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LOMA LINDA UNIVERSITY
School of Behavioral Health
in conjunction with the
Faculty of Graduate Studies

Sleep, Body Dissatisfaction, and Eating Among Adolescents

by

Megan White

A Project submitted in partial satisfaction of
the requirements for the degree
Doctor of Psychology

September 2023

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Each person whose signature appears below certifies that this doctoral project in his/her opinion is adequate, in scope and quality, as a doctoral project for the degree Doctor of Psychology.

_____, Chairperson
Tori Van Dyk, Assistant Professor of Psychology

Janet Sonne, Professor of Psychology

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ABBREVIATIONS

ICSD-3	The International Classification of Sleep Disorders
AN	Anorexia Nervosa
BN	Bulimia Nervosa
BED	Binge Eating Disorder
PSG	Polysomnography
EES-C	Emotional Eating Scale for Children and Adolescents
BDS	Body Dissatisfaction Scale
ASHS	Adolescent Sleep Hygiene Scale
PISI	Pediatric Insomnia Severity Index
EES	Emotional Eating Scores
EES AAF	Emotional Eating for Anxiety/Anger/Frustration
EES DEP	Emotional Eating for Depression
EES US	Emotional Eating for Feeling Unsettled
INS	Insomnia Severity
EDE_Q	Eating Disorder Examination - Questionnaire

ABSTRACT OF THE DOCTORAL PROJECT

Sleep, Body Dissatisfaction, and Eating Among Adolescents

by

Megan White

Doctor of Psychology, Department of Psychology
Loma Linda University, September 2023
Dr. Tori Van Dyk, Chairperson

Sleep difficulties in adolescence have been linked to greater impulsivity, negative affect, propensity to interpret neutral stimuli as negative, and higher rates of anxiety and depressive symptomatology (Van Dyk, 2016). However, minimal research has looked at the relationship among sleep difficulties, emotional eating, and body dissatisfaction within this population. Therefore, the aim of the current study was to explore the relationship among sleep difficulties, emotional eating, and body dissatisfaction among adolescents aged 12-18 years. Specifically, the current study stands to 1) confirm the relationship between emotional eating and body dissatisfaction; 2) test if sleep difficulties are related to emotional eating; 3) test if sleep difficulties are related to body dissatisfaction; 4) test if body dissatisfaction moderates the relationship between emotional eating and sleep difficulties; and 5) test if body dissatisfaction mediates the relationship between emotional eating and sleep difficulties. Bivariate analyses revealed shorter sleep duration was correlated with body dissatisfaction in the direction of desiring thinness ($r = -0.323, p < .05$). Multiple linear regressions showed a moderation effect of body dissatisfaction on the relationship between sleep duration and emotional eating, such that for adolescents desiring thinness, shorter sleep was associated with increased emotional eating in response to feeling angry, anxious, and/or depressed, $R^2\Delta = .138, F(1,$

52) = 8.613, $p < .05$. Thus, results from the current study highlight the use of sleep optimization treatments as possible intervention strategies for youth with high levels of body dissatisfaction and emotional eating tendencies.

CHAPTER ONE

INTRODUCTION

In the last decade, sleep difficulties have become an increasing problem for teens (Chaput, Dutil, & Sampasa-Kanyinga, 2018). For the purpose of the current study, sleep difficulties will be defined as difficulty falling asleep, staying asleep, or insufficient sleep duration. Such sleep difficulties are associated with negative outcomes such as worsened mood (Palmer & Alfano, 2017), poor emotion regulation (Owens & Weiss, 2017), and compensatory changes in eating behavior (Soares et al., 2011). However, while the literature on the relationship between sleep difficulties and internalizing emotions (i.e., depression and anxiety) is substantial, minimal research has been conducted on the relationship between sleep difficulties and emotion-driven eating. Furthermore, little is known about the association between sleep difficulties and a negatively skewed view of self (i.e., body dissatisfaction). Considering the onset of disordered eating has the highest prevalence in teens, particularly between the ages of 14 and 19 years (Stice, Marti, & Rohde, 2013), understanding the relationships among sleep difficulties, emotional eating, and body dissatisfaction is particularly crucial for informing adolescent physical and mental health care.

Sleep Difficulties in Adolescents

International polls have found that 80% of adolescents in the United States regularly sleep less than the recommended eight hours per night (Carskadon, Mindell, & Drake, 2006), sleeping about three fewer hours per night during the school week than

during the weekend (Swanson et al., 2011). Adolescents are particularly at risk for sleep difficulties largely in part to increased late-night technology use, caffeine intake, earlier school start times, autonomy over bedtimes, and homeostatic circadian phase delay (Carskadon, 2004).

Sociocultural Factors Contributing to Adolescent Sleep Difficulties

In a society where being tired has become a status symbol, and the idea that less time asleep leads to greater productivity reigns supreme, individuals of all ages have fallen prey to the pressure to keep themselves awake (Knutson et al., 2017). This notion may be heightened among adolescent students, as social, academic, and extracurricular pressures hit their pinnacle during middle- and high-school years. Compounded with modern technologies associated with blue-light exposure and excessive stimulation, increased caffeine consumption, earlier school start times, decreased parental control over sleeping times, and the overall lack of priority that sleep is given from both immediate family members as well as society, adolescents' lack of sleep is becoming a health behavior crisis (Chaput & Dutil, 2016).

Biological Factors Contributing to Adolescent Sleep Difficulties

Sociocultural changes in adolescence contributing to sleep difficulties are compounded by homeostatic changes in adolescents' sleep patterns. Homeostatic changes include a circadian phase delay, and consequently, a biological propensity toward later sleep and wake times (Crowley, Acebo, & Carskadon, 2007). Specifically, as an adolescent enters puberty, there is a natural forward jump in their biological clock of

approximately two hours, leading not only to later bedtimes, but also, later waking times (Carskadon, Vieira, & Acebo, 1993). This biological shift is ill-matched with earlier school start times which aim to incorporate more academic and extracurricular courses into the standard school day while still accommodating parent work schedules and district-wide transportation systems (Wolfson & Carskadon, 2005). Consequently, some high school-aged adolescents are having to wake up as early as 5:00 AM in order to get ready and commute to school (Mindell & Owens, 2015). With biologically-inclined bedtimes hovering around 11:00 PM as a result of adolescent circadian phase delays, many teens are currently getting about 5-6 hours asleep (Si, 2006). Falling 2-3 hours behind the recommended 8 hours of sleep for teens aged 13-19 years, the combination of poor sleep and the transition into adolescence has quickly become a worldwide public health concern (Becker, Langberg, Eadeh, Isaacson, & Bourchtein, 2019).

Organic sleep conditions may also compound the detrimental effects of teens' naturally occurring circadian phase delay and behavioral sleep difficulties (Millman, 2005). The International Classification of Sleep Disorders (ICSD-3) lists (1) insomnia disorder, (2) sleep-related breathing disorders, (3) disorders of hypersomnolence, (4) circadian rhythm sleep-wake disorders, (5) non-REM-related parasomnias and REM-related parasomnias, and (6) sleep-related movement disorders (ICSD, 2014) as the most common sleep disorders among adolescents. Adolescents' circadian phase delay and behavioral sleep difficulties can be comorbid with organic sleep conditions, such as parasomnias, sleep-related movement disorders, sleep-related breathing disorders, and sleep-related medical and neurological disorders at rates of 18.1%, 5.3%, 19.1%, and 0.5%, respectively.

Association of Adolescent Sleep Difficulties and Psychological and Behavioral Functioning

Short sleep in adolescence is further shown to exacerbate emotional and behavioral functioning. The frontal lobe region of the adolescent brain does not fully mature until an individual reaches his or her early- to mid-twenties (Johnson, Blum, & Giedd, 2009). Sleep deprivation is therefore shown to disrupt the prefrontal lobe maturation, as well as cortical functioning circuit in the adolescent brain, thus impairing adolescents' executive functioning and inhibitory control (O'Brien & Mindell, 2005). With decreased performance in this region, sleep deprived adolescents are at an increased likelihood for experiencing decreased ability to adaptively regulate emotions and behavioral impulses, leading to greater risk-seeking (O'Brien & Mindell, 2005). Such risk-seeking behavior is demonstrated through increased suicidal ideation and attempts, higher engagement in health risk behaviors such as alcohol and substance use, and increased rates of car crashes, occupational injuries, and sports-related injuries all of which are likely compounded by inattentiveness and reductions in executive control (Owens & Weiss, 2017).

Short sleep is also associated with an increased risk of developing and/or exacerbating symptoms anxiety and depression among adolescents (Johnson, Roth, & Breslau, 2006). Short sleep is also associated with higher sensitivity to the negative affect of others, higher likelihood of experiencing of negative emotions, reduced expression and feeling of positive emotions, and more frequent shifts in the interpretation of neutral stimuli into negative (Palmer & Alfano, 2017). Such emotion dysregulation in youth resulting from sleep difficulties may further contribute to increased suicidal ideation and

attempts, decreased self-esteem, and increased likelihood to engage in risky behavior (Winsler, Deutsch, Vorona, Payne, & Szklo-Coxe, 2015).

This relationship between sleep difficulties and psychopathology is complex and bidirectional, with shortened sleep duration, mood, and behavior apparently affecting each other (Van Dyk, Thompson, & Nelson, 2016). Adolescent mental health diagnoses such as anxiety, depression, ADHD, and ASD are commonly linked to exacerbations in sleep disturbances, such as increased sleep latency, nocturnal awakenings, nightmares, snoring, restless sleep, excessive daytime sleepiness, bedtime struggles, and fear of the dark (Baddam, Canapari, Van Noordt, & Crowley, 2018). Further, research has found youth with anxiety disorders tend to go to bed even later than youth without anxiety disorders (Storch et al., 2008), and that dysregulated sleep is associated with more pervasive and severe symptomology in depressed youth (Liu, Liu, Owens, & Kaplan, 2005).

Not only have correlational studies demonstrated this bidirectional relationship between disrupted sleep, and emotional and behavioral functioning, but also, experimental studies are beginning to show poor sleep as *causally* related to mood and behavior in teens. For example, one experimental study demonstrated habitual sleep insufficiency was related to reductions in adolescents' self-ratings of positive affect, changes in vocal inflections in a manner suggesting heightened negative affect, and an increased propensity towards negative moods in response to challenges and stress (Dagys et al., 2012). To probe the relationship between less sleep and negative affect and to test if the negative alterations in mood within sleep-deprived adolescents could be remedied through extended sleep, an experimental study in 2017 found that lengthening sleep on

school nights improved adolescents' feelings of sleepiness, anger, loss of vigor, confusion, and fatigue (Van Dyk et al., 2017). In viewing these improvements, it is possible that extended sleep could stand as a remedy for pronounced anger, risk-seeking behavior, and depressed affect within adolescent populations.

Association of Adolescent Sleep Difficulties and General Eating Behavior

Beyond an increase in negative affect and risk-seeking behavior in response to decreased sleep (Wang et al., 2018), sleep-deprived adolescents may also be more prone to utilize coping behaviors that are chosen based on hedonistic needs (i.e., pleasure, attention, indulge) rather than rational, homeostatic needs. Such hedonistic coping is predominantly seen in food intake changes (Chaput & St-Onge, 2014). Adolescents reporting less hours asleep simultaneously report higher food-related disinhibition traits that may exacerbate food-seeking behavior, especially for palatable (i.e., high sugar, high salt, high fat) foods (Blumfield, Bei, Zimberg, & Cain, 2018). In adolescents, functional neuroimaging studies of this pattern of sleep-deprived food choice shows that even the image of palatable foods trigger a greater response in reward-relevant brain regions after a period of sleep restriction compared to a period of full rest (Simon, Field, Miller, DiFrancesco, & Beebe, 2015).

Furthermore, metabolic processes may also be disturbed in adolescents with poor sleep (Duraccio, Krietsch, Chardon, Van Dyk, & Beebe, 2019). Studies have found a negative relationship between the amount of sleep an individual gets and their levels of the stress hormone cortisol, as well as a positive association between cortisol levels and calories consumed (Epel, Lapidus, McEwen, & Brownell, 2001). Hormones associated

with appetite regulation include ghrelin (i.e., an appetite-stimulating hormone) and leptin (i.e., an appetite-suppressing hormone), with examinations of limited sleep showing increased levels of ghrelin (Al-Disi et al., 2010).

A 2013 pilot study observing mild sleep deprivation (i.e., 6.5 hours of sleep per night) and caloric intake among teens showed that restricted sleep led teens to double their intake only of sweet foods (Beebe et al., 2013). While preliminary data, it is suggested that even mild sleep restriction may alter teens' perceptions of sweets, rapidly igniting neural reward centers (Blumfield et al., 2018). Higher sensitivity to the reward aspect of sweets is likely compounded by adolescents' increased independence with regard to food choice, newfound accessibility to highly palatable foods at middle and high school snack lines and social events, and increased stress levels. Combined with developmentally expected increases in rates of impulsivity, adolescents are susceptible to disinhibited, high-calorie food consumption as a result of intrinsic reward-seeking urges (Dweck, Jenkins, & Nolan, 2014).

Association of Adolescent Sleep Difficulties and Emotional Eating

Emotional eating may also be present in adolescents with sleep difficulties (Duraccio et al., 2019). Emotional eating refers to the tendency to eat in response to emotional triggers as opposed to a true physiological need for food (Arnou, Kenardy, & Agras, 1995). While there are numerous triggers leading to emotional eating, it is assumed that before emotional eating takes place, individuals experience some form of negative emotionality that they feel unable to control. They are then motivated to engage in a behavior that they can control: eating (Evers, Marijn Stok, & de Ridder, 2010).

Emotional eating appears to occur in response to some psychological conditions like depression, anxiety, and loneliness – all of which create negative emotionality in varying degrees (Dweck et al., 2014). As the need to regulate negative emotionality heightens, the desire to eat has the potential to turn maladaptive, leading to emotion-triggered overeating.

Various theories have been presented explaining the psychological mechanism behind emotional eating as a form of emotion regulation. However, the exact mechanism by which emotion dysregulation affects eating behavior remains an unresolved question in the field of emotional eating research (Leith & Baumeister, 1996). Thus far, scholars have proposed that the act of bingeing (i.e., consuming a large amount of food within a distinct amount of time) is attributed to attempts to escape from negative self-awareness (Heatherton & Baumeister, 1991). During a binge, attention is focused on the immediate act of eating and away from aversive emotions. However, narrowing focus so intensely on food can sometimes lead to disinhibition and the risk of engaging in repeated binge episodes (i.e., feelings of loss of control over food intake). It has also been proposed that overeating in finite moments has been linked to attempts to increase the positive emotions inherently related to eating (i.e., taste, odor; Lehman & Rodin, 1989) or the joy in eating foods that are deemed taboo due to lack of nutritional value yet intensely pleasurable taste (Fairburn & Cooper, 1982). Other theorists have postulated that overeating may be an attempt to attribute feelings of stress to eating rather than the original external stressor inflicting discomfort on the individual (Herman & Polivy, 1988).

Recent studies have built upon these theories, hypothesizing that it is perhaps the way in which negative emotions are regulated that directly affects food intake rather than the presence of negative emotions in general. Specifically, emotion regulation researchers have been investigating whether or not maladaptive emotion regulation strategies (i.e., emotion suppression) lead to increased food intake relative to adaptive emotion regulation strategies (i.e., emotion reappraisal, (Evers et al., 2010). This hypothesis is based on cognitive-affective processing systems theory that suggests that an individual is capable of entering into a cool (i.e., thinking, planning, focused on controlling the self, and delaying gratification) cognitive state and a hot (i.e., impulsive and focused on instant gratification) emotional state (Mischel & Ayduk, 2004). Cognitive reappraisal has been linked to a cognitive cooling strategy while emotional suppression has been linked to heating up (Mischel & Ayduk, 2004).

Considering the aforementioned bidirectional relationship between sleep difficulties and emotional distress (Van Dyk et al., 2016), it is possible that individuals with impairments in their sleep quality may also experience high levels of dysregulated and impulsive eating as a means of emotion-regulation (Saleh-Ghadimi, Dehghan, Abbasalizad Farhangi, Asghari-Jafarabadi, & Jafari-Vayghan, 2019). Furthermore, based on prior research (Harrison & Horne, 2000), it is possible that people who are sleep deprived are more likely to already be in a “hot” emotional state (i.e., impulsive) and thus less likely to exert control over their eating habits than people in a “cool” cognitive state marked by executive and emotional control. This relationship is seen in children as young as 5 years old. An experimental study of children aged 5-12 years revealed that decreased sleep duration was associated with higher levels of external eating (i.e., eating in response

to palatable appearance of food), and decreased sleep continuity was associated with increased emotional eating, or food intake in response to emotional distress (Burt, Dube, Thibault, & Gruber, 2014).

While the connection between sleep difficulties and emotional eating has not been specifically confirmed in adolescents aged 12-18 years, the literature suggests that eating highly palatable foods in response to emotional distress is highly probable in this population (Simon et al., 2015). As previously mentioned, emotional eating often occurs in response to psychological conditions like depression, anxiety, and/or loneliness (Dweck et al., 2014) – all of which are frequently observed in adolescence (Thapar, Collishaw, Pine, & Thapar, 2012). Therefore, adolescents with sleep difficulties may also experience emotional stress, which likely increases an individual's risk of emotional eating (Saleh-Ghadimi et al., 2019).

Association of Adolescent Sleep Difficulties and Body Dissatisfaction

Furthermore, for both adolescent males and adolescent females, emotional eating may be linked to the internalization of culturally prescribed body images, and consequently, higher rates of body dissatisfaction. Previous studies have found numerous cultural, social, physical, and psychological changes uniquely linked to adolescence that negatively affect body image for both males and females between the ages of 12 and 18 years (Voelker, Reel, & Greenleaf, 2015). Specifically, the changes that occur during puberty are among the most impactful in human development, encompassing rapid changes in weight, body shape, and sex characteristics. Unfortunately, these changes coincide with heightened media exposure and subsequent comparisons to cultural ideals

of beauty in adolescence. For many young boys, lean and muscular bodies tend to be the gold standard, while for many of young girls, ultra-thin bodies tend to be idolized (Smolak & Murnen, 2008). Additionally, for young girls, as female athletes increase their presence in social media, experimental studies have found that viewing an image of a woman who is both thin and fit leads to more negative affect amongst girls than images of women who are fit yet a typical weight (Homan, McHugh, Wells, Watson, & King, 2012). Therefore, changes associated with puberty (i.e., increases in adiposity, widening of the hips in girls, lanky limb development in boys) may be perceived negatively, and even more, as incongruent with the prototypical cultural ideals, leading to higher levels of body dissatisfaction.

Further, preliminary examinations have also shown that an individual's sleep history may play a fundamental role in the perception and judgments of his or her attractiveness and health – or the level of their body satisfaction (Axelsson et al., 2010). In females aged 18-22 years, attempts to decrease body weight, fears of becoming fat, binge-eating episodes, and higher levels of body image dissatisfaction have been shown to be significantly associated with sleep maintenance difficulties and non-restorative sleep (Soares et al., 2011). Adult-focused studies have found that insomnia symptoms are significantly associated with greater dissatisfaction with cutaneous body image – or the mental perception of the appearance of one's own skin, hair, and nails (Akram, 2017). Dissatisfaction among adults has been found to be particularly heightened when viewing aspects of their facial appearance and skin-age (i.e., complexion) after poor sleep, as evidenced by negative thought cycles. Beyond self-perception, the facial cues of sleep deprived people are enough evidence by which their peers and colleagues are able to

label them as more tired, less healthy, and ultimately less attractive (Axelsson et al., 2010). Considering the the affect of appearance on social judgments (i.e. perceived attractiveness, trustworthiness), the physical manifestation of poor sleep on an individual's face may have psychosocial implications (i.e., isolation, rejection), and ultimately, more emotional distress (Akram, 2017).

Due to greater sleep deprivation (Becker et al., 2019), ensuing impulsivity (O'Brien & Mindell, 2005), high sensitivity to negative stimuli (McKnight-Eily et al., 2011), and increased risk for body dissatisfaction due to puberty-related body changes and social pressure, teens in the present day may be at the highest risk for emotional eating as a means of emotion-regulation (Paxton, Neumark-Sztainer, Hannan, & Eisenberg, 2006). Further, they additionally may be at a greater risk of developing a clinical eating disorder as these maladaptive patterns fester without professional attention (Wendell, Masuda, & Le, 2012).

CHAPTER TWO

PURPOSE OF THE PROPOSED STUDY

The insufficient amount of sleep that teenagers are getting is rapidly becoming a nationwide health concern. While extensive research examining the contributory and resulting factors of this epidemic has already been conducted, limited research exists on how the effects of sleep difficulties in adolescence may be perpetuating some specific forms of psychopathology. Bidirectional relationships between clinical anxiety and sleep difficulties, as well as clinical depression and sleep difficulties, have been shown in both adult and adolescent populations (McKnight-Eily et al., 2011). With decreased sleep already showing connections to higher rates of impulsivity (O'Brien & Mindell, 2005), negative affect (Clarke & Harvey, 2012), and the quest for highly palatable foods (Simon et al., 2015), it is important to consider how additional symptoms such as body dissatisfaction and emotional eating are related to sleep difficulties, and even more, how they may be contributing to the etiology of clinical eating disorders.

Therefore, with decreased sleep becoming a ubiquitous aspect of adolescence, and the average age of onset for both anorexia nervosa (AN) and bulimia nervosa (BN) hovering between the ages of 14 and 19 years of age, it is vital that research is conducted with regard to sleep difficulties as a possible precipitating factor in the onset of disordered eating in an effort to inform prevention and treatment (Patriciello et al., 2017). The present study will attempt to fill the gaps in the literature with regard to the relationships among sleep difficulties, emotional eating, and body dissatisfaction in adolescents, with the specific aims of exploring associations between sleep difficulties

and emotional eating, sleep difficulties and body dissatisfaction, and the ways in which these variables interact. Ultimately, the current study seeks to inform the clinical picture behind the onset of disordered eating symptomology and/or a negative sense of self among teens with the intention of impacting clinical treatment.

Significance and Innovation for the Prevention of Clinical Eating Disorders

Meta analyses spanning the course of 50 years of research have confirmed that Anorexia Nervosa (AN) has the highest mortality rate of any mental disorder due to its associated weight loss and starvation effects on the body and brain (Arcelus, Mitchell, Wales, & Nielsen, 2011). Bulimia Nervosa (BN) and Binge Eating Disorder (BED) mortality rates fall close behind. Furthermore, the age of onset for the most severe eating disorder pathology falls between the ages of 14-19 years of age, underlying the importance of studying precipitating factors within adolescents (Patriciello et al., 2017). Preliminary research showing that adolescents with AN exhibit more nighttime awakenings and lower sleep efficiency relative to age-matched controls (Dahl & Harvey, 2007), and adolescents with BN experience higher difficulty falling asleep (Wells & Cruess, 2006). Additionally, prolonged dietary restriction has shown to be positively correlated with higher levels sleep discontinuity (Soares et al., 2011). Therefore, examining the relationship of sleep difficulties and symptoms associated with eating disorder development within adolescent populations is of critical importance to inform prevention and treatment efforts.

The need to examine these relationships is further supported by the literature showing higher levels of impulsivity, compensatory eating fluctuations, anxiety, and

depression to all also covary systematically with decreased sleep in adolescent populations (Colrain & Baker, 2011). Though negative self-image in response to decreased sleep has only been seen in adults up until now, increasing rates of insomnia and resulting negative affect, exposure to social media accounts of unattainable cultural expectations for physical beauty, and hormonal shifts are likely leading to negative self-image development in teens as well (Thompson et al., 2017). Should the current study find evidence in support of the relationship between disrupted sleep and negative self-image in adolescents, as well as evidence in support of the relationship between disrupted sleep and emotional eating in adolescents, eating disorder prevention and treatment for this population can be reconstructed to specifically include improvements in sleep hygiene and duration. Currently, there is limited literature on sleep and symptoms directly related to eating disorder development in adolescents, and therefore, the current examination will offer a novel perspective to the field.

Specific Aims

The present study has been designed to examine (1) the relationship between sleep difficulties and the severity of emotional eating, (2) the relationship between sleep difficulties and body dissatisfaction, (3) the relationship between body dissatisfaction and emotional eating, and (4) the relationship between sleep difficulties and the frequency of emotional eating in the presence of body dissatisfaction in male and female adolescents. Not only will an investigation of the relationship between disrupted sleep, emotional eating, and negative self-image inform health-care management and recommendations for our nation's youth, but also, an investigation of the relationship between disrupted sleep

and emotional eating and/or negative self-image has the potential to inform adolescent eating disorder prevention and treatment protocols as they currently stand.

Aims

Aim 1: Determine if sleep disruption correlates with an increase in the urge to engage in emotional eating among adolescents presenting with sleep difficulties.

Hypothesis 1. Within an adolescent population presenting with sleep difficulties, there will be a significant relationship between sleep disruption (i.e., sleep duration [negative] and symptoms of insomnia [positive]) and the urge to engage in emotional eating (i.e., the urge to eat in response to overall negative affect, anger/anxiety/frustration, depression, and unsettled feelings).

Aim 2: Determine if sleep disruption correlates with an increase in body dissatisfaction among adolescents presenting with sleep difficulties.

Hypothesis 2. Within an adolescent population presenting with sleep difficulties, there will be a significant relationship between sleep disruption (i.e., sleep duration [negative] and symptoms of insomnia [positive]) and body dissatisfaction ratings.

Aim 3: Determine if body dissatisfaction correlates with an increase in the urge to engage in emotional eating among adolescents presenting with sleep difficulties.

Hypothesis 3: Within an adolescent population presenting with sleep difficulties, there will be a significant positive relationship between severity of body dissatisfaction and urge to eat in response to overall negative affect, anger/anxiety/frustration, depression, and unsettled feelings.

Aim 4. Determine if there is a moderating effect of body dissatisfaction on the strength of the relationship between sleep disruption and the urge to engage in emotional eating in adolescents presenting with sleep difficulties.

Hypothesis 4. There will be a moderating effect of body dissatisfaction severity on the relationship between sleep difficulties (i.e., sleep duration [negative] and symptoms of insomnia [positive]) and the urge to engage in emotional eating (i.e., the urge to engage in emotional eating in response to overall negative affect, anger/anxiety/frustration, depression, and unsettled feelings) will be exacerbated for those with greater body dissatisfaction (see Figure 1).

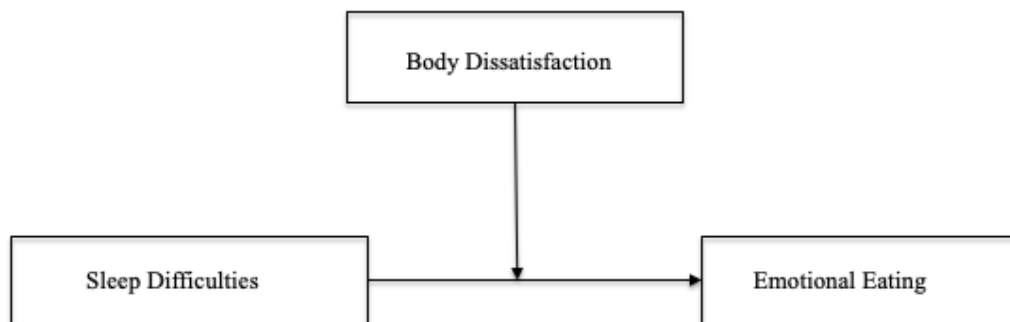


Figure 1. Body dissatisfaction moderates the relationship between sleep difficulties and emotional eating.

Aim 5. Determine if body dissatisfaction is a mediator of the relationship between sleep difficulties and the urge to engage in emotional eating in adolescents presenting with sleep difficulties.

Hypothesis 5. Body dissatisfaction will mediate the relationship between sleep difficulties (i.e., sleep duration [negative] and symptoms of insomnia [positive]) and the urge to engage in emotional eating (i.e., the urge to engage in emotional eating in response to overall negative emotion and the three sub-categories of emotion (i.e.,

anger/anxiety/frustration, depression, feeling unsettled), such that poorer sleep (as defined above) will predict greater body dissatisfaction, which in turn will predict an increased urge to engage in emotional eating (as defined above; see Figure 2).

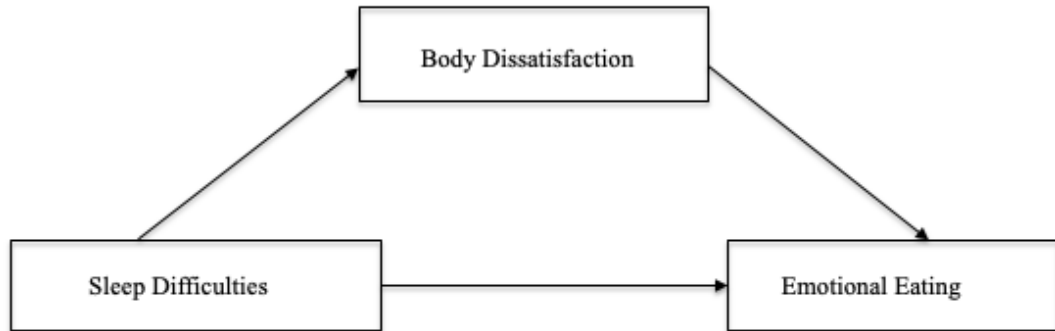


Figure 2. Body dissatisfaction mediates the relationship between sleep difficulties and emotional eating.

CHAPTER THREE

METHOD

Participants

The current study will examine the relationships among sleep difficulties, emotional eating, and body dissatisfaction in male and female adolescents. Participants will include adolescents and their accompanying parent/legal guardian who are presenting to the Loma Linda University Health Sleep Disorders Center in Loma Linda, California.

To be eligible to participate, adolescents must have been referred for an overnight sleep study (polysomnography; PSG) due to concerns related to sleep such as insomnia or sleep apnea. Furthermore, participants must be between the ages of 12 and 18, accompanied by a parent/legal guardian, and the parent and child must be able to speak and understand English for the purpose of accurately completing study protocol.

Procedure

Participant recruitment from the Loma Linda University Sleep Disorders Center (LLU Sleep Center) began in August 2019 and is ongoing. Thus far, 61 eligible participants have been recruited. Recruitment is currently paused due to COVID-19, but will resume as soon as is safe to do so. The LLU Sleep Center is an outpatient clinic where sleep technologists and sleep medicine physicians operate polysomnography machines (PSGs) and help diagnose and provide treatment recommendations, respectively. PSGs are non-invasive monitors connected to patients through wires that

monitor brain activity, body movements, breathing patterns, eye movements and heart rhythm use to detect common and rare sleep disorders.

Participants are being recruited by research assistants located at the LLU Sleep Center. At the beginning of an appointment, sleep technologists ask families if they would like to hear about a research study run by the Loma Linda University Psychology Department before the beginning of their PSG monitoring. If families give consent to be approached to learn more information about the study, a trained research assistant introduces the study to the adolescent and their parent(s) with an invitation to participate. If both parents and adolescent express interest, study details are described and both parental consent and adolescent assent are obtained. After providing consent and assent, the parent and child independently complete tablet-based surveys asking about demographics, mental health, physical health, and sleep behavior in a private room.

To facilitate recruitment and retention of participants, families are asked if they would like to be entered into a raffle to win one of 50 amazon gift cards ranging from \$25-\$100. Entry into the raffle is not contingent on participants' completion of their respective surveys, but rather, all those invited to complete the study regardless of study completion. All procedures have been approved by the Loma Linda University Institutional Review Boards.

Materials

Demographic Information

Study surveys include both a parent- and child-report demographic questionnaire that inquire about youth age, sex, and ethnicity in addition to family socioeconomic information (e.g., parental income). Adolescent participants are asked via the child-report questionnaires to indicate their height and weight for approximate BMI calculations. Parent-report questionnaires request a list of any diagnosed current/active medical conditions, psychological disorders, and/or prescribed medications for the child.

The Emotional Eating Scale—Adapted for Children and Adolescents (EES-C).

Adolescent participants are asked to complete the short form version of the EES-C (Limbers, Larson, Young, & Simmons, 2019). The short form of the EES-C is a 10-item self-report measure used to assess the urge to cope with negative affect by eating (see Appendix 1). The short form of the EES-C has been chosen for use rather than the original 25-item scale for the sake of time; however, still includes the 10 major eating-associated emotions. The major eating-associated negative affects included within the short-form of the EES-C include jealousy, confusion, nervousness, anger, guilt, helplessness, feelings of not doing enough, sadness, loneliness, and disobedience. In response to each of the aforementioned emotions, participants are asked to rate their desire to eat on a 5-point Likert scale, ranging from 1 to 5. Option choices include, 1) No desire, 2) Small desire, 3) Moderate desire, 4) Strong desire, and 5) Very strong desire to eat. Higher total scores are indicative of greater desire to eat in response to negative

mood states. The EES-C generates three subscales based upon the mean of items reflecting the urge to eat in response to (1) anger, anxiety, and frustration; (2) depressive symptoms; (3) feeling unsettled (Tanofsky-Kraff et al., 2007). The EES-C has demonstrated good internal consistency, temporal stability, and discriminant validity in adolescent samples (Arnold et al., 1995).

Body Dissatisfaction Scale (BDS)

Adolescent participants are asked to complete the BDS (Mutale, Dunn, Stiller, & Larkin, 2016). The BDS presents computer-generated female and male body images ranging from 1- 9, in ascending order of body size (see Appendix 2). The generated bodies are imported into 3dsMax, which is a computer program able to estimate the height of the body in real world measurements (cms), as well as the weight (kgs). This enables the BMI of each body to be calculated. The BMIs of the nine bodies in both the female and male scales range from underweight to obese: bodies 1-3 are underweight, bodies 4-6 are in the normal range, and bodies 7-9 are overweight/obese (Crossley, Cornelissen, & Tovée, 2012). The bodies are presented in grey scale and without hair to ameliorate the effects of perceived race or ethnicity in influencing participant body choice. Body dissatisfaction is measured by first asking participants to choose the body figure they would most like to look like (ideal) and second, the body he or she thinks is the most similar to their actual body shape (actual). The discrepancy between each participant's selected ideal and actual body shapes is operationalized as that participant's body dissatisfaction score. A higher absolute value score on the BDS is indicative of a greater discrepancy between ideal and actual perceived body size, and consequently, a

proxy for greater body dissatisfaction. Through careful examination, the BDS for both the male and female versions appears to exhibit good construct validity and test-retest reliability over a five-week period (Mutale et al., 2016).

Sleep Difficulties

For the current study, sleep difficulties will be defined as average sleep duration and insomnia severity.

Sleep Duration

As a part of their responses to the Adolescent Sleep Hygiene Scale (ASHS, Storfer-Isser, 2013) participants are asked to report typical weekday bedtimes and wake times. Average sleep duration will be calculated from responses to these items. While based on adolescent self-report, average sleep duration, self-reported sleeping times in children has shown to be as valid as objective measures of sleep, as what children report as troublesome to them must be considered when making decisions about their health (Erwin & Bashore, 2017). Although there is a lack of statistical validation, data derived from the self-reported measurement of sleep in children has shown to be clinically valuable (Erwin & Bashore, 2017).

Pediatric Insomnia Severity Index (PISI)

Adolescent participants will be asked to complete the PISI (Byars, Simon, Peugh, & Beebe, 2017). The PISI is a six-question, self-report measure of insomnia severity (See Appendix 3). Participants are asked to reflect on the past week when answering questions

related to how many nights per week they experience difficulty falling asleep, difficulty maintaining sleep, and daytime sleepiness, as well as a final question about their sleep duration (Byars et al., 2017)see Appendix 4). In response to each of the statements provided, participants are asked to rate their behavioral frequency on a 6-point Likert scale, ranging from 0 to 5. Option choices include: 0) 0 nights per week, 1) 1-2 nights per week, 2) 2-3 nights per week, 3) 4-5 nights per week, 4) 5-6 nights per week, and 5) 7 nights per week. When summed together, scores range from 0 to 30, with higher scores representing greater insomnia severity. The PISI adolescent form has been shown to have acceptable validity through correlation with other validated sleep measures ($r = .418$) and has also demonstrated high internal consistency ($\alpha = .80$) (Byars et al., 2017).

Analytic Plan

Descriptive statistics for demographics, sleep difficulties (i.e., sleep duration and insomnia severity), the urge to engage in emotional eating (i.e., overall negative affect and three subscale scores), and body dissatisfaction will first be run. Next, to address Aims 1-3 examining correlations among target variables, bivariate analyses will be conducted to determine the relationships among the urge to engage in emotional eating (i.e., overall negative affect and three subscale scores), body dissatisfaction, and sleep difficulties (i.e., sleep duration and insomnia severity). To address Aim 4 examining body dissatisfaction as a possible moderator of the relationship between the urge to engage in emotional eating and sleep difficulties, a series of hierarchical multiple linear regression analyses will be used to examine the urge to engage in emotional eating (i.e., overall negative affect and three subscale scores) (entered on the first step) and body

dissatisfaction (entered on the second step) as individual predictors of sleep difficulties (i.e., sleep duration and insomnia severity). The urge to engage in emotional eating (i.e., overall negative affect and three subscale scores) x body dissatisfaction interaction will be entered on the third step of the model in order to examine the moderating effect of body dissatisfaction on the association between the urge to engage in emotional eating (i.e., overall negative affect and three subscale scores) and sleep difficulties (i.e., sleep duration and insomnia severity). Separate regression analyses will be used for both sleep difficulty constructs – sleep duration and insomnia severity.

To address Aim 5, simple mediation analyses will be performed using the SPSS PROCESS macro (Hayes, 2013) to test the indirect effect of the urge to engage in emotional eating (i.e., overall negative affect and three subscale scores) on sleep difficulties (i.e., sleep duration and insomnia severity) by the way of body dissatisfaction. The outcome variables under examination are sleep duration and insomnia severity which will be examined in separate mediation analyses. The predictor variable under examination will be the urge to engage in emotional eating (i.e., overall negative affect and three subscale scores). The mediator variable under examination will be body dissatisfaction.

Effect sizes and p-values will be assessed to determine meaningful relationships within each analysis conducted. Based on the linear regression analyses, an a priori power analysis was conducted using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) with an alpha equal to .05 (p-value) for 80% power and three predictors. The power analysis projected a need for 77 participants to have 80% power to detect a significant medium effect size ($f^2 = .15$) at an alpha of .05 with three predictors (i.e., the urge to

engage in emotional eating, body dissatisfaction, and the interaction between the urge to engage in emotional eating and body dissatisfaction). The continuous predictors of the urge to engage in emotional eating and body dissatisfaction will be centered at the mean to enhance interpretation of the linear regression analyses (Jaccard, Wan, & Turrisi, 1990). Tests for assumptions of the hierarchical multiple linear regression analyses will also be run to ensure normality of the sample. All analyses will be run using SPSS Version 25 (SPSS, 2017).

CHAPTER FOUR

RESULTS

Participating adolescents ($N = 59$) were between the ages of 12 and 18 ($M = 14.42$, $SD = 1.73$), with 50.8% of the adolescents identified as male and 49.2% as female. The sample consisted of adolescents with ethnically diverse backgrounds, including 39 individuals identifying as Hispanic or Latino (66.1%), 14 as White (23.7%), 2 as Multiracial (3.4%), 1 as Black (1.7%), 1 as Asian American (1.7%), 1 as Middle Eastern (1.7%), and 1 identifying as Other (1.7%). Descriptive statistics also indicated that on average our sample of participating adolescents reported sleeping 8.5 hours per night, meeting the recommended 8-10 hours of sleep for adolescents (M. Carskadon et al., 2006). However, 30% of our sample fell below standard sleep recommendations and 11% fell above. Despite most participants meeting the recommended sleep duration, the average pediatric insomnia severity index (PISI) score for our select population of adolescents was 20.00. This compares to prior clinical samples of adolescents with sleep difficulties that demonstrated an average PISI score of 18.83 (Byars & Simon, 2014). Furthermore, with respect to body dissatisfaction, 18.6% of our sample indicated a desire to have a larger frame than they actually embodied, 15.3% did not indicate a desire for any change in their body, and 66.1% indicated a desire to have a smaller frame. With respect to emotional eating scores, the average score for overall emotional eating within our sample was 11.07 with a standard deviation of 9.60. For this variable, a minimum score of 0.00 and maximum score of 43.00 defined the possible range of scores. For emotional eating in response to feeling anger, anxiety, and frustration, our sample scored

an average of 6.49 with a standard deviation of 5.46 out of a possible 0.00-27.00 score range. For emotional eating in response to feeling depressed, our sample scored an average of 4.00 with a standard deviation of 4.23 out of a possible 0.00-15.00 score range. Lastly, for emotional eating in response to feeling unsettled, our sample scored an average of 0.58 with a standard deviation of 1.10 out of a possible 0.00-5.00 score range. Refer to Table 1 for a complete summary of participating adolescent demographics and Table 2 for descriptives on primary independent and dependent variables.

Given prior research for gender differences across our primary variables, we examined differences between males and females. Using between-group ANOVAs, we examined differences between males and females for body sleep duration, overall emotional eating, and body dissatisfaction. Males and females significantly differed on body dissatisfaction, $F(1, 57) = 7.94, p = 0.007$, with females ($M = 1.55, SD = 1.59$) on average having a greater desire for thinness compared to males ($M = 0.4, SD = 1.54$). Although not statistically significant, males and females were approaching significance for both sleep duration and overall emotional eating. Specifically, males and females differed on sleep duration, $F(1, 57) = 3.217, p = 0.078$, with females ($M = 486.07, SD = 90.70$) on average sleeping less minutes compared to males ($M = 529.21, SD = 89.29$). Additionally, males and females differed on overall emotional eating $F(1, 57) = 2.159, p = 0.144$, with females ($M = 12.93, SD = 10.48$) on average experiencing increased urges to engage in emotional eating compared to males ($M = 9.27, SD = 8.44$). However, given the sample size for the current study, we were unable to control for gender differences in the formal models.

Table 1. Demographics.

Demographics	M(<i>SD</i>); N (%)
Child's Age	14.42 (1.73)
Child's Sex	
Male	30 (50.8%)
Female	29 (49.2%)
Ethnicity	
White	14 (23.7%)
Black	1 (1.7%)
Hispanic/Latino	39 (66.1%)
Asian American	1 (1.7%)
Middle Eastern	1 (1.7%)
Multiracial	2 (3.4%)
Other	1 (1.7%)

Table 2. Descriptives for primary variables.

	<i>M</i>	<i>SD</i>	min	max
Pediatric Insomnia Severity Index	20.00	7.84	7.00	34.00
Adolescent Sleep Wake Scale				
Weeknight Average Sleep Duration (hours)	8.46	1.53	5.00	13.42
Body Dissatisfaction	0.97	1.66	-3.00	5.00
Emotional Eating Total Score	11.07	9.60	0.00	43.00
Emotional Eating (Anger, Anxiety Frustration)	6.49	5.46	0.00	27.00
Emotional Eating (Depression)	4.00	4.23	0.00	15.00
Emotional Eating (Unsettled)	0.58	1.10	0.00	5.00

Correlations Between Sleep Disruption, Body Dissatisfaction, and Emotional Eating

To address Aims 1-3, bivariate correlations were run for insomnia severity, average subjective sleep duration, adolescent-reported body dissatisfaction scores, emotional eating total score, emotional eating in response to anxiety, anger, and depression, emotional eating in response to depression, and emotional eating in response to feeling unsettled. Table 3 includes information on relationships demonstrating statistical significance ($p < .05$) in addition to effect sizes ($r \geq .10$, small effect; $r = .30$ to $.49$, medium effect; $r \geq .50$, large effect). In sum, based on relationships demonstrating a medium to large size effect, average sleep duration was negatively correlated with body dissatisfaction; as sleep duration decreased, desire for a thinner body frame increased. Furthermore, each of the emotional eating subscales (emotional eating in response to feeling anger, anxiety, frustration; emotional eating in response to feeling depressed; emotional eating in response to feeling unsettled) were all correlated with one another, as well as with the overall emotional eating subscale.

Table 3. Bivariate correlations between primary variables.

Primary Variables	PISI	Sleep Duration (min)	BDS	Total EES	EES_AAF	EES_DEP	EES_US
PISI	-	0.012	0.035	0.216	0.217	0.215	-0.021
Sleep Duration (min)		-	-0.323*	0.026	0.008	0.065	-0.061
BDS			-	-0.128	-0.145	-0.100	-0.008
Total EES				-	0.944**	0.888**	0.614**
EES_AAF					-	0.703**	0.563**
EES_DEP						-	0.406**
EES_US							-

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

Body Dissatisfaction as a Moderator of Sleep Disruption and Emotional Eating

To address Aim 4, regression analyses were used to analyze the effects of sleep disturbance and body dissatisfaction on emotional eating, and the interaction between sleep disturbance and body dissatisfaction on emotional eating. A separate regression analysis was conducted for each of the two sleep disruption constructs (i.e., sleep duration, insomnia severity). In each separate analysis, the sleep variable was entered on the first step, while the second step consisted of body dissatisfaction, and the third step consisted of the interaction between the sleep variable and body dissatisfaction. Separate analyses were run with the dependent variables including total emotional eating severity, emotional eating in response to feeling anger, anxiety, and frustration, emotional eating in response to feeling depressed, and emotional eating in response to feeling unsettled.

Sleep Disruption Variable I – Sleep Duration

With the exception of the subscale measuring emotional eating in response to anger, anxiety, and frustration, all analyses looking at body dissatisfaction as a moderator between sleep duration and emotional eating (i.e., total emotional eating; emotional eating in response to feeling depressed; emotional eating in response to feeling unsettled) did not account for a significant amount of variance at any step of the model, within each analysis. Furthermore, none of the overall moderation analyses were significant. Refer to Tables 4-6 for the results of the nonsignificant multiple linear regression models looking at sleep duration as a predictor, body dissatisfaction as a moderator, and the outcome variables of total emotional eating, emotional eating in response to feeling depressed, and emotional eating in response to feeling unsettled.

Table 4. Results of a multiple regression analysis predicting total emotional eating from average sleep duration, body dissatisfaction, and their interaction.

	<i>b</i>	β	<i>p</i>	<i>t</i>	ΔR^2	f^2
Step 1					.001	
DUR	.003	.026	.851	8.614		0.001*
Step 2					.019	
DUR	.189	.196	.382	.900		
BDS	-.282	-.439	.061	-2.015		0.019*
Step 3					.085	
DUR	.242	.251	.372	.920		
BDS	-.285	-.443	.067	-1.975		
DUR x BDS	.005	.096	.730	.352		0.093*

Note. *small effect; **medium effect; ***large effect.

Table 5. Results of a multiple regression analysis predicting emotional eating in response to feeling depressed from average sleep duration, body dissatisfaction, and their interaction.

	<i>b</i>	β	<i>p</i>	<i>t</i>	ΔR^2	f^2
Step 1					.004	
DUR	.003	.065	.634	.479		.004*
Step 2					.010	
DUR	.001	.032	.827	.220		
BDS	-.252	-.104	.476	-.719		.010*
Step 3					.017	
DUR	.002	.050	.733	.342		
BDS	1.296	.532	.434	.788		
DUR x BDS	-.003	-.644	.340	-.964		.017*

Note. *small effect; **medium effect; ***large effect.

Table 6. Results of a multiple regression analysis predicting emotional eating in response to feeling unsettled from average sleep duration, body dissatisfaction, and their interaction.

	<i>b</i>	β	<i>p</i>	<i>t</i>	ΔR^2	f^2
Step 1					.004	
DUR	-.001	-.061	.654	-.450		.004*
Step 2					.001	
DUR	-.001	-.073	.616	-.505		
BDS	-.024	-.037	.799	-.256		.001*
Step 3					.034	
DUR	-.001	-.048	.743	-.330		
BDS	.564	.853	.210	1.268		
DUR x BDS	-.001	-.901	.181	-1.354		.035*

Note. *small effect; **medium effect; ***large effect.

Eating in response to Anger, Anxiety, and Frustration

Results from the regression analysis with emotional eating severity in response to anger, anxiety, and frustration as the dependent variable revealed that adolescent-reported sleep duration, which was entered on the first step, did not account for a significant amount of variance in adolescents' emotional eating severity in response to anger, anxiety, and frustration, $R^2 = .000$, $F(1, 54) = 0.003$, $p > .05$. There was a small effect of sleep duration on emotional eating in response to anger, anxiety, and frustration ($f^2 = .000$). Adolescent body dissatisfaction was entered on the second step and did not account for a significant amount of change in variance in predicting adolescents' emotional eating severity in response to anger, anxiety, and frustration, $R^2\Delta = .026$, $F(1, 53) = 1.406$, $p > .05$. There was a small effect of body dissatisfaction on emotional eating in response to anger, anxiety, and frustration ($f^2 = .027$). The adolescent-reported sleep duration and adolescent body dissatisfaction interaction was entered on the third step and did account for a significant amount of change in variance in adolescents' emotional eating severity in response to anger, anxiety, and frustration, $R^2\Delta = .138$, $F(1, 52) = 8.613$, $p < .05$, and yielded a small effect size ($f^2 = .160$). Furthermore, the overall moderation model was significant $F(3, 52) = 3.408$, $p < .05$. Refer to Table 7 for results of the multiple linear regression model.

Specifically, post hoc probing revealed that among adolescents reporting decreased sleep duration, those who sought to be thinner (i.e., positive body dissatisfaction score) reported significantly greater levels of emotional eating in response to anger, anxiety, and frustration (simple slope = -0.029 , $t = -2.418$, $p < .05$). Those who reported negligible body dissatisfaction reported non-significant levels of emotional

eating in response to anger, anxiety, and frustration (simple slope = -0.010, $t = -1.241$, $p > .05$). Finally, those who sought larger body frames (i.e., negative body dissatisfaction score) also reported non-significant levels of emotional eating in response to anger, anxiety, and frustration (simple slope = 0.008, $t = 0.917$, $p > .05$) (see Figure 3).

Table 7. Results of a multiple regression analysis predicting emotional eating in response to feeling anger, anxiety, and frustration from average sleep duration, body dissatisfaction, and their interaction

	<i>b</i>	β	<i>p</i>	<i>t</i>	ΔR^2	f^2
Step 1					.000	
DUR	.000	.008	.953	.059		0.000*
Step 2					.026	
DUR	-.003	-.047	.745	-.327		
BDS	-.542	-.170	.241	-1.186		0.027*
Step 3					.138	
DUR	.000	.004	.974	.032		
BDS	5.199	1.629	.012	2.596		
DUR x BDS	-.011	-1.821	.005	-2.935		0.160*

Note. *small effect; **medium effect; ***large effect

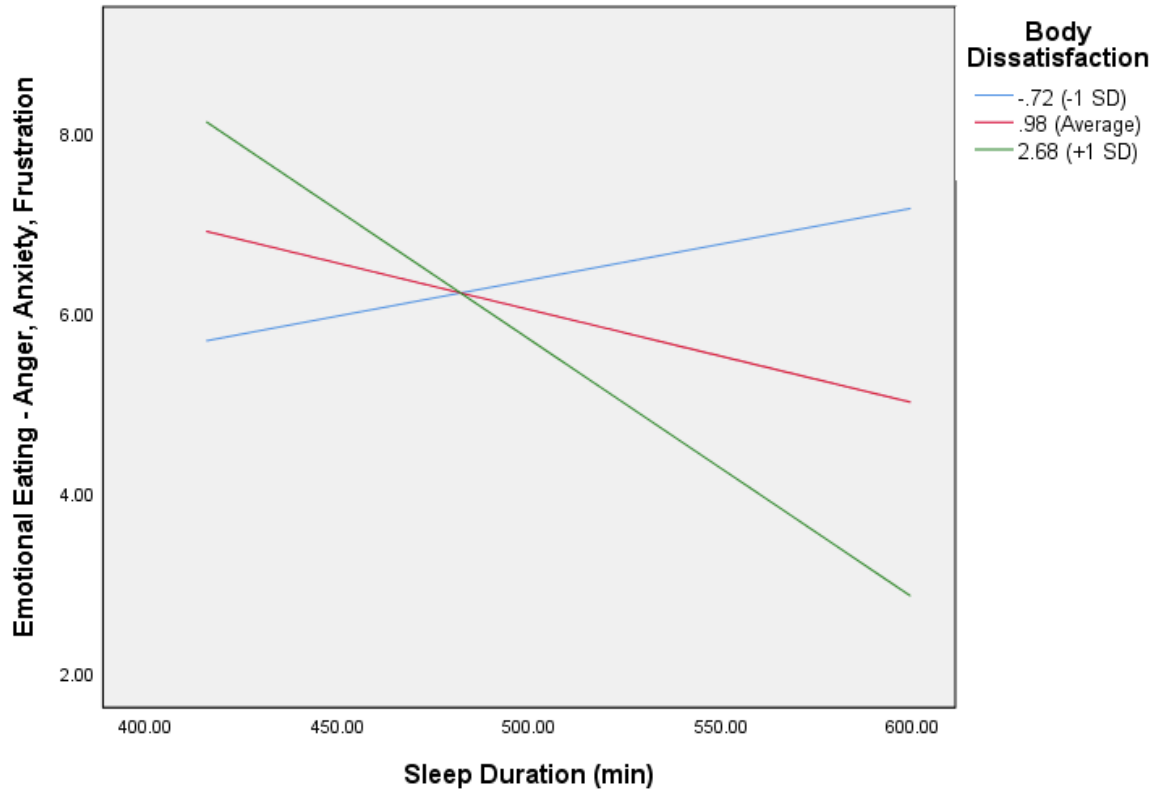


Figure 3. Interaction between emotion eating in response to anger, anxiety, and frustration, sleep duration, and body dissatisfaction.

Sleep Disruption Variable II – Insomnia Severity

None of the moderation analyses looking at body dissatisfaction as a moderator between insomnia severity and emotional eating (i.e., total emotional eating; emotional eating in response to feeling anxiety, anger, and frustration; emotional eating in response to feeling depressed; emotional eating in response to feeling unsettled) accounted for a significant amount of variance at any step of any of the models. Furthermore, none of the overall moderation analyses were significant. Refer to Tables 8-11 for the results of the multiple linear regression models looking at insomnia severity as a predictor, body dissatisfaction as a moderator, and each of the emotional eating subscales as the outcome variables.

Table 8. Results of a multiple regression analysis predicting total emotional eating from insomnia severity, body dissatisfaction, and their interaction

	<i>b</i>	β	<i>p</i>	<i>t</i>	ΔR^2	f^2
Step 1					.047	
INS	.268	.216	.1113	1.612		0.049*
Step 2					.014	
INS	.273	.220	.107	1.639		
BDS	-.692	-.120	.376	-.893		0.014*
Step 3					.013	
INS	.211	.170	.254	1.155		
BDS	-.755	-.131	.338	-.967		
INS x BDS	.088	.126	.398	.853		0.013*

Note. *small effect; **medium effect; ***large effect.

Table 9. Results of a multiple regression analysis predicting emotional eating in response to feeling anger, anxiety, and frustration from insomnia severity, body dissatisfaction, and their interaction.

	<i>b</i>	β	<i>p</i>	<i>t</i>	ΔR^2	f^2
Step 1					.047	
INS	.153	.217	.111	1.621		0.049*
Step 2					.019	
INS	.156	.222	.103	.1.658		
BDS	-.453	-.139	.305	-1.036		0.019*
Step 3					.015	
INS	.118	.168	.258	1.145		
BDS	-.492	-.151	.269	-1.116		
INS x BDS	.054	.136	.360	.924		0.015*

Note. *small effect; **medium effect; ***large effect.

Table 10. Results of a multiple regression analysis predicting emotional eating in response to feeling depressed from insomnia severity, body dissatisfaction, and their interaction.

	<i>b</i>	β	<i>p</i>	<i>t</i>	ΔR^2	f^2
Step 1					.046	
INS	.118	.215	.115	1.604		0.048*
Step 2					.009	
INS	.120	.218	.111	1.620		
BDS	-.242	-.095	.486	-.702		0.009*
Step 3					.002	
INS	.109	.197	.190	1.328		
BDS	-.254	-.099	.471	-.726		
INS x BDS	.017	.053	.723	.356		0.002*

Note. *small effect; **medium effect; ***large effect.

Table 11. Results of a multiple regression analysis predicting emotional eating in response to feeling unsettled from insomnia severity, body dissatisfaction, and their interaction.

	<i>b</i>	β	<i>p</i>	<i>t</i>	ΔR^2	f^2
Step 1					.047	
INS	.003	.026	.851	8.614		0.001*
Step 2					.014	
INS	.189	.196	.382	.900		
BDS	-.282	-.439	.061	-2.015		0.019*
Step 3					.013	
INS	.242	.251	.372	.920		
BDS	-.285	-.443	.067	-1.975		
INS x BDS	.005	.096	.730	.352		0.093*

Note. *small effect; **medium effect; ***large effect.

Body Dissatisfaction as a Mediator of Sleep Disruption and Emotional Eating

To address Aim 5, body dissatisfaction was examined as a potential mediating factor of the relationship between sleep difficulties and emotional eating. A separate mediation analysis was conducted for each independent sleep disruption construct variable (i.e., sleep duration, insomnia severity) for each dependent emotional eating variable (i.e., emotional eating total severity score; emotional eating in response to feeling anger, anxiety, frustration; emotional eating in response to feeling depressed; and emotional eating in response to feeling unsettled). For each distinct combination of variables, the PROCESS macro version 2.6 within SPSS version 27 was used in order to run a mediation analysis with bootstrapping (Hayes, 2017). For each of these particular analyses, the sleep disruption variable was included as the predictor of each emotional eating outcome variable. Body dissatisfaction was included in each analysis as the potential mediating factor of each relationship. By utilizing bootstrapping, the indirect effects of sleep disruption on emotional eating were estimated. For the purpose of these analyses, the indirect effects and associated 95% bias-corrected confidence intervals (BC CIs) were included utilizing 5,000 bootstrap samples. Effects were considered to be statistically significant if the BC CI did not include the value zero and if values had an alpha of less than 0.05. Furthermore, we assessed for outliers and violations of assumptions for simple mediation. As such, no outliers or violations were found.

Sleep Disruption Variable 1 – Sleep Duration

The primary hypothesis that body dissatisfaction would mediate the relationship between sleep duration and emotional eating (total score and subscales) was not supported. All mediation analyses looking at sleep duration as a predictor of the

emotional eating total score and three subscales of emotional eating (e.g., emotional eating in response to feeling anxiety, anger, and frustration; emotional eating in response to feeling depressed; emotional eating in response to feeling unsettled) through the mediating effect of body dissatisfaction were not significant, nor were any of the primary hypotheses supported. Consistent with correlation analyses reported above, for each of these models, sleep duration significantly predicted body dissatisfaction ($b = -0.006$, $p < .05$); however, this was the only significant finding. Refer to Figures 4-7 for the results of the mediation models looking at body dissatisfaction as a mediator of the relationship between sleep duration and total emotional eating severity, as well as each of the emotional eating subscales.

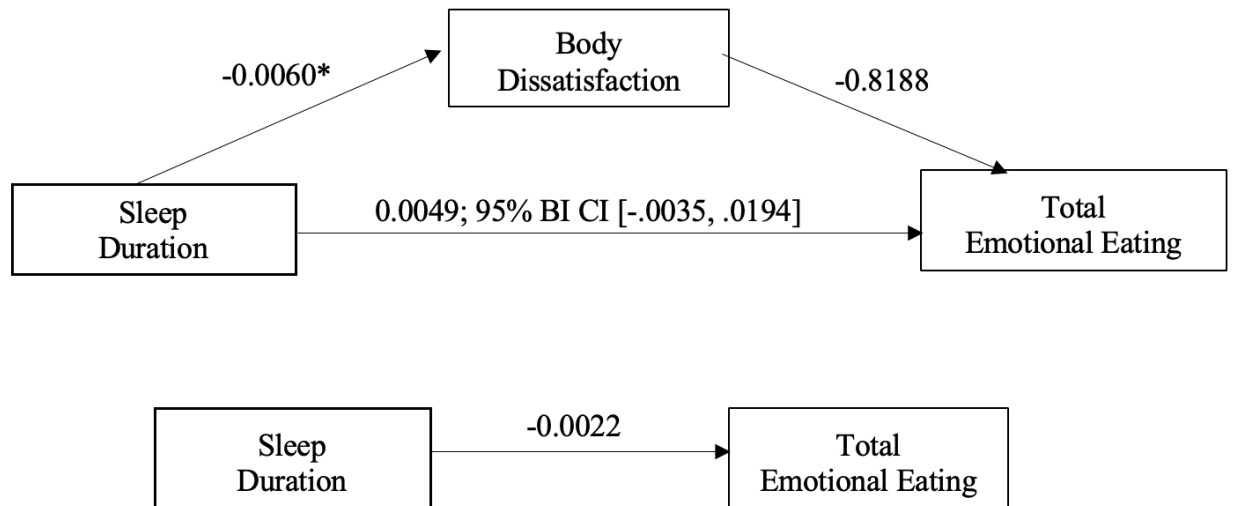


Figure 4. Mediation model of the relationship between sleep duration and total emotional eating severity mediated by body dissatisfaction. *Note.* $*p < .05$.

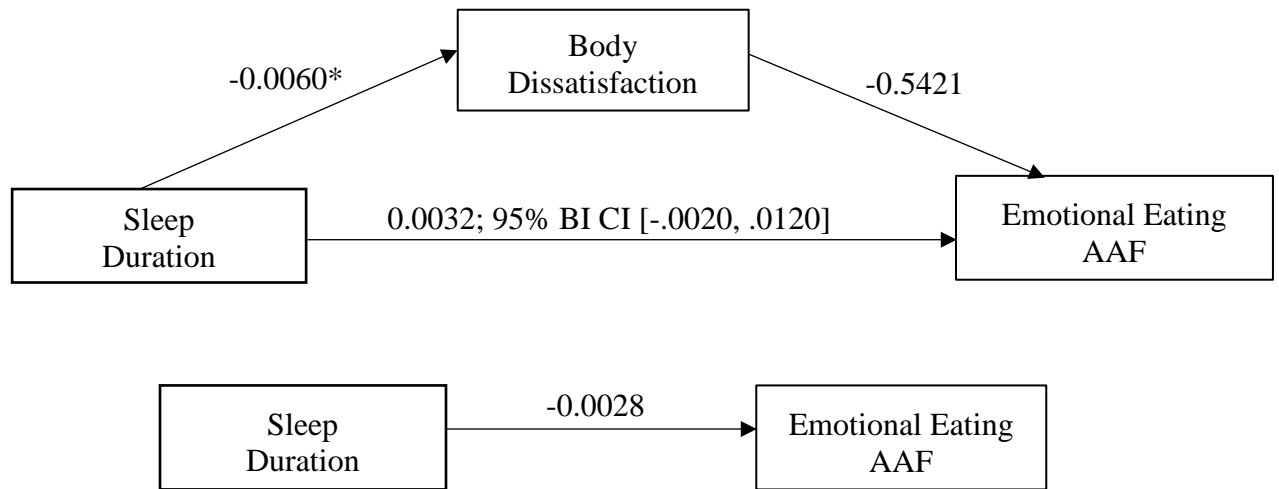


Figure 5. Mediation model of the relationship between sleep duration and emotional eating in response to feeling angry, anxious, and/or frustrated mediated by body dissatisfaction. *Note.* $*p < .05$

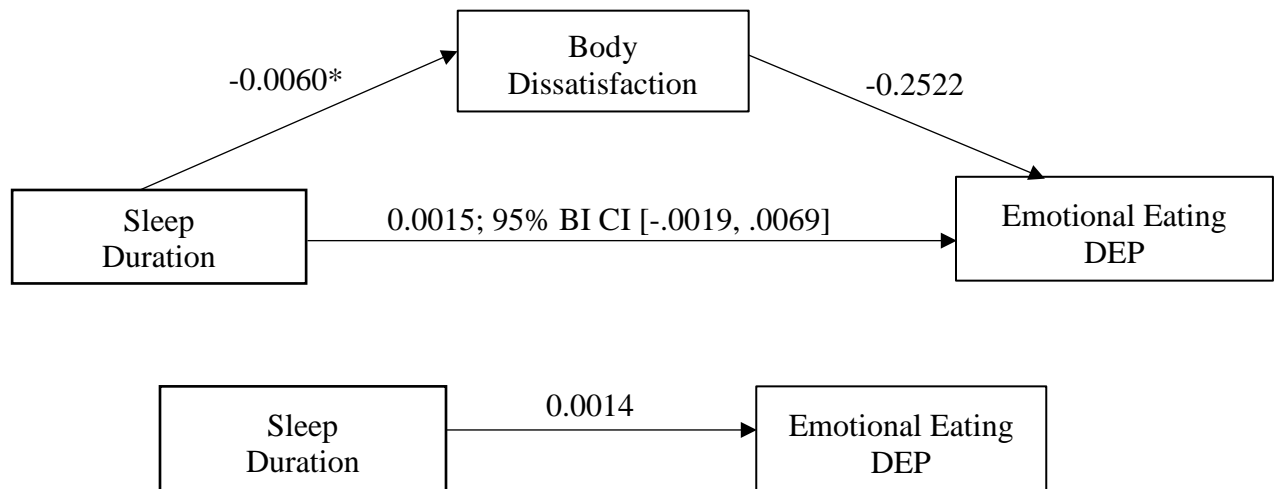


Figure 6. Mediation model of the relationship between sleep duration and emotional eating in response to feeling depressed mediated by body dissatisfaction. *Note.* $*p < .05$.

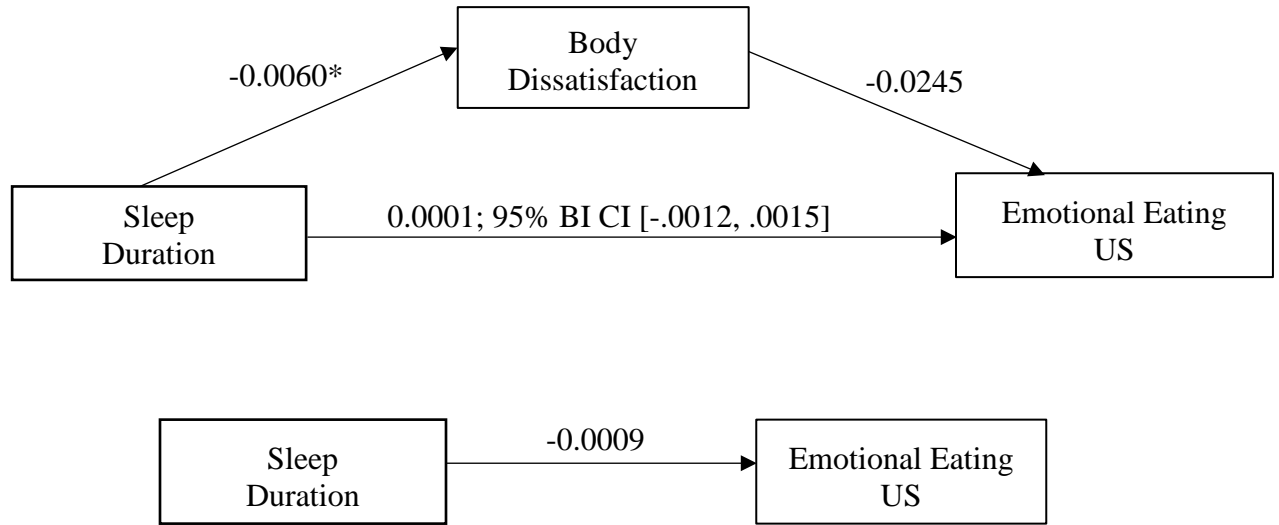


Figure 7. Mediation model of the relationship between sleep duration and emotional eating in response to feeling unsettled mediated by body dissatisfaction Note. * $p < .05$.

Sleep Disruption Variable II – Insomnia Severity

The hypothesis that body dissatisfaction would mediate the relationship between insomnia severity and emotional eating (total score and subscales) was not supported. None of the mediation analyses looking at insomnia severity as a predictor of the emotional eating total score and three subscales of emotional eating (e.g., emotional eating in response to feeling anxiety, anger, and frustration; emotional eating in response to feeling depressed; emotional eating in response to feeling unsettled) through the mediating effect of body dissatisfaction were significant. Refer to See Figures 8-11 for the mediation models looking at body dissatisfaction as a mediator of the relationship between insomnia severity and total emotional eating severity, as well as each of the emotional eating subscales.

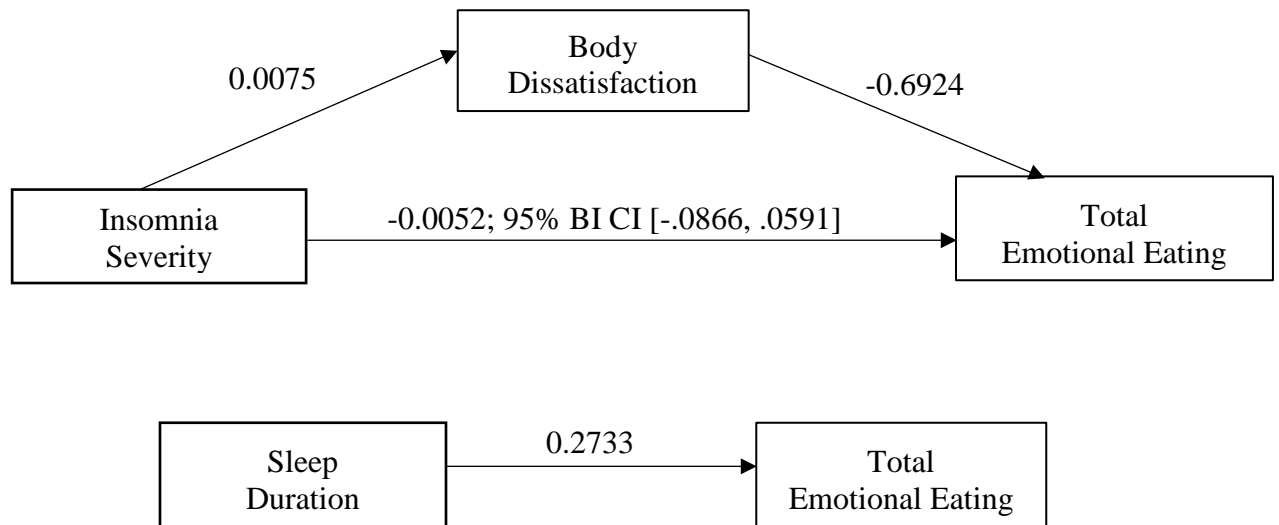


Figure 8. Mediation model of the relationship between insomnia severity and total emotional eating severity mediated by body dissatisfaction. Note * $p < .05$.

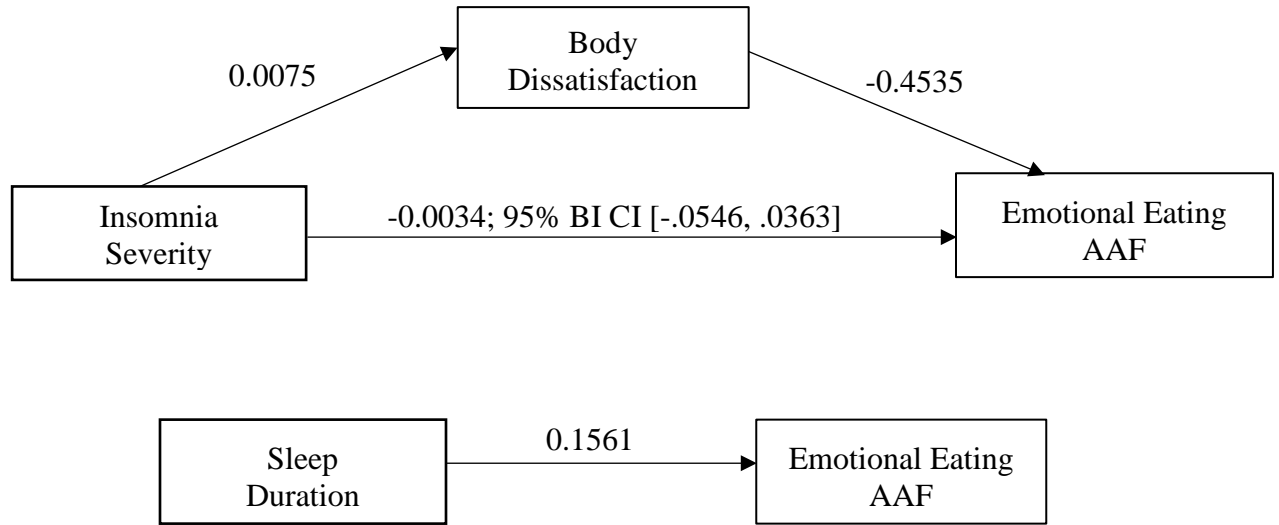


Figure 9. Mediation model of the relationship between insomnia severity and emotional eating in response to feeling angry, anxious, and/or frustrated mediated by body dissatisfaction. Note $*p < .05$.

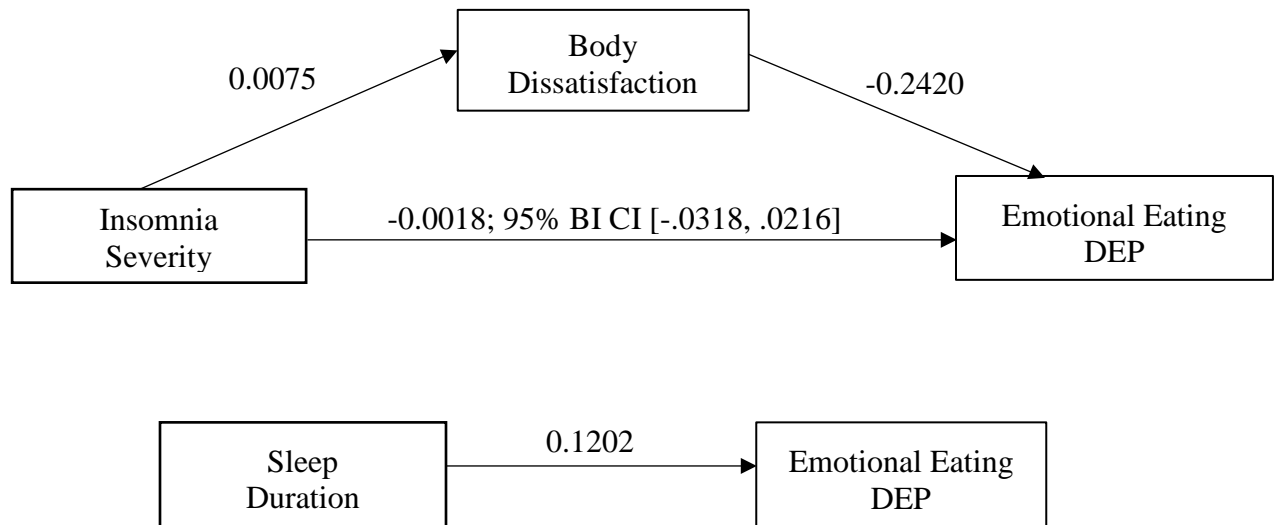


Figure 10. Mediation model of the relationship between insomnia severity and emotional eating in response to feeling depressed mediated by body dissatisfaction.

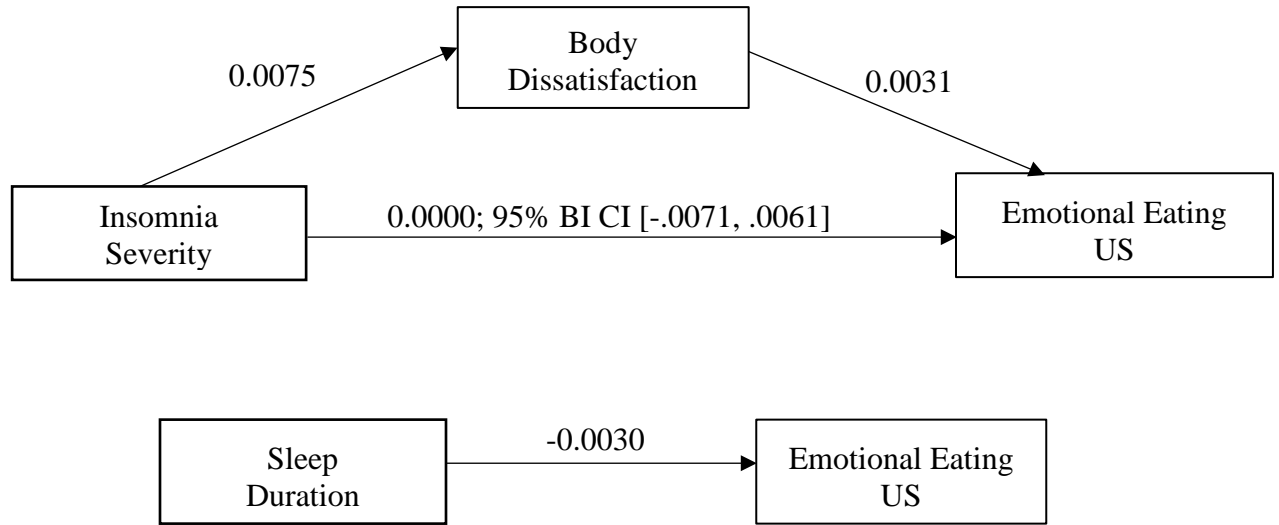


Figure 11. Mediation model of the relationship between insomnia severity and emotional eating in response to feeling unsettled mediated by body dissatisfaction.

CHAPTER FIVE

DISCUSSION

Overall Findings

The present study examined the relationship among sleep disruption, body dissatisfaction, and emotional eating in adolescents presenting with sleep problems. The results of the study indicated that shorter sleep duration is related to a greater desire for thinness among adolescents with sleep problems. Moreover, findings suggested that body dissatisfaction levels may moderate the relationship between sleep deprivation and emotional eating in response to feelings of anger, anxiety, and/or frustration in such populations. Specifically, the current findings suggested that for teens who desire to be thinner than they perceive their body frames to be, the relationship between shorter sleep duration and the urge to emotionally eat is intensified – specifically in response to feelings of anger, anxiety, and/or frustration. These findings support the extensive literature on the detrimental physiological and psychological effects of diminished sleep with adolescent populations (Chaput et al., 2018). Although sleep duration and aspects of emotional eating were not related in most models, the finding that less sleep is related to emotional eating in response to anger, anxiety, and/ frustration when body dissatisfaction is taken into account, is consistent with previous research findings of a positive relationship between adolescents’ physiological vulnerabilities (i.e., less sleep) and emotional eating (Saleh-Ghadimi et al., 2019) while also shining light on a possible third variable at play in the relationship (i.e., body dissatisfaction). Furthermore, while previous research on young adult females (ages 18-22 years) has shown that higher levels

of body image dissatisfaction were significantly associated with sleep maintenance difficulties and non-restorative sleep (Soares et al., 2011), the current study has replicated these findings in an adolescent sample with sleep problems with respect to sleep duration. The present study therefore extends the research between sleep disturbances and eating behavior by examining the relationship between these two variables together in a novel sample and further examining this relationship with particular respect to how body dissatisfaction (i.e., desire for thinness) may strengthen the association.

Beyond these significant findings, many of the study hypotheses were not supported. Specifically, sleep duration was not directly associated with emotional eating (total score and subscales) in the absence of body dissatisfaction. Despite previous research showing that adolescents who spend less hours asleep also report higher food-related disinhibition and food-seeking behavior (Blumfield et al., 2018) and children who spend less hours asleep report increased emotional eating (Burt et al., 2014), the current sample did not show the same pattern. It is possible that the current sample is not representative of the general population, as participants were presenting to a sleep study with other medical comorbidities, possibly contributing to unseen effects. It is also possible that the emotional eating scale used for the present study did not properly capture the food-seeking behavior previously studied. It is also true that the direct connections to decreased sleep and emotional eating in prior studies were seen in child populations (i.e., 12 years of age and younger).

Body dissatisfaction rates were also not directly associated with emotional eating (total score and subscales) within the present adolescent population. We predicted such a connection would exist among adolescents based on previous research findings

suggesting that insomnia symptoms are significantly associated with a more negative mental perception of the appearance in adult samples (Akram, 2017) and that sleep deprived adolescents are more likely to interpret neutral stimuli as negative (Palmer & Alfano, 2017) and engage in disinhibited eating. It is possible that body dissatisfaction in teens does not lead to emotional eating, but rather, simply exists in isolation as an additional consequence of disrupted sleep contributing to the negative psychological and physiological consequences of poor sleep within adolescent populations.

Finally, the present study did not find evidence that body dissatisfaction (i.e., the desire to be thinner than present body size) may explain the relationship between sleep disturbance and the urge to emotionally eat; all mediation analyses were nonsignificant. While seeking thinness does not explain the relationship between the two factors (i.e., sleep disturbance and emotional eating), it does appear to significantly intensify the relationship for those who desire thinness. This effect was only true for adolescents who experienced shortened sleep duration and only when considering emotional eating in response to feeling angry, anxious, and or frustrated. The relationship did not hold for emotional eating in response to feeling depressed or unsettled or for adolescents reporting average or above average sleep duration for our sample.

The findings that sleep duration and body dissatisfaction are related and that, further, body dissatisfaction exacerbates the relationship between sleep duration and emotional eating in response to anxiety, anger, and frustration are consistent with prior research. Specifically, shorter sleep time in adolescent populations is related to heightened sensitivity to the negative affect of others (which subsequently may influence body dissatisfaction), higher likelihood of experiencing of negative emotions and reduced

expression and feeling of positive emotions (which could impact emotional eating in response to these emotions), and more frequent shifts in the interpretation of neutral stimuli into negative (Palmer & Alfano, 2017).

Clinical Implications

In addition to shining light onto how sleep affects body dissatisfaction and emotional eating, the present findings may have implications for the prevention of disordered eating symptoms and clinical eating disorders, as well as the treatment of such problems. With respect to prior research emphasizing the connection between body dissatisfaction and the manifestation of altered eating habits (i.e., emotional eating, restrained eating, binge eating,), emotional and disordered eating habits heighten the risk of developing a clinical eating disorder (Wendell et al., 2012). Seeing as though the current study has shown evidence to support a relationship between shorter sleep duration and a drive for thinness even in the absence of an emotional eating response, it is possible that shorter sleep duration may have an indirect effect on the onset of altered eating habits, and disordered eating habits specifically, as well. This is particularly true for the present study's population of interest, as the development of disordered eating has the highest prevalence in teens, particularly between the ages of 14 and 19 years (Stice et al., 2013). As previously mentioned, within this age range, emotional stress, higher levels of body dissatisfaction, increased independence with regard to food choice, and poor sleep habits greatly enhance adolescents' risk for maladaptive behavior patterns (Patriciello et al., 2017).

With specific focus on shorter sleep duration, initial studies examining sleep in patients with eating disorders have found that adolescents with anorexia nervosa (i.e., restricted food intake, extremely low body weight) exhibit more awakenings and lower sleep efficiency relative to age-matched controls (Clarke & Harvey, 2012; Padez-Vieira & Afonso, 2016). Soares and colleagues also found that the prolonged dietary restriction seen in anorexia nervosa is associated with high levels of sleep disruption and decreased sleep needs (Soares et al., 2011). Furthermore, examinations of sleep and bulimic behavior (i.e., binge, purge, restrict) show higher difficulty falling asleep and daytime sleepiness to be linked to more critical bulimia diagnoses (Wells & Cruess, 2006).

While the reasons fueling these relationships are still inconclusive, decreased sleep and eating disorder symptoms have in fact been seen to covary systematically, with a higher severity of sleep disruption associated with a higher severity of disordered eating symptoms (Lombardo et al., 2014). As the present findings suggest that shorter sleep duration is associated with eating in reaction to feeling anxiety, anger, and/or frustration for adolescents who seek to be thinner, it is possible that eating disorder prevention and treatment for adolescents can be expanded to specifically include improvements in sleep hygiene and duration. Adolescents who exhibit disordered eating behaviors and thus may be at risk for clinical eating disorders as well as those diagnosed with an eating disorder may benefit from interventions aimed at sleep improvement.

Fortunately, psychologists have already made significant advances in the dissemination of sleep optimization protocols – particularly with therapeutic, rather than preventative, approaches to treatment. Cognitive behavioral treatment for insomnia (CBT-I) has shown to be the most effective treatment for those of all ages with chronic

sleep problems, more effective even than sleeping pills in the generation of sustainable sleep (Orchard et al., 2020). The tenants of CBT-I emphasize the importance of recognizing the beliefs that affect one's ability to sleep (i.e., I can't, I've never been able to, I have insomnia) and making behavioral changes. This type of therapy can help an individual control or eliminate negative thoughts that contribute to or maintain insomnia, while also developing consistent sleep habits to replace maladaptive behaviors leading to sleep dysfunction. And, psychologists have been able to modify adult sleep intervention protocols for adolescents. A multimodal sleep therapy, "JuSt," includes six weeks of weekly group therapy sessions focused on psychoeducation about sleep and its disorders, behavioral strategies such as the creation of bedtime routines and limited screen time, cognitive therapy addressing rumination and dysfunctional cognitions that prevent relaxation into sleep, guided imagery to foster relaxation, and clinical hypnosis (Roeser, Schwerdtle, Kübler, & Schlarb, 2016). In contrast to preventative seminars on sleep that have shown to only increase adolescent knowledge of the importance of sleep, the therapeutic nature of the JuSt program promotes falling asleep faster, less time spent awake during the night, and feeling more refreshed after awaking for adolescents who participate in the program for six weeks.

Furthermore, previous examinations have shown the effectiveness of dialectical behavioral treatment (DBT) in combination with standardized cognitive behavioral treatment (CBT) in improving affect regulation in females with clinical diagnoses of anorexia nervosa (AN) and bulimia nervosa (BN). In such populations, DBT treatment coupled with CBT improves affective regulation as measured by the DERS (Difficulties in Emotion Regulation Scale), disordered eating behaviors (e.g., reduction in bingeing,

purging, restricting, and excessive exercise), and food-rumination thoughts and body dysmorphism as measured by the EDE-Q (Eating Disorder Examination-Questionnaire; Ben-Porath, Federici, Wisniewski, & Warren, 2014). Interestingly, and relevant given the results of this study, DBT specifically highlights balanced sleep as one of the major areas of vulnerability for teens, specifically via the dissemination of PLEASE skills. PLEASE skills focus on reducing an individual's emotional vulnerabilities by way of physical health maintenance. In the treatment of teens, PLEASE skills stand for treating [p]hysical illness, [l]imiting screen time, balanced [e]ating, [a]voiding mood altering drugs, balanced [s]leep, and [e]xercise (Miller, Wyman, Huppert, Glassman, & Rathus, 2000). In implementing this in psychotherapy sessions, specifically for teens with decreased sleep duration as well as higher emotionality, it is possible that treatment providers are enhancing treatment outcomes for adolescents with eating disorder diagnoses, and moreover, potentially preventing the onset of disorder progression.

Limitations and Future Directions

The present study found shorter sleep duration to be significantly correlated with greater body dissatisfaction. Furthermore, the present study found evidence to support that body dissatisfaction may modify the relationship between decreased sleep duration and the severity of emotional eating when feeling angry, anxious, and/or depressed, particularly for adolescents who desire thinness. However, there were some methodological limitations in the current study that warrant discussion. To begin, all data collected was by means of self-report. Self-report measures are not as reliable as objective measures, and future studies may improve upon the current findings by using

other report (e.g., parents) and objective measures of sleep duration and insomnia severity (e.g., ActiGraphs). Body dissatisfaction and emotional eating severity were also measured by self-report; however, self-report was the most reliable measure for these constructs. Further, the self-report scales used for emotional eating (The Emotional Eating Scale—Adapted for Children and Adolescents (EES-C)) and body dissatisfaction (Body Dissatisfaction Scale (BDS)) may not have held the highest construct validity, and therefore, not stood as the most sensitive measures for these constructs as self-report leaves room for subjective error. However, the EES-C and the BDS used in the present study are the most reliable measures available. This said, these existing measures may need further evaluation to enhance psychometric properties, or new measures should be created for higher sensitivity.

Additionally, participants were not screened prior to participating in the current study for preexisting disordered eating diagnoses. As the scope of the study was focused on the relationship between sleep difficulties, emotional eating, and body dissatisfaction, a diagnosis of an eating disorder was not exclusionary. However, had there been a large percentage of preexisting disordered eating diagnoses within the current sample, results may have been swayed in the direction of more severe emotional eating responses and/or body dissatisfaction ratings than can be expected in non-clinical populations.

Furthermore, all participants for the current study were recruited from San Bernardino, CA within the Loma Linda University Sleep Center. Although reflective of our geographic region, the participant sample did not represent the ethnic breakdown ratios of the entire general population of adolescents within the United States, and therefore, results from the current study cannot be generalized. Additionally, all

participants recruited from the Sleep Center had a suspected clinical sleep disorder and many had a physical health ailment or developmental disorder. Considering the severity of these adolescents' sleep difficulties and/or physical disabilities that may have been influencing eating habits, sleeping habits, and/or body image evaluations, study results are further rendered not generalizable to the larger population. Future research should control for organic sleep disorders and/or other aspects of general sleep such as sleep efficiency or sleep onset.

Lastly, descriptive statistics showed differences between males and females on scores of emotional eating, sleep duration, and body dissatisfaction. Therefore, it is possible that females were driving the effects in our moderation of the significant moderations found. Future research should control for sex effects on the data by collecting a larger sample size, and separating analyses between males and females.

The aforementioned limitations considered, the present study results remain valuable to the larger literature on sleep difficulties among adolescents, as the results lend credence to support the implementation of sleep optimization techniques within disordered eating treatment regimens.

Conclusion

For years, sleep difficulties in adolescence have been linked to greater impulsivity, risk-seeking behavior, propensity to interpret neutral stimuli as negative, and high rates of internalizing symptoms (Van Dyk, 2016). The present study pursued a new line of focus by exploring the relationship among sleep difficulties, emotional eating, and body dissatisfaction among adolescents presenting with existing sleep concerns. For

adolescents aged 12-18 years of age, shorter sleep duration was found to be significantly correlated with greater body dissatisfaction in the direction of desiring thinness.

Furthermore, body dissatisfaction modified the relationship between sleep duration and the presence of emotional eating in response to feeling angry, anxious, and/or depressed, particularly for adolescents who seek to have a thinner body. With adolescents standing as both the most sleep-deprived population and the most at-risk population for disordered eating onset, results from this study suggest possible prevention or intervention strategies for populations at risk for disordered eating habits and clinical diagnoses, particularly through the optimization sleep for youth with high levels of body dissatisfaction and emotional eating tendencies.

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APPENDIX A

EMOTIONAL EATING SCALE – SHORT FORM.

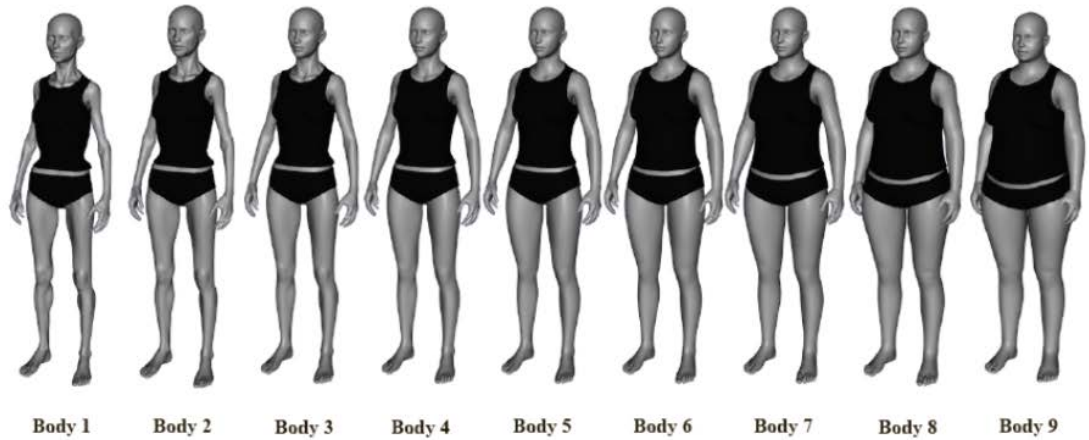
We all react to different feelings in different ways. Some types of feelings make us want to eat. Please let us know how much the following feelings make you want to eat by checking the appropriate box.

WHEN I FEEL THIS WAY	I do not experience this emotion	I have no desire to eat	I have a small desire to eat	I have a moderate desire to eat	I have a strong desire to eat	I have a very strong desire to eat	<i>On average, how many days a week do you eat because you feel this way?</i>
1. Jealous	0	1	2	3	4	5	
2. Confused	0	1	2	3	4	5	
3. Nervous	0	1	2	3	4	5	
4. Angry	0	1	2	3	4	5	
5. Guilty	0	1	2	3	4	5	
6. Helpless	0	1	2	3	4	5	
7. Not doing enough	0	1	2	3	4	5	
8. Sad	0	1	2	3	4	5	
9. Lonely	0	1	2	3	4	5	
10. Disobedient	0	1	2	3	4	5	

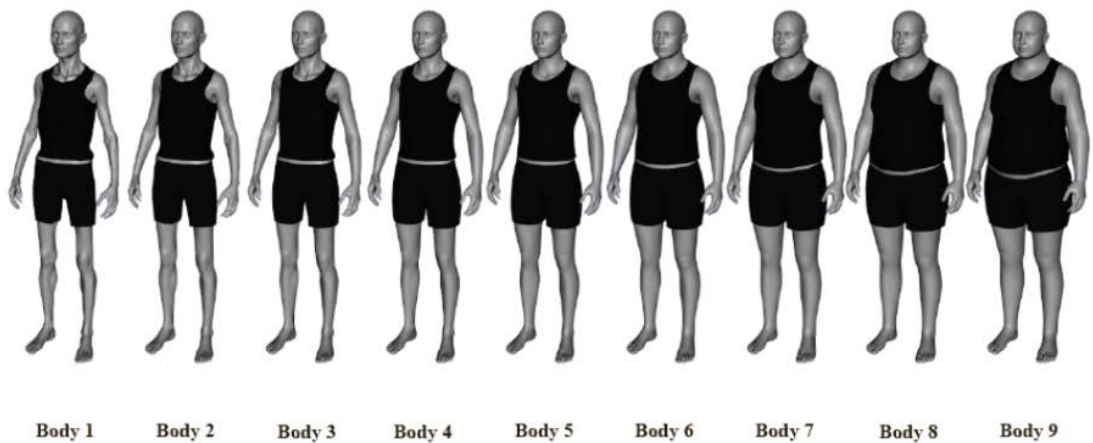
APPENDIX B

STIMULI USED IN BODY DISSATISFACTION SCALE (BDS).

1. Female body stimuli



2. Male body stimuli



APPENDIX C

THE PEDIATRIC INSOMNIA SEVERITY INDEX (PISI).

Please answer each of the following questions about your sleep. The following statements are about your sleep habits and possible difficulties with sleep. Think about the **past week** in your life when answering these questions. If last week was unusual for a specific reason (such as you were ill, traveling, or the TV set was broken), choose the most recent typical week.

After each statement please circle only one answer.

	Never (0 nights)	Once in a while (1-2 nights)	Sometimes (2-3 nights)	Quite often (4-5 nights)	Frequently (5-6 nights)	Always (7 nights)
1. It takes me longer than 30 minutes to fall asleep after going to bed.	0	1	2	3	4	5
2. In general I have trouble going to sleep.	0	1	2	3	4	5
3. During the night, I wake up more than once.	0	1	2	3	4	5
4. After waking up during the night I have trouble returning to sleep.	0	1	2	3	4	5
5. I feel sleepy during the day.	0	1	2	3	4	5
Number of hours per night						
	More than 9	8-9	7-8	6-7	5-6	Less than 5
6. How many hours of sleep do you get on most nights?						