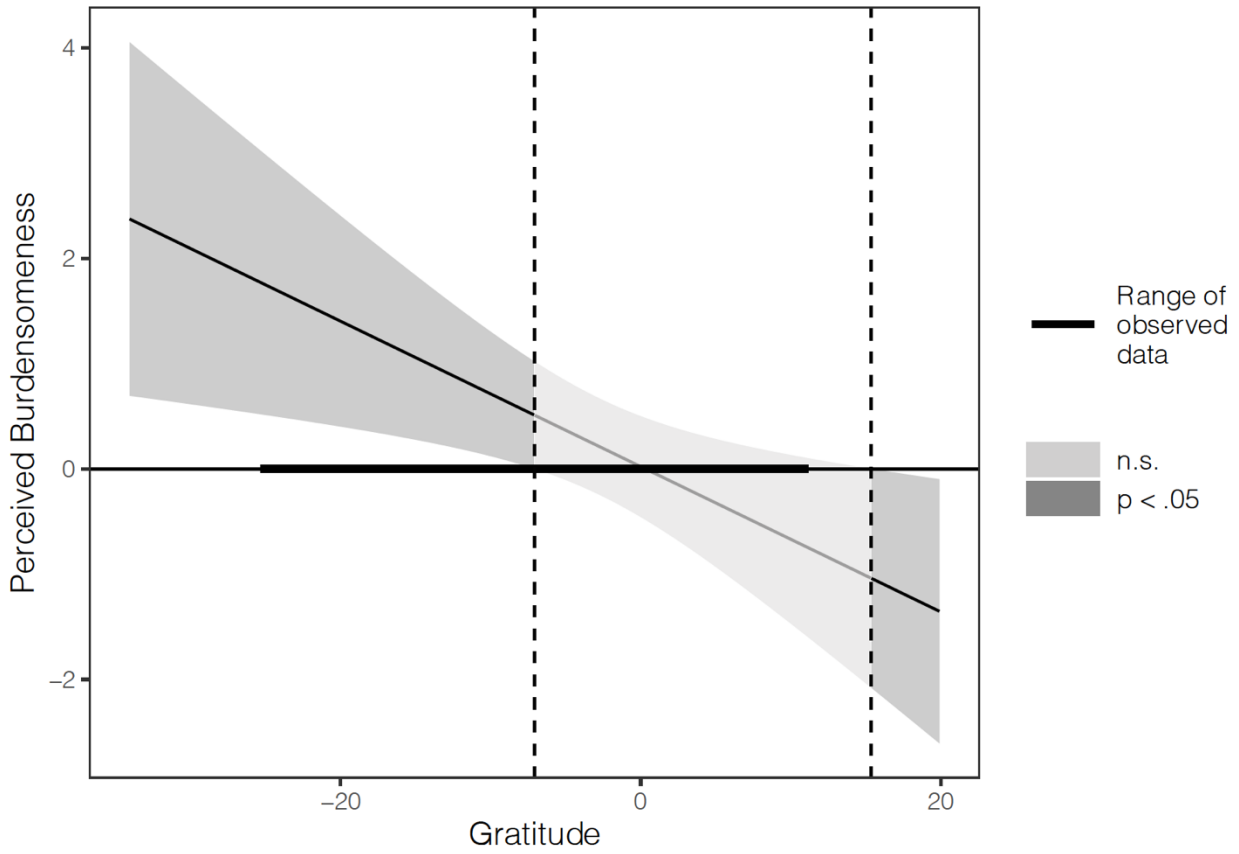
*Conditional Effect of Depressive Symptoms on Sleep Disturbances as a Function of Gratitude*




*Note:* Sleep Disturbances = Medical Outcomes Study Sleep Scale - Sleep Problems Index 2; Depressive Symptoms = Patient Health Questionnaire - 9; Gratitude = Gratitude Questionnaire – 6. The effect of depressive symptoms on sleep disturbances at all values of gratitude is pictured. The darkened line indicates the range of gratitude values endorsed in the sample. The darker shaded region denotes gratitude values at which the slope of gratitude*depressive symptoms is significant.

Figure 5

*Conditional Effect of Perceived Burdensomeness on Sleep Disturbances as a Function of Gratitude*




*Note:* Sleep Disturbances = Medical Outcomes Study Sleep Scale - Sleep Problems Index 2; Perceived Burdensomeness = Perceived Burdensomeness - Interpersonal Needs Questionnaire; Gratitude = Gratitude Questionnaire – 6. The effect of perceived burdensomeness on depressive symptoms at all values of gratitude is pictured. The darkened line indicates the range of gratitude values endorsed in the sample. The darker shaded region denotes gratitude values at which the slope of gratitude*perceived burdensomeness is significant.

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## EDUCATION

M.A./Ph.D., Clinical Psychology (*in progress; M.A. expected Aug. 2020*) 2018- present
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B.A., Individualized Major, Psychology and Video Production 2004- 2007
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## RESEARCH AND WORK EXPERIENCE

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***Graduate Research Assistant*** Aug. 2018- present
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***Health Educator II*** March 2015- July 2018
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Epidemiology Program
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***Human Services Specialist II/Case Manager*** April 2013- Feb. 2015
Child and Adult Protective Services
South Carolina Department of Social Services, Georgetown, SC

***Health Program Assistant I/Surveillance Officer*** May 2009- Aug. 2012
Active Bacterial Core Surveillance Project
Epidemiology & Emerging Infections Program
Connecticut Department of Public Health, Hartford, CT

***Health Services Worker*** June 2008- May 2009
Zoonotic and Vector-borne Diseases & Influenza
Epidemiology & Emerging Infections Program
Connecticut Department of Public Health, Hartford, CT

## GRADUATE POSTER AND ORAL PRESENTATIONS

- **Altier, H.**, Toussaint, L., Kohls, N., Hanshans, C., Sirois, F., Untner, J., … & Hirsch, J. (2020, February). *Benefits of gratitude and self-compassion for sleep in chronic pain: Mediating effects of stress, anxiety, and depression.* Poster presentation at the 23rd Annual American Association of Behavioral and Social Sciences Conference, Las Vegas, NV.

- **Altier, H.**, Meek, R., Toussaint, L., Kohls, N., Hanshans, C., Sirois, F., … & Hirsch, J. (2019, November). *Effects of self-compassion and self-forgiveness on functional disability in chronic pain: Exploring stress, depression, and sleep as mediators.* Oral

presentation at the 66th Annual Convention of the Tennessee Psychological Association, Nashville, TN.

- Byerley, S., **Altier, H.,** & Hirsch, J. (2019, November). *Psychological distress and treatment adherence in fibromyalgia: Do hope and illness impact explain the association?* Oral presentation at the 66th Annual Convention of the Tennessee Psychological Association, Nashville, TN.

- **Altier, H.**, Treaster, M., & Hirsch, J. (2019, May). *Interpersonal distress and health-related quality of life in primary care: Do hope, optimism, and depression explain the association?* Poster presentation at the 31st Annual Convention of the Association for Psychological Science, Washington, DC.

- **Altier, H.**, Treaster, M., & Hirsch, J. (2019, April). *Positive future time perspective, ptsd and insomnia in veterans: Do anger and shame keep you awake?* Poster presentation at the 2019 Appalachian Student Research Forum, Johnson City, TN.

- **Altier, H.**, Treaster, M., & Hirsch, J. (2018, November). *Trust in healthcare personnel and psychological distress in cancer: Hope as a mediator.* Oral presentation at the 65th Annual Convention of the Tennessee Psychological Association, Nashville, TN.

## GRADUATE HONORS AND AWARDS

- ETSU Department of Psychology Excellence in Research Award — Spring 2020
- First Place, Graduate Oral Competition, Annual Convention of the Tennessee Psychological Association, Nashville, TN — Fall 2019

## GRADUATE GRANTS AND SCHOLARSHIPS

- School of Graduate Studies Student Research Grant — Spring 2020
- Professional Development Travel Scholarship — Spring 2020
- Graduate and Professional Student Association Travel Grant — Spring 2020
- Psychology Department Travel Grant — Fall 2019
- Graduate and Professional Student Association Travel Grant — Spring 2019
- Psychology Department Travel Grant — Spring 2019
- Psychology Department Travel Grant — Fall 2018
- ETSU Graduate Assistantship with full tuition waiver and stipend — 2018-present
- George L. Carter Scholarship (declined) — Fall 2018

## MENTORED MANUSCRIPT REVIEWS

- International Journal of Mental Health and Addiction — March 2019, October 2018