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Effect Of Adolescent Sleep Quality On Appetite, Dietary Intake, And Body Mass Index

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EFFECT OF ADOLESCENT SLEEP QUALITY ON APPETITE, DIETARY INTAKE, AND BODY MASS INDEX

by

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Janell Juelich
1-21-2021

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ABSTRACT

Purpose and Background: Several factors have been associated with excess weight gain in adolescents, including loss of sleep. The purpose of this study was to examine the effect of sleep quality, quantity, latency, and hygiene on appetite, dietary intake, and body mass indices (BMI) of adolescents.

Theoretical Framework: Orem's Self-Care Deficit Theory guided this study to examine the relationship of adolescents' sleep effects on their appetite, dietary intake, and BMI.

Specific Aims:
1. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene of adolescents and determine the levels of appetite, dietary intake, and BMI levels of adolescents.
2. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene and determine the relationship to appetite, dietary intake, and BMI levels of adolescents.
3. To determine to what extent demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene affect appetite, dietary intake, and BMI levels of adolescents.

Sample: Adolescents aged 12-18 years from upper Midwest churches were recruited for enrollment. A sample of 76 participants completed the study. Data collection of sleep was measured for five days and nights.

Method: This study used Fitbits ($\alpha = 0.88$), and the Pittsburgh Sleep Quality Index ($r = .85$) to measure sleep quality, sleep quantity, and sleep latency. BMI levels were assessed; a Visual Analog Scale ($\alpha = 0.84$) measured adolescents' appetites. The Block Kids Food Screener ($\alpha = .88$) measured dietary intake. The Adolescent Sleep Hygiene Practice Scale ($\alpha = .84$) measured the adolescent's sleep hygiene.

Analysis: Sleep quality, quantity, latency, demographics, BMI levels, dietary intake, and appetite levels were reported as frequencies. Correlations and regression analyses were used to determine the effects of sleep quality, quantity, latency, and hygiene on the participants' appetite, dietary intake, and BMI levels.

Results: The Pittsburgh Sleep Quality Index indicated that 39.5% of participants had poor sleep quality, 75% of participants had inadequate sleep time (7.48 hours). Short sleep latency was found in 73.7% of the participants. The global Pittsburgh Sleep Quality Index was associated with increased appetite ($r = .33$, $p < .01$). The participant's age was associated with increased BMI ($r = .37$, $p < .01$). Regression results indicated that sleep quality, quantity, latency, and hygiene were not statistically significant with appetite, dietary intake, or BMI.

Study implications: This study has identified factors for future nursing intervention studies to explore sleep hygiene practices for improvement of overall health.

Key words: *appetite, BMI, dietary intake, sleep*

CHAPTER 1

INTRODUCTION

The 2015-2016 National Health and Nutrition Examination Survey indicated that 18.5% of U.S. youth aged 12-19 years were obese (Hales et. al., 2017). Furthermore, 16.6% of adolescents aged 12-19 years were overweight, and 5.6% of adolescents aged 12-19 years were severely obese (Fryar et al., 2018). Additionally, the overall trend of adolescent obesity has increased (Gohil & Hannon, 2018) as previous data from the National Health and Nutrition Examination Survey 2011-2012 indicated that 31.8% of youth in the U.S. were either overweight or obese (Ogden et al., 2014).

The causes of overweight and obesity in adolescents are multifactorial; however, some behaviors that influence excess weight gain include eating high-calorie, low-nutrient foods and beverages, lack of physical activity, sedentary activities, and inconsistent sleep times and routines (Centers for Disease Control [CDC], 2016). Concurrent with the epidemic of childhood and adolescent obesity is a marked increase in sleep disturbances and sleep deprivation (He et al., 2018; Park, 2020). This is important because the association between sleep and obesity could be bidirectional (Bruce et al., 2019; Magee & Lee, 2014).

Adolescents need 8 to 10 hours of sleep per night (Hirshkowitz et al., 2015; Paruthi, et al., 2016). However, over two-thirds of high school students in the U. S. have reported getting less than 8 hours of sleep on school nights (Wheaton et al., 2016; Windome et al., 2019). One study found that only 15% of teenagers reported sleeping 8.5 hours on school nights (Wheaton et al., 2016), and a second study noted that 15% of adolescents sleep 8-10 hours at night (Windome et al., 2019). However, the problem of lack of sleep in adolescents may be worse in the summer as one study noted that “each additional hour of day length was associated with 2.11 minutes less average nightly sleep duration” (Quante et al., 2019b, p. 5).

Quality sleep and good health is well established, and the link between poor sleep and the increase risk of premature death is also well established (Park, 2020). In addition, research has suggested that sleep quality, or how well an individual sleeps, is essential and may have more of an effect on physiological and behavioral factors than sleep quantity (Fatima et al., 2016; Hayes et al., 2018; He et al., 2018). Furthermore, sleep hygiene practices, which is a sleep routine, may also influence sleep quality and sleep quantity (Lawless et al., 2018; Shimura et al., 2020).

Sleep loss, either from poor sleep quality or decreased sleep quantity, may affect adolescents in numerous ways through a variety of biological and behavioral pathways (Fatima et al., 2016). For example, sleep loss can increase the risk of mental health issues and chronic diseases (Meldrum & Restivo, 2014; Wheaton et al., 2016). Furthermore, poor sleep hygiene practices have been associated with weight gain in at-risk populations such as adolescent youth (Fatima et al., 2016; Hayes, et al., 2018; He et al., 2018). Not getting enough sleep may cause adolescents to eat too much or to eat unhealthy foods that can lead to weight gain (National Sleep Foundation, 2019c, para 2), and poor sleep has been noted to increase risk of all causes of mortality (Meldrum & Restivo, 2014; Wheaton et al., 2016).

The first chapter of this dissertation includes the study problem, study purpose, specific aims, significance, operational definitions, theoretical framework, and innovation. This chapter concludes with assumptions and limitations.

Study Purpose

Although the CDC (2018) has remarked that sleep quality, sleep quantity, and sleep latency influence adolescent obesity, sleep has received considerably less research attention than other modifiable behaviors such as nutrition and physical activity (Chaput & Dutil, 2016; He et al., 2018). Additional research has suggested that sleep quality is essential and may have more of

an effect on physiological and behavioral factors than sleep quantity (Hayes et al., 2018). Furthermore, adequate sleep has been noted to be an emerging risk factor for overweight and obesity in adolescents (Fatima et al., 2018). As sleep hygiene, sleep latency, sleep quality, and sleep quality are all variables of sleep (National Institute of Health, 2019a), this study examined all four elements of sleep. Therefore, the purpose of this study was to examine the effect of sleep quality, sleep quantity, sleep latency, and sleepy hygiene, on appetite, dietary intake, and body mass index levels of adolescent youth. The hypothesis of this study was that poor sleep quality would affect appetite, dietary intake, body mass index in adolescent youth.

Specific Aims

The outcomes for this study were achieved by examining following specific aims:

1. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene of adolescents and determine the levels of appetite, dietary intake, and BMI levels of the adolescents.
2. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene and determine the relationship to dietary appetite, dietary intake, and BMI levels of adolescents.
3. To determine to what extent demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene affect appetite, dietary intake, and BMI levels of adolescents.

Significance

Health

Adolescence is a period when sleep habits change (Hayes et al., 2018). In addition, chronic diseases such as diabetes, heart disease, and depression can begin early in life and, if not addressed, can last for an individual's lifetime (Jensen et al., 2014). Therefore, poor sleep and

obesity can combine for very unhealthy outcomes in adolescents which may carry over into adulthood.

Adolescent's sleep loss has been associated with numerous health risks such as diabetes, insulin sensitivity, hyperglycemia, heart disease, and depression (Gohil & Hannan, 2018). In addition to sleep loss, adolescent obesity also carries increased risk for health issues. For example, obese adolescents are more likely to experience high blood pressure, impaired glucose tolerance, insulin resistance, type 2 diabetes, asthma, joint problems, gallstones, and increased risk of all causes of mortality (Meldrum & Restivo, 2014; Wheaton et al., 2016). Furthermore, psychological problems such as depression, low self-esteem, and social problems such as bullying have been linked with adolescent obesity (Halfton et al., 2013; Park, 2020), and researchers have also noted increased odds of suicide attempts and high-risk behavior such as smoking and alcohol use to be associated with adolescent sleep loss (Meldrum & Restivo, 2014; Wheaton et al., 2016). One research study noted that not only is sleep loss a factor for suicide ideation, but obese adolescents also have greater odds of suicide ideation; however, suicide attempts were similar in healthy weight and overweight adolescents (Zeller, et al., 2013). The relationship between lack of sleep and mental health also appears to be bidirectional. One research study noted that student who reported poor coping strategies also displayed poor sleep health. These adolescents had shorter sleep duration, more fragmented sleep, delayed sleep (Matthews et al., 2016). Additionally, obese adolescents are also more likely to become obese adults (Fatima, et al., 2018; Gordon-Larsen, 2010; Hart, 2011), with an increased risk of heart disease, type 2 diabetes, and cancer (Jensen et al., 2014).

Cost

Adolescent obesity also carries substantial economic burden with obese children estimated to incur $19,000 as incremental lifetime medical costs as compared to normal weight adolescents (Finkelstein et al., 2014). Moreover, adolescent obesity is estimated to cost $14 billion dollars annually in direct health care expenses (Childhood Obesity, 2016). As obese adolescents are more likely to become obese adults, the overall economic impact of adolescent and adult obesity costs the U. S. healthcare system $147 billion a year (Finkelstein, et al., 2009). Additionally, research has noted that the long-term direct costs of childhood and adolescent obesity are not consistently measured (Zanganeh et al., 2018). Furthermore, the indirect costs of adolescent obesity, such as loss of work and decreased productivity, are usually measured in adult studies (Trogdon et al., 2008).

Research

To address this national and worldwide problem of inadequate sleep, the Institute of Medicine (2006) has recognized the health problems of sleep deprivation by calling for greater public and professional awareness of the problem. Moreover, Healthy People (2020) has a specific objective to increase the proportion of students in grades 9 through 12 who get sufficient sleep to address this national and worldwide problem.

More research on sleep quantity as opposed to sleep quality was found in the literature (Arora et al., 2018; Fatima et al, 2016; Hayes, et al., 2018). As previously noted, research has suggested that sleep quality is essential and may have more of an effect on physiological and behavioral factors than sleep quantity (Fatima et al., 2016; He et al., 2018). Sleep, including sleep quality, and the possible effects on adolescent's health has not well studied (Arora et al., 2018; Brown et al., 2015; Hayes et al., 2018). This research focused on the understudied area of

adolescents' sleep quality, sleep quantity, sleep latency, sleep hygiene and the relationship between sleep quality, sleep quantity, sleep latency, sleep hygiene and appetite, dietary intake, and BMI levels of adolescent youth. This information can provide a more comprehensive understanding of the adolescent obesity epidemic, reduce preventable chronic diseases, reduce obesity related healthcare costs, and address the obesity epidemic.

Operational Definitions

Operational definitions for the variables of this study are provided as follows. Table 1 provides an overview of study variables and operational definitions.

Table 1

Study Variables and Operational Definitions

Variable	Operational Definition	Source
Adolescent	Male or female youth between the ages of 12-18 years.	CDC (2018)
Appetite	Appetite is the natural desire for food to satisfy a bodily need.	Psychology Today (2019)
BMI	Body weight in kilograms divided by height in meters squared.	CDC (2019)
Dietary intake	The type and amount of food consumed in a given period of time.	NutritionQuest (2019)
Sleep latency	The length of time to transition from full wakefulness to sleep.	National Sleep Foundation (2019b) Shirvastava et al. (2014)

Sleep quantity	Number of minutes slept per 24-hour day.	National Sleep Foundation (2019b) Shirvastava et al. (2014)
Sleep quality	The percentage of time spent asleep while in bed.	National Sleep Foundation (2019b) Shirvastava et al. (2014)
Sleep hygiene	Practices that individuals use to promote sleep.	de Bruin et al. (2014) Storfer-Isser, et al. (2013)

Adolescents

For this study, adolescents were male or female youth age 12-18 years (CDC, 2018). Age was measured in years and recorded onto a demographic form.

Appetite

Appetite is the natural desire for food to satisfy a bodily need. Appetite is influenced by physical conditions such as blood sugar levels, exercise, and hormones as well as non-physical conditions (Psychology Today, 2019). Appetite was measured using an Appetite Visual Analog Scale (Parker et al., 2004).

BMI

Body mass index is body weight in kilograms divided by the meters squared (CDC, 2019). All body weights and heights were self-reported in pounds and feet/inches respectively and converted to kilograms and meters using standard methods.

Body Weight

Body weight referred to the participant's body mass (CDC, 2019) and was reported in pounds by the participants and/or parents, and then converted to kilograms using standard methods.

Dietary Intake

Dietary intake refers to the amount and type of foods consumed in a given period of time. The Block Kids Food Screener was used to assess dietary intake (NutritionQuest, 2019). This study assessed macronutrients, which included fat, carbohydrates, and protein. In addition, kilocalories, as part of dietary intake, were also included in the study.

Sleep Latency

Sleep latency is the length of time to transition from full wakefulness to sleep (National Sleep Foundation, 2019b, Shirvastava et al., 2014). Sleep latency minutes were measured by the Fitbit Charge 3 and displayed as number of minutes on a daily, weekly, and monthly report (Fitbit Health Solutions, 2019; Lee et al., 2019; Svensson et al., 2019). In addition, a question on sleep latency is self-reported on the Pittsburgh Sleep Quality Index (PSQI) (Shirvastava et al., 2014). Comparisons of sleep latency were made with the numerical display from the Fitbit Charge 3 and the self-reported data from the Pittsburgh Sleep Quality Index.

Sleep Measures

Sleep measures refer to multiple methods of assessing sleep (National Sleep Foundation, 2019b). Sleep quality, sleep quantity, and sleep latency were measured by the Fitbit Charge 3. All sleep measures are displayed as a numerical value on a daily, weekly, and monthly report downloaded from the Fitbit (Fitbit Health Solutions, 2019; Lee et al., 2019; Svensson et al., 2019). In addition, questions on sleep latency, sleep quality, and sleep quantity were also self-

reported on the Pittsburgh Sleep Quality Index (Shirvastava et al., 2014). For this study, sleep measures referred to sleep quality, sleep quantity, and sleep latency.

Sleep Quantity

Sleep quantity is the number of minutes slept (CDC, 2018). Sleep quantity was measured by the Fitbit Charge 3. The number of minutes slept is displayed as a number on a daily, weekly, and monthly report downloaded from the Fitbit (Fitbit Health Solutions, 2019; Lee et al., 2019; Svensson et a., 2019). In addition, questions on number of hours slept is self-reported on the Pittsburgh Sleep Quality Index (Shirvastava et al., 2014). The number of minutes slept were converted to hours of sleep using standard methods. Comparisons of sleep quantity were made with the numerical display from the Fitbit Charge 3 and the self-reported data from the Pittsburgh Sleep Quality Index.

Sleep Quality

Sleep quality was measured as is the percentage of time spent asleep while in bed, and sleep quality was calculated by dividing the number of minutes slept by the number of minutes spent in bed (Shirvastava et al., 2014). Sleep quality was measured by the Fitbit Charge 3. The Fitbit sleep quality score is displayed as a numerical value on a daily, weekly, and monthly report downloaded from the Fitbit (Fitbit Health Solutions, 2019; Lee et al., 2019; Svensson et a., 2019). In addition, a global sleep quality score is calculated on the self-reported Pittsburgh Sleep Quality Index (Shirvastava et al., 2014).

Sleep Hygiene

Sleep hygiene habits are the practices that individuals take to promote sleep. Sleep habits may include a wide variety of healthy and unhealthy practices, and sleep hygiene habits are often learned at a young age (Storfer-Isser, et al., 2013). Sleep hygiene habits of the adolescents were

measured by the Adolescent Sleep Hygiene Practice Scale (de Bruin et al., 2014; Storfer-Isser, et al., 2013).

Theoretical/Conceptual Framework

Orem's Self-Care Deficit Theory

This dissertation study utilized Orem's Self-Care Deficit Theory for the conceptual framework. Orem's Self-Care Deficit Theory is based on the premise that all individuals are capable of self-care. According to Orem (2001), self-care consists of actions that individuals freely and deliberately initiate and perform on their own behalf in maintaining life, health, and well-being. Furthermore, self-care is purposeful and must be learned. The acquired ability of a person to know and meet life's needs is known as self-care. The needs of life and health are known as self-care demands. Another concept of the Self-Care Deficit Theory (Orem, 2001) is the self-care agent, which is the provider of the self-care. Self-care agency consists of personal traits that give an individual the ability to perform self-care actions. This includes functional traits, enabling traits, and operational traits, which are the person's ability to perform self-care. Another central concept of the Self-Care Deficit Theory is self-care deficit, which is a term that expresses the relationship of capabilities of individuals and their demands for care. Self-care deficit is expressed as limitations and provides guidance for helping individuals achieve optimal health. Finally, Orem also recognized the balance between activity and sleep as a universal self-care requisite (McEwen and Wills, 2019; Nursing Theory, 2019).

Assumptions of Self-Care Deficit Theory

The Self-Care Deficit Theory has five underlying premises, also referred to as assumptions. First, human beings require deliberate input to themselves in order to function. Second, human agency, or the power to act deliberately, is exercised in the form of self-care.

Third, human beings experience limitations in self-care; fourth, human agency is exercised in identifying means for inputs for self and others. Finally, groups of humans may allocate responsibility for providing care (Nursing Theory, 2016; Orem, 2001). Orem's Self-Care Deficit Theory conceptual framework is illustrated in Figure 1.

Figure 1

Orem's Self-Care Deficit Theory

Note. This image was retrieved online from http://upoun207tfn.blogspot.com/2010/07/dorothea-orems-theory-of-self-care_17.html

Adolescents

As noted by Slusher (1999), adolescents are assumed to have self-care agency and to participate in self-care practice. In addition, an adolescent self-care practice scale has been developed and validated using Orem's Self-Care Deficit Theory (Moore, 1995). Furthermore, Orem (2001) identified developmental self-care as requisites associated with human developmental processes and with conditions and events during various stages of the life cycle.

Finally, Self-Care Deficit Theory assumes that adolescents have self-care agency, and adolescents participate in self-care practices to meet their self-care requisites (Orem, 2001).

Moore (1995) developed and tested three self-care questionnaires designed for adolescents. These three instruments were noted to be valid and reliable for measuring self-care in adolescents. As measuring the self-care practices of adolescents has evolved and grown, the Self-Care Deficit Theory is well suited for use in adolescents (de Bruin, et al., 2014).

Application

Incorporating the Self-Care Deficit Theory into the present study included individuals recognizing the need for good sleep quality, which relates to the concept of self-care. For purposes of this study, sleep is a self-care requisite; the adolescents were their own self-care agents. Self-care deficit was the difference between what the adolescents know they should achieve for sleep self-care versus what they actually perform for sleep self-care practices. For this study, self-care practices from the Self-Care Deficit Theory model were addressed as the participants' sleep hygiene habits were measured using the Adolescent Sleep Hygiene Practice Scale.

Innovation

Most previous studies on adolescent sleep focus on only one area of sleep, such as only considering sleep quality or sleep quantity or sleep latency (Cappuccio et al., 2008; Liu et al., 2014; Vargas et al., 2014). Furthermore, when sleep has been studied in adolescents, most research has focused on sleep restriction or decreased sleep quantity (Broussard et al., 2016; Khatab et al., 2016). However, this study was innovative as it addressed a lesser studied area of sleep quality in addition to sleep latency and sleep quantity. As previously noted, sleep has received considerably less research attention than other modifiable behaviors such as nutrition

and physical activity (Chaput & Dutil, 2016; He et al., 2018). Because few studies were found that address the effect of sleep quality on adolescent's appetite, dietary intake, and BMI levels, this research will inform an understudied area as well as contribute to a more comprehensive understanding of a modifiable factor in the adolescent obesity epidemic.

Instruments

Multiple tools were selected to provide a better understanding of adolescent sleep. These instruments will be introduced in the following subsection with complete descriptions detailed in Chapter 3.

Sleep Assessment

In order to gain a more comprehensive sleep assessment of adolescents, this study utilized multiple methods of sleep analysis and did not rely on one or two methods of data collection. For example, many studies have only included either Pittsburgh Sleep Quality Index or sleep watches or self-reported information, and not all three methods of analysis (Cappuccio et al., 2008; Liu et al., 2014; Vargas et al., 2014). However, this study measured sleep quality, sleep quantity, and sleep latency not only a Fitbit Charge 3, but also by using the Pittsburgh Sleep Quality Index. To provide a more comprehensive approach to understanding sleep, this research also included the Adolescent Sleep Hygiene questionnaire. Therefore, sleep measures were assessed by using the Fitbit Charge 3, the Pittsburgh Sleep Quality Index, and the Adolescent Sleep Hygiene questionnaire. Complete details of study instruments, including the Fitbit Charge 3, the Pittsburgh Sleep Quality Index, and the Adolescent Sleep Hygiene questionnaire, where were all used to assess sleep quality, sleep quantity, sleep latency, and sleep hygiene will be covered in Chapter 3.

Appetite, Dietary Intake, and BMI Assessment

To provide a more comprehensive approach to understanding the effects of poor sleep quality on appetite, dietary intake, and BMI, this research used multiple methods of assessment. For example, adolescent appetite was measured using an Appetite Visual Analog Scale; adolescent dietary intake was assessed using the Block Kids Food Screener, and the health assessment questionnaire developed by Doenges (2009) was used to assess health and BMI. Complete details of the health assessment questionnaire, Appetite Visual Analog Scale, and Block Kids Food Screener will be covered in Chapter 3.

Assumptions

Assumptions of this study were as follows:

1. The etiology of adolescent obesity is complex and multifaceted with several contributing and modifiable factors (CDC, 2016).
2. Sleep loss in adolescents is multifactorial and may affect adolescents in numerous ways (Fatima et al., 2016; Hayes, et al., 2018; He et al., 2018; National Sleep Foundation, 2019c).
3. Eligible participants for this study were honest in their responses.

Limitations

This study had several limitations:

1. **Prospective correlational design**. Correlational studies do not infer causality. In addition, as this study is non-experimental, confounding variables, such as cell phones in the bedroom or excessive nighttime noise, may occur (Polit & Beck, 2017). However, since this study sought a natural sleep setting, confounding variables were not controlled. Additional threats to design validity would be the Hawthorne effect as the participants may have sought to sleep the recommended time and not their usual sleep habits.

2. **Sample.** Due to the ethnic makeup of the upper Midwestern U. S., the sample was homogenous and lacking in cultural diversity. This does not represent a diverse population of adolescents across the U. S. and hence hinders the generalizability of the data (Polit & Beck, 2017). Requirements for inclusion criteria such as no current medical diagnosis and not taking medications that affect sleep may limit the number of adolescents with pre-existing conditions who may also be at risk for poor sleep and obesity.

3. **Missing data.** The presence of missing data for any of the questionnaires or for the Fitbit Charge 3 posed a limitation. As noted in previous studies, the reliability of the Fitbit was unscorable when excessive missing data occurred. Previous studies have used 20 continuous minutes of no data as times when the watch is not being worn, and these data points were eliminated and not used for calculations. Furthermore, these studies have remarked there is no consistent format for addressing missing data with wearable devices (Lee & Suen, 2017; Ustinov & Lichstein, 2013). Fitbits missing greater than 5% of data were deleted. To minimize the impact of missing data, Pittsburgh Sleep Quality Index and Adolescent Sleep Hygiene Practice Scale validated sleep quality, sleep quantity, and sleep latency (Shirvastava et al., 2014; Short et al., 2017). Questionnaires with missing data were calculated by default pairwise deletion (Polit & Beck, 2017; Tabachnick & Fidell, 2019).

4. **Self-reported data.** The most serious concern with self-reported data is the validity and accuracy of the answers as most individuals want to represent themselves positively. In addition, self-reported data is dependent upon the recall ability of the adolescents (Polit & Beck, 2017). The researcher assumed that the adolescents' answers were frank and honest.

5. **Pandemic**. This study was designed to take place during the school year when adolescents had school Monday through Friday with consistent wake up times. In addition, school meals of

breakfast and lunch would have provided consistent dietary offerings. This study was also designed to have recruitment take place in person at various churches in the upper Midwestern U. S. In addition, demographics, consent, assent, anthropometric measurements, and health assessments were planned to take place in person at the area churches when both participants and their parents were present. This study was planned to take place during the spring. Due to the COVID-19 pandemic, all churches and schools were closed during the spring. In addition, the uncertainty of school reopening made rescheduling this study during the fall unlikely. Therefore, this study took place during the summer months when adolescents did not have consistent sleep schedules. In addition, adolescents did not have consistent school meals as planned. Furthermore, all individuals were, and continue to, dealing with stress and uncertainty due to the COVID-19 pandemic. This stress could have affected adolescent sleep and appetite variables as well as other variables of this study. Due to the multiple unknowns of the COVID-19 pandemic, it was decided by this student and the dissertation advisor to complete this study during the summer months with the circumstances of a global COVID-19 pandemic noted in the limitations and discussion.

Summary

Sleep loss may affect adolescents in numerous ways (Fatima et al., 2016; Hayes, et al., 2018; He et al., 2018). Most previous studies on sleep have focused on only one area of sleep, and most sleep research has focused on sleep restriction or decreased sleep quantity (Broussard et al., 2016; Khatab et al., 2016). In addition, few research studies have utilized multiple methods of sleep analysis and rely on one or two methods of data collection. Regarding the obesity epidemic, sleep has also received considerably less research attention than other modifiable behaviors such as nutrition and physical activity (Chaput & Dutil, 2016; He et al., 2018).

Research has suggested that sleep quality is essential and may have more of an effect on physiological and behavioral factors than sleep quantity (Hayes et al., 2018). Because few studies were found that address the effect of sleep quality on adolescents' appetite, dietary intake, and BMI levels, this research has provided information to an understudied area and contributed to a more comprehensive understanding of a modifiable factor in the adolescent obesity epidemic.

CHAPTER 2

REVIEW OF LITERATURE

The purpose of this study was to examine the effect of sleep quality, sleep quantity, sleep latency, and sleep hygiene on appetite, dietary intake, and BMI levels of adolescent youth. The hypothesis of this study was that poor sleep quality would affect appetite, dietary intake, body mass index in adolescent youth. The following specific aims were examined:

1. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene of adolescents and determine the levels of appetite, dietary intake, and BMI levels of adolescents.
2. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene and determine the relationship to appetite, dietary intake, and BMI levels of adolescents.
3. To determine to what extent demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene affect appetite, dietary intake, and BMI levels of adolescents.

This chapter focused on sleep and the known literature on sleep quality, sleep quantity, sleep latency, sleep hygiene and the association with appetite, dietary intake, and BMI levels in adolescents.

Sleep

"Sleep is vital to your well-being, as important as the air you breathe, the water you drink and the food you eat" (National Sleep Foundation, 2019c, para 2), and sleep is a basic requirement for adolescent development (Takokh, et al., 2016). As in adults, sleep plays an important role in the health of adolescents (Bruce et al., 2019). Sleep has many functions, including promoting growth, cell restoration, energy conservation, learning, and cognitive development (Kopasz et al., 2010; Price, 2015). For example, studies have shown that people who sleep less than 8 hours do not perform well on concentration and memory tests (Park, 2020).

In addition, human bodies need sleep to grow muscle, repair tissue, and synthesize hormones as well as short-term and long-term memory processes. Finally, sleep is needed to restore and rejuvenate the body (Price, 2015), and to fight disease. In a study of 164 healthy adults, the number of hours a person slept at night was found to be the biggest predictor of whether someone caught the common cold or not. Sleep was found to be a more important factor that age, stress, and body mass in predicting 'catching a cold' (Oaklander, 2020).

Sleep is defined as a state of reduced consciousness. Sleep progresses through four stages: non rapid eye movement (NREM) 1, NREM 2, NREM 3, and rapid eye movement (REM). NREM 1 is a drowsy state, and individuals may easily arouse in this state. An individual spends approximately 5% of their time sleeping in NREM I stage. NREM 2 is defined as muscles being relaxed and disappearance of environmental awareness. An individual spends approximately 45% of their time sleeping in NREM 2. NREM 3 is associated with elements such as night terrors, sleep walking, and sleep talking. An individual spends approximately 25% of their time sleeping in this stage. REM sleep is noted as the muscles of the body being paralyzed, and the electrical activity of the brain is similar to activity during wakefulness. An individual spends approximately 25% of their time sleeping in REM sleep (Lockley & Foster, 2012). Finally, individuals typically cycle through the four stages 4 to five times in a period of 7 – 8 hours of sleep (Lewis, 2013).

Sleep Theory

Although essential, the need for sleep is not fully understood. However, all experts do agree that sleep is critical for health and wellness (Takokh, et al., 2016). Three physiological theories have been identified regarding why humans need sleep (Cedernaes et al., 2015; Kopasz et al., 2010).

The first theory is that sleep is needed for cell repair and restoration (Price, 2015). Cellular activity is influenced by circadian rhythms, and this cycle of activity recurs regularly over a period of about 24 hours. During sleep, cells repair, and regeneration activity takes place, and current research has indicated that most of the cell repair and restoration takes place during the NREM sleep cycles (Cedernaes et al., 2015). In addition, cellular reproduction has been associated with sleep. Medical research has noted that much of the repair and reproduction of cells has been associated with periods of sleep (Cedernaes et al., 2015; Kopasz et al., 2010). In addition, bone building, sugar breakdown, and muscle recovery and repair also occur during sleep. Furthermore, the brain cells are thought to shrink and squeeze out debris during sleep, and this activity is thought to balance hormones and enzymes as well (Park, 2020).

The second theory is that sleep represents an energy conservation measure (Price, 2015). NREM sleep, which usually occurs during the first hours of sleep, is particularly associated with energy conservation. This second theory suggests that the body can only cycle so much energy production; hence, the human body must recharge, similar to a battery (Martin, 2003). Sleeping is thought to provide protection by this energy conservation measure (Park, 2020).

The third theory of sleep consists of sleep as facilitating memory and learning (Lewis, 2013). NREM sleep has been associated with declarative learning, such as recalling facts. REM sleep has been associating procedural learning, such as how something is done. Sleep deficit has been studied at varying levels, noting that lack of NREM and REM sleep makes it difficult for people to learn, reason, and remember in unique ways (Killgore, 2010). Dreaming, where personally relevant experiences are mixed together in REM sleep, are thought to represent the brain processing memories. Furthermore, lack of REM sleep has been associated with difficulty learning (Born & Wilhelm, 2012).

Other factors have been known to influence sleep include the circadian rhythm and the relationship to light and the biological clock. The amount of light which the human brain is exposed to has been directly related to the amount of sleep an individual received (Price, 2015; Quante et al., 2019b).

Adolescent Sleep Recommendations

The need for sleep varies across ages and are especially impacted by lifestyle and health (National Sleep Foundation, 2019b, para. 4). School children ages 6-13 years are recommended to sleep 9-11 hours per night, although 7-12 hours may be appropriate (Hirschkowitz et al., 2015). Teenagers ages 14-17 years are recommended to sleep 8-10 hours per night, although 7-11 hours may be appropriate (Hirschkowitz et al., 2015). However, most youth are sleeping less than is recommended for optimal health (Gohil & Hannon, 2018, p.2).

Sleep and Adolescents

Research has remarked upon the importance of sleep at any age, but to the developing adolescent brain, sleep is particularly important (Tarokh et al., 2011). Research has noted maturational changes in adolescent physiology during both waking and sleeping times (Fogel & Smith, 2012). Furthermore, electroencephalography images conducted in adolescents during times of sleep and wake suggest brain development in adolescents is active during sleep (Campbell et al., 2012; Tarokh et al., 2011). In a study of adolescent mice, which used photon microscopy, researchers found changes to synaptic myelination during times of sleep. These changes were not present during times of wake; hence the researchers theorized a distinctive role for sleep in the adolescent brain (Maret et al., 2012). Correlational studies in humans have also noted an association between sleep and brain development. One research examined MRI scans of

290 youth ages 5 – 18 years and found that self-reported sleep was positively correlated with grey matter volume (Taki, 2011).

Sleep Quality and Adolescents

According to the Youth Risk Behavior Surveillance System (2019), at baseline, only 30.9% of students in grades 9-12 get sufficient sleep quality on an average week. Interestingly, insufficient sleep quality varies somewhat by ethnicity and age. The ethnic group with the least sufficient sleep is Asian Americans followed by adolescents with two or more races with approximately only 20% of both ethnic groups' adolescents achieving sufficient sleep quality on an average week. Caucasians and American Indians are the only ethnic groups to report greater than 25% of adolescents obtaining sufficient sleep quality. Previous longitudinal studies have also shown that older teenagers sleep less than younger teenagers, including a poorer sleep quality (Carskadon, 2002). Sleep also declines as students age as over 33% of 9th graders reported sufficient sleep quality in an average week; then approximately 25% of 10th graders, next approximately 20% of 11th graders, and finally less than 20% of 12th graders reported sufficient sleep quality in an average week (Youth Risk Behavior Surveillance System, 2019).

Sleep Quantity and Adolescents

Over two-thirds of high school students in the U. S. have reported getting less than 8 hours of sleep on school nights (Wheaton et al., 2016), and one study found that only 15% of teenagers reported sleeping 8.5 hours on school nights (Wheaton et al., 2016) and another study finding that only 15% of adolescents sleep 8-10 hours of sleep each night (Windome et al., 2019). Still another study noted that adolescents average only 7 hours of sleep each night, which is not the recommended amount of 8 – 10 hours per night (Hirschkowitz et al., 2015). Finally,

sleep loss is common in adolescents nationwide as research has noted that 73% of high school students from 30 states are not getting enough sleep (Wheaton et al., 2016).

The problem of lack of sleep quantity in adolescents may be worse in the summer as one study noted that "each additional hour of day length was associated with 2.11 minutes less average nightly sleep duration" (Quante et al., 2019b, p. 5). Additional researchers have noted that individuals across all ages remark that it is easier to sleep in the winter when there is less sunlight (Price, 2015). Therefore, this study was needed to provide additional information on adolescent sleep. As this study took place in the summer months, this study provided additional information on adolescent sleep quantity.

Sleep Latency and Adolescents

Finally, previous studies estimate that 20%-30% of children and 6%-37% of adolescents reported problems related to prolonged sleep latency, difficulty initiating and maintaining sleep, frequent nocturnal awakening, and poor sleep quality (Beebe et al., 2007; Ogden, et al., 2014). This study provided additional information on sleep latency.

Sleep Loss

Sleep loss in adolescents, or any age group, can occur for several reasons; however, the main reasons for sleep loss in adolescents are decreased sleep time and poor sleep efficiency or quality. Individuals may cut back on sleep for a variety of reasons including work, family, hormones, stress, or entertainment, such as cell phones or televisions in the bedroom (CDC, 2018). In addition, delays in bedtimes, but no change in wake times also result in a loss of sleep (Chaput & Duhil, 2016). During adolescence, numerous factors influence changes in sleep. Psychosocial influences, such as increased homework and school commitments may affect sleep (Richter, 2015), and one research noted a decline in sleep duration on school days as well as non-

school days. These researchers remarked that the sleep loss was thought to be environmentally driven rather than biological (Ohayon et al., 2014). In addition, later bedtimes, and greater discrepancies between weekday and weekend sleep schedules can affect overall sleep (Hayes, 2018; Richter, 2015). According to the Adolescent Sleep Working Group (2014), chronic sleep loss in adolescents has become the norm. Furthermore, adolescents are understood to have a distinctive 'sleep architecture' due to changes in melatonin levels during puberty and an associated shift in circadian rhythms, later onset of tiredness and a need for greater sleep time (Crowley et al., 2007; Lockley & Foster, 2012).

Short term consequences of sleep loss have been associated with impaired mental health such as irritability and difficulties concentrating. In addition, mistakes and accidents are more likely to occur during periods of sleep loss (del Angel et al., 2015; Frenda & Fenn, 2016). Repeated exposure to sleep loss has been associated with musculoskeletal problem and fatigue, and long-term sleep loss has been associated with diabetes as well as increased risk of cardiovascular disease and stroke (Cedernaes et al., 2015).

Sleep and Physical Activity

Research has noted a correlational relationship between sleep and physical activity insomuch as regular physical activity has been shown to increase sleep quality and sleep duration (Kredlow et al., 2015). In addition, a 4-week study of 59 adults, researchers found sleep efficiency improved in those individuals who had higher daily active minutes (Sullivan Bisson, et al., 2019). However, additional adult studies have noted conflicting information. In a study of 54 healthy adults, physical activity was found not to predict subsequent night's sleep (Mead et al., 2019). The relationship between sleep and physical activity also appears to be bidirectional (National Sleep Foundation, 2019c) with additional studies noting increased sleep quality and

quantity associated with increased physical activity (Hayes et al., 2018; Ho et al., 2018; Windome, et al., 2019).

Sleep Quality

Sleep quality is the percentage of time spent asleep while in bed. Tossing and turning at night is a common indication of poor sleep quality (Shirvastava et al., 2014). Poor sleep quality is common in the pediatric population, especially in adolescents (Owens, 2019). As previously noted, some studies have indicated that not only is decreased sleep quantity a risk factor for adolescent obesity, but poor sleep quality may also be an important, but less studied, factor in adolescent obesity (Arora et al., 2018; Fatima et al., 2016). Although less reported in the literature compared to sleep quantity, sleep quality may also affect dietary intake in adolescents (Arora et al., 2018; Gohil & Hannon, 2018; Hayes et al., 2018). Dietary intake can refer to the number of kilocalories consumed, as the type and number of foods groups, and/or micro and macro nutrients consumed in a given period of time (NutritionQuest, 2019). In this review of literature, due to the focus of this research, dietary intake in relation to sleep quality will be presented.

Sleep Quality and Appetite

Similar to the literature on dietary intake, most research on appetite and sleep has focused on sleep quantity. Therefore, literature on sleep quality and the appetite of adolescents was less abundant that literature on sleep quantity and appetite.

In a study by Yang et al. (2019), increased hunger and food cravings have been reported in adults after sleep loss. This study consisted of 24 adult women; however, increased portion sizes were also noted in those individuals who experienced decreased sleep (Yang et al., 2019). Additional research on college students noted poor sleep quality was significantly associated

with increased hunger and higher levels of nighttime eating (Pona, 2015); however, these findings are not consistent. For example, in a study with 655 children aged 7-17 years, research indicated no association between sleep quality and appetite. For this study, sleep quality was measured by polysomnography. Furthermore, appetite hormones were measured by self-reports and blood draws (Boeke et al., 2014).

The information on sleep quality and appetite is also noted in adolescent literature. For example, in a 14 day and night study of 29 adolescent participants ages 10-18 years, researchers noted no relationship of loss of control eating habits the day after a poor night's sleep. This included number of awakenings at night in addition to sleep quality. Sleep efficiency was measured by Actigraphy and the ASA24-Kids, a dietary assessment tool for children aged 10 and older, provided estimates for dietary intake (Goldschmidt, 2020). Conversely, in another study of 256 adolescents aged 10-16 years, sleep was measured with Actigraphs and food cravings were measured by the Food Craving Inventory. For this study, researchers noted no significant associations between sleep quality and cravings. However, sleep quality was inversely related to sweet craving as those adolescents who slept better had fewer cravings for sweets (Kracht et al., 2019).

As previously noted, fewer adolescent studies have researched the relationship of perceived hunger and satiety in relation to poor sleep quality as compared to the relation of adolescent perceived hunger and sleep quantity. Because fewer studies have focused on the relationship of poor sleep quality, perceived hunger, and satiety in adolescence, this study has examined this lesser studied area.

Sleep Quality and Dietary Intake

Sleep and sleep quality are postulated to impact dietary intake and subsequent body weight within several neuroendocrine, metabolic, cognitive, and behavioral pathways (St. Ogne, 2017). Although, some research has indicated an association between sleep quality and diet (Klingenberg et al., 2012), the underlying explanatory mechanisms are still unclear (Felso, et al., 2017). Concurrent with the epidemic of adolescent obesity is a marked increase in sleep disturbances and sleep deprivation. Self-reported sleep deprivation in adolescents has become common (He et al., 2018). This is important because the association between sleep loss and adolescent obesity could be bidirectional or inter-related (Bruce et al., 2019; Magee & Lee, 2014). Research has also indicated that that adolescents demonstrate a biological delay in sleep onset, which may result in adolescents staying awake longer (Bruce et al., 2019).

In a study of 186 adolescents ages 12-17 years, Hayes et al. (2018) noted sleep disturbance or poor sleep quality and unhealthy diet scores. This study used the Insomnia Severity Index to monitor sleep and diet was measured using the Youth Risk Behavior Scale. Hence, those adolescents with greater sleep efficiency or quality showed healthier diet scores. Similarly, Chaput et al. (2018) examined sleep efficiency with sugary beverage consumption and noted that poor sleep quality was associated with higher intake of soft drinks, which also was related to a higher consumption of carbohydrates.

In a study of 324 adolescents, researchers noted sleep variability affected dietary intake. For this study, the participants wore Actiwatches for eight consecutive days and nights and completed a Youth/Adolescent Questionnaire to assess nutrition. Results showed that participants with habitual sleep variability or poor sleep quality had a significant increase in snack consumption, calories, fat, and carbohydrate associated with poor sleep quality.

Furthermore, those participants who experienced a one hour increase in sleep variability or poor sleep quality also consumed 170 more calories per day as compared to those participants who experienced good sleep variability (He et al., 2015).

In another study of 256 adolescents aged 10-16 years, sleep was measured with Actigraphs and food cravings were measured by the Food Craving Inventory. The researchers noted sleep efficiency or quality was inversely associated with sweet cravings. In addition, greater sleep quality was associated with was related to lower cravings for indices such as high fat and carbohydrates and greater sleep quality was associated with greater vegetable intake (Kracht et al., 2019).

In a cross-sectional study, Min et al. (2018) researched sleep quality and sleep quantity in 118,462 adolescents aged 12-18 years of age. With participants obtaining 7-8 hours of sleep, poor sleep quality was associated with less intake of vegetables, fruits, and milk. Hence, poor sleep quality was associated with a less healthy dietary intake.

Conversely, another study found no association between poor sleep quality and increased junk food consumption. In a study of 29,510 youth 9-18 years of age, researchers used a survey called Middle Years Development Instrument to assess sleep and dietary intake in both male and female youth. As noted, a ‘good night’s sleep’ was not associated with increased consumption of junk food (Agostini et al., 2018).

As noted, most research on sleep and diet has focused on sleep quantity. As sleep quality and the possible effects on dietary intake in adolescents is not as well studied as sleep quantity (Arora et al., 2018; Hayes et al., 2018), this research is focused on the lesser studied area of sleep quality and dietary intake of adolescents.

Sleep Quality and Body Mass Index

Overall, research studies have focused on the association of sleep duration and obesity; however emerging research suggests that sleep quality may be just as important as sleep quantity in relation to adolescent obesity (Arora et al., 2018; Cappuccio et al., 2008). For example, in one study, a significant relationship between poor sleep quality and indicators for obesity in children were indicated (Arora et al., 2018). However, there were some inconsistencies in the literature. For example, a study of adults found that poor sleep quality did not predict increased BMI levels (de Arujo et al., 2014).

One study identified more sleep disturbances in overweight youth in comparison to normal weight youth aged 5-17 years. This study was a retrospective cohort study comparing 41 overweight children to normal weight children. Sleep was measured by polysomnography. Results indicated altered sleep quality and more sleep disturbances in overweight and obese youth (Pancheco et al., 2017). Similarly, in a study of 335 school children who wore wrist Actigraphy for 7 consecutive days and nights, researchers found poor sleep efficiency was positively associated with body fat percentage (Arora et al., 2018). In a systematic review, Fatima et al. (2016) noted sleep quality having a considerable role in overweight and obesity, and that sleep quality was perhaps independent of sleep duration in overweight and obesity sleep studies.

As fewer research studies specific to adolescent's weight and sleep quality as compared to adolescent's weight and diet or physical activity exist (Fatima et al., 2016), this study was planned to provide additional information to this gap in research.

Sleep Quantity

Short sleep quantity is more common in the pediatric population, especially of adolescents (Owens, 2019). The following section will examine literature on sleep quantity and appetite, dietary intake, and BMI levels in adolescents.

Sleep Quantity and Appetite

Adolescents' appetites also may be affected by poor sleep quantity (Landis et al., 2009; Simon et al., 2015); however, more studies have been conducted on adults as compared to adolescents. Lack of sleep quantity is thought to interfere with the neuroendocrine system causing increased appetite and enhanced sensitivity to food (Park, 2020). For example, one study of adults noted increased food cravings and hunger after decreased sleep quantity (McNeil et al., 2016; Yang et al., 2019).

A 3 week within subject study examined appetite and sleep quantity 31 healthy adolescents aged 14-16 years. During this study, week 1 was a baseline sleep week. During week 2, the adolescents were restricted to 6.5 hours of sleep for 5 nights. During week 3, adolescents slept 10 hours at night for 5 nights will all phones and electronics shut off. Bedtimes on the weekends were self-selected and served as a 2 day wash out period. The adolescents were to refrain from napping and limited their caffeine intake to one coffee or two sodas per day. Sleep was monitored by sleep watches. A computerized food-appeal rating system of 42 sweets/desserts and 42 non-sweets (vegetables/meat) was administered each week. Adolescents were to rate how appetizing the pictures looked on a 1- 4 scale. Results indicated that the sweets/desserts were more appealing after sleep restriction; however, the self-reported hunger was not significant with sleep manipulation (Simon et al., 2015).

Similar studies have been noted in the literature. For example, one longitudinal study examined short sleep duration with increased food responsiveness or appetite of younger children. Results of this study found increased food responsiveness significantly associated with short sleep quantity (McDonald et al., 2015). In a study of 85 students aged 14-18 years, researchers used the Sleep Habits Survey to assess sleep. Hunger and satiety, not appetite, were measured via a daily diary and Likert scale, and food cravings were measured by the Food Craving Inventory. This study was conducted over seven days and nights. Results showed that decreased nighttime sleep was associated with increased food cravings (Landis et al., 2009).

As fewer articles regarding adolescent sleep quantity and appetite were noted in the literature as compared to appetite and physical activity, (Landis et al., 2009; Simon et al., 2015), this study was designed to provide additional research to sleep quantity and appetite.

Sleep Quantity and Dietary Intake

Literature has noted that many research studies regarding sleep quantity and dietary intake are epidemiological or observational. In addition, numerous factors affect dietary intake including physical activity, income, and environmental factors (Bruce et al., 2019). Dietary intake can relate to various areas of an individual's diet. For example, dietary intake can examine micro or macro nutrients (Beebe et al., 2012) or food groups (Felso, et al., 2017). In addition, kilocalorie intakes can also be assessed in dietary intake (Beebe et al., 2012; Goldschmidt, 2020).

Dietary Intake

Previous studies of adolescents ages 12 -18 have noted changes in energy (kcal) consumption in relation to sleep quantity, and evidence suggests that food intake increases during periods of sleep restriction (Beebe et al., 2012). In a study of 41 healthy adolescents aged 14-16 years. This study was conducted over 3 weeks. For this study, week 1 was a baseline sleep

week. During week 2, the adolescents were restricted to 6.5 hours of sleep for 5 nights. During week 3, adolescents were in bed 10 hours at night for 5 nights will all phones and electronics shut off. Bedtimes on the weekends were self-selected with this being a 2 day wash out period. For this study, the adolescents were to refrain from napping and limit caffeine to one coffee or two sodas per day, but otherwise they were not given any directions on diets. Sleep was monitored by sleep watches, and the USDA Multiple Pass Method was used for 24-hour diet recall. Results noted no significance in intake of fat and protein across the experimental weeks of sleep. However, during the sleep restricted week, the teens consumed foods with higher glycemic index and trended towards greater carbohydrate and calorie consumption.

Still other studies showed similar results with decreased sleep quantity and food quality. For example, in a study of 256 adolescents aged 10-16 years, researchers noted that meeting sleep duration guidelines had a positive association with diet quality. In this study, researcher noted longer sleep duration to be associated with better diets (Kracht et al., 2019). Similarly, Chaput et al., (2018) examined sleep duration with sugary beverage consumption and noted that shorter sleep quantity was associated with higher intake of soft drinks. Furthermore, research on 315 adolescents aged 13-18 years revealed a significant relationship between short sleep quantity, as measured by the Children's Sleep Habits questionnaire, and less healthy dietary intake, as measured by the Rapid Eating Assessment for Patients (Levers-Landis et al., 2016). Finally, Franckle et al. (2015) noted that students who slept less than 10 hours per night consumed more soda and less vegetables as compared to those students who slept greater than 10 hours per night. In a systematic review, researchers examined sleep duration and dietary habits (Felso, et al., 2017). Overall, a negative association was found between sleep duration and healthy dietary intake. In a cross-sectional study, Min et al. (2018) researched sleep quality and

sleep quantity in 118,462 adolescents aged 12-18 years of age. Short sleep duration of less than 6 hours was associated with increased consumption of soft drinks and unhealthy food choices. Hence, poor sleep quantity was associated with less healthy dietary intake.

Finally, in a large study of adolescents from the National Longitudinal Study of Adolescent Health (n =13,284), adolescents with short sleep duration had reduced vegetable and fruit consumption as compared with the adolescents who slept the recommended sleep duration in adjusted models (Kruger et al., 2014).

Despite the fairly consistent findings with decreased sleep quantity and poor dietary intake, sleep quantity, or hours of sleep, in context with other sleep factors was not well depicted in the existing literature. Therefore, this study has sought to determine sleep quantity in context with other sleep factors in relation to dietary intake.

Energy Intake

Previous studies of adolescents ages 12-18 have noted changes in kilocalorie consumption in relation to sleep quantity, and evidence suggests that food intake increases during periods of restricted sleep (Beebe et al., 2012). In a study of 41 adolescents aged 14-16 years, researchers measured baseline sleep for one week, then restricted sleep to 6.5 hours for 5 nights. Next the researchers allowed for a 2-day weekend wash out, and finally the adolescents were to be in bed for 10 hours each night for 5 night. The researchers found that adolescents who slept 6.5 hours consumed more calories, as measured by a 24-hour dietary recall, than those adolescents who slept approximately 9 hours per night (Beebe et al., 2012).

Additionally, in a 14 day and night study of 29 adolescent participants, researchers noted that more sleep time was associated with decreased energy intake the next day. In this study, sleep was measured by Actigraphy and the ASA24-Kids, a dietary assessment tool for children

aged 10 and older, provided estimates for dietary intake. Researchers in this study noted that each additional hour of sleep per night was associated with consuming fewer calories (Goldschmidt, 2020).

However, these findings are not consistent. Intriguingly, Hayes et al. (2018) noted sleep duration was not related to kilocalorie intake, which is contrary to much of the literature. In addition, a crossover study of 21 healthy adolescent males revealed decreased energy intake in sleep restricted participants (Klingenberg et al., 2012). Klingenberg et al. (2012) restricted adolescents' sleep to 4 hours a night for 3 consecutive nights, and then had the adolescents sleep for 9 hours a night for 3 consecutive nights. Results revealed 13% less calorie consumption in the 4 hour a night sleep group as compared to 9 hours of sleep per night.

Some studies have noted shorter sleep duration in adolescents was associated with changes in kilocalorie intake (Beebe et al., 2012; Goldschmidt, 2020). This study was planned to clarify the more precise number of hours of sleep with adolescents' kilocalorie intake. In addition, as inconsistencies of sleep quantity have been associated with changes in kilocalorie intake (Hayes, et al., 2018; Klingenberg et al., 2012), this study was designed to clarify sleep quantity with kilocalorie changes in adolescents.

Sleep Quantity and Body Mass Index

Overall, short sleep quantity has been associated with an increased risk of adolescent obesity (Cappuccio et al., 2008; Chaput 2016; Magee & Hale, 2012; Simon et al., 2018). For example, in a study of 256 adolescents aged 10-16 years, short sleep duration was positively associated with increased BMI levels (Kracht et al., 2019). In an epidemiological study, Magee and Lee (2013) investigated sleep duration and BMI. For this research, 1390 adolescents aged 14-18 years were followed for 4 years at 6-month intervals. Results of this study noted that self-

reported height and weight, used to determine BMI increased as self-reported sleep duration decreased. Furthermore, in a study of 335 school children who wore wrist Actigraphs for 7 consecutive days and nights, researchers found those who achieved less than 8 hours of sleep per night had an increased BMI levels compared to those participants who were sleeping more than 8 hours per night (Arora et al., 2018).

Moreover, systematic reviews have also reviewed the relationship between sleep duration and adolescent obesity. In a review examining 23 studies, researchers noted that most studies in the review had participants wearing accelerometers. Overall, a negative relationship between sleep time and adiposity was noted in most of the reviewed studies, although not consistently. In a systematic review of 17 studies, there was an association between short sleep quantity and obesity; however, six studies in a systematic review found no association between adolescent sleep quantity and obesity (Felso, et al., 2017).

Even though lack of sleep quantity has been noted to be associated with higher BMI levels in adolescents (Cappuccio et al., 2008; Chaput 2016; Magee & Hale, 2012), study results are not consistent (Felso, et al., 2017). Using polysomnography, one retrospective cohort study found no significant difference in sleep quantity in overweight versus normal weight youth aged 5-17 years. For this study, poor sleep quantity was defined as less than the recommended number of hours of sleep (8-10) (Pacheco et al., 2017). Additionally, in a study of 4,175 adolescents aged 11-17 years, researchers noted no association between sleep restriction and obesity. For this study, poor sleep quantity was defined as less than 6 hours per night on weeknights or weekends (Roberts & Duong, 2018).

Interestingly, researchers used the Youth Risk Behavior Survey data of 15,364 high school students 14-18 years of age to evaluate whether the strength of the association between

sleep deprivation and negative behavioral and health outcomes varied according to the relative amount of sleep deprivation. The researchers assessed hours of sleep by the question 'On average school night, how many hours of sleep do you get?'. This study found no difference in the odds of obesity with 6 hours of sleep versus 7 hours of sleep relative to getting the recommended minimum of 8 hours of sleep. However, the odds ratio for obesity was higher in those students getting more than 5 hours of sleep than the odds ratio for those students getting fewer than 5 hours of sleep. Thus, the researchers noted that the results for the obesity model demonstrated that moderate amounts of sleep deprivation are not related to the risk of obesity; however, more extreme forms of sleep deprivation were significantly and substantively related to obesity (Meldrum & Restivo, 2014).

Finally, a study of 599 youth noted that for each additional hour of sleep each week, a 16% decreased likelihood of obesity was noted (Huang & Wong, 2019). However, research has not been consistent that less sleep quantity is associated with increased obesity in adolescents. In addition, there is limited or inconsistent data regarding sleep quantity and dietary intake and appetite in adolescents. Furthermore, most sleep quantity data and obesity are cross sectional or longitudinal in nature (Reldrum & Restivo, 2014). Therefore, this proposed research will provide a more comprehensive approach to understanding adolescent sleep quantity and the relation to appetite, dietary intake, and BMI levels.

Sleep Latency

Sleep latency is often researched with other sleep measures, such as sleep quantity (Norouzi et al., 2018). In addition, research on sleep latency has been conducted more on adults than on adolescents (Pacheco et al., 2017). One adult study noted a significant association between sleep latency and weight as well as waist circumference. The study included 108

healthy adults, sleep assessment with actigraphy for 7 consecutive days and nights, and a 3-day food dietary record analyzed by the Nutritionist IV software (Norouzi et al., 2018).

The only adolescent sleep latency and obesity study found in the literature described a retrospective cohort study of 41 overweight versus normal weight youth 5-17 years of age. The study noted sleep latency greater than 30 minutes in 17% of overweight adolescents and sleep latencies of greater than 30 minutes in 24% of normal weight participants (Pacheco et al., 2017).

As noted, research studies on only sleep latency and appetite, dietary intake, and BMI levels in adolescents were very limited in the literature. Therefore, this research was planned to address an understudied area of adolescent sleep.

Sleep Hygiene

In a qualitative study, Quante et al. (2019a) conducted a focus discussion with 27 adolescents aged 14-18 years of age. This research described adolescents has having a general lack of awareness of sleep hygiene practice recommendations. The researchers noted a lack of adolescent knowledge in areas such as avoiding naps, limiting noise and light, and avoiding electronic devices at bedtime.

In a study of 167 urban adolescents, researchers used the Pittsburgh Sleep Quality Index and Adolescent Sleep Hygiene Practice Scale. Results of this study noted that those adolescents with poor sleep hygiene scores, particularly on the cognitive factors, had greater sleep quality scores, which indicate poor sleep. This study focused on ethnic minorities in urban areas (Gold et al., 2020). In a study of 2,815 adolescents in an intervention group and 1,347 adolescents in a control group, researchers examined the use of sleep hygiene education. The intervention group had significantly greater prevention of insomnia and prevention of short sleep duration of less than 6 hours as compared to the control group. However, no significant differences were noted

post sleep hygiene intervention for sleep quality and sleep hygiene practices, such as late bedtime (Otsuka et al, 2019).

In a systematic review, Griggs et al. (2020) noted seven studies that evaluated sleep promotion and healthy sleep habits in adolescents. The review indicated that sleep efficiency or quality improved after implementing sleep hygiene measures; however, the improvement in sleep efficiency was not statistically significant. Hence, additional research is needed in the area of sleep habit promotion of adolescents.

Cell phones

Interestingly, in a qualitative study, 31 adolescent youth stated that they understood the recommended sleep requirements: however, most reported insufficient sleep. A common obstacle to sleep was electronic devices. Another obstacle was social pressure to remain in the online environment. In addition, adolescent participants felt that their sleep need was different than the expert recommendations (Godsell & White, 2019). Research with cell phone use and sleep has noted that nighttime use and late use of cell phones to be associated with poor sleep quality (Caumo et al., 2020). In a study of 3,622 adolescents, researchers noted that 55% of the adolescents reported using technology after bedtime ‘always’. The next most common response was 37% at ‘almost always (Bauducco et al., 2019). Furthermore, in a study of 234 families, researchers studied electronic device use at bedtime. Study results indicated a significant increase of technology use at bedtime among those participants with an elevated BMI (Fuller et al., 2018). The information on cell phone use and deficient sleep has also been noted in qualitative literature. In a study of 27 adolescents aged 14-18 years of age, Quante et al. (2019a) noted that participants cited that cell phones and electronic use prior to bedtime as a barrier to

sufficient sleep; however, participants reported using cell phones and keeping the phones in their rooms regardless of their knowledge of decreased sleep.

Summary

As sleep quality and the possible effect on appetite, dietary intake, and BMI in adolescents is less studied than sleep quantity (Arora et al., 2018; Hayes et al., 2018), this research focused on the area of sleep quality. As there are some inconsistencies in the literature and fewer research studies specific to sleep quality and BMI (Agostini et al., 2018; Chaput et al., 2018; Hayes et al., 2018; Kracht et al., 2019), this study was designed to provide additional information to this gap in research. As compared to sleep quantity, fewer studies were found that address the effect of sleep quality on adolescent's appetite (Goldschmidt, 2020 Kracht et al., 2019), dietary intake, and BMI levels (Arora et al., 2018; Fatima et al., 2016; Pacheco et al., 2017), this study provided additional information to these areas and provide a more comprehensive approach to the adolescent obesity epidemic.

Although the precise amount of decreased sleep quantity is not consistent, decreased sleep quantity has been associated with poor diet quality (Beebe et al., 2012; Goldschmidt, 2020). Also, there are inconsistencies in the literature regarding sleep quantity and adolescent obesity (Felso et el., 2017). Furthermore, inconsistencies have been noted in the literature regarding sleep quantity and appetite (Landis et al., 2009; Simon et al., 2015). This research addressed this inconsistency

This study provided a more comprehensive assessment of adolescent sleep including, sleep quality, sleep quantity, sleep latency, and sleep hygiene. By assessing several demographics and sleep variables, this study was designed to provide a more thorough

examination of how sleep relates to adolescent obesity and weight-related behaviors in this age group.

CHAPTER 3

METHODS

The purpose of this study was to examine the effect of demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene on dietary intake, appetite, dietary intake, and BMI levels of adolescent youth. The hypothesis of this study was that poor sleep quality would affect appetite, dietary intake, body mass index in adolescent youth. The following specific aims were examined:

1. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene of adolescents and determine the levels of appetite, dietary intake, and BMI levels of adolescents.
2. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene and determine the relationship to appetite, dietary intake, and BMI levels of adolescents.
3. To determine to what extent demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene affect appetite, dietary intake, and BMI levels of adolescents.

This chapter presents the procedures for study design, sample and setting, instruments, data collection, procedures, sleep quality, sleep quantity, and sleep latency, data management and analysis, and human subject protection.

Study Design

Previous research is limited for a comprehensive approach to sleep quality, sleep quantity, sleep latency, and sleep hygiene in relation to appetite, dietary intake, and BMI levels among adolescents. This prospective correlational study was designed to achieve the aforementioned specific aims.

First, Institutional Review Board (IRB) approval was sought from the University of North Dakota. Due to the COVID-19 pandemic, this research took place as a non-contact only. Upon IRB approval, recruitment began. See Appendix A for IRB approval.

Ads were purchased and emailed to churches of various denominations in eastern North Dakota and west-central Minnesota. Potential participants and/or their parent(s) responded to the ad taken out in church bulletins or emails sent to the youth and/or parent(s) by the church. See Appendix C for the church ad. Potential participants who expressed interest in completing the study then contacted the researcher via phone, text, or email, which was included on the church ad. During this initial informational discussion, adolescents and parent(s) were informed of the study purpose as well as inclusion and exclusion criteria, which was included on the health assessment form. Participants and their parent(s) were informed that participation was voluntary, and that they could withdraw at any time. Procedures were explained by the researcher and all participant and parental questions were addressed. After successful recruitment, parental consent and participant assent was obtained, usually by email. See Appendix B for the Consent/Assent form. The researcher emailed the consent/assent form to the parent. A digital signature was approved by IRB. After reviewing study expectations and protocols, health assessments, demographic data, and anthropometric measures were recorded for each participant. After receiving a signed consent/assent form, the researcher then mailed a Fitbit to the participant at their home address. Instructions verbally conveyed during the initial phone call stated to wear the Fitbit for five days and nights. Written instructions were also included in the envelope with the Fitbit. See Appendix D for letter included and mailed with Fitbit. In addition to the Fitbit, questionnaires were also mailed to the participant with instructions to complete the questionnaires on the last day of the study, when the Fitbits were removed. Following five days

and nights of sleep monitoring, participants then mailed the Fitbits and the completed questionnaires back to the researcher's home address in a prepaid envelope. Upon receiving the Fitbit via U.S. Postal Service, the recorded sleep data from the Fitbit was downloaded for analysis. The dietary screener, appetite scale, sleep questionnaire, and sleep hygiene practice scale, were also mailed to this researcher with the Fitbit in the same prepaid envelope. Upon receiving all dietary screeners, the dietary screeners were mailed to NutritionQuest for analysis. The dietary analysis was then emailed to the researcher by NutritionQuest. After completion of the dietary analysis, the dietary screeners were then mailed back from NutritionQuest to the researcher. The data from these questionnaires and Fitbits was entered into Statistical Package for Social Sciences (SPSS) version 26 by the researcher for analysis.

It was estimated that recruitment of participants would take three months. Recruitment of participants took a total of 12 weeks and completion of data collection took a total of 13 weeks.

Sample

An adolescent population was the focus for this research as the effects of adolescent sleep quality, sleep quantity, and sleep latency. As compared to diet and physical activity, sleep is less frequently researched in adolescent obesity (Arora et al., 2018; Brown et al., 2015; Hayes et al., 2018).

Participants were selected from area churches in the upper Midwestern U. S., specifically in eastern North Dakota and west-central Minnesota. As adolescents and/or parent(s) who read the ad and were interested in participating in the study, a convenient sample was used (Polit & Beck, 2017). According to the U. S. Census Bureau (2019), the estimated size of eastern North Dakota and west-central Minnesota with the target churches was over 100,000 individuals. There were estimated to be 3,600 high school students and 3,900 middle school students from the upper

Midwestern community in eastern North Dakota and west-central Minnesota who would be potentially available for participation in this study; however, it is estimated that only 25 – 50% of those youth attend church or religious education regularly. Therefore, those participants from outside of the church were recruited using snowball recruitment within the community. It was also estimated that 25% of the participants would not meet the inclusion criteria (Blake et al., 2017; Hart et al., 2013). Therefore, 3,750 potential participants were anticipated to be eligible for this study.

According to the U. S. Census Bureau (2019), estimates of the proposed study site indicate the sample population consists of 85% white, 10% Hispanic, and 5% African American individuals. This is a representative sample of adolescents in the selected area of eastern North Dakota and west-central Minnesota of the upper Midwestern U. S. It was anticipated that minority and non-minority adolescents would participate at the same rate. The proposed study sites' representatives indicated an equal split of boys and girls. In addition, little economic or ethnic diversity exists in the community. These factors limited the generalizability of the study results (Polit & Beck, 2017).

Inclusion

Eligible participants included both males and females. Inclusion criteria included participants who: (1) had the ability to read and understand English at a 5th grade level, (2) were 12-18 years of age at the time of the study, (3) had given parental and/or legal guardian consent and participant assent, (4) were not taking any medications that may affect sleep, (5) had no medical or psychiatric diagnosis. Additionally, (6) adolescents needed keep their usual sleep habits at their usual place of sleep.

Exclusion

Exclusion criteria for this study included (1) being unable to read or understand English, (Both parents and/or legal guardians as well as the participant had to be able to read and understand English to ensure the participants were adequately informed about the research study and the potential risks and benefits of participation); (2) not being 12 -18 years of age at the time of the study, (3) not having parental and/or legal guardian consent, (4) taking any medication that affects sleep, (5) a diagnosis of a medical or psychiatric condition, including sleep disorder, or (6) any activity that would affect usual sleep habits such as a vacation.

Human Subject Protection

As this study took place during the global COVID-19 pandemic, a 'no contact' study took place. Upon IRB approval from the University of North Dakota (Appendix A), participants were recruited for this prospective correlational study. Participants and/or their parent(s) read the ad taken out in the church bulletins or emails. If potential participants were interested in the study, the potential participant and/or their parent(s) contacted this research via phone or email. During initial the initial phone call or email, potential participants and their parent(s) were made aware that participation was voluntary, and they were free to withdraw at any time without any negative consequences. Participants and parents were also provided with a detailed description of the study. The researcher personally delivered the information in both written and verbal form to ensure accuracy of information. Informed consent was obtained from parents, and assent was obtained from the participants (Appendix B). When email consent and assent was not an option, two paper copies of the consent/assent form were mailed from this researcher to the participant and their parent(s). Parents and participants were asked to sign and return one consent/assent form in a prepaid envelope with this researcher's home address. The participant's address was

not included on the pre-paid envelope. The parents were also instructed to keep the second copy for their own records. A unique, random identification code was linked to the consent/assent forms. If either parental consent or participant assent was missing, the participant was not allowed to complete the study. This is consistent with National Institute of Health (2019b) recommendations.

Participants were also assigned a second random identification number for study purposes. No names or identifiable information were linked to this code. Information from the demographic form, anthropometric data, baseline health assessment, Fitbit, Appetite Visual Analog Scale, Pittsburgh Sleep Quality Index, Adolescent Sleep Hygiene Practice Scale, and the Block Kids Food Screener were linked to the second random identification number and not the participant. The researcher de-identified all data, including all consent/assent forms as well as all Fitbit data and all questionnaires. Data from the study was not reported individually, but all data was reported in aggregate and in de-identified form.

All study materials were stored securely in accordance with university policy. Consent forms that were obtained via emailed were printed by this researcher. All email correspondence took place from a state issued computer using a university email address. All correspondence emails were deleted per university policy. Paper copies of all consent and assent forms are kept in a state university locked office in a locked cabinet. All questionnaires and study information were coded and kept in a separate locked office and on a computer with password security. Only researchers involved in the study have access to the information. Data from this study was not reported individually, but as a group. Confidentiality was maintained at all times. All information was placed into SPSS on this researcher's state assigned computer, with password only access. After completion of the research, data has been stored and will be subsequently destroyed per

university policy. To compensate for any inconveniences, a $25.00 gift card for completion of the sleep data and questionnaires was mailed to participants upon completion of the study.

Inclusion of Women. According to the U. S. Census Bureau (2019), approximately 50% of the potential participants in the area would be female; therefore, equal representation of female participants was anticipated.

Inclusion of Minorities. As previously noted, the area in eastern North Dakota and west-central Minnesota in the upper Midwestern U. S. consists of approximate the 85% white, 10% Hispanic, and 5% African American individuals (U.S. Census Bureau, 2019).

Inclusion of Children. As the focus of this proposed study was adolescents, this group was included in the study (National Institute of Health, 2019b).

Sample Size

Using Power Analysis and information from previous research, a sample size of 77 participants was determined. Details from the previous research and power analysis are explained in the following subsections.

Previous Research Participation and Attrition Rates

As previously noted, there are estimated to be 3,600 high school students and 3,900 middle school students from the in eastern North Dakota and west-central Minnesota community who could potentially be available for participation in this study (U. S. Census Bureau, 2019). Estimates from previous studies indicated approximately 35%-65% of the adolescents would not meet eligibility criteria (Blake et al., 2017; Hart et al., 2013).

Participation rates were noted from previous studies that included adolescents wearing sleep watches for one week and completing questionnaires (Jones, 2011; Pona 2015). As noted by previous research (Goldschmidt et al., 2020; Tonetti, 2008), approximately 50% of eligible

individuals participated in studies that included adolescents wearing watches and completing questionnaires, although another study noted a 35% participation rate (Sirard & Slater, 2009).

An attrition rate of 10%-15% had occurred in previous studies of youth wearing sleep watches for one week (Jones, 2011; Pona, 2015; Sirard & Slater, 2009). According to other previous sleep studies, an attrition rate of 10% also occurred (Goldschmidt et al., 2020; Mi et al., 2019). Thus, the researcher enrolled a 10% rate of oversampling to potentially compensate for poor attrition. Additional participants were sought from the community by contacting and emailing additional churches in order to obtain a large enough sample size to achieve statistical power.

Power Analysis

A power analysis was conducted using G*Power version 3.0.10 (UCLA Institute for Digital Research & Education, 2019). Correlational and regression analysis was used along with an alpha of .05 and a statistical power of .80. A small to medium effect size was used for the power analysis. Most nursing studies cannot expect effect sizes in excess of .50, and those in the range of .20 to .40 are most common (Polit & Beck, 2017). A previous study used a small to moderate effect size of .35 (Beebe et al., 2012).

From previous studies with adolescents wearing sleep watches and monitoring diets, a sample size of 41 participants was used (Beebe et al., 2012). Adult studies of participants wearing Actigraphs and completing dietary assessments have consisted of 108 participants (Norouzi et al., 2018). Studies of children wearing Actigraph watches and monitoring eating behaviors have used a sample size of 115 children (Martoni et al., 2016). Furthermore, previous studies with 75 -119 participants wearing Acitwatches were used for the total sample (Jones, 2011; Pona, 2015). Based on estimates in previous literature, a drop out of 10%-15% for a one-

week study may occur (Jones, 2011; LeMay-Russell et al., 2019; Pona, 2015). For these reasons, an oversampling of 10% additional participants was selected for entry into the study to allow for the possible attrition.

According to Polit and Beck (2017), a sample size of 77 participants was needed for a medium effect for regression analysis. Considering a 10% oversampling to compensate for possible attrition, 84 participants were sought for this research study. The researcher continued to take ads out in various churches and recruit participants until 84 participants were obtained.

Setting

Participants slept as usual at their usual place of sleep. This included sleeping in the place where participants spend most of their sleep time as well as keeping their usual sleep practices. In addition, participants consumed their usual dietary intake at home for the study five days as a natural study setting was sought. All study activities such as donning and doffing of the Fitbit, obtaining BMI levels and consent and assent, and questionnaire completion were conducted at the participant's home.

Procedure

Procedures of the study are described in the following section. Procedures for recruitment, informed consent, instruments, measurements, and data analysis were in place prior to recruitment of participants.

Recruitment

When a church bulletin only allowed for a small space, an advertisement without pictures was used. Church bulletins with more space used pictures within the ads. Potential participants and their parents read the ad in the church bulletin or email. If they were interested in participating in this study, the parents/ legal guardians and/or the participant contacted the

researcher via email, phone, or text message. As adolescents and/or parent(s) who read the ad and were interested in participating in the study, a convenient sample was used. (Polit & Beck, 2017). In addition, parents whose adolescents completed the study sent the ad via texted picture, forwarded email of the ad, or verbally informed other potential participants and their parent(s) or legal guardians of the study. Due to the snowball effect, participants outside of churches may have participated in the study. The researcher contacted churches in the selected area of eastern North Dakota and west-central Minnesota on a varying schedule over 12 weeks.

Informed Consent

If a potential participant was interested the study, the participant or their parent contacted this researcher via phone or email. After being contacted by a potential participant or parent, the researcher explained the study to the potential participant and their parent/legal guardian. The participants, their parents and/or legal guardians were provided with a detailed description of the study, including the purpose of the study.

In addition, both participant and parent(s) were contacted via phone prior to the participant starting the study. All questions by both parent(s) and participant were addressed at the time of the initial phone call. Phone calls either took place with potential participants separate from their parent(s), or the parent(s) and the potential participant participated in the same phone call with this researcher on speaker phone. Inclusion criteria for the study was discussed to determine if the potential participant was eligible to participate in the study. Once a potential participant was deemed to be eligible, complete directions for the study were provided. Additional questions after the initial phone call were answered via emails, text messages, or additional phone calls.

Informed consent and assent were obtained from the participant and their parent, usually via email. See Appendix B for the Informed Consent/Participant Assent form. If email consent and assent was not an option, the consent and assent form was sent by mail via U. S. Postal Service to the participant and/or legal guardian prior to the participant starting the study. The researcher mailed via U. S. Postal Service or emailed via the university email address the information in written form to ensure accuracy of information. If U.S. Postal Service was used to obtain informed consent, a prepaid envelope with the researcher's address was also provided to allow the participant and parent to return the signed consent/assent form. The potential participant's address was not included in the return line. A second consent/assent form was included in the envelope and verbal and written instructions asked the parent and participant to sign and date one form while retaining the second form for their personal records. Informed consent was obtained from parents and/or legal guardians with the adolescents providing informed assent. If either a parental consent form or a participant assent form was missing, the participant was not be allowed to complete the study (National Institute of Health, 2019b). Furthermore, if the researcher was unable to personally speak with both the participant and a parent or legal guardian, the participant was not allowed to complete the study. Participants and their parent(s) were made aware that participation was voluntary and that they could withdraw at any time without penalty.

Confidentiality

Study protocols were explained by the researcher and all participant and parental questions were addressed. After successful recruitment, participants were assigned a random identification number for study purposes. The consent/assent form was linked to the first random identification number. Participants were not identified by name and identifiable information was

not contained on any documents. The researcher asked for the participant's home address to mail the study materials. However, this information was not retained in any document.

Information from the demographic form, anthropometric data, baseline health assessment, Fitbit, Appetite Visual Analog Scale, Pittsburgh Sleep Quality Index, Adolescent Sleep Hygiene Practice Scale, and the Block Kids Food Screener were linked to a second random identification number and not the participant. The two random identification numbers were not linked to each other. Consent/assent forms have been kept in paper copy in a locked cabinet in a locked university office. Data from the demographic form, anthropometric data, baseline health assessment, Fitbit, Appetite Visual Analog Scale, Pittsburgh Sleep Quality Index, Adolescent Sleep Hygiene Practice Scale, and the Block Kids Food Screener have been kept in paper copy in a separate university office in a separate locked cabinet. All written materials will be destroyed per university policy. All electronic records will be destroyed per university policy.

Measurements

The study prospectively collected data using study tools that had been psychometrically analyzed and validated by the original authors. Protocols were pilot tested. All instruments had been confirmed to be reliable with a significance level of $p < .05$.

Demographic Information

Demographic information was collected at the time of enrollment. Age was measured in years stated by the participant or parent. Age was noted as the participants age at the time of the study. Grade in school was measured as the grade that the student would be entering during the upcoming fall. Those who had just graduated high school were noted as graduated. Place of residence was reported as house, apartment, or other. Gender was stated as either male, female, or prefer not to answer. Race or ethnic background was stated by the participants or parent, and

recorded as white, not of Hispanic origin; black, not of Hispanic origin; American Indian/Alaskan native; Asian; Pacific Islander; other; or prefer not to answer. See Appendix E for the Demographic form.

Baseline Health Assessment

A health assessment questionnaire developed by Doenges (2009) was used for this study. This health assessment questionnaire was also used as a screening tool to determine inclusion and exclusion criteria. Conditions, such as neurologic, endocrine, cardiac, respiratory, gastrointestinal, urinary, sensory, integumentary, psychiatric, and metabolic disorders that might affect study outcomes were assessed. In addition, medications and allergies were also assessed. Any prescription medication, any over the counter medications, any medical or psychological diagnosis, and any allergies were included on the health assessment. See Appendix F for the Health Assessment form.

Body Mass Index

Anthropometrics were included on the health assessment form. Due to the no contact nature of the study, height and weight were self-reported by the participant or parent. Anthropometric data was given as an estimate based on parent and/or participant self-reported a personal measurement of the participants using home equipment such as a tape measure or home scales. All participant weights were self-reported in pounds, and all participant heights were self-reported feet/inches. Weight and height were converted to kilograms and meters using standard methods. Body mass index is body weight in kilograms divided by the square of height in meters (CDC, 2019). To determine BMI levels, the height-to-weight (kg/m^2) ratio was used. Body mass indices were calculated using the BMI Percentile Calculator for Child and Teen (CDC, 2020). Adolescent participants were noted as underweight, less than the 5^{th} percentile; healthy weight,

5th percentile up to the 85th percentile; overweight, 85th to less than the 95th percentile; and obese, equal to or greater than the 95th percentile according to CDC guideline (CDC, 2019). An overview of the study variables and instruments are presented in Table 2.

Table 2

Study Variables and Instruments

Variable	Instrument	Data Source	Timing of measurement
BMI (kg/m²)	none	Parent or participant stated height and weight	Prior to starting study
Sleep quality	Fitbit data report	Fitbit	5 days and nights
	PSQI	Questionnaire	Last day of study upon removing Fitbit
	Adolescent Sleep Hygiene Practice Scale	Questionnaire	Last day of study upon removing Fitbit
Sleep quantity	Fitbit data report	Fitbit	5 days and nights
	PSQI	Questionnaire	Last day of study upon removing Fitbit
	Adolescent Sleep Hygiene Practice Scale	Questionnaire	Last day of study upon removing Fitbit
Sleep latency	Fitbit data report	Fitbit	5 days and nights
	PSQI	Questionnaire	Last day of study upon removing Fitbit
	Adolescent Sleep Hygiene Practice Scale	Questionnaire	Last day of study upon removing Fitbit
Sleep hygiene	Adolescent Sleep Hygiene Practice Scale	Questionnaire	Last day of study upon removing Fitbit

Appetite	Appetite Visual Analog Scale	Questionnaire	Last day of study upon removing Fitbit
Dietary intake	Block Kids Food Screener	Questionnaire	Last day of study upon removing Fitbit

Sleep Measures

This study sought a more comprehensive assessment of sleep in adolescents. Therefore, sleep quality, sleep quantity, and sleep latency were assessed using multiple methods of assessment.

Fitbit

Overview. A Fitbit is a small, portable wristwatch-like devices. Fitbits are used to track a variety of metrics including sleep, step counts, and calories burned. The Fitbit measures sleep quality, quantity, and latency by estimating a combination of movements and heart rate patterns. The length of time between the movements is indicative of sleep. While sleeping, the Fitbit tracks beat to beat changes of the heart rate, known as heart rate variability, to more precisely measure sleep. The Fitbit then calculates a sleep quality number, by dividing the number of minutes slept by the number of minutes spent in bed or the percentage of time spent sleeping. Sleep quantity and sleep latency are displayed in minutes as time spent sleeping and time awake respectively. Sleep quality was calculated using the sleep data from the Fitbit. In addition to sleep quality, quantity, and latency, the Fitbit can also be used to track sleep cycles. Each day, the Fitbit recorded the sleep measures by the Fitbit and displayed this number on both the daily Fitbit data report as well as the 5 day and night Fitbit data report that was downloaded to an excel spreadsheet (Fitbit Health Solutions, 2019).

Fitbits use Bluetooth Low Energy technology to sync with certain computers. The Fitbit will sync information with the computer every time the app is open on the computer (Fitbit Health Solutions, 2019). For this study, the Fitbit Charge 3 was used to monitor sleep measures and activity. The information stored in a Fitbit can be retrieved for 30 days. Fitbits are a cost-effective tool for estimating sleep and physical activity (Mead et al., 2019). Fitbit devices are the most common consumer monitors used in published work (89%), clinical trials (83%) and NIH-funded research (95%) (Wright et al., 2017).

Reliability and Validity. In a study comparing Fitbits and Actiwatches in 58 adolescents, researchers found that both devices underestimated total sleep time by 47 minutes and 38 minutes, respectively. The sensitivity for both devises was noted to be 95% when the sensitivity was set for high threshold and 90% when set to standard threshold. The wake specificity of the Fitbit was > 0.88 (Lee et al., 2019). In a similar study of 20 adults, researchers found the Fitbit to have a 92.1% sensitivity and 88.5% accuracy for total sleep time and efficiency (Svensson et al., 2019). In a study of adult participants, researchers compared Fitbits and polysomnography in good sleepers and individuals with insomnia. Results of this study found that the Fitbit measured total sleep time accurately as compared to polysomnography with a 1.7% difference in readings between the two instruments (Kang, et al., 2017). Finally, a study of 25 adults revealed no significant differences between Fitbits, Actigraphs, and polysomnography in measuring total sleep time, wake episodes, sleep latency, and sleep efficiency (Hamill, et al., 2019).

Study Use. The Fitbit sleep sensitivity was set for high threshold as this has been shown to achieve the most accurate sleep data (Lee et al., 2019). For this study, the Fitbit recorded the following data: (1) sleep quality, as the number of minutes slept per night divided by the total

length of time spent in bed; (2) sleep quantity, the minutes slept in the five days and nights, and (3) sleep latency, time in minutes for each participant to achieve the transition from wakefulness to sleep.

Pittsburgh Sleep Quality Index

Overview. The Pittsburgh Sleep Quality Index is a validated self-report measure of subjective sleep quality and sleep disturbance. The Pittsburgh Sleep Quality Index has a Likert scale of 19 items to assess sleep quality, sleep quantity, and sleep latency. The Pittsburgh Sleep Quality Index scale contains seven component scores with a range of 0 (good sleep efficiency) to 3 (poor sleep efficiency). Summing all seven scores provides a global sleep quality score for each participant. Pittsburgh Sleep Quality Index scores have a range of 0-21 (Buysse et al., 1989; Luyster et al., 2016). A Pittsburgh Sleep Quality Index score greater than 5 indicates poor sleep quality (Shirvastava et al., 2014). The test–retest reliability of this questionnaire is reported as r = 0.85 over 4 weeks in adult studies (Buysse et al., 1989). See Appendix G for the Pittsburgh Sleep Quality Index questionnaire.

Reliability and Validity. The Pittsburgh Sleep Quality Index has been validated in adolescents with internal consistency = 0.72 and good test-retest reliability = 0.81 (de la Vega et al., 2015). Additional studies have noted the Pittsburgh Sleep Quality Index to have a strong internal consistency (Cronbach's alpha = 0.83) across its 7 subscales, which measures subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction.

Scoring. The Pittsburgh Sleep Quality Index is scored in the following manner.

- First, the score of question number 9, which is the participant's rating of sleep quality on a 0-3 scale, is noted.

- Second, the information from question 2 is added, which asks how many minutes participants feel it takes them to fall asleep at night. The information is given a numeric value in the following manner: (< 15 min (0), 16-30 min (1), 31-60 min (2), >60 (3)).
- Next, question number 4, which is number of hours the participant sleeps, is added. This information is given a value in the following manner: (>7(0), 6-7(1), 5-6(2), < (3).
- Next, the reported sleep hours slept are divided by reported hours in bed.
- Then the sum of environment scores, all rated on a scale of 0 = not in the past month, 1 = less than once a week, 2 = once or twice a week, and 3 = three or more times a week, are added. Components of the environmental area include difficulty getting to sleep, night waking, use of bathroom, breathing, snoring, being hot or cold, having bad dreams, experiencing pain or other reasons.
- Finally, the last questions are added in in the same numeric 0-3 scale previously described. Elements of these questions include use of medications, daytime sleepiness, and lack of enthusiasm.

A global cutoff score of 5 on all components correctly identified 88.5% of all patients and controls (Cohen's kappa = .75, $p < .001$) (Pona, 2015). For this study, a Pittsburgh Sleep Quality Index score of 5 of higher indicated poor sleep quality, and a score of less than 5 indicated good quality sleep.

Study Use. The Pittsburgh Sleep Quality Index instructions stated to complete the Pittsburgh Sleep Quality Index on the last day of the study. The instructions on the Pittsburgh Sleep Quality Index, which were on the same page as the questions, stated to relate the participants usual sleep habits during the past month only. Data from the Pittsburgh Sleep Quality Index was used to calculate a global sleep quality score.

Adolescent Sleep Hygiene Practice Scale

Overview. The Adolescent Sleep Hygiene Practice Scale was used to assess sleep hygiene. The Adolescent Sleep Hygiene Practice Scale was developed for youth age greater than 12 years (de Bruin et al., 2014). This 33-item scale considers physiological, cognitive, behavioral, environmental, sleep stability, daytime sleep, substance factors, and sleep routines. See Appendix I for the Adolescent Sleep Hygiene Practice Scale.

The Adolescent Sleep Hygiene Practice scale has 8 subscale scores. Questions regarding caffeine, late exercise, drinking water prior to sleeping, going to bed with a stomach ache or hungry on the questionnaire address physiological factors; questions about gaming, watching television or reading prior to bedtime address behavioral factors; questions such as going to bed thinking of things to do the next day, replaying the day's events, and worrying about home address cognitive factors; questions such as a hot or cold room, falling asleep to music, or being in a bright room address environmental factors; questions about weekend sleep address sleep stability factors; questions regarding napping address daytime sleepiness; questions on tobacco, alcohol, and smoking address substance factors; one question addresses a bedtime routine. A total adolescent sleep hygiene score is calculated by determining the mean of all 8 subscales (de Bruin et al., 2014). An additional question regarding cell phones in the bedroom was included; this question was not tested for reliability or validity. Therefore, this questionnaire consisted of a total of 34 questions.

Reliability and Validity. In a study of 514 adolescents, Actiwatches were worn and sleep diaries were completed for 7 days. Internal consistency was alpha = 0.84; subscale alphas were physiological alpha 0.60; behavioral alpha = 0.62; cognitive alpha = 0.81; environment alpha = 0.61; sleep stability alpha = 0.68; daytime sleep alpha = 0.68. This scale was also noted

to have an internal consistency, Cronbach's alpha = 0.67 in Dutch adolescents (de Bruin et al., 2014).

Scoring. Participants received directions on the same page as the questionnaire. These directions applied to all 33 responses. Directions on this questionnaire stated to choose how often the following sleep hygiene practices happened int the past week. Answers ranged from:

- Never – this has not happened
- Once in Awhile – happened 20% of the time
- Sometimes – happened 40% of the time
- Quite Often – happened 60% of the time
- Frequently, if not Always – happened 80% of the time
- Always – happened 100% of the time

Study Use. Instructions stated to complete the Adolescent Sleep Hygiene Practice Scale on the last day of the study. For this study, an additional question on cell phone use was included as question number 34. This question was not validated for reliability or validity. Physiological factors were noted by calculating the mean of questions 3, 10, 12, 18, and 19. Behavioral factors were noted by calculating the mean of questions 11, 13, and 28. Cognitive factors were noted by calculating the mean of questions 9, 14, 15, 16, 17, and 29. Environmental factors were found by calculating the mean of questions 20, 21, 22, 23, and 24. Stability factors were found by calculating the mean of questions 30, 32, and 33. Daytime sleep factors were found by calculating the mean of questions 1 and 4. Substance factors were found by calculating the mean of questions 6 and 7; and routine factors were calculated by question 27. A total Adolescent Sleep Hygiene Scale score was found by calculating the mean of all 8 subscales (de Bruin et al., 2014).

Sleep Quality

Sleep quality was measured by the Fitbit. The Fitbit measures sleep quality by measuring small movements, such as rolling over while sleeping. The Fitbit also uses heart rate monitoring to measure sleep data to develop an accurate assessment of sleep and sleep quality. The length of time between the movements are indicative of sleep. While sleeping, the Fitbit tracks beat to beat changes of the heart rate, known as heart rate variability, to measure sleep more precisely. The Fitbit then calculates a sleep quality number, by dividing the number of minutes slept by the number of minutes spent in bed or the percentage of time spent sleeping (Fitbit Health Solutions, 2019). Sleep quality was calculated using the sleep data from the Fitbit. Each day, the Fitbit recorded the sleep quality measured by the Fitbit and displayed this number on both the daily Fitbit data report as well as the 5 day and night Fitbit data report that was downloaded to an excel spreadsheet. A sleep quality score above 85% was considered normal sleep quality, and a sleep quality score of less than 85% was considered to be poor sleep quality (Fitbit Health Solutions, 2019).

Sleep quality was also verified by the Pittsburgh Sleep Quality Index and the Adolescent Sleep Hygiene Practice Scale. Sleep quality was measured as the percentage of time spent asleep while in bed, and sleep quality was calculated by dividing the number of minutes slept by the number of minutes spent in bed (National Sleep Foundation, 2019b; Shirvastava et al., 2014). Data from the Pittsburgh Sleep Quality Index was used to calculate a global sleep quality score. A global Pittsburgh Sleep Quality Index score of 5 or greater indicates poor sleep quality while a global Pittsburgh Sleep Quality Index score of less than 5 indicates normal sleep quality (Shirvastava et al., 2014).

Sleep Quantity

Sleep quantity was measured each night by the Fitbit by subtracting the start sleep time from the wake-up time and is presented as the total amount of sleep minutes. In addition, wake minutes during the night were measured by the Fitbit. Wake minutes during the night were also subtracted from the total sleep time. This data was measured by the Fitbit and verified by the Pittsburgh Sleep Quality Index and the Adolescent Sleep Hygiene Practice Scale. The Fitbit measures sleep quantity by measuring small movements. The Fitbit also uses heart rate monitoring to measure sleep data to develop an accurate assessment of sleep and sleep minutes (Fitbit Health Solutions, 2019). Sleep quantity of 8 -10 hours per night in adolescents is considered adequate or normal sleep time. Sleep quantity of less than 8 hours per night in adolescents is considered inadequate or short sleep time. Sleep time greater than 10 hours per night in adolescents is considered excessive sleep time (Hirshkowitz et al., 2015; Paruthi, et al., 2016).

For the study, naptime was also calculated. These naps were captured by the Fitbit. Questions on the Pittsburgh Sleep Quality Index and Adolescent Sleep Hygiene Practice Scale also addressed napping. Night sleep time in minutes and total sleep time, which included night sleep time in minutes plus nap sleep time in minutes, were calculated.

Sleep Latency

Sleep latency was calculated each night by subtracting the time the individual goes to bed to the sleep start time. This data was also measured by the Fitbit. The Fitbit measures sleep latency by measuring small movements, such as rolling over. Moreover, the Fitbit also uses heart rate monitoring to measure sleep data to develop an accurate assessment of sleep and sleep latency (Fitbit Health Solutions, 2019). Each day, the Fitbit recorded the sleep latency measured

by the Fitbit and displayed this number in minutes on the daily Fitbit data report. In addition, sleep latency was verified by the Pittsburgh Sleep Quality Index and the Adolescent Sleep Hygiene Practice Scale. Falling asleep in less than 8 minutes at night is considered short sleep latency for adolescents; falling asleep in 8-20 minutes at night is considered normal sleep latency in adolescents; falling asleep in greater than 20 minutes at night is considered prolonged sleep latency in adolescents (National Sleep Foundation, 2019b; Shirvastava et al., 2014).

Physical Activity

In addition to sleep measures, the Fitbit is also able to monitor steps per day and active minutes, although the active minutes are only recorded in bouts of activity of 10 minutes or longer (Fitbit Health Solutions, 2019).

Appetite

Assessment of the adolescent's perceived appetite was measured by an Appetite Visual Analog Scale developed by Mood (1992). The Visual Analog Scale has been shown to accurately relate food intake to feelings of hunger and fullness in young adults, although it has been studied less in adolescents. Additionally, the Appetite Visual Analog Scale has been used to determine appetite in response to sleep, diet, and exercise. As noted in literature, a visual analog scale is the best approach to assess satiety and appetite (Douglas and Leidy, 2019). The alpha reliability coefficient for this scale = 0.84 when used with young adult populations (Parker et al., 2004). See Appendix H for the Appetite Visual Analog Scale.

Directions on the Appetite Visual Analog questionnaire stated to answer all 10 questions by placing an "X" on the horizontal line that corresponds to what the participant felt during the study week. The participants rated sensations of fullness and hunger by using anchors to mark a "X" on the horizontal line that ranged from 'not at all 'to 'a great deal' to indicate varying

degrees of hunger, appetite, and related information. Vertical lines further to the left and right on the horizontal line indicated that the participant did not feel that sensation at all or felt the sensation strongly, respectively. Participants were instructed to indicate their overall appetites over a period of 5 days.

Study Scoring

To compute a calculated number, the response line was measured in millimeters with each line for all answers measuring 55 millimeters, with 'not at all' measuring at the 0 point and 'a great deal' measuring at the 55-millimeter point. Then this researcher measured the exact point of the participant's "X" on the line.

Dietary Intake

Dietary intake was assessed by the Block Kids Food Screener. See Appendix J for the Block Kids Food Screener. The questionnaire provided information about recent individual food intake, and the questionnaire has a database specifically developed for use with this questionnaire. The Block Kids Food Screener includes not only beverages, but also food groups and food servings. The questionnaire includes 42 items, and the food list for this questionnaire was developed form the National Health and Nutrition Examination Survey dietary recall data (NutritionQuest, 2019). In a study of 99 adolescents, study results indicated that the Block Kids Food Screener correlates well with children over 12 years of age and has reliability scores of up to .88 (Hunsberger, et al., 2012) for most nutrients and food groups when used with adolescents (Webber Cullen et al., 2008).

Study Scoring

Directions were printed at the top of the page of the Block Kids Food Screener. Directions stated to think about everything the participants ate or drank in the past week,

including breakfast, lunch, dinner, as well as other times such as while watching TV and at bedtime. Instructions also stated to use a pencil to complete the survey. The researcher then coded the questionnaire with a unique number for each participant. The questionnaires were then mailed to NutritionQuest for their dietary intake analysis. Upon completion of the analysis, NutritionQuest emailed the completed dietary information back to the researcher. Macronutrient amounts and analysis were completed by NutritionQuest. Calories from protein, fat, and carbohydrates were calculated using standard methods. Total calories were calculated by adding all calories from all macronutrients (CDC, 2020).

Data Collection

Prior to being admitted into the study, participants and/or parent(s) verbally completed a demographic survey and health assessment questionnaire developed by Doenges (2009). Health assessment questionnaires were used to determine inclusion and exclusion criteria. The health questionnaires were completed by the participant and/or parent, frequently with both parent and participant on the phone at the same time. Conditions, such as neurologic, endocrine, cardiac, respiratory, gastrointestinal, urinary, sensory, integumentary, psychiatric, and metabolic disorders that might affect study outcomes were assessed during the initial health assessment. In addition, medications and allergies were also assessed. Participants or parents were asked to provide a list of any prescription medication, any over the counter medications, any medical or psychological diagnosis, and any allergies. The assessment results were reviewed by this researcher to identify any conditions or medications that might compromise the study variables. For example, a diagnosis of a medical or psychological condition was an exclusion criterion for the study.

During the phone conversation or emails prior to starting the study, anthropometrics and baseline health assessments were obtained. Due to the no contact nature of the study, health assessments, height, and weight were self-reported by the participant or parent, and the researcher was unable to validate any measurements. Anthropometric data was given based on parent and/or participant estimates. Parent and/or participant also personally measured the participants using home equipment such as a tape measure or home scales. Additionally, demographic data including age, sex, ethnicity, and educational level were obtained at this time. See Appendix F for the Health Assessment form.

After completing the demographic and health assessment form, the researcher asked for the participant's or parent's home address and email address. Informed consent and assent were obtained either by email or U. S. mail. Once the signed informed consent and assent forms were received, the researcher mailed a package to the participant that contained a Fitbit and a return address mailing envelope with paid postage and the researcher's address on the prepaid envelope. Prior to mailing the Fitbit to the participants, each Fitbit was cleaned per manufacture guidelines. As 30 Fitbits were used for 84 participants, multiple Fitbits were returned and cleaned per manufactural guidelines multiple times. Also, the Fitbits were recharged by this researcher. In addition, the surveys for the study were also included in the package. These paper surveys included the Appetite Visual Analog Scale, Pittsburgh Sleep Quality Index, Adolescent Sleep Hygiene Practice Scale, and the Block Kids Food Screener Directions. Written instructions were included to donn the Fitbit for 5 days and 5 nights and to leave the Fitbit on at all times (see Appendix D). Verbal instructions during the phone call included that the Fitbit could be removed during specific physical activity or during periods of time when the Fitbit would be completely submerged in water for 30 minutes (Fitbit Health Solutions, 2019; Ustinov & Lichstein, 2013).

Also, questionnaires were to be completed at the end of the five days. Directions were to mail the Fitbit and all completed questionnaires using the prepaid envelope, which included the researcher's address. This return envelope did not contain the participants' home address, and instructions were given to the participants and their parents to not include their home address on the return envelope. Information was also included to contact this researcher via email, text, or phone if any questions arose during the study. Upon return of the Fitbit and questionnaires, the researcher mailed a study incentive to the participant.

Participants slept at their usual place of sleep (the place where participants spent most of their sleep time). In addition, participants consumed their usual dietary intakes for the study. All study activities such as donning and doffing of Fitbits, signing consent and assent forms, and completion of questionnaires took place at the participant's home. As vacations could alter the participant's usual sleep routine, the participants and their parent(s) were told to complete the study during a time of regular sleep practices and not during vacations. Other extraneous variables such as environmental noise, disturbed sleep, or use of cell phones in the bedroom were considered to be usual sleep pattern and were not controlled for this study. Use of cell phones in the bedroom was included on the Adolescent Sleep Hygiene Practice questionnaire. Participants were advised to consume their usual diet for the duration of the study. The length of the study was five total nights. As noted by previous studies, 4 - 5 nights provides sufficient information on sleep quality, sleep quantity, and sleep latency in adolescents (Landis et al., 2009; Lee & Suen, 2017; Short et al., 2017; Sirard & Slater, 2009; Ustinov & Lichstein, 2013).

On the last day of the study, the Fitbits were removed by the participants and mailed back to the researcher in the pre-paid envelope. This return envelope did not contain the participants home address, and verbal instructions were given to the participants and their parents to not

include their home address on the return envelope. The study questionnaires, which included the Pittsburgh Sleep Quality Index, Appetite Visual Analog Scale, Adolescent Sleep Hygiene Practice Scales, and Block Kids Food Screener, were completed on the last day of the study. These questionnaires were mailed back to the researcher along with the Fitbit in the same prepaid envelope. Upon return of the Fitbit and questionnaires, the researcher mailed a study incentive to the participant at their home address.

Incentive

Upon return of the Fitbit and questionnaires, a study incentive was mailed to the participant. The study participants received a $25.00 gift card stipend upon completion of the study week. Funding for the stipend was provided by the ND EPSCoR Seed Grant. Upon successful completion of wearing the Fitbit for 5 days and 5 nights and successful completion of the surveys and return of the Fitbit and surveys via mail, the participants were mailed the $25.00 gift card.

Data Analysis

The Fitbit was removed on the last day of the study and mailed back to the researcher in the addressed pre-paid envelope. Upon receiving the Fitbit, data were downloaded for analysis using software according to the user manual. The Fitbit measured sleep data in minutes. Sleep quality, sleep quantity, and sleep latency were analyzed using sleep minutes as recorded on Fitbit (Fitbit Health Solutions, 2019). Data from the Fitbit, including a sleep quality numerical value, sleep quantity minutes, and sleep latency minutes, were entered into SPSS version 26 by the researcher. Data were confirmed with double entry procedure to reduce error rates.

Upon receiving the completed questionnaires from the Post Office, the researcher entered the data from the Pittsburgh Sleep Quality Index surveys into SPSS Version 26. Sleep

data were also analyzed with Pittsburgh Sleep Quality Index and Adolescent Sleep Hygiene Practice Scale. The Adolescent Sleep Hygiene Practice Scale was analyzed by all 8 subscales as well as a mean of all 8 subscales for a total sleep hygiene score. Sleep data were analyzed using the SPSS statistical computer program Version 26. Data were confirmed with double entry procedure to reduce error rates. The statistical significance was set at $p < .05$. BMI levels were calculated using the equation weight/height^2 (kg/m^2). Analysis of Pittsburgh Sleep Quality Index, Appetite Visual Analog Scale, Adolescent Sleep Hygiene Practice Scale, and the Block Kids Food Screener were conducted. All data from questionaries were entered into SPSS by the researcher. Data entry was double checked for accuracy, and measurement on the Appetite Visual Analog Scale were measured twice for accuracy. Final sleep measurements were calculated to determine the effect of the participants' sleep quality, sleep quantity, and sleep latency on appetite, dietary intake, and BMI levels.

Missing Data

Data analysis strategies are described for management of missing data and outliers Frequency and explorative techniques were used to evaluate data for accuracy. In addition, these same methods were used to evaluate missing data and outliers.

Fitbit

As noted in previous studies, the reliability of Fitbit was unscorable with excessive missing data (Fitbit Health Solutions, 2019). Previous studies have used 20 continuous minutes of no data from the Actiwatches and Fitbits as times when the device is not being worn, and these data points were eliminated and not used for calculations. Furthermore, these studies have remarked there is no consistent format for addressing missing data with wearable devices (Lee & Suen, 2017; Ustinov & Lichstein, 2013).

All demographic and health assessment information, including height and weight, were taken by the researcher with no missing data identified. Missing data from the Appetite Visual Analog scale was calculated by default pairwise deletion. Six of the Block Kids Food Screener questionnaires were completed in pen and not pencil as the instructions stated. In order to retain data, questionnaires were copied with the participant answers precisely as the participants answered. These answers were placed on the questionnaire in pencil. All participants completed the Block Food Frequency questionnaire, and NutritionQuest completed their analysis with information from the participants.

Outliers

All demographic and health assessment information, including height and weight, were taken by the researcher either by phone prior to starting the study, all 76 participants had complete data for demographics and health assessment data with no outliers identified. No outliers were identified on the questionnaires. Statistical methods were used to identify outliers. Independent variables were examined to identify values. Potential outliers were further examined for accuracy. All outliers were within two standard deviations. No adjustments of outliers were made.

Analysis Techniques

Significance levels were set at .05 (Field, 2009; Polit & Beck, 2017; Tabachick & Fidell, 2019). Analyses for each specific aim were outlined as follows.

Specific Aim One

Specific aim one was to analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene of adolescents and determine the levels of appetite, dietary intake, and BMI levels of the adolescents. Frequency distributions were determined for the demographic,

anthropometric, health assessment, sleep quantity, sleep quality, sleep latency, sleep hygiene, appetite indices, dietary intake, and BMI levels of the adolescents. Descriptive statistics, including mean, median, range, and standard deviations were determined and recorded for demographic, anthropometric, health assessment, sleep quality, sleep quantity, sleep latency, sleep hygiene, appetite scores, dietary intake, and BMI levels. A mean appetite score was calculated by computing the mean for all questions on the appetite questionnaire.

Specific Aim Two

Specific aim two was to analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene and determine the relationship to appetite, dietary intake, and BMI levels of adolescents**.** For analysis, male was coded as 2 and female was coded as 1. Bivariate correlational analyses were used to examine the relationships of any dependent and independent variables. For example, the relationships among sleep quality, sleep quantity, sleep latency, and sleep hygiene scores with appetite scores, dietary intake, and BMI indices of the adolescent study participants were examined (Field, 2009; Polit & Beck, 2017; Tabachick & Fidell, 2019).

Specific Aim Three

Specific aim three was to determine to what extent demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene affect appetite, dietary intake, and BMI levels of adolescents. Hierarchical regression was selected to analyze the relationship of the study variables with variables being entered into the equation based on previous research (Tabachick & Fidell, 2019). Pearson correlations were analyzed using SPSS statistical package. Pearson correlations were analyzed to show the effect of each individual variable as it was entered into the equation while controlling for the other independent variables. The cumulative R^2 was shown for each variable as it was entered into the equation, along with the corresponding R^2 change

value. The standardized beta coefficients explained the relative weights of the independent variables while controlling for the other independent variables in the equation. The order of predictor entry into the equation was based on previous studies (Field, 2009; Tabachick & Fidell, 2019). Screening procedures were used to evaluate singularity, multicollinearity, normality, linearity, and homoscedasticity. Graphical and statistical methods were used to evaluate the assumptions for multiple regression (Field, 2009; Tabachick & Fidell, 2019).

Techniques. To determine to what extent demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene affect BMI, appetite, and dietary intake, regression models were constructed. Based on previous research (Tabachick & Fidell, 2019), the variables were entered into the regression equation in the following order.

1. Age
2. Global sleep quality scores
3. Fitbit sleep minutes
4. Fitbit sleep latency minutes
5. Sleep hygiene scores

Adolescents aged 12-18 years need 8 to 10 hours of sleep per night (CDC, 2018; Hirshkowitz et al., 2015; National Sleep Foundation, 2019b; Paruthi, et al., 2016); therefore, age was entered into the regression first. Research has suggested that sleep quality is essential (CDC, 2018) and may have more of an effect on physiological and behavioral factors than sleep quantity (Hayes et al., 2018); therefore, the Pittsburgh Sleep Quality Index global sleep quality scores were entered into the regression next. As adolescents need 8 to 10 hours of sleep per night (CDC, 2018; Hirshkowitz et al., 2015; National Sleep Foundation, 2019b; Paruthi, et al., 2016), Fitbit total sleep minutes were next entered into the regression model. As sleep latency minutes

were not well studied and contribute to the total minutes of sleep (Beebe et al., 2007; Ogden, et al., 2014), Fitbit average sleep latency minutes were then entered into the regression. The association between sleep hygiene and appetite, dietary intake, and BMI in adolescents is also not abundant in existing literature (Quante et al., 2019a); therefore, the sleep hygiene score was entered into the regression following the previous variables. Appetite, dietary intakes, and BMI were entered as the dependent variable in three separate regression models. Appetite was entered as a mean appetite score from the Appetite Visual Analog Scale. Mean calorie intake over the 5 days as calculated by NutritionQuest was entered for dietary intake. Participant's self-reported body mass indices were entered for BMI.

Summary

The purpose of this study is to examine the effect of demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene on appetite, dietary intake, and BMI levels of adolescent youth. The hypothesis of this study was that poor sleep quality would affect appetite, dietary intake, body mass index in adolescent youth. The prospective correlational design allowed for examination of the relationship between sleep quality, sleep quantity, and sleep latency and appetite, dietary intake, and BMI levels of adolescent youth. The use of Fitbit and Pittsburgh Sleep Quality Index to assess sleep quality, sleep quantity, and sleep latency provided comprehensive sleep data. The use of Adolescent Sleep Hygiene Practice Scale provided assessment of the adolescent sleep hygiene. The use of Appetite Visual Analog Scale and Block Kids Food Screener provided information on appetite and dietary intake. Together these sources of data addressed the study purpose, which is to examine the effect of demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene on appetite, dietary intake, and BMI levels of adolescent youth.

Chapter 4

RESULTS

The purpose of this study was to examine the effect of sleep quality, sleep quantity, sleep latency, and sleep hygiene on appetite, dietary intake, and BMI levels of adolescent youth. The hypothesis of this study was that poor sleep quality would affect appetite, dietary intake, body mass index in adolescent youth. The following specific aims were examined:

1. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene of adolescents and determine the levels of appetite, dietary intake, and BMI levels of adolescents.
2. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene and determine the relationship to appetite, dietary intake, and BMI levels of adolescents.
3. To determine to what extent demographics sleep quality, sleep quantity, sleep latency, and sleep hygiene affect appetite, dietary intake, and BMI levels of adolescents.

This chapter will present the study results.

Response Rate

Recruitment

Fifty-two churches of various denominations were contacted in the upper Midwestern U.S in eastern North Dakota and west-central Minnesota. Churches of various denominations were contacted at staggered times over 12 weeks. Fifteen of the churches responded that that they did not want to participate with this study, or they did not return this researcher's phone calls or emails. Two of the churches cited that many of their members spoke English as a second language. One church stated that several of their members spoke Spanish. The second church did not state the primary language of their members. See Appendix C for the church ad.

One church had a paper bulletin which allowed this researcher to purchase an ad space for one month. Twenty-seven churches stated that they would include the ad in their online or paper bulletin for a one-week duration. When a church bulletin only allowed for a small space, an advertisement without pictures was used. Church bulletins with more space used pictures within the ads. Nine churches stated or emailed that they would email the ad out to all youth aged 12-18 years and parents or legal guardians who regularly attend their youth group activities. Church ads and emails took place over a 12-week period in the summer with various churches responding at staggered times. In addition, parents whose adolescents completed the study sent the ad via texted picture, forwarded email of the ad, or verbally informed other potential participants and their parent(s) or legal guardians of the study. Due to the snowball effect, participants outside of churches may have participated in the study. A total of 123 participants or parents contacted this researcher either by phone, text, or email over 12 weeks.

Exclusion

One participant reported having wisdom teeth recently removed. One participant stated that their allergies were ‘acting up’. One participant reported a new diagnosis (2 weeks previous) of celiac disease. One parent reported a recent move to a new home. All four of these potential participants contacted this researcher early in the data collection process. All were not included in the study, but they were encouraged to contact the researcher in one month. None of these early excluded potential participants responded at a later date.

Twenty-one text messages were received from various potential participants. Individuals would text ‘hi’, ‘I’m interested in your study’, or stated their name. However, when asked for further information such as parent’s name, minimal or no other communication took place. Therefore, due to no parental consent, these individuals were not included in the study.

Eleven additional potential participants contacted the researcher via phone or text. All participants stated they were interested in the study. All 11 of the participants verbally stated or texted their parents' names and phone numbers. The parents were contacted by phone and text; however, nine of the parents did not respond. One parent was noted to have limited English-speaking abilities. Therefore, due to lack of parental consent, these participants were not allowed to complete the study. In addition, one other parent stated that she had 4 adolescents interested in completing the study; however, this parent also did not return any consent forms. Therefore, these 16 potential participants did not meet eligibility.

Attrition

Two participants returned the Fitbits and questionnaires. The Fitbits contained no data, and the questionnaires were not completed. These two participants were not contacted again, their data was not used, and they were replaced with other participants.

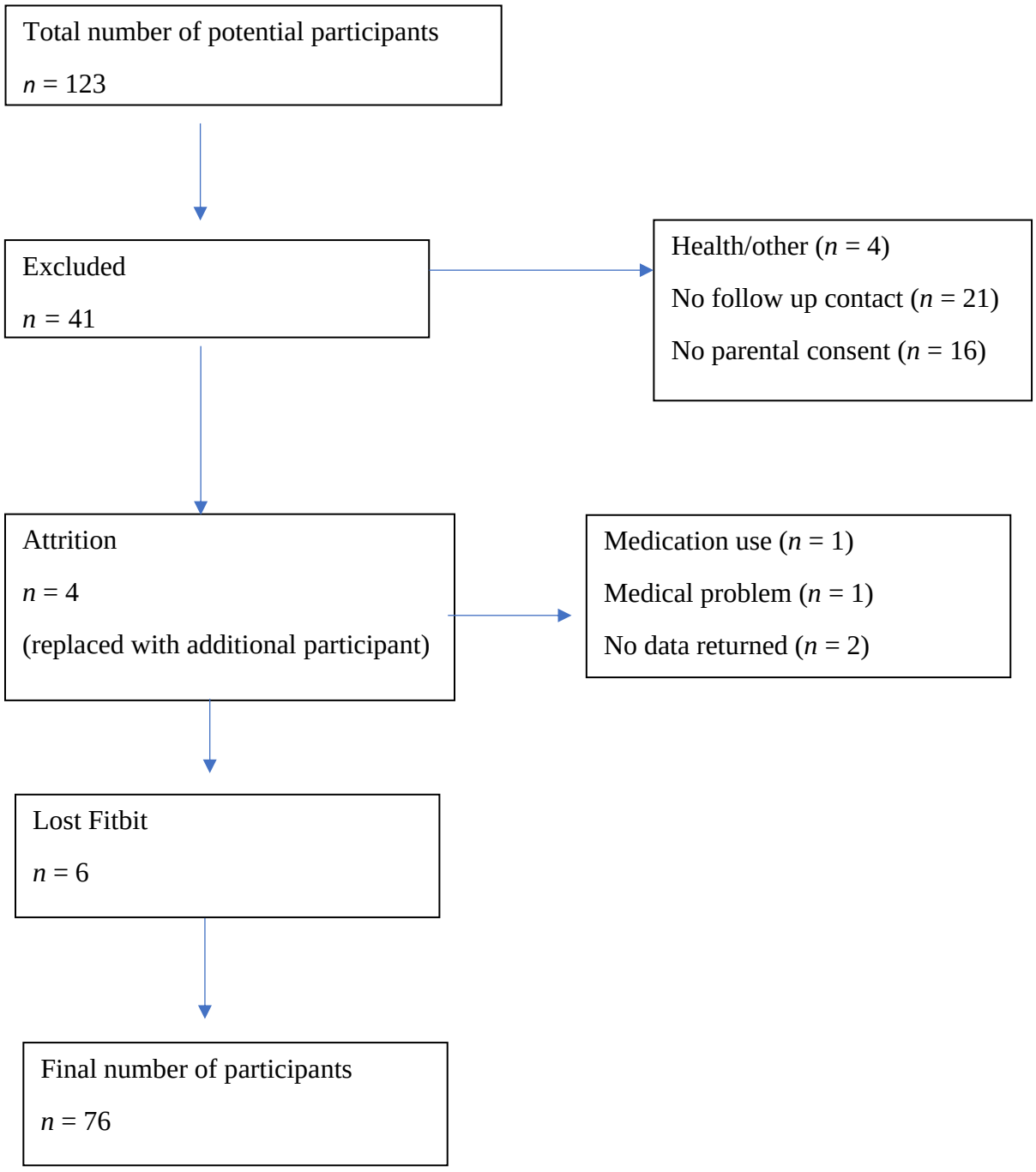
Two participants returned the Fitbits and completed questionnaires, but the Fitbits only contained 4 of the 5 days of data, but both participants agreed to repeat the wearing of the Fitbits for 5 days and 5 nights. Therefore, the Fitbits were mailed out to the participants again; the participants then wore the Fitbits for 5 nights and days, and then the participants returned the Fitbits in a prepaid envelope addressed to this researcher. The questionnaires completed by these two participants were paired with the data from their 5 day and night worn Fitbit data.

One parent stated that their adolescent did not take any medications; however, upon receiving the questionnaires, the participant wrote that they took a prescription sleep medication. This participant was removed from the study and replaced. Another participant's parent texted to stated that the participant was hospitalized with appendicitis on day 4 of the sleep study. This participant was removed from the study and replaced with an additional participant.

In week 2 of the study, one parent of two participants texted that they returned the Fitbits and questionnaires via U. S. Postal Service. Upon daily trips to the Post Office for over one month, the Fitbits were never located in the Post Office, and the Fitbits were deemed lost. After losing the two Fitbits with the Postal Service, all return envelopes had tracking numbers placed on the envelopes. On week 12 of the study, a second parent with 4 participants also texted that they returned the Fitbits and questionnaires. The researcher checked for 2 additional weeks, but the Post Office was also unable to locate the Fitbits. Therefore, a 11.9% attrition rate occurred for this study. This resulted in 76 completed surveys and Fitbits with 5 days and nights of data. Figure 2 shows the overview of participant enrollment including, potential participants, number of excluded participants, replaced participants, and total number of participants who completed the study.

Figure 2

Overview of Participant Enrollment



Physical Activity

A total of 28 participants emailed, verbalized, or texted that they were unable to wear the Fitbits during various activities for 1-8 hours at a time during the day. For example, four participants cited wearing devices on their wrist as not being allowed while working in food services due to possible and potential spread of infection. Two participants stated that they washed dishes in a long-term care facility and were not able to wear the Fitbits at work due to the possibility of bleach damaging the Fitbits. (According to manufacture instructions, the Fitbit does become damaged when in contact with bleach.) Nine participants stated that they were not allowed to wear the Fitbits to varying activities such as baseball or volleyball practice. Thirteen participants stated that they were going to a lake or swimming and would have the Fitbits submerged for over 30 minutes. As previously noted, according to manufacture guidelines, the Fitbit does become damaged when submerged in water for greater than 30 minutes (Fitbit Health Solutions, 2019).

Participants and/or their parents stated or texted that the participant would have to remove the Fitbit for 1-8 hours, depending on the reason for removal. As greater than 5% of physical activity data was missing for 28 participants, physical activity was not calculated.

Questionnaires

The amount of missing data for the individual variables varied. Many of the variables did not have any missing data, some variables had a small amount (<5%) of missing data. Missing data was assessed for patterns of missingness and determined to be missing completely at random. For these variables, data was calculated by default pairwise deletion. The missing data variables are noted on all tables and discussed in analysis (Field, 2009; Polit & Beck, 2017; Tabachick & Fidell, 2019).

Results

Upon receiving the Fitbits via U. S. mail, this researcher downloaded data from Fitbits per manufactural guidelines. In addition, information from the questionnaires was entered into SPSS statistical program. Data was double-checked for accuracy. The statistical significance was set at $p < .05$.

Specific Aim One

Specific aim one was to analyze demographics, sleep quality, sleep quantity, sleep latency, sleep hygiene, appetite, dietary intake, and BMI levels of adolescents.

Demographics

Demographics were completed via phone by the researcher prior to mailing the Fitbit and additional questionnaires to the participants. The demographics were stated by participants and/or parent(s), frequently with both parent and participant on the phone at the same time. A total of 76 adolescents were identified as being eligible for this study according to eligibility criteria. Information regarding recruitment is included in Chapter 3. Results of the study demographic data are presented in this section. Demographic information was completed for all 76 participants.

Age

Participant age was included on the demographic form. The participant's age ranged from 12-18 years. Participants in this study had a mean age of 15.22 (standard deviation [*SD*] = 1.9). and a median of 15 years of age. The most frequently reported age of the participant was 15 years of age, and the least frequently reported year of age was 16 years.

Grade

Grade was included on the demographic form. The grade that the participant would be entering in the next school year was self-reported by the participant or their parent. Those participants that had recently graduated high school were noted as such. The participant's grade in school ranged from 6th grade to having graduated high school this year. The median grade in school was at the sophomore level. The most reported grade in school was sophomore and senior, and the least reported grade was those who had just graduated high school this year. Frequencies and descriptive information of participant age and grade in school are presented in Table 3.

Table 3

Descriptive and Frequency Data of Participant Age and Grade

Demographic	Mean	SD	Range	Frequency of responses	Valid percent
Age	15.22	1.91	(12 – 18)		
12				9	11.8
13				5	6.6
14				14	18.4
15				16	21.1
16				7	9.2
17				14	18.4
18				11	14.5

Grade in school		
6th	1	1.3
7th	8	10.5
8th	9	11.8
Freshman	10	13.2
Sophomore	17	22.4
Junior	9	11.4
Senior	17	22.4
Graduated high school	5	6.6

Note: n = 76

Ethnicity

Ethnicity was self-reported by either the participant or the parent prior to starting the study. Eighty-six-point eight percent of participants in this study were Caucasian, not of Hispanic origin. Of the 4 participants who stated 'other', one participant stated Asian. The other 3 participants reported being of Middle Eastern decent.

Gender

Gender was self-reported by either the participant or the parent prior to starting the study. Thirty-one participants reported being male; forty-five of the participants reported being female. Therefore, 40.8% of the participants were male, and 59.2% of the participants were female.

Residence

Residence was also self-reported by either the participant or the parent prior to starting the study. Seventy-three of the participants reported residing in a house, with 3.9% of the participants reported living in an apartment. Frequencies of participant ethnicity, gender, and residence are presented in Table 4.

Table 4

Frequency of Participant Ethnicity, Gender, and Residence

Demographic	Frequency	Valid percent
Ethnicity		
White, not Hispanic	66	86.8
Native American	3	3.9
Black, not Hispanic	3	3.9
Other	4	5.3
Gender		
Male	31	40.8
Female	45	59.2
Residence		
House	73	96.1
Apartment	3	3.9

Note: n = 76

Health Assessment

As part of the inclusion and exclusion criteria, health assessment data was collected by this researcher prior to participant admission into the study. This information included the self-reported verbal statements of the participant's health information either by the participant or by the parent. All body weights were self-reported in pounds and heights were self-reported feet/inches and converted to kilograms and meters using standard methods. Body mass index was then calculated by taking body weight in kilograms divided by the square of height in meters (CDC, 2019). Body mass indices were calculated using the BMI Percentile Calculator for Child

and Teen (CDC, 2020). Results of the study health assessment are presented in this section. Health assessment was completed for all 76 participants.

Height, Weight, and Body Mass Index

The height of the participants ranged from 54 inches (137.16 cm) to 79 inches (200.66 cm). The mean height of the participants was 66.14 inches (167.99 cm) (*SD* = 4.62) with a median height of 65 inches (165.1 cm). The weight of the participants ranged from 80 pounds (36.29 kg) to 240 pounds (10.86 kg). The mean weight of the participants was 140.17 pounds (63.58 kg) (*SD* = 27.17) with a median weight of 140 pounds (63.5 kg).

Two participants (2.6%) were noted to be less than the 5th percentile or underweight. Both participants were female. Three participants (3.9%) were noted to be greater than the 95th percentile. These three participants were female. Seventeen participants (22.4%) were noted to be overweight. Eight of these participants were male and 9 of these participants were female. Therefore, 54 or 71.1% of the participants self-reported being a healthy weight. Twenty-three of these participants were male, and 31 of these participants were female. Frequencies and descriptive data of the results from the height, weight, and BMI information from the participants are presented in Table 5.

Table 5

Frequency and Descriptive Data of Participant Height, Weight, and BMI

Variable	Mean	SD	Range	Valid percent	Frequency of responses
Height in inches	66.14	6.62	(54 – 79)		
Weight in pounds	140.17	27.17	(80-240)		
BMI	22.12	2.95	(15.6-31.0)		
Underweight					
Boy				0	0
Girl				2	2.6
Healthy weight					
Boy				23	30.3
Girl				31	40.8
Overweight					
Boy				8	10.5
Girl				9	11.8
Obese					
Boy				0	0
Girl				3	3.9

Note: n = 76

Health Frequencies

As noted, as part of the inclusion and exclusion criteria, health assessment data was collected by this researcher prior to participant admission into the study. Health assessment was completed for all 76 participants.

Medical or Psychiatric Diagnosis

Medical or psychiatric diagnosis was self-reported by the participants or their parent. A current self-reported assessment of past medical or psychiatric diagnosis was part of the exclusion criteria; therefore, no participants in the study had a medical or psychiatric diagnosis.

Medications

Medication use was self-report by the participant or parent prior to starting the study. Use of any medication that may affect sleep was an exclusion criterion for this study. Six of the participants (7.9%) reported being on a prescription medication. Of the six participants who reported that they were taking a prescription medication, four of the stated or wrote that they were taking oral contraceptives. These four participants were not eliminated from the study. Two participants stated or wrote that they were prescribed allergy medications; however, both participants reported that the prescription allergy medication was to be taken as needed. Both participants reported that they were not taking the allergy medication at the time of the study.

Ten of the participants (13.2%) reported taking over-the-counter medications at times. All ten of the participants reported that they over-the-counter medications was acetaminophen or ibuprofen. The participants denied use of over-the-counter medications during the 5 days and nights of the study.

Allergies

Participant allergies was self-report by the participant or parent prior to starting the study. Twelve participants (15.8%) reported having allergies. One participant reported a penicillin

allergy; one participant reported a sulfa allergy; one participant reported a dog dander allergy. Five participants reported seasonal allergies, and four participants reported a cat dander allergy. All participants who reported allergies also reported avoiding the allergen during the 5 days and nights of the study. Frequencies of the results from the health assessment information is presented in Table 6.

Table 6

Frequency of Participant Health Information

Variable	Frequency	Valid percent
Prescription medication		
Yes	6	7.9
No	70	92.1
Over-the-counter medication		
Yes	10	13.2
No	66	86.8
Allergies		
Yes	12	15.8
No	64	84.2

Note: n = 76

Sleep by Fitbit

Sleep Quality

Sleep quality was measured by the Fitbit, by measuring small movements, such as rolling over while sleeping and using heart rate monitors to measure sleep quality. The Fitbit calculates a sleep quality number, by dividing the number of minutes slept by the number of minutes spent

in bed or the percentage of time spent sleeping. The Fitbit displays this number on a daily report (Fitbit Health Solutions, 2019). A sleep quality score above 85 is considered normal sleep quality, and a sleep quality score of less than 85 is considered to be poor sleep quality (Shirvastava et al., 2014).

The Fitbit sleep quality scores ranged from 70.8 to 90.8. The mean Fitbit sleep quality score was 87.01 (*SD* =2.55). Results on Fitbit sleep quality are presented in the following area.

As captured by Fitbit, over the 5 days and nights of data, 9 of the 76 participants had an average sleep quality of less than 85. Therefore, 11.8% of the participants of this study had a poor sleep quality score, according to the data from the Fitbit. Frequencies and descriptive data of sleep quality as captured by the Fitbit are presented in Table 7.

Table 7

Descriptive and Frequency Sleep Quality Data from Fitbit over Five Days

Factor	Mean	SD	Range	Frequency of responses	Valid percent
Fitbit sleep quality score	87.01	2.55	(70.8– 90.8)		
Poor (< 85)				9	11.8
Adequate (≥ 85)				67	88.2

n = 76

Sleep Quantity

The Fitbit measures sleep quantity by measuring small movements, such as rolling over while sleeping and using heart rate monitors to measure sleep quantity. The Fitbit calculates the number of minutes spent sleeping and displays this number on daily, weekly, or monthly reports (Fitbit Health Solutions, 2019). As previously noted, sleep quantities of 8 – 10 hours per night is considered adequate or normal sleep time for adolescents. Sleep quantities of less than 8 hours is

considered inadequate or short sleep time for adolescents. Sleep time greater than 10 hours is considered excessive (Hirshkowitz et al., 2015; Paruthi, et al., 2016). Sleep quantity information is presented in this section.

Nighttime Sleep. Nighttime sleep among the participants ranged from a total of 1566 minutes over the 5-total night to 2711 minutes over the 5 total nights. Therefore, the participants sleep ranged from an average between 5.22 hours per night over the 5 nights to an average of 9.03 hours of sleep per night over the 5 nights. The average number of minutes over the 5 nights was 2200.66 minutes (*SD* = 243.80) or 7.33 hours over the 5 nights. The median number of minutes over the 5 nights was 2254.5 minutes or 7.52 hours of sleep per night over the 5 nights.

A sleep quantity of less than 8 hours is considered inadequate or a short sleep time for adolescents (Hirshkowitz et al., 2015; Paruthi, et al., 2016). Total nighttime minutes of sleep of less than 2400 minutes (less than 8 hours average per 5 nights) was calculated as inadequate sleep time. Of the participants, 59 slept less than an average of 8 hours per night over the 5 nights. Therefore, 77.6% of the participants in this study slept an inadequate amount of sleep time during the study.

Sleep quantities of 8 -10 hours per night is considered adequate or normal sleep time for adolescents (Hirshkowitz et al., 2015; Paruthi, et al., 2016). Average sleep was calculated in minutes over the 5 nights. The total nighttime minutes of sleep between 2400 minutes – 3000 minutes (8-10 hours average over 5 nights) was calculated as adequate sleep time. Seventeen (22.4%) total participants slept an average of 8-10 hours over the 5 nights of the study.

Sleep times greater than 10 hours per night are considered excessive sleep time for adolescents (Hirshkowitz et al., 2015; Paruthi, et al., 2016). Total nighttime minutes of sleep of greater than 3000 minutes (greater than 10 hours average per 5 nights) was calculated as

excessive. No participants in this study slept a 5-night average of excessive sleep time. See Table 8 for frequency and descriptive sleep quantity data from the Fitbit over 5 nights.

Table 8

Frequency and Descriptive Sleep Quantity by Fitbit for Five Nights

Factor	Mean	SD	Range	Frequency of responses	Valid percent
Fitbit night sleep quantity hours	7.33	.81	(5.22 - 9.03)		
Less than 8 hours				59	77.6
8-10 hours				17	22.4
Greater than 10 hours				0	0

Note: n = 76

Total Sleep. Twenty-seven (36%) participants were noted to take a nap at some time during the study. As several participants took more than one nap, a total of 37 nap times were calculated into total sleep time, which included nighttime sleep as well as daytime napping. The naps captured by the Fitbit varied greatly in length of time as well as time of day. As noted in the operational definitions, sleep quantity for this study consisted of the total minutes of sleep in the 24-hour day, which included daytime and nighttime sleep. Total sleep minutes, including nighttime sleep and daytime napping, among the participants ranged from a total of 1721 minutes over the 5-total day and night to 2885 minutes over the 5 total days and nights. Therefore, the participants sleep ranged from an average between 5.74 hours per night over the 5 days and nights to a maximum of 9.62 hours of sleep per night over the 5 days and nights. The average number of minutes over the 5 days and nights was 2243.77 minutes (*SD* = 241.00) or 7.48 hours over the 5 days and nights.

Sleep quantities of less than 8 hours are considered inadequate or short sleep time for adolescents (Hirshkowitz et al., 2015; Paruthi, et al., 2016). Total daytime and nighttime minutes

of sleep of less than 2400 minutes (less than 8 hours average per 5 days and nights) was calculated as inadequate sleep time. Of the participants, 57 slept less than an average of 8 hours per night over the 5 nights. Therefore, 75% of the participants in this study slept an inadequate amount of sleep time during the study.

Sleep quantities of 8 -10 hours is considered adequate or normal sleep time for adolescents (Hirshkowitz et al., 2015; Paruthi, et al., 2016). Average sleep was calculated in minutes over the 5 days and nights. The total nighttime minutes of sleep between 2400 minutes - 3000 minutes (8-10 hours average over 5 days and nights) was calculated as adequate sleep time. Nineteen (25%) total participants slept an average of 8-10 hours over the 5 days and nights.

Sleep time greater than 10 hours is considered excessive sleep time for adolescents (Hirshkowitz et al., 2015; Paruthi, et al., 2016). Total daytime and nighttime minutes of sleep of greater than 3000 minutes (greater than 10 hours average per 5 days and nights) was calculated as excessive sleep time. No participants in this study slept a 5 day/night average of excessive sleep time. See Table 9 for frequency and descriptive sleep quantity data from the Fitbit over 5 days and nights.

Table 9

Frequency and Descriptive Five Day and Night Total Sleep Time

Factor	Mean	SD	Range	Frequency of responses	Valid percent
Fitbit day and night sleep quantity hours	7.48	.81	(5.74 - 9.62)		
Less than 8 hours				57	75
8-10 hours				19	25
Greater than 10 hours				0	0

Note: $n = 76$

Sleep Latency

The Fitbit measures sleep latency in the same manner as sleep quality and sleep quantity, by measuring small movements, such as rolling over while sleeping and using heart rate monitors to measure sleep latency (Fitbit Health Solutions, 2019). Falling asleep in less than 8 minutes at night is considered short sleep latency; falling asleep in 8-20 minutes is considered normal sleep latency; needing greater than 20 minutes to fall asleep is considered prolonged sleep latency (Shirvastava et al., 2014). The minimum time to fall asleep was 1 minute as captured by the Fitbit, and the maximum time to fall asleep was 15.8 minutes. The mean time for the adolescents to fall asleep was 6.09 minutes (*SD* = 3.260).

Results captured by Fitbit indicated that 56 or 73.7% of participants had an average sleep latency of less than eight minutes for the 5 days and nights of the study. Furthermore, 20 or 26.3% of the participants had an average normal sleep latency, or 8 – 20 minutes, for the 5 days and nights of the study. No participants had a 5-day average long sleep latency during this study. Frequency and descriptive data on Fitbit captured sleep latency is noted in Table 10.

Table 10

Frequency and Descriptive Mean Sleep Latency Data by Fitbit for Five Nights

Factor	Mean	SD	Range	Frequency of responses	Valid percent
Mean sleep latency minutes per night	6.09	3.26	(1 – 15.8)		
Less than 8 minutes				56	73.7
8-20 minutes				20	26.3
Greater than 20 minutes				0	0

Note: n = 76

Bedtime and Wake Time

Sleep start and stop times were captured by the Fitbits and downloaded for analysis. Sleep start times varied widely with sleep starting for the night at 1809 (6:09 pm) at the earliest and at 0623 (6:23 am) at the latest. With 76 participants over 5 nights, 380 nights were monitored for sleep. Eleven of the 380 nights (2.89%) included participants going to sleep prior to 2200 or 10:00 pm. Sleep wake times also varied greatly with participant wake times starting as early as 0514 (5:14 am) or as late at 1352 (1:52 pm).

Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index is a self-reported measure of subjective sleep quality. The Pittsburgh Sleep Quality Index was completed by the participants on the last day of the study, when the Fitbits were removed. The questionnaire was mailed to this researcher in the same prepaid envelop as the Fitbit. The Pittsburgh Sleep Quality Index has a Likert scale of 19 items to assess sleep quality, sleep quantity, and sleep latency. The Pittsburgh Sleep Quality Index scale contains seven component scores with a range of 0 to 3. Summing all seven scores provides a global sleep score for each participant. Pittsburgh Sleep Quality Index scores have a range of 0-21 (Buysse et al., 1989; Luyster et al., 2016). A Pittsburgh Sleep Quality Index score >5 indicates poor sleep quality (Shirvastava et al., 2014).

Reported Sleep Quality

Reported sleep quality is the first element calculated in a global Pittsburgh sleep quality score. Eighteen (23.7%) of the participants reported that they felt they sleep very well; 54 or 71.1% of the participants report that they sleep well. Four (5.3%) participants reported that they sleep poorly. Frequencies of participant sleep quality rating is presented in Table 11.

Table 11

Frequency of PSQI Reported Sleep Quality

Sleep quality	Frequency	Valid percent
Bad	0	0
Fairly bad	4	5.4
Fair good	54	71.1
Very good	18	23.7

Note: $n = 76$

Latency

Reported sleep latency is the second element calculated in a global Pittsburgh Sleep Quality score. Participants reported a minimum sleep latency of 2 minutes and a maximin sleep latency of 90 minutes. The mean response for sleep latency was 20.45 minutes ($SD = 17.38$). The most common response for sleep latency was 15 minutes ($n = 19$) followed by 10 minutes ($n = 16$).

Seventeen participants reported being able to fall asleep withing 30 minutes every day during the last month. Thirty-three participants reported not being able to fall asleep within 30 minutes less than once a week; 14 participants reported not being able to fall asleep within 30 minutes once or twice a week, and 12 participants reported not being able to fall asleep within 30 minutes three or more times a week.

Hours of Sleep

Reported sleep quantity is the third element calculated in a global Pittsburgh Sleep Quality score. Participants reported a range of hours of sleep from 5 hours to 12 hours. The most

common response was 9 hours (*n* = 16) followed by 8 hours (*n* = 15). The mean hours of sleep for the participants was 8.49 (*SD* = 1.39).

Bedtime

Participants reported a range of bedtime from 2145 to 0300. The most frequently reported bedtime was midnight (*n* = 16) followed by 2300 (*n* = 14). This value is not calculated into the global Pittsburgh Sleep Quality Index score. The calculation of reported hours of sleep divided by the reported hours in bed was completed next. This calculation was added into the global Pittsburgh Sleep Quality Index score.

Night Waking

Information from night waking reported from the Pittsburgh Sleep Quality Index is added together in the next step of calculating a global Pittsburgh Sleep Quality Index score. A variety of questions are addressed in this section of the Pittsburgh Sleep Quality Index. The frequency and reasons for night waking as recorded from the Pittsburgh Sleep Quality Index is presented in Table 12.

Table 12

Frequency and Reasons for Night Waking from PSQI

Reasons for night waking	Frequency	Valid percentage
Bathroom		
Not during the last month	45	59.2
Less than once a week	16	21.1
Once or twice a week	9	11.8
Three or more times a week	6	7.9
Unable to breath comfortably		

Not during the last month	68	89.5
Less than once a week	5	6.3
Once or twice a week	2	2.5
Three or more times a week	1	1.3
Feeling too cold		
Not during the last month	44	57.9
Less than once a week	21	27.6
Once or twice a week	10	13.2
Three or more times a week	1	1.3
Feeling too hot		
Not during the last month	28	36.8
Less than once a week	28	36.8
Once or twice a week	13	17.1
Three or more times a week	7	9.2
Coughing or snoring		
Not during the last month	68	89.5
Less than once a week	5	6.6
Once or twice a week	1	1.3
Three or more times a week	2	2.6
Pain		
Not during the last month	61	80.3
Less than once a week	10	13.2
Once or twice a week	3	3.9

Three or more times a week	2	2.6
Bad dreams		
Not during the last month	47	59.5
Less than once a week	19	25
Once or twice a week	8	10.5
Three or more times a week	2	2.6

Note: $n = 76$

Daytime Sleepiness

Information from daytime sleepiness reported from the Pittsburgh Sleep Quality Index is added together in the next step of calculating a global Pittsburgh Sleep Quality Index score. Frequencies on daytime enthusiasm and sleepiness reported from the Pittsburgh Sleep Quality Index is presented in Table 13.

Table 13

Frequency of Daytime Enthusiasm and Sleepiness from PSQI

Daytime enthusiasm and sleepiness	Number	Valid percent
Lacking enthusiasm during day		
Not during the last month	38	50.0
Less than once a week	29	38.2
Once or twice a week	7	9.2
Three or more times a week	2	2.6
Trouble staying awake		
Not during the last month	56	73.7
Less than once a week	14	18.4

Once or twice a week	5	6.6
Three or more times a week	1	1.3

Note: n = 76

Calculating PSQI Sleep Quality

As noted, the Pittsburgh Sleep Quality Index scale contains seven component scores with a range of 0 to 3. Summing all seven scores provides a global sleep score for each participant. Pittsburgh Sleep Quality Index scores have a range of 0-21 (Buysse et al., 1989; Luyster et al., 2016). As previously noted, a global Pittsburgh Sleep Quality Index score of 5 or greater indicates poor sleep (Shirvastava et al., 2014). Thirty of the 76 participants or 39.5% of participants had a calculated Pittsburgh Sleep Quality Index Score that indicated poor sleep quality. Pittsburgh Sleep Quality Index data for global sleep quality was noted in Table 14.

Table 14

Descriptive Data from PSQI over Five Days and Nights

PSQI	Mean	SD	Range	Frequency of responses	Valid percent
Reported sleep quantity hours	8.49	1.39	(5 -12)		
Reported sleep latency minutes	20.45	17.38	(2- 90)		
Global sleep quality score	3.87	2.19	(0 -10)		
< 5 (good sleep quality)				46	60.5
≥ 5 (poor sleep quality)				30	39.5

Note: n = 76

Adolescent Sleep Hygiene Practice Scale

The Adolescent Sleep Hygiene Practice Scale was completed by the participants on the last day of the study, when the Fitbits were removed. The questionnaire was mailed to this researcher in the same prepaid envelope as the Fitbit. Data from the Adolescent Sleep Hygiene Practice Scale is presented in this section. The data from the Adolescent Sleep Hygiene Practice scale is presented by the 8 subscale factors.

Physiological

Physiological factors were noted by calculating the mean of questions 3, 10, 12, 18, and 19 from the Adolescent Sleep Hygiene Practice Scale. Physiological factors include caffeine use after 6:00 pm, exercising late in the day or after 6:00 pm, drinking over 4 ounces of water within one hour of going to bed, going to bed with a stomachache, and going to bed hungry. Frequency of the physiological factors are presented in Table 15.

Table 15

Frequency of Physiological Factors from the Adolescent Sleep Hygiene Practice Scale

Physiological factor	Frequency	Percent
Caffeine use after 6:00 pm		
Never	26	34.2
Once in a while	24	31.6
Sometimes	14	18.4
Often	7	9.2
Frequently	2	2.6
Always	3	3.9

Late exercise		
Never	5	6.6
Once in a while	11	14.5
Sometimes	20	26.3
Often	19	25.0
Frequently	13	17.1
Always	8	10.5
Drinking water at bedtime		
Never	35	46.1
Once in a while	22	28.9
Sometimes	12	15.8
Often	2	2.6
Frequently	2	2.6
Always	3	3.9
Stomachache		
Never	58	76.3
Once in a while	13	17.1
Sometimes	2	2.6
Often	2	2.6
Frequently	1	1.3
Always	0	0
Hungry		
Never	45	59.2

Once in a while	24	31.6
Sometimes	3	3.9
Often	4	5.3
Frequently	0	0
Always	0	0

Note: n = 76

Behavioral

Behavioral factors were noted by calculating the mean of questions 11, 13, and 28 from the Adolescent Sleep Hygiene Practice Scale. Frequency and valid percent of behavioral factors, which are gaming and reading or watching television prior to bedtime and use of bed for something other than sleep, as identified by the Adolescent Sleep Hygiene Practice Scale are presented in Table 16.

Table 16

Frequency of Behavioral Factors from the Adolescent Sleep Hygiene Practice Scale

Behavioral factor	Frequency	Percent
Gaming		
Never	5	6.6
Once in a while	11	14.5
Sometimes	13	17.1
Often	17	22.4
Frequently	18	23.7
Always	12	15.8

Reading or Watching TV		
Never	11	14.5
Once in a while	11	14.5
Sometimes	1o	13.2
Often	20	26.3
Frequently	6	7.9
Always	18	23.7
Use of bed other than sleep		
Never	11	14.5
Once in a while	9	11.8
Sometimes	15	19.7
Often	7	9.2
Frequently	13	17.1
Always	21	27.6

Note: n = 76

Cognitive

Cognitive factors, questions 9, 14, 15, 16, 17, and 29, on the Adolescent Sleep Hygiene Practice Scale include going to bed thinking of things to do the next day, replaying the day's events, and worrying about home. Participants' responses on these factors were varied. The responses are presented in Table 17.

Table 17

Frequency of Cognitive Factors from the Adolescent Sleep Hygiene Practice Scale

Cognitive factor	Frequency	Percent
Thinking		
Never	5	6.6
Once in a while	18	23.7
Sometimes	18	23.7
Often	16	21.1
Frequently	14	18.4
Always	5	6.6
Replaying		
Never	17	22.4
Once in a while	19	25.0
Sometimes	19	25.0
Often	10	13.2
Frequently	6	7.9
Always	5	6.6
Worrying		
Never	31	40.8
Once in a while	23	30.3
Sometimes	12	15.8
Often	6	7.9
Frequently	4	5.3

Always	0	0
Upset		
Never	35	46.1
Once in a while	28	36.8
Sometimes	8	10.5
Often	2	2.6
Frequently	1	1.3
Always	2	2.6
Strong emotions		
Never	30	40.0
Once in a while	29	38.7
Sometimes	11	14.7
Often	3	4.0
Frequently	2	2.7
Always	0	0

Note: $n = 76$

Environmental

Environmental factors, questions 20, 21, 22, 23, and 24 on the Adolescent Sleep Hygiene Practice Scale, include participant's reporting the frequency they sleep in a hot or cold room, fall asleep listening to loud music, fall asleep in a bright room, and fall asleep but then move to a different location during the night. Results are presented in Table 18.

Table 18

Frequency of Environmental Factors on the Adolescent Sleep Hygiene Practice Scale

Environmental factor	Frequency	Percent
Hot or cold room		
Never	37	48.7
Once in a while	20	26.3
Sometimes	7	9.2
Often	2	2.6
Frequently	4	7.9
Always	6	7.9
Loud music		
Never	60	78.9
Once in a while	8	10.5
Sometimes	4	5.3
Often	1	1.3
Frequently	2	2.6
Always	1	1.3
Bright room		
Never	67	88.2
Once in a while	5	6.6
Sometimes	2	2.6
Often	1	1.3
Frequently	1	1.3

Always	0	0
Moving at night		
Never	57	75
Once in a while	9	11.8
Sometimes	2	2.6
Often	0	0
Frequently	4	5.3
Always	4	5.3
Checking clock		
Never	31	40.8
Once in a while	20	26.3
Sometimes	10	13.2
Often	10	13.2
Frequently	2	2.6
Always	3	3.9

Note: n = 76

Sleep Stability

Sleep stability factors, questions 30, 32, and 33 on the Adolescent Sleep Hygiene Practice Scale, include frequency of staying up at least one hour later on weekends than on weekday. In addition, sleeping in one hour later or more on weekends as compared to weekdays is also included. Information on stability factors on the Adolescent Sleep Hygiene Practice Scale are include in Table 19.

Table 19

Frequency of Stability Factors on the Adolescent Sleep Hygiene Practice Scale

Sleep stability factor	Frequency	Percent
Late sleep on weekends		
Never	19	25.0
Once in a while	20	26.3
Sometimes	18	23.7
Often	7	9.2
Frequently	4	5.3
Always	8	10.5
Late waking on weekends		
Never	49	64.5
Once in a while	18	23.7
Sometimes	2	2.6
Often	0	0
Frequently	4	5.3
Always	3	3.9

Note: $n = 76$

Daytime Sleep

Daytime sleep factors, questions 1 and 4 on the Adolescent Sleep Hygiene Practice Scale, include frequency of napping and late napping. Daytime factors from the Adolescent Sleep Hygiene Practice Scale are presented in Table 20.

Table 20

Frequency of Daytime Sleep Factors on the Adolescent Sleep Hygiene Practice Scale

Daytime sleep factors	Frequency	Percent
Napping		
Never	39	52.0
Once in a while	26	34.7
Sometimes	3	4.0
Often	2	2.7
Frequently	2	2.7
Always	2	2.7
Late napping		
Never	64	84.2
Once in a while	8	10.5
Sometimes	1	1.3
Often	2	2.6
Frequently	1	1.3
Always	0	0

Note: $n = 76$

Substances

None of the participants reported any alcohol use. One participant reported frequent tobacco use. Seventy-three or 96.1% of the participants reported no one smoked in their home.

Routine

Participants' responses to a bedtime routine or question 27 on the Adolescent Sleep Hygiene Practice Scale, are presented in Table 21.

Table 21

Frequency of Bedtime Routine on the Adolescent Sleep Hygiene Practice Scale

Bedtime routine factor	Frequency	Percent
Never	5	6.6
Once in a while	5	6.6
Sometimes	1o	13.2
Often	9	11.8
Frequently	14	18.4
Always	33	43.4

Note: $n = 76$

Phone in Room

An additional question was included on the Adolescent Sleep Hygiene Practice Scale. This question was not piloted to be reliable or valid. Fifty-five or 72.4% reported keeping their cell phone in their bedroom during the night always. Information on cell phones in the bedroom is presented in Table 22.

Table 22

Frequency of Cell Phone in Room at Night

Cell phone in room at night	Frequency	Percent
Never	12	15.8
Once in a while	3	3.9

Sometimes	2	2.6
Often	4	5.3
Frequently	44	57.9
Always	22	28.9

Note: n = 76

Appetite

Assessment of the adolescent's perceived appetite was measured by an Appetite Visual Analog Scale. The Appetite Scale was completed by the participants on the last day of the study, when the Fitbits were removed. The questionnaire was mailed to this researcher in the same prepaid envelop as the Fitbit. Directions on this questionnaire stated to answer all 10 questions by placing an "X" on the horizontal line that corresponds to what the participant felt during the study week. The participants rated sensations of fullness and hunger by using anchors to mark a "X" on the horizontal line that ranged from 'not at all ' to 'a great deal' to indicate varying degrees of hunger, appetite, and related information. Vertical lines further to the left and right on the horizontal line indicated that the participant did not feel that sensation at all or felt the sensation strongly, respectively. Participants were instructed to indicate their overall appetites over a period of 5 days. To compute a calculated number, this researcher measured the line in millimeters with each line for all answers measuring 55 millimeters, with 'not at all' measuring at the 0 point and 'a great deal' measuring at the 55 millimeter point. Then this researcher measured the exact point of the participant's "X" on the line. Two participants marked their responses with a vertical line instead of the "X" as stated in the instructions; therefore, this researcher measured the point on the line where the vertical line met with this horizontal answer line. These numbers were placed in SPSS statistical package for analysis. One participant wrote

the word “kinda” on one of the answer lines; another participant hand wrote “not really” on one of the answer lines; another participant wrote “Pasta” on one of the answer lines, and one of the participants wrote “normal” on one of the answer lines. Therefore, the researcher was unable to assign the answer a numeric value to those questions and answers. Descriptive information on the Appetite Visual Analog Scale is presented in Table 23.

Table 23

Descriptive Data of Appetite Visual Analog Scale

Variable	Mean	SD	Range
Appetite in last week	32.69	13.47	(5-55)
Food cravings	23.75	17.33	(0-55)
Desire to eat	23.30	18.90	(0-55)
Hunger pains	3.71	8.11	(0-42)
Hunger affecting appetite	25.59	15.07	(0-55)
Interest in eating	25.13	18.21	(0-55)
Feeling full after starting to eat	13.45	16.96	(0-55)
Nausea after eating	4.09	11.77	(0-50)
Craving non-food	0	0	0
Eating non-food	0	0	0

Note: $n = 76$
Hunger affecting appetite ($n = 75$)
Appetite in last week ($n = 74$)
Food craving ($n = 73$)

Macronutrient Dietary Intake

The Block Kids Food Screener was used to obtain information on the participant's dietary information. The screener was completed by the participants on the last day of the study, when the Fitbits were removed. The questionnaire was mailed to the researcher in the same prepaid envelop as the Fitbit. This researcher then mailed the questionnaires to NutritionQuest. Dietary intake and analysis were completed by NutritionQuest, and information was then mailed back to this researcher. Ounces of protein were converted to grams of protein using standardized methods (NutritionQuest, 2019). Total calories from fat grams, protein grams, and carbohydrate grams were calculated using standardized methods (NutritionQuest, 2019). Descriptive data from the Block Kids Food Screener is presented in this section.

Carbohydrates

The number of grams of carbohydrates reported being consumed per day by the participants ranged from 11.39 grams to 334.95 grams. The mean number of carbohydrate grams consumed per day was 154.38 grams (*SD* = 57.57).

Protein

The number of grams of protein reported by the participants per day ranged from 6.8 grams to 338.78 grams. The mean number grams of protein reported by the participants as being consumed per day was 81.31 (*SD* = 65.53) grams.

Fat

The number of grams of fat reported being consumed by the participants per day ranged from 6.23 grams to 50.68 grams. The mean number of grams of fat reported by the participants as being consumed per day was 20.36 (*SD* = 9.36) grams. Descriptive data for macronutrient consumption reported by the study participants is in Table 24.

Table 24

Descriptive Data on Macronutrient Intakes per Day per Participant

Variable	Mean	SD	Range
Fat grams per day	20.36	9.36	(6.23 - 50.60)
Carbohydrate grams per day	154.38	57.57	(11.39 - 334.95)
Protein grams per day	81.31	65.53	(6.8 - 331.98)

Note: n = 76

Energy Intake (kcal)

Energy from protein, fat, and carbohydrates were calculated using standard methods. Total kilocalorie intakes were calculated by adding all calories from all macronutrients (CDC, 2020). The mean reported daily calorie intake for the study participants was 1126.07 (*SD* = 485.70). Information on kilocalorie intake as reported by the study participants is reported in Table 25.

Table 25

Descriptive Data on Daily Energy Intake

Variable	Mean	SD	Range
Fat (kcal/d)	183.32	84.22	(56.07 - 456.12)
Carbohydrate (kcal/d)	617.53	230.30	(45.56 - 2339.80)
Protein (kcal/d)	325.23	258.10	(27.20 - 1355.12)
Total intake (kcal)	1126.07	485.70	(333.32 - 2711.96)

Note: n = 76

Specific Aim Two

Specific aim two was to analyze demographics, sleep quality, sleep quantity, sleep latency, sleep hygiene and determine the relationship to appetite, dietary intake, and BMI levels of adolescents. Corrections were analyzed using SPSS Version 26. The statistical significance is

set at $p < .05$. Correlations were used to examine the relationship among sleep and appetite, dietary intake, and BMI of the adolescent study participants.

Sleep Correlations

Age

The participant's age was significantly positively associated with the global Pittsburgh Sleep Quality Index score ($r = .28$, $p < .05$), and the participant BMI ($r = .37$, $p < .01$). As the participant's age increased, the global Pittsburgh Sleep Quality Index score, indicating poor sleep quality, also increased. As the participant's age increased, the participant's reported BMI also increased.

Pittsburgh Sleep Quality Index

The global Pittsburgh Sleep Quality Index scores, which reflect overall sleep quality, were significantly positively associated with total appetite scores ($r = .31$, $p < .01$), and the total Adolescent Sleep Hygiene Practice Scale scores ($r = .45$, $p < .001$). As the participant scores on the Pittsburgh Sleep Quality Index increased, the mean appetite scores, indicating increased appetite, and Adolescent Sleep Hygiene Practice scores, indicated poor sleep hygiene practices, also increased.

Sleep Latency

The sleep latency score was significantly positively associated with the mean sleep hygiene score ($r = .32$, $p < .05$). As the participant sleep latency times, the number of minutes to fall asleep as captured by Fitbit, increased, the mean Adolescent Sleep Hygiene scores, indicating poor sleep hygiene practices, also increased. See Table 26 for sleep correlations.

Table 26

Intercorrelations for Demographics, Sleep Quality, Quantity, Latency, Hygiene, and Dietary Intake, Appetite, and BMI

Variable	Age	Sleep quality (PSQI)	Fitbit sleep quantity	Sleep latency	Sleep hygiene	Appetite scale	Dietary intake (kcal)	BMI
Age	1							
Sleep quality (PSQI)	.28*	1						
Fitbit sleep quantity	-.07	-.12	1					
Sleep latency	-.09	.12	.11	1				
Sleep hygiene	.19	.45**	-.02	.32*	1			
Appetite scale	.07	.33**	.12	-.08	.15	1		
Dietary intake (kcal)	.18	.05	.06	-.10	.18	.18	1	
BMI	.37**	.12	.02	-.08	.18	-.03	.02	1

Note: $n = 76$

Significance: *$p \leq .05$; **$p \leq .01$; ***$p \leq .001$

Sleep Hygiene Correlations

Physiological

The participant's physiological sleep hygiene factors were significantly positively associated with the global Pittsburgh Sleep Quality Index score ($r = .28$, $p < .05$). As the participant's physiological sleep hygiene factors, such as late caffeine use and exercise use and indicating poor sleep hygiene practices, increased, the global Pittsburgh Sleep Quality Index score, indicating poor sleep quality, also increased.

Behavioral

The participant's behavioral sleep hygiene factors were significantly positively associated with the global Pittsburgh Sleep Quality Index score ($r = .36$, $p < .01$), and the participant's Fitbit mean sleep latency ($r = .29$, $p < .05$), and significantly negatively associated with the participant's total sleep minutes ($r = -.28$, $p < .05$). As the participant's behavioral sleep hygiene factors, such as gaming or watching television and indicating poor sleep hygiene practices, increased, the global Pittsburgh Sleep Quality Index score, indicating poor sleep quality, also increased. As the participant's behavioral sleep hygiene factors, indicating poor sleep hygiene practices, increased, the participant's mean sleep latency as captured by the Fitbit, or number of minutes that it took the participants to fall asleep, also increased. As the participant's behavioral sleep hygiene factors, indicating poor sleep hygiene practices, increased, the total sleep minutes over the five nights as captured by the Fitbit, decreased.

Cognitive

The participant's cognitive sleep hygiene factors were significantly positively associated with the global Pittsburgh Sleep Quality Index score ($r = .47$, $p < .01$), and the participant's age ($r = .27$, $p < .05$). As the participant's cognitive sleep hygiene factors, such as worrying and

indicating poor sleep hygiene practices, increased, the participant's age also increased. As the participant's cognitive sleep hygiene factors, indicating poor sleep hygiene practices, increased, the global Pittsburgh Sleep Quality Index score, indicating poor sleep quality, also increased.

Environmental

The participant's environmental sleep hygiene factors were significantly positively associated with the global Pittsburgh Sleep Quality Index score ($r = .23$, $p < .05$), and the participant's total calorie intake ($r = .31$, $p < .05$). As the participant's environmental sleep hygiene factors, such as warm or cold room and indicating poor sleep hygiene practices, increased, the participant's total calorie intake also increased. As the participant's environmental sleep hygiene factors, indicating poor sleep hygiene practices, increased, the global Pittsburgh Sleep Quality Index score, indicating poor sleep quality, also increased.

Stability

The participant's stability sleep hygiene factors were significantly positively associated with the global Pittsburgh Sleep Quality Index score ($r = .23$, $p < .05$). As the participant's stability sleep hygiene factors, indicating inconsistent weekend and weekday sleep and wake times, increased, the participant's mean sleep latency as captured by the Fitbit, or number of minutes that it took the participants to fall asleep, also increased.

Daytime

The participant's daytime sleep hygiene factors were significantly positively associated with the global Pittsburgh Sleep Quality Index score ($r = .28$, $p < .05$), and the participant's total calorie intake ($r = .36$, $p < .01$). As the participant's daytime sleep hygiene factors, such as napping and indicating poor sleep hygiene practices, increased, the participant's total calorie intake also increased. As the participant's daytime sleep hygiene factors, indicating poor sleep

hygiene practices, increased, the global Pittsburgh Sleep Quality Index score, indicating poor sleep quality, also increased.

Total Score

Finally, the participant's total sleep hygiene factors were significantly positively associated with the global Pittsburgh Sleep Quality Index sore ($r = .44$, $p < .01$). As the participant's total sleep hygiene factors, indicating poor sleep practices, increased, the participant's the global Pittsburgh Sleep Quality Index score, indicating poor sleep quality, also increased. See Table 27 for sleep hygiene correlations.

Table 27

Intercorrelations for Sleep Hygiene Factors and Demographics, Sleep Quality, Quantity, Latency, Dietary Intake, Appetite, and BMI

Variable	Physiologic	Behavior	Cognitive	Environment	Stability	Daytime	Substance	Total
Age	.07	.14	.27*	.11	-.06	.15	-.19	.21
Sleep quality (PSQI)	.28*	.36**	.47**	.23*	.13	.28*	.06	.44**
Fitbit sleep quantity	.09	-.28*	-.11	.02	.03	.49	-.21	-.06
Sleep latency	.06	.29*	.07	.15	.23*	.05	.01	.19
Appetite scale	.17	-.02	.21	.09	.13	-.02	-.03	.15
Dietary intake (kcal)	.12	.03	.13	.31*	.22	.36**	-.03	.22
BMI	-.05	.14	.09	.06	.21	.01	-.13	.14

Note: $n = 76$
Significance: *$p \leq .05$; **$p \leq .01$; ***$p \leq .001$

Specific Aim Three

Specific aim three was to determine to what extent demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene affect appetite, dietary intake, and BMI levels of adolescents.

Appetite

To determine the extent that demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene explain the variance in adolescent's appetite scale scores, a hierarchical regression was calculated in the following order: (1) age, (2) sleep quality (from the global Pittsburgh Sleep Quality Index score), (3) sleep quantity (total minutes of sleep from the Fitbit over 5 days and nights), (4) sleep latency (minutes to fall asleep from the Fitbit over 5 nights), and (5) sleep hygiene (the mean score from the Adolescent Sleep Hygiene Practice Scale). The mean appetite score from the Appetite Visual Analog scale was used as the dependent variable. Regression results indicated that sleep quality, sleep quantity, sleep latency, and sleep hygiene was not statistically significant $p > .05$. Regression coefficients can be found in Table 28.

Table 28

Hierarchical Regression Equation for Relationship of Age, Sleep Measures, and Sleep Hygiene to Appetite

Predictor Variables	Pearson correlation	R^2	R^2 *change*	Beta coefficients
Age	.08	.01	.01	.08
Global PSQI quality	.33**	.11	.10	.33**
Sleep quantity	.12	.13	.02	.16
Sleep latency	-.08	.16	.03	-.15
Sleep hygiene	.15	.16	.00	.08
$R^2 = .16$, $F(5,70) = .08$, $p = .55$				Adjusted $R^2 = .01$

Note: $n = 76$

*p = < .05
**p = < .01

Dietary Intake

To determine the relationship between dietary intake and sleep quality, sleep quantity, sleep latency, and sleep hygiene, a hierarchical multiple regression was run in the following order: (1) age, (2) sleep quality (from the global Pittsburgh Sleep Quality Index score), (3) sleep quantity (total minutes of sleep from the Fitbit over 5 days and nights), (4) sleep latency (minutes to fall asleep from the Fitbit over 5 nights), and (5) sleep hygiene (the mean score from the Adolescent Sleep Hygiene Practice Scale). Mean calorie participant intake over the 5 days was entered as the dependent variable. Regression results indicated that sleep quality, sleep quantity, sleep latency, and sleep hygiene was not statistically significant $p > .05$. Regression coefficients can be found in Table 29.

Table 29

Hierarchical Regression Equation for Relationship of Age, Sleep Measures, and Sleep Hygiene to Dietary Intake

Predictor variables	Pearson correlation	R^2	R^2 *change*	Beta coefficients
Age	.18	.03	.03	.18
Global PSQI quality	.05	.03	.00	-.01
Sleep quantity	.06	.04	.01	.07
Sleep latency	-.10	.05	.01	-.10
Sleep hygiene	.18	.09	.04	.23
R^2 = .09,F(5,70) = .23, p = .26				Adjusted R^2 = .02

Note: n = 76
*p = < .05
**p = < .01

Body Mass Index

To determine the relationship between body mass index and sleep quality, sleep quantity, sleep latency, and sleep hygiene, a hierarchical regression was run in the following order: (1) age, (2) sleep quality (from the global Pittsburgh Sleep Quality Index score), (3) sleep quantity (total minutes of sleep from the Fitbit over 5 days and nights), (4) sleep latency (minutes to fall asleep from the Fitbit over 5 nights), and (5) sleep hygiene (the mean score from the Adolescent Sleep Hygiene Practice Scale). Participant was entered as the dependent variable. The regression model that included sleep quality, sleep quantity, sleep latency, and sleep hygiene was not predictive of dietary intake. Regression coefficients can be found in Table 30.

Table 30.

Hierarchical Regression Equation for Relationship of Age, Sleep Measures, and Sleep Hygiene to Body Mass Index

Predictor variables	Pearson correlation	R^2	R^2 *change*	Beta coefficients
Age	.37**	.14	.14	.37**
Global PSQI quality	.12	.14	.00	.02
Sleep quantity	.02	.14	.00	.04
Sleep latency	-.08	.14	.00	-.06
Sleep hygiene	.18	.16	.02	.18
R^2 = .16, F(5,70) = .17, p = .20				Adjusted R^2 = .10

Note: n = 76
*p = < .05
**p = < .01

Summary

The mean sleep quality score from the Fitbit was 87.01. According to the Fitbit, the mean sleep quantity hours was 7.33 hours at night and 7.48 hours of mean total sleep in a 24-hour period. The mean sleep latency was 6.09 minutes from the Fitbit. According to the Pittsburgh

Sleep Quality Index scores, the participants reported a mean of 8.49 hours of sleep at night and a sleep latency of 20.45 minutes at night. The participants also reported a mean global Pittsburgh Sleep Quality Index score of 3.87. As analyzed by NutritionQuest, the participants reported consuming a mean of 154.38 grams of carbohydrate grams per day, a mean of 81.31 grams of protein per day, and a mean of 20.36 grams of fat per day.

The participant's age was significantly positively associated with the global Pittsburgh Sleep Quality Index sore and the participant BMI. The global Pittsburgh Sleep Quality Index scores were significantly positively associated with total appetite scores and the total Adolescent Sleep Hygiene Practice Scale scores. The sleep latency score was significantly positively associated with the mean sleep hygiene score. Several areas of the Adolescent Sleep Hygiene Practice Scale correlated with age, sleep quality, sleep quantity, sleep latency, and kilocalorie intake.

No statistically significant regressions were noted to determine the extent demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene affect appetite, dietary intake, and BMI.

Chapter V

DISCUSSION

The purpose of this study was to examine the effect of sleep quality, sleep quantity, sleep latency, and sleep hygiene on appetite, dietary intake, and BMI levels of adolescent youth. The hypothesis of this study was that poor sleep quality would affect appetite, dietary intake, body mass index in adolescent youth. The following specific aims were examined:

1. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene of adolescents and determine the levels of appetite, dietary intake, and BMI levels of adolescents.
2. To analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene and determine the relationship to appetite, dietary intake, and BMI levels of adolescents.
3. To determine to what extent demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene affect appetite, dietary intake, and BMI levels of adolescents.

This chapter includes a discussion of the results of the statistical analysis detailed in Chapter 4. Areas of discussion include overall discussion of sleep, sleep quality, sleep quantity, and sleep hygiene. Sleep factors and associations between appetite, dietary intake, and BMI will also be discussed. The study results will also be discussed in the context of Orem's Self-Care Deficit Theory. Finally, study limitations and future recommendation will be covered.

Recruitment

Participants were randomly selected from a pool of eligible and consenting adolescent volunteers from various churches in the upper Midwestern U. S. Potential participants and/or their parent(s) responded to an ad taken out in church bulletins or emails sent to the youth and/or parent by the church. The use of churches as a place for recruitment has been well established in nursing literature, particularly for community-based health promotion intervention studies

(Bonner, et al., 2017; U. S. Department of Health and Human Services, 2020; Whitt-Glover et al., 2016). Churches have been noted to be an ideal setting for recruitment due to the central role they play in an individual's holistic health (Whitt-Glover et al., 2016) as well as the churches well-established trust and credibility within a community (Bonner, et al., 2017). Only participants who were interested in the research responded to the ad, thus, time was not spent on potential uninterested participants. However, recruiting via churches could limit the generalizability of the study results (Bonner, et al., 2017) due to lack of economic and ethnic diversity (Bonner, et al., 2017; Polit & Beck, 2017).

After successful recruitment, Fitbits and questionnaires were mailed via U. S. Postal Service to participants. In recent years, the use of Postal Service in nursing research has declined due to cost of printing and postage (Larsen, et al., 2015); however, due to the non-contact nature of this study, mailing via Postal Service presented the best option for this study. This study did experience several Fitbit losses via the U.S. Postal Service.

Specific Aim One

Specific aim one was to analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene of adolescents and determine the levels of appetite, dietary intake, and BMI levels of the adolescents.

Demographics

The mean age of the participants was 15.22 years. Participants in this study were 86% Caucasian, and 40.8% of the participants were male, and 59.2% were female. The mean BMI of the participants was 22.12. Six of the participants (7.9%) reported being on a prescription medication, and ten of the participants (13.2%) reported taking over-the-counter medications at times.

This study did include an ethnic makeup in congruence with the U. S. Census Bureau (2019) reported ethnic makeup of the area. According to the Census Bureau (2019), 85% of the ethnic makeup in the area is white, not Hispanic, and this study had 86.8% or the participants report being white, not Hispanic. However, a disproportionate number of females (59.2%) participated in the study.

Body Mass Index

Only 26.4% of the participants in this research self-reported a height and weight that had yielded a BMI meeting guideline for being overweight. This was a lower percentage of overweight or obese adolescent youth as compared to the national approximate of 33% (Fryar et al., 2018). Studies have recognized the limitations and inaccuracy of self-reported heights and weights in studies with adolescents (Nikolaou et al., 2017; Opichka & Smith, 2018). In a study of 2656 participants, Opichka and Smith (2018) found that youth over reported heights and under reported weights which lead to the miscalculation of BMI for 4% - 8% of participants. If this 4%-8% is accurate, this study would have a percentage of overweight and obese adolescents that aligns with the national average. However, due to the non-contact nature of this study, it was not possible to validate the self-reported data. These discrepancies in self-reported BMI and national averages of BMI could have occurred for a variety of reasons including embarrassment (Opichka & Smith, 2018) or parents not knowing their adolescent's weight (Nikolaou et al., 2017)

Fitbit

The Fitbit measured sleep quality, quantity, and latency by estimating a combination of movements and heart rate patterns. The length of time between the movements are indicative of sleep (Fitbit Health Solutions, 2019). The sensitivity for the Fitbit was noted to be 95% when the sensitivity was set for high threshold (Lee et al., 2019), and all Fitbits for this study were set to a

high threshold. Although some Fitbits were returned via U. S. Postal service with a dead battery, the data from the Fitbit was still retrievable upon recharging the device.

Sleep Quality

The Fitbit sleep quality of the participants (88.2%) in this study was recorded as a sleep quality score at 85 or greater, which indicates good sleep quality. These findings are not consistent with previous study (Blake et al., 2017) in which less than 50% of adolescents had a good quality sleep score. Healthy People 2020 noted at baseline, only 30.9% of students in grades 9-12 get sufficient sleep quality on an average week (Youth Risk Behavior Surveillance System, 2019); however, this study did include adolescents in grades 6-8 in addition to grades 9-12. Considering the erratic bedtimes and wake times and short sleep quantity captured by the Fitbit, it could be theorized that the high sleep quality scores captured by the Fitbit may be explained as the participants being overtired and sleeping with a better quality of sleep (Arora & Taheri, 2017) as their body attempted to negate the erratic sleep schedules.

Sleep Quantity

Sleep quantity was also recorded as an average of 7.33 hours of sleep per night over the 5 nights for all participants. In addition, during the 5 days and nights of the study, 77.6% of the participants slept less than the recommended 8 -10 hours of sleep per night (Hirshkowitz et al., 2015; Paruthi, et al., 2016). The findings from this study do coincide with previous studies which have noted adolescents to average approximately 7 hours of sleep each night (Wheaton et al., 2016). As previously noted, over two-thirds of high school students in the U. S. have reported getting less than 8 hours of sleep on school nights (Wheaton et al., 2016;) with similar results of only one-third of adolescents receiving the recommended amount of sleep (Chaput & Janssen, 2016); therefore, the participants in this study slept even less than previous research has reported.

However, as this study took place in the summer months, additional research as noted that adolescents sleep even less in the summer months (Quante et al., 2019b). This is thought to be due to greater daytime hours, brighter light in the early morning, and no school commitment. However, even with the consideration of summer sleep schedules, overall, the participants slept fewer minutes as compared to previously reported studies (Chaput & Janssen, 2016; Quante et al., 2019b).

In addition, the Fitbit captured 37 naps taken by 27 participants. As noted, these naps also took place 24 hours during the day with some participants napping in the morning, some participants napping in the evening, and some participants napping during the night. The erratic napping of the participants was not anticipated, and at times, was difficult to translate from the Fitbit. These naps also varied in length of time with a range of nap time from 11 minutes to 316 minutes.

Interestingly, 27 participants napped at some time during the study 5 days and nights. Calculating a 24-hour day of sleep, the participant's averaged 7.48 hours of sleep per day. The addition of nap time only yielded 2 participants moving from less than 8 hours of total sleep time per day and night to the recommended 8-10 hours of total sleep time per day and night. Hence, napping rarely improved overall sleep times for the participants of this study. Research has noted that benefits of napping are well established; however, napping does not help the individual catch up on lack of sleep (McDonald, 2020). This research did confirm that napping rarely increases an individual's overall sleep quantity to the recommended amount of sleep.

Sleep Latency

The sleep latency captured by the Fitbit showed that 73.7% of the participants had short sleep latency, or a sleep latency of less than 8 minutes, and no participants had a long sleep

latency. The findings of this study are not like one study which found that 6%-37% of adolescents report problems related to prolonged sleep latency (Ogden, et al., 2014). Considering the lack of sleep time, erratic bedtimes, erratic wake times, and naps, it is surmised that the participants were overtired fell asleep quickly.

Bedtime and Wake Time. The timing of the participant sleep was found to be erratic and of any hour of either day or night. The erratic and extreme sleep schedules were not anticipated. The Fitbit captured bedtimes and wake time 24 hours during the day with some participants falling asleep for the night at 1809 (range 1809 – 0623), while other participants were waking up at 0514 (range 0514 – 1352). This lack of consistent schedule has been established to have increased poor health outcomes in adolescents and adults (Arora & Taheri, 2017). However, this erratic adolescent sleep schedule is consistent with other studies (Quante, et al., 2019a).

Intriguingly, adolescents are recognized has having a biological delay in the onset of sleep as well as the timing of sleep, both of which can contribute to them staying awake longer during the night. This is often associated more often with older adolescents rather than younger adolescents. The reduced urge to fall asleep results in adolescents and increased urge to stay awake longer has been noted in research (Bruce et al., 2019). In addition, research has also noted adolescent sleep being strongest or most restful in the morning (Park, 2020). This study concurred with the sleep delay research as only 2.89% of the participants' sleep times were prior to 2200. These findings are not unique as additional research as noted that 5% of adolescents go to sleep past midnight on school nights (Chaput & Janssen, 2016). The importance of sleep consistency and earlier bedtimes is not well practiced by adolescents and represents an area of education for nursing (Bruce et al., 2019).

Pittsburgh Sleep Quality Index

According to the calculated Pittsburgh Sleep Quality Index score, 60.5% of the participants in this study had a good sleep quality score; however, according to the Fitbit data, 88.2% of participants had a good sleep quality score. According to the Pittsburgh Sleep Quality Index, the participants self-reported a mean of 8.49 hours of sleep each night; however, according to the Fitbit data, the participants experienced a mean sleep quantity of 7.33 hours each night. According to the Pittsburgh Sleep Quality Index, the participants self-reported a mean sleep latency of 20.45 minutes each night; however, however, according to the Fitbit data, the participants had a mean sleep latency of 6.09 minutes. These inconsistencies are not uncommon in studies with self-reported data from adolescents as individuals tend to report their 'best selves' (Opichka & Smith, 2018). In addition, another study noted that self-reported adolescent studies tend to contain more pronounced or distorted data as compared to adult studies (Fan, et al., 2016).

The Pittsburgh Sleep Quality Index is a self-reported scale which contains seven component scores with a range of 0 (good sleep quality) to 3 (poor sleep quality). Summing all seven scores provides a global sleep quality score for each participant, and the Pittsburgh Sleep Quality Index scores have a range of 0-21 (Buysse et al., 1989; Luyster et al., 2016). A global Pittsburgh Sleep Quality Index score >5 indicates poor sleep quality (Shirvastava et al., 2014). As noted, 30 of 76 participants had a calculated Pittsburgh Sleep Quality Index score that indicated poor sleep quality, which is far below the percentage of adolescents with good sleep quality in previous studies (Blake et al., 2017; Hayes, et al., 2018).

Adolescent Sleep Hygiene Practice Scale

Physiological, Behavioral, and Cognitive Factors

Physiological factors include caffeine use after 6:00 pm, exercising late in the day or after 6:00 pm, drinking over 4 ounces of water within one hour of going to bed, going to bed with a stomachache, and going to bed hungry. Most participants answered ‘never’ or ‘once in a while’ to these questions, indicating good sleep hygiene practices. Behavioral factors include gaming and reading or watching television prior to bedtime and use of bed for something other than sleep. The participant responses to these questions were more dispersed, indicating not good sleep practices. Cognitive factors in the Adolescent Sleep Hygiene Practice Scale include going to bed thinking of things to do the next day, replaying the day’s events, and worrying about home. Most of the participants’ responses indicated ‘never’ or ‘once in a while’, which indicated good sleep hygiene practices; however, two of the questions did have a more varied response. These results indicated some inconsistencies with the cognitive sleep hygiene factors. It appears that one bad sleep hygiene practice easily leads to or relates to additional poor sleep hygiene practices. A cycle of poor sleep practices can ensue and be difficult to break. Interventions focused on interrupting one element of the poor sleep hygiene practice could potentially affect numerous other areas and promote positive sleep hygiene and ultimately better, longer, adequate sleep. Intervention studies to determine which element of sleep hygiene to promote and break the poor sleep hygiene practice cycle should be considered (Arora & Taheri, 2017; Blake et al., 2017).

Environmental Factors

Most participant responses indicated ‘never’ or ‘once in a while to environmental sleep hygiene factors, which included sleeping in a hot or cold room, falling asleep listening to loud

music, falling asleep in a bright room, and falling asleep, but then move to a different location during the night. These responses indicated good sleep hygiene practices. Interestingly, adult studies regarding environmental factors have revealed an increase in thyroid activity with sleep loss, and the relationship of thyroid to hot and cold temperature regulation are well established (Klingenberg et al., 2012). This thermogenesis dysregulation may affect the participant's perception of the environmental factor of a hot or cold room. As the environmental factor of a hot or cold room was noted by several participant responses, the cyclical relationship of sleep hygiene factors may be further explained. Hence, the sleep loss may be further exacerbated by this process.

Sleep Stability

Most participants in this study answered 'never' or 'once in a while' to questions on sleep stability, which includes late sleep and late waking on weekends. This is yet another aspect of the sleep hygiene. In a study by Wang et al. (2019), 68%-75% of adolescent participants used the weekend to catch up on sleep time, with boys having a larger proportion of those catching up on sleep on weekends as compared to girls. This catch up on sleep was also associated with a lower risk of obesity. In their review, these authors did not recommend oversleeping on weekends as a means to overcome lack of weekday sleep. This study also suggested that further research was needed to examine the potential detrimental effects of long weekend sleep on the physiological body systems in addition to the overall mental health of adolescents. Although using the weekend to catch up on sleep is in direct conflict with the sleep stability factor of sleep hygiene, the participants of this study reported practicing this lack of sleep stability.

Modifiable sleep hygiene stability factors have also been explored. One area of current debate is school start times, as some areas are considering delaying the start of school in an

attempt to increase adolescent sleep (Gohil & Hannon, 2018; Park, 2020). However, as this study took place in the summer, the extreme and erratic sleep times and bedtimes noted in study do not promote such practices. Without the necessary wake up times and structure due to school, the adolescents in this study experienced very irregular sleep patterns.

Bedtime Routine

One area of interest for this study and the sleep hygiene aspect is the use of a bedtime routine. This study found that most of the participants (73.6%) used a bedtime routine. Interestingly, research indicates that adolescents are aware of the importance of a good sleep routine; however, adolescents also reported social pressures to defer or waive the routine. Furthermore, bedtime routines are usually instigated by parents (Godsell & White, 2019). Hence, the importance of parental involvement in adolescent's health remains evident.

Cell Phone

The non-validated question of this this study was keeping of cell phones in the bedroom during the night. In this study, 72.4% of participants reported keeping their cell phone in their rooms, which has been noted in previous research to be a distraction to sleep (Godsell & White, 2019). Adolescents have also reported social pressures to remain on cell phones (Godsell & White, 2019; Quante et al., 2019a). Intriguingly, one study found a high prevalence of 'social jet lag' as a strong disconnect of the acknowledgement of the importance and need for sleep versus the social and behavioral use of electronics. Even though the adolescents were aware of the importance of sleep, they deemed social activity as more important (Quante et al., 2019a). As cell phone use at bedtime has been associated with poor sleep quality (Caumo et al., 2020) and increased obesity in adolescents (Fuller et al., 2018), parents and/or guardians have an increase

challenge to not only promote sleep for their adolescent's health but to also enforce good sleep hygiene practices by removing cell phones from adolescent bedrooms.

In addition, increased knowledge of sleep and sleep hygiene practices has been found to improve sleep attitude (Price, 2015). Intriguingly, sleep attitude is a term gaining popularity. Sleep attitude is defined as the degree of favor or disfavor to the process of sleep. With the complex nature of the biological need for sleep, many adolescents view sleep as a choice; hence the attitude towards sleep and sleep hygiene is not positive, but rather viewed as not a priority or even an annoyance. Additionally, research has noted that some adolescents and adults view sleep as a waste resource rather than an investment (Price, 2015). Hence, sleep attitude is one additional component of the sleep process for additional research in adolescents.

Appetite

The participants' mean appetite rating during this study was 32.69, with a range of 5-55 on the Appetite Visual Analog Scale. Participant's placed an "X" on the horizontal line in the Appetite Visual Analog Scale that corresponded to what the participant felt during the study week, with possible answers ranging from 0 – 55. Participant ratings of appetite were the only rating that was above the median point. Food cravings, desire to eat, interest in eating, and feeling full had mean responses below the median. No participants reported a craving for or eating any non-food items. These findings are consistent with similar studies on adolescent self-reports of appetites, with appetites being self-reported as higher (Yang et al., 2019), and food cravings as lower (Kracht et al., 2019).

Dietary Intake

A wide range of dietary information was self-reported by the participants. The number of grams of carbohydrates reported being consumed per day by the participants ranged from 11.39

grams to 334.95 grams. Although the adolescent needs for carbohydrates may vary by age, gender, and activity (Mayo Clinic, 2020; NutritionQuest, 2019), males and females 9-18 years of age are recommended to consume 130 grams of carbohydrates per day. In addition, 45%-65% of daily energy intake in adolescents should come from carbohydrates (National Institute of Health, 2020).

The number of grams of protein reported by the participants per day ranged from 6.8 grams to 338.78 grams. Although the adolescent needs for protein may vary by age, gender, and activity (Mayo Clinic, 2020; NutritionQuest, 2019), males 9-13 years of age are recommended to consume 34 grams of protein per day, and males 14-18 years of age are recommended to consume 52 grams of protein per day. Females 9-13 years of age are recommended to consume 34 grams of protein per day, and females 14-18 years of age are recommended to consume 46 grams of protein per day. In addition, 10-30% of daily energy intake for adolescents should come from protein (National Institute of Health, 2020).

The number of grams of fat reported being consumed by the participants per day ranged from 6.23 grams to 50.68 grams. Similar to carbohydrates and protein, the adolescent need for fats vary by age, gender, and activity (Mayo Clinic, 2020; NutritionQuest, 2019). According to the National Institute of Health (2020), the daily needs for fats in adolescents is not determined; however, 25%-35% of daily energy intake for adolescents should come from fat intake.

Considering that both male and females were included in these ranges of macronutrient intakes, these results are not surprising. In addition, the wide range of ages (12-18 years) also supports a wide range of macronutrient intake (NutritionQuest, 2019). Finally, the activity levels of the adolescents may also have varied; hence, changing the daily needs for macronutrients.

A wide range of calorie intake was also self-reported by the participants. The mean reported daily calorie intake for the study participants was 1126.07, with a range of 333 – 2711 calories per day being reported. As noted, considering the age range and both female and male participants being represented in the calorie data, a wide range of calorie intake is not surprising. In addition, the activity levels of the adolescents may also have varied; hence, changing the daily needs for calories. However, the average of 1126 calories per day is far below the recommended number of calories per day. As noted by the USDA Dietary Guidelines for Americans (2020) boys 9-13 years of age should consume 1,600 – 2,600 kilocalories per day, depending on level of activity. Boys 14-18 years of age should consume 2,000 – 3,200 kilocalories per day, depending on level of activity. Girls 9-13 years of age should consume 1,400 – 2,200 kilocalories per day, depending on level of activity. Girls 14-18 years of age should consume 1,800 – 2,400 kilocalories per day, depending on level of activity.

These low values for macronutrients and kilocalorie intake coincide with self-reported data from adolescents as individuals tend to report their socially desirable answers (Opichka & Smith, 2018). In addition, another study noted that self-reported adolescent studies tend to contain more distorted data as compared to adult studies (Fan, et al., 2016). Finally, adolescents tend to report dietary patterns as they perceive they would like to have, rather than the dietary practices they consume (Golley et al., 2016).

Specific Aim Two

Specific aim two was to analyze demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene and determine the relationship to appetite, dietary intake, and BMI levels of adolescents.

Appetite and Age

Age was not associated with the participant's self-reported appetite scores or the participant's self-reported dietary intake. These results were surprising; however, as noted, all ages of participants rated appetite above the median point in the Appetite Visual Analog Scale. However, the average of 1126 calories per day was far below the recommended number of calories per day. As previously noted, the self-reported nature of this information and the desire to report socially acceptable information can occur in adolescent studies (Golley et al., 2016).

Body Mass Index and Age

The participant's age was significantly associated with the participants' BMI's. As the participant's age increased, their reported BMI also increased. These findings are consistent with information on childhood and adolescent overweight and obesity rates in the U. S as well as previous research (Grander et al., 2015). According to the CDC (2019) 14% of middle school age adolescents are obese as compared to 14.5% of high school age adolescents. Additionally, 16.5% of middle school age adolescents are overweight as compared to 16.9% of high school age adolescents. As with adolescent obesity, the reasons for increased BMI with age are complex and multifaceted (CDC, 2019). Research has suggested that older adolescents spend more time away from home; hence, fewer family meals and more fast-food meals (Kracht et al., 2019). Research has also noted that older adolescents tend to spend more time gaming; hence they spend less time engaging in physical activity (Quante et al., 2019a). Finally, lack of sleep as adolescents become older may also affect the increase in BMI (Grander et al., 2015; Magee & Lee, 2013).

Sleep Quality and Age

The participant's age was significantly positively associated with the global Pittsburgh Sleep Quality Index score. As the participant's age increased, the global Pittsburgh Sleep Quality Index score, indicating poor sleep quality, also increased. Research has suggested that electronic use at bedtime can affect sleep quality (Fuller et al., 2018), and older adolescents engage in more electronic use at bedtime as compared to younger adolescents (Caumo, et al., 2020; Quante et al., 2019a).

Sleep Quality and Appetite

The global Pittsburgh Sleep Quality Index scores, which reflect overall sleep quality, were significantly positively associated with total appetite scores. As the participant scores on the Pittsburgh Sleep Quality Index increased, the mean appetite scores, indicating increased appetite, also increased. These findings are not consistent with adolescent studies that have found no association between eating control and sleep quality (Goldschmidt, 2020; Kracht et al., 2019).

Previous research indicates a possible mechanism of short sleep time and weight gain through appetite-regulating hormones. Broussard et al., (2016) remarked upon the appetite-regulating hormones ghrelin (increases hunger) and leptin (decreases hunger) and the relationship between fluctuations in these hormones and sleep restriction. Additional researchers have noted the leptin levels in healthy adults are lower during the day and ghrelin levels are lower during sleep (Arora & Taheri, 2017). Furthermore, in adult studies, appetite and energy intake have been shown to increase even in the absence of these hormone fluctuations (Miller et al., 2015). Insufficient sleep for any reason, such as poor sleep quality and decreased sleep quantity, stresses the body and body systems in ways that science continues to work to explain (Chaput & Dutil, 2016). Further investigation may be warranted to the relationship of ghrelin and

leptin with not only sleep restriction, but also sleep quality in adolescents and the ultimate effect of sleep quality on appetite.

Intriguingly, the concentrations of ghrelin and leptin are not consistently reported in adolescent studies in which these levels are measured immediately following sleep loss. However, when monitoring the measurement of these hormones 24 hours post sleep loss, the profiles of ghrelin and leptin provided a more comprehensive view and consistency of the relationship with findings supporting previous research with ghrelin showing increased hunger and leptin showing decreased hunger (Klingenberg et al., 2012). Therefore, the complexity of hormones and sleep may be even more complex in adolescents.

Sleep Quality, Body Mass Index, and Dietary Intake

No associations between the global Pittsburgh Sleep Quality Index and BMI were noted in this study. As research had suggested that sleep quality may be just as important as sleep quantity in relation to adolescent obesity (Arora et al., 2018; Cappuccio et al., 2008), these results were unexpected. However, as most participants self-reported a calculated mean global Pittsburgh Sleep Quality Index of 3.87 (with greater than 5 indicating poor sleep quality), the participants may have experienced good sleep quality during this study, which may have affected the outcome. In addition, the erratic sleep bedtimes and wake times may have affected the sleep quality (Hayes, et al., 2018).

No associations between the global Pittsburgh Sleep Quality Index and dietary intake were noted in this study. These findings are not consistent with a study that noted an increase in calorie, fat, and carbohydrate consumption associated with poor sleep quality (He et al., 2015). As noted, the self-reported dietary intake by the participants in this study was low as compared to the recommendations (National Institute of Health, 2020).

Considering the aforementioned information on brain development in adolescent and sleep (Tarokh et al., 2011), the production of hormones during adolescent sleep loss may be a factor in sleep and diet (St. Ogne, 2017). However, hormones are not the only factor that modulate dietary intake. For example, adolescents may eat for reasons unrelated to hunger, such as boredom, stress, fatigue, joy, or socialization (St. Ogne, 2017).

Sleep Hygiene and Sleep Quality

The global Pittsburgh Sleep Quality Index scores, which reflect overall sleep quality, were significantly positively associated with the total Adolescent Sleep Hygiene Practice Scale scores. As the participant scores on the Pittsburgh Sleep Quality Index, indicating poor sleep quality, increased, the mean Adolescent Sleep Hygiene Practice scores, indicated poor sleep hygiene practices, also increased. These results were not surprising. One research study on college students noted that a more positive sleep attitude was indirectly associated through sleep hygiene with better sleep quality (Peach et al., 2018). Research has indicated that interventions focused on improving one element of sleep hygiene practice could potentially affect numerous other areas of sleep hygiene and promote positive sleep hygiene improved sleep quality (Arora & Taheri, 2017; Blake et al., 2017; Peach et al., 2018). For example, Bauducco et al. (2019) researched 3,622 adolescents in an intervention group and 3,336 adolescents in an intervention group. The intervention group received a school-based sleep education curriculum. Results indicated that the intervention group was 2 times less likely to report poor sleep quality post intervention; however, the intervention group reported minimal improvement in sleep hygiene practices.

Sleep Quantity and Appetite, Dietary Intake, and Body Mass Index

This study found no association between sleep quantity and appetite, dietary intake, and BMI. These findings contrast with many studies that have indicated increased obesity and increased BMI's to be associated with shorter sleep duration (Arora et al., 2018; Cappuccio et al., 2008; Sluggett et al., 2018). As noted, this study had a lower percentage of self-reported overweight or obese adolescent youth as compared to the national average of adolescents being overweight or obese (Fryar et al., 2018), and several studies have recognized the limitations and inaccuracy of self-reported heights and weights in studies with adolescents (Nikolaou et al., 2017; Opichka & Smith, 2018). Therefore, the self-report of the participant's weight could have resulted in inaccurate BMI levels and an incorrect lack of association of BMI and sleep quantity. This limitation to self-reported data may also explain the lack of association between dietary intake and sleep quality. As noted, the self-reported dietary intake from the adolescents in this study was low compared to recommended dietary intake. Therefore, the self-reported data may explain the lack of association between dietary intake and sleep quantity.

One theory on the relationship between short sleep and obesity is the energy imbalance theory as short sleep is thought to dysregulate the homeostatic mediated intake of energy, which noted the relationship of the leptin, ghrelin, insulin, and cortisol. As these hormones contribute to appetite, subsequent BMI may also be affected (Sluggett et al., 2018). As appetite scores for this study were solid across all age groups, this consistently strong self-reported score may further explain the lack of association between sleep quantity and appetite.

Intriguingly, the relationship between decreased sleep and increased BMI has been notably inconsistent in the research (Arora et al., 2018). Increased research has noted the U-shape association that indicates both long and short sleep duration are associated with increased

obesity and increased BMI. Also, the association between sleep and BMI has been found to be less notable in older adolescents (Grandner et al., 2015). Further research has indicated that the more profound the lack of sleep, the higher the incidence of obesity. For example, in a study of adolescents who slept 5 hours a night as compared to adolescents who slept 7 hours a night, results noted that the adolescents who slept only 5 hours at night had a greater incidence of obesity as compared to the adolescents who slept 7 hours at night (Meldrum & Restivo, 2014). As noted, the average sleep per night for this study was 7.33 hours. Therefore, the lack of extreme sleep loss in this study could explain the BMI findings being inconsistent with research.

Sleep Latency and Appetite, Dietary Intake, and Body Mass Index

No significant associations were noted between the participant's sleep latency and the participant's appetite scores, dietary intake, or BMI. As previously noted, studies on sleep latency and adolescent dietary intake, appetite, and BMI are less frequent in current nursing literature as compared to sleep quantity. One study has noted an association between increased sleep latency and overweight adolescents (Pacheco et al., 2017); however, the current study did not confirm these results.

The sleep latency score was significantly positively associated with the mean sleep hygiene score. As the participant sleep latency times, the number of minutes to fall asleep as captured by Fitbit, increased, the mean Adolescent Sleep Hygiene scores, indicating poor sleep hygiene practices, also increased. These results were not surprising; however, poor sleep hygiene practices resulting in an individual needing longer time to fall asleep are reasonable. For example, activities such as gaming or late activities, which indicate poor sleep hygiene practices, have been shown to increase sleep latency in previous research. Hence, the poor sleep hygiene in

the form of stimulation at bedtime resulted in a prolonged time to fall asleep (Zimmermann et al., 2020).

Sleep Hygiene, Appetite, Dietary Intake, and Body Mass Index

No associations were noted between the reported sleep hygiene practices and self-reported appetite scores, dietary intake, and BMI levels among the adolescent participants. To better understand the possible association between sleep hygiene and appetite, dietary intake, and BMI, sleep hygiene was also calculated by specific factors (see Table 27). Even among specific sleep hygiene factors, no association was noted with appetite scores or BMI. As sleep patterns disrupt the balance of physiological and hormonal responses within the body (Price, 2016), this lack of association was surprising. Waking during the night for various reasons or falling asleep at inconsistent times allows more opportunity for energy consumption (Fatima et al., 2016); however, the self-report of BMI may have limited the possible association between sleep hygiene and BMI for this study.

Sleep Hygiene and Dietary Intake

Significantly, the environmental factors, such as a hot or cold room, and the daytime factors, such as napping, were associated with increased kilocalorie intake. As previously noted, this study found extreme and erratic sleep start and stop times both at night and during the day with napping. As the extreme sleep start and stop times along with extreme napping times were difficult to analyze, these extreme schedules and the relationship to dietary intake should be considered for exploration. Research has indicated that interventions focused on improving one element of sleep hygiene practice could potentially affect numerous other areas of sleep hygiene and promote positive sleep hygiene improved sleep quality (Arora & Taheri, 2017; Blake et al., 2017; Peach et al., 2018). For example, in a study of adolescents, researcher noted those who

reported poor sleep hygiene practices, such as later bedtimes, had higher odds of junk food consumption as compared to those adolescents who reported average sleep hygiene practices (Agostini et al., 2018).

Sleep Quality and Sleep Hygiene

Several factors in the Adolescent Sleep Hygiene Scale were associated with higher global Pittsburgh Sleep Quality Index scores, which reflect overall sleep quality. Participant responses on physiological factors, such as late exercise or late caffeine intake, were significantly correlated with higher poor sleep quality scores ($r = .28$, $p < .05$). Participant responses on behavioral factors, such as bedtime gaming, were also significantly correlated with poor sleep quality scores ($r = .36$, $p < .01$). Participant responses on cognitive factors, such as worrying, were also significantly correlated with poor sleep quality scores ($r = .47$, $p < .01$). Participant responses on environmental factors, such as a hot or cold room, were significantly correlated with poor sleep quality scores ($r = .23$, $p < .05$). The participant responses on sleep stability, such as weekend bedtime and wake time, were significantly correlated with poor sleep quality scores ($r = .23$, $p < .05$). Participant responses on daytime factors, such as napping, were also significantly correlated with poor sleep quality scores sore ($r = .28$, $p < .05$). These results were not surprising; however, information on sleep hygiene and sleep quality in adolescents is not abundant in current literature (Peach et al., 2018). As previously noted, research has indicated that interventions focused on improving one element of sleep hygiene practice could potentially affect numerous other areas of sleep hygiene and promote positive sleep hygiene improved sleep quality (Arora & Taheri, 2017; Blake et al., 2017; Peach et al., 2018). For example, in their systematic review, Arora and Taheri (2017) proposed a pathway of interactions with the biological and social factors that relate to sleep loss and obesity. This proposed pathway included

elements such as caffeine intake, nighttime technology use, unhealthy food intake, sleep loss, and obesity all included in a complex pattern of interactions. The authors concluded their review with proposed interventions to improve sleep hygiene practices in adolescents one element at a time in order to positively promote sleep and overall health in adolescents.

Specific Aim Three

Specific aim three was to determine to what extent demographics, sleep quality, sleep quantity, sleep latency, and sleep hygiene effect appetite, dietary intake, and BMI levels of adolescents.

Appetite

Regression results indicated that sleep quality, sleep quantity, sleep latency, and sleep hygiene were not statistically significant $p > .05$ in determining appetite scores. However, the global Pittsburgh Sleep Quality Index score was correlated with the mean Visual Analog Appetite score ($r = .33$, $p < .01$). These findings are not consistent with existing literature. For example, increased hunger and food cravings have been reported in adults after sleep loss (Yang et al., 2019), and research on college students has noted poor sleep quality was significantly associated with increased hunger and higher levels of nighttime eating (Pona, 2015). Furthermore, studies on adolescents have also noted food cravings and appetite to be related to poor sleep quality (Kracht, et al., 2019).

It is unclear how sleep quality may affect appetite as much research has focused on sleep quantity and the relationship of the hormone's ghrelin and leptin; however, other hormones should also be considered. These physiological variables were not able to be analyzed for this study. For example, sleep loss has been associated with reduced glucose tolerance as well as imbalance with glucose homeostasis and insulin resistance and insulin sensitivity in adolescent

studies (Arora & Taheri, 2017; Felso et al., 2017). Moreover, puberty is associated with transient insulin resistance, which resolves over time (Pacheco, et al., 2016). Hence, the participants in the study may or may not have been in a transient state of insulin resistance therefore adding additional elements to the study. These natural hormonal fluctuations of adolescents further complicate studies that research these hormones. However, glucose and insulin are one of the possible hormonal mechanisms affected by sleep. Ghrelin, leptin, and cortisol are additional factors to consider (Felso, et al., 2017); hence the complexity of sleep and sleep loss on the body is immense.

Research has also noted disruptions in the hormone cortisol, a stress hormone, to be association with abnormal sleep and wake times; hence stress levels and the appetite regulation are likely to also be disrupted and likely increase in response to poor sleep (Price, 2016). As noted, not only should decreased sleep quality or quantity be considered, but also sleep hygiene factors as they may also contribute to this complex mechanism. It is also important to note that the vast majority of studies involving fluctuations in hormones in relation to sleep variations have been completed in adult studies (Gohil & Hannon, 2017); hence the importance of long term effects on these hormones in adolescents is not yet well understood. Considering the aforementioned natural hormone fluctuations during adolescents, this area of research is immensely complex.

Dietary Intake

Regression results indicated that sleep quality, sleep quantity, sleep latency, and sleep hygiene were not statistically significant $p > .05$ in determining dietary intake. These findings are not consistent with previous research as sleep restriction was found to be related to increased carbohydrate (Beebe et al., 2012; Broussard, et al., 2016; Franckle et al., 2015) as well as

unhealthier diets in general (Cespedes et al., 2016). Additional research has noted sleep deprivation to be associated with increase intake of fats with decrease intake of protein (Khatib et al., 2017). As most research on sleep loss has focused on sleep quantity, this research offers a different perspective on sleep loss.

Research has also hypothesized that adolescents with less sleep duration or poor sleep quality will be less active as they are more tired; hence, there will be less demand for food. This hypothesis could not be confirmed (Felso, et al., 2017). However, this possible hypothesis could help explain the decrease in calorie intake for this study. As the participant's did not experience good sleep quantity (n = 7.48 hours), an increase in tiredness could have resulted in less activity and less demand for food; hence the adolescent participants chose a lower calorie food choice as they needed less energy for less activity. The self-reported nature of the study also poses as a limitation for these findings.

One study found shift in bedtime and wake time between weekdays and weekends to be the most important variable associated with dietary intake (Landis et al., 2016). Hence the shifts in circadian rhythms may be associated with dietary intake more than sleep loss. Although sleep stability factors of this study did not support changes in dietary intake, the shifts in circadian rhythms were evident with the aforementioned erratic sleep.

As previously noted, disruption to leptin and ghrelin with experimental sleep loss have been linked to increased appetite in adults; however, in the same study, disruption of these hormones had also been linked to increased consumption of energy dense foods (Arora & Taheri, 2017). In addition, the homeostatic hormone balances, including cortisol, appear to work together to regulate the use of carbohydrates in the body (Price, 2016). The disruption of the

hormonal balance due to sleep hygiene inconsistencies provide yet another opportunity for not only appetite, but also for poor dietary intake.

Late bedtimes have been associated with excessive food intake and poor dietary intake (Chaput & Dutil, 2016). Research has noted that improving bedtime to an earlier start time has been associated with consumption of less junk food such as high fat foods, and increased consumption of fruits and vegetables (Asarnow, et al., 2017). Considering the irregular sleep times and schedule captured by Fitbits in this study, it may be reasonable to assume that irregular meals and snacking of poor dietary food choices among the adolescent participants also occurred.

Body Mass Index

Regression results indicated that sleep quality, sleep quantity, sleep latency, and sleep hygiene were not statistically significant $p > .05$ in determining BMI indices. However, the participant's age was correlated with the BMI scores ($r = .37$, $p < .01$). As noted, the relationship of increased age and increased BMI is well documented (CDC, 2019), which is also noted in this study. As there are multiple known factors, such as lack of physical activity, consuming high calorie, low nutrient foods, and medication use (CDC, 2019), these results were not expected.

Overall, short sleep quantity has been associated with an increased risk of adolescent obesity (Cappuccio et al., 2008; Chaput 2016; Magee & Hale, 2012; Simon et al., 2018). However, these results are not consistent. For example, in a systematic review of 17 studies, 11 studies revealed an association between short sleep and obesity; however, six studies in the systematic review found no association between adolescent sleep quantity and obesity (Felso, et al., 2017). Therefore, this study's findings contribute to the complexity of the adolescent overweight and obesity concern.

Summary

Only 26.4% of the participants in this research self-reported a height and weight that yielded an overweight or obese BMI, which is lower than the national average across the U. S (Fryar et al., 2018). The Fitbit recorded most of the participants in this study (88.2%) as having a sleep quality score at 85 or greater, which indicates good sleep quality. The Fitbit also recorded the participant's average of 7.48 hours of sleep per day, which is below recommendations (Hirshkowitz et al., 2015). Finally, the Fitbit showed that 73.7% of the participants had short sleep latency. The global Pittsburgh Sleep Quality Index was associated with increased appetite (r = .33, p <.01). The participant's age was associated with increased BMI (r = .37, p <.01). Regression results indicated that sleep quality, sleep quantity, sleep latency, and sleep hygiene were not statistically significant with appetite, dietary intake, or BMI. The hypothesis of this study was that poor sleep quality would affect appetite, dietary intake, body mass index in adolescent youth. The global Pittsburgh Sleep Quality Index was associated with increased appetite; however, no other associations between sleep quality and dietary intake or BMI were noted in this study. Furthermore, regression results for sleep quality were not statistically significant with appetite, dietary intake, and BMI. Therefore, the hypothesis of this study was not supported.

As noted, the fluctuations with adolescent hormones in conjunction with the sleep induced hormone fluctuations can yield the potential for appetite and dietary intake changes. In addition, social-behavioral pressures such as autonomy and societal pressures such as school and peers have been discussed as elements contributing to adolescent lack of sleep quality. These factors have been described as a 'perfect storm' for adolescent sleep and subsequent health

problems (Crowley et al., 2018). Therefore, sleep and sleep quality represent a strong, potential area for nursing interventions to promote adolescent health practices.

Orem's Self-Care Deficit Theory

As noted by Orem (2001), the acquired ability of a person to know and meet life's needs is known as self-care, and all individuals, including adolescents, are capable of self-care. Self-Care Deficit Theory assumes that adolescents have self-care decision capabilities, and adolescents participate in self-care practices to meet their self-care requisites (Orem, 2001). Orem (2001) also recognized that adolescents can take responsibility for their own self-care in areas such as sleep. Self-care and self-care deficit relate to several areas of this study's specific aims. All elements of sleep, sleep quality, sleep quantity, sleep latency, and sleep hygiene are present in self-care, as the ability to meet life's basic needs and demands are part of self-care (Orem, 2001). Additionally, the Self-Care Deficit Theory also relates to the specific aims of this study as dietary intake are also, choices in self-care (Orem, 2001). Incorporating the Self-Care Deficit Theory into the present study included individuals recognizing the need for good sleep quality, which relates to the concept of self-care. Self-care deficit was the difference between what the adolescents knew they should achieve for sleep self-care verses what they actually performed for sleep self-care practices.

Factors from the Adolescent Sleep Hygiene Practice Scale align well with Orem's Self-Care Deficit Theory. For example, adolescents can promote self-care by avoiding naps, partaking of a bedtime routine, limiting light and noise from their bedrooms, and removing cell phones from their bedrooms. Additional factors in the Adolescent Sleep Hygiene Practice Scale that align with self-care include choices to consume caffeine late in the day, late exercise, consistency of bedtime and wake times, and substance use. Self-care deficit was noted in the lack of sleep

self-care as demonstrated in the results of the Adolescent Sleep Hygiene Practice Scale. Intriguingly, a high prevalence of 'social jet lag' has been described a strong disconnect with the acknowledgement of the importance and need for sleep versus the social and behavioral use of electronics (Quante et al., 2019a). This 'social jet lag' disconnect is an example of self-care deficit. As previously discussed, the cycle of self-care deficit with poor sleep hygiene practices represents a major challenge for healthcare. Interventions to break one element of the self-care sleep hygiene deficit could affect several other areas of sleep self-care.

Limitations

The recruitment of participants from area churches was a limitation for this study. As only interested participants contacted this researcher, this did not allow for a diverse sample. The lack of personal recruitment in the churches is also a limitation of this study. The personal recruitment may have allowed for participants who did not see or read the ad to participate in the study.

The self-reported BMI's were also a limitation of this study; however, due to the non-contact nature of the study, this was the only viable option. The researcher was unable to verify any height or weight information from the participants or their parents.

Sleep quality, sleep quantity, and sleep latency were recorded and calculated with Fitbits, but polysomnography may have produced more reliable sleep recordings (Marino et al., 2013). However, this study took place in the participant's natural sleep setting, which would not allow for polysomnography. In addition to Fitbits, this study used the Pittsburgh Sleep Quality Index and the Adolescent Sleep Hygiene Practice Scale to strengthen the sleep data.

The self-reported questionnaires are also a limitation of this study. All questionnaires for this study were self-reported. Self-reported data answers may be exaggerated, respondents may

be embarrassed to reveal private information and details, participants may attempt to answer what they feel are desirable responses, and participants want to represent their best selves (Polit & Beck, 2017).

The summer sleep schedule posed a unique situation as a lack of structure was apparent for several of the participants. This lack of structure could not only affect adolescents' sleep schedules, but also their eating schedules as well (Quante et al., 2019b).

It must also be noted that this study took place during a global pandemic with stress levels in families and participants possibly being elevated and affecting sleep and dietary intake. Lack of consistent food options and meals also posed a limitation. As school was not in session, several participants may have missed breakfast and/or lunch as part of their usual routines, hence affecting the findings of this study.

Implications

Future Research

This study was planned to take place during the school year with more structured sleep and wake times along with more structured available food intake. Due to a pandemic, adjustments needed to be made to the study, but it is recommended to complete the research study as planned to provide a more comprehensive understanding of sleep quality, quantity, latency, hygiene, and appetite, dietary intake, and BMI. Additionally, future nursing research could include measurement of hormones related to adolescents' appetites as this is an understudied area (Felso et al., 2017).

Nursing Practice

Previous studies have noted improvement in adolescent sleep quality following sleep interventions (Arora & Taheri, 2017; Blake et al., 2017) as well as improvement with total sleep

times following sleep interventions (Griggs et al., 2020). Furthermore, research has indicated that adolescents are receptive to sleep promoting interventions (Griggs et al., 2020). The inter-related factors surrounding sleep, appetite, food consumption, and ultimate BMI are now better understood. Given the noted health benefits of sleep, a sleep intervention study geared towards improved sleep for improved overall health would be indicated. Intervention areas such as later wake times, earlier bedtimes, and improved sleep practices are warranted (Gohil & Hannon, 2018). The use of behavioral therapy and change theory has been discussed in nursing literature as a means to improve adolescent sleep and overall heath. In addition, school programs on sleep education have been discussed; however, electronic and cell phone use in the bedroom can be major barriers to overcome (Arora & Taheri, 2017). Interestingly, Gold et al. (2020) found that 60% of adolescents reported they would participant in a sleep intervention program of four or more sessions in an effort to improve their sleep hygiene practices and subsequent sleep quality; hence, many adolescents are interested in improving their sleep habits and health.

Nursing Education

The bidirectional relationship between sleep and health increase the complexity of the relationship. Sleep problems have been shown to develop early in life, and the fragmentation of lifelong sleep problems can further contribute to future health consequences (Bruce et al., 2019). Hence, early education and interventions are essential. Nursing research has suggested that health professionals routinely question sleep and promote sleep during routine physical examinations, but little evidence exists to suggest that this is practiced (Chaput, 2016). One research has noted some improvement with sleep quality post school-based education intervention (Bauducco et al., 2019), and other study noted improvement of less short sleep

duration of less than 6 hours post school-based sleep education intervention (Otsuka et al., 2019); therefore, further efforts in this area may be warranted.

The importance of sleep is generally acknowledged; however, school, life, and the balance of sleep is not always a priority, particularly for adolescents (Price, 2016), and adolescents often view sleep as a waste of time (Chaput & Dutil, 2016). Scientists are now calling for a change in sleep attitude as a first step in promotion of sleep and overall health (Price, 2016). Sleep attitude studies are not abundant in adult populations and even more rare in adolescent populations (Grandner, et al., 2013); hence this is yet another needed area for additional research. Further research has suggested to establish positive sleep attitudes among adolescents with subsequent intervention studies to improve sleep attitude (Chaput & Dutil, 2016).

Conclusion

The purpose of this study was to examine the effect of sleep quality, sleep quantity, sleep latency, sleep hygiene on appetite, dietary intake, and BMI levels of adolescent youth. As increased self-reported appetite scores were associated with poor sleep quality, but not with sleep quantity, sleep quality may affect adolescents' appetites. No associations between sleep factors and dietary intake or BMI were noted in this study; therefore, additional factors appear to be involved with adolescent dietary intake and BMI. With only 60.5% of the participants having a calculated good sleep quality by the Pittsburgh Sleep Quality Index, promotion of sleep quality is an area that can be improved upon for adolescent health.

APPENDICES

Appendix A

UND IRB Approval

UNIVERSITY OF NORTH DAKOTA

UND.edu

Office of Research Compliance & Ethics
Tech Accelerator, Suite 2050
4201 James Ray Drive Stop 7134
Grand Forks, ND 58202-7134
Phone: 701.777.4279
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May 21, 2020

Principal Investigator:	Janell Juelich
Project Title:	The Effect of Adolescent Sleep Quality on Dietary Intake, Appetite, and Body Mass Index
IRB Project Number:	IRB-202005-293
Project Review Level:	Expedited 4, 7
Date of IRB Approval:	05/21/2020
Expiration Date of This Approval:	05/20/2021
Consent Form Approval Date:	05/21/2020

The application form and all included documentation for the above-referenced project have been reviewed and approved via the procedures of the University of North Dakota Institutional Review Board.

Attached is your original consent form that has been stamped with the UND IRB approval and expiration dates. Please maintain this original on file. ***You must use this original, stamped consent form to make copies for participant enrollment. No other consent form should be used.*** It must be signed by each participant prior to initiation of any research procedures. In addition, each participant must be given a copy of the consent form.

Prior to implementation, submit any changes to or departures from the protocol or consent form to the IRB for approval. No changes to approved research may take place without prior IRB approval.

You have approval for this project through the above-listed expiration date. When this research is completed, please submit a termination form to the IRB. If the research will last longer than one year, an annual review and progress report must be submitted to the IRB prior to the submission deadline to ensure adequate time for IRB review.

The forms to assist you in filing your project termination, annual review and progress report, adverse event/unanticipated problem, protocol change, etc. may be accessed on the IRB website: http://und.edu/research/resources/human-subjects/

Sincerely,

Michelle L. Bowles, M.P.A., CIP
IRB Manager

MLB/sy
Enclosures

Cc: Dr. Glenda Lindseth

Appendix B

Consent Form

THE UNIVERSITY OF NORTH DAKOTA
CHILD ASSENT & PARENT/GUARDIAN CONSENT TO PARTICIPATE IN RESEARCH

Project Title:	**The Effect of Adolescent Sleep Quality on Dietary Intake, Appetite, and Body Mass Index**
Principal Investigator:	**Janell Juelich**
Phone/Email Address:	**Janell.juelich@ndus.edu**
Department:	**Nursing**
Research Advisor	**Dr. Glenda Lindseth**
Phone/Email Address:	**701-777-4506** **Glenda.lindseth@und.edu**

What should I know about this research?

- Someone will explain this research to you.
- Taking part in this research is voluntary. Whether you take part is up to you.
- If you don't take part, it won't be held against you.
- You can take part now and later drop out, and it won't be held against you.
- If you don't understand, ask questions.
- Ask all the questions you want before you decide.

How long will I be in this research?
We expect that your taking part in this research will last five days, which is the total number of nights you will need to wear a Fitbit. The surveys will take about 30 minutes to complete.

Why is this research being done?
The purpose of this research is to see how well you do or do not sleep affects your appetite, the food you eat, and your body weight.

What happens to me if I agree to take part in this research?
First, we will discuss the purpose of the study and you will give consent and assent by signing this form. After I receive the signed consent, I will mail you a package. This package will contain a Fitbit, several surveys, and a self-adhesive return envelope. You will need to wear the Fitbit to wear at all times for the next 5 days and nights. This Fitbit can only come off if it will be under water for over 30 minutes or for specific physical activities. Over the next 5 days and nights, you should eat and sleep at home as normal.

After the 5 days, you will remove the Fitbit and place it in the self-adhesive previously addressed return envelope. You do not need to include your home address on this return envelope. At this

time, you also need complete several surveys about your appetite over the past 5 days, what you ate over the past 5 days, and how you slept over the past 5 nights. These surveys may take up to 30 minutes to complete. Please complete these surveys and return them with the Fitbit in the self-adhesive previously addressed envelope.

Could being in this research hurt me?
There are no risks in participating in this research beyond those experienced in everyday life. You may experience some discomfort from wearing the Fitbit at all times. You may uncomfortable or uneasy since you know someone is measuring your sleep. To reduce the risk of infection, I have washed my hands, worn gloves and a mask while preparing the envelopes and Fitbits, and cleaned the Fitbit the way the manufacture instructed prior to sending it to you.

Will being in this research benefit me?
The most important benefits that you may expect from taking part in this research include having a better idea of how well you sleep and how your sleep affects what you eat the next day. Your parent/guardian may also become more aware of how well you do or do not sleep. You both may notice that your sleep affects how you eat the next day.

How many people will participate in this research?
Approximately 84 people will take part in this study through the University of North Dakota.

Will it cost me money to take part in this research?
You will not have any costs for being in this research study.

Will I be paid for taking part in this research?
After you complete the study, you will be mailed a $25.00 gift card to the West Acres Mall for your time.

Who is funding this research?
North Dakota EPSCoR (Established Program to Stimulate Competitive Research) is funding this research study. This means that UND is receiving payments from North Dakota EPSCoR to support the activities that are required to conduct the study. No one on the research team will receive a direct payment or an increase in salary from North Dakota EPSCoR for conducting this study.

What happens to information collected for this research?
Your private information may be shared with individuals and organizations that conduct or watch over this research, including:

- The Institutional Review Board (IRB) that reviewed this research
- The research advisor, Dr. Glenda Lindseth
- National Science Foundation (EPSCoR's funding source)

What happens to information collected for this research?
We may publish the results of this research. However, we will keep your name and other identifying information confidential. We protect your information from disclosure to others to the extent required by law. We cannot promise complete secrecy.

Data collected in this research will not be used or distributed for future research studies, even if identifiers are removed.

You should know, however, that there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court or to tell authorities if we believe you have abused a child, or you pose a danger to yourself or someone else.

What if I agree to be in the research and then change my mind?
If you decide to leave the study early, we ask that you call Dr. Glenda Lindseth, the research advisor. There are no consequences or penalties for early withdrawal.

Who can answer my questions about this research?
If you have questions, concerns, or complaints, or think this research has hurt you or made you sick, talk to the research team at the phone number listed above on the first page.

This research is being overseen by an Institutional Review Board ("IRB"). An IRB is a group of people who perform independent review of research studies. You may talk to them at 701.777.4279 or UND.irb@UND.edu if:

- You have questions, concerns, or complaints that are not being answered by the research team.
- You are not getting answers from the research team.
- You cannot reach the research team.
- You want to talk to someone else about the research.
- You have questions about your rights as a research subject.
- You may also visit the UND IRB website for more information about being a research subject: http://und.edu/research/resources/human-subjects/research-participants.html

Approval Date: 5/21/2020

Expiration Date: 5/20/2021

University of North Dakota IRB

Date: _____
Subject Initials: _____

Assent of Child Participant:
Your signature documents your assent to take part in this study. You will receive a copy of this form.

Child's Name: _____

_____ _____
Signature of Child Date

Consent of Parent/Guardian:

Your signature documents your consent for your child to take part in this study. You will receive a copy of this form.

_____ _____
Name of Parent/Guardian Date

_____ _____
Signature of Parent/Guardian Date

I have discussed the above points with the subject or, where appropriate, with the subject's legally authorized representative.

_____ _____
Signature of Person Who Obtained Consent Date

Approval Date: 5/21/2020

Expiration Date: 5/20/2021

University of North Dakota IRB

Date: _____
Subject Initials: _____

Appendix C

Church Bulletin Ad

Are you interested in earning a $25.00 gift card to the West Acres mall and participating in a University of North Dakota study?

If you are 12-18 years old,and able to wear a Fitbit for five days, and answer some study questions, please call or text Janell at 320-305-1118.

Janell.juelich@ndus.edu

Appendix D

Letter in Envelope to Participants

Thank you for agreeing to participant in my study!

I have included this paper to help you review any instructions that we discussed on the phone.

1. Please put on the Fitbit. Please wear the Fitbit all day and all night (including time in the shower or playing sports) for the next 5 days and 5 nights.

2. After 5 nights, please take the Fitbit off and place it in the self-adhesive envelope that I sent with the Fitbit.

3. Please complete all of the surveys and place them in the envelope with the Fitbit.

Once I receive the Fitbit and completed surveys, I will mail you a $25.00 West Acres Mall gift card. Please let me know if you have any questions.

Janell Juelich, PhD (c), RN
PhD Student
University of North Dakota

Appendix E

Demographic Form

1. What year were you born?

2. What is your current grade in school?

3. What is your place of residence?

a. House

b. apartment

c. other

4. Please list all of the prescribed medications that you currently are taking (such as inhalers, insulin, antibiotics) _____

5. Please list all of the medications that you are currently taking that are not prescribed (such as vitamins, ibuprofen). _____

6. Please list any current medical diagnosis that may affect your ability to sleep (such as ADD, ADHD) _____

7. What is your race or ethnic background?

a. White, not of Hispanic origin

b. Black, not of Hispanic origin

c. Hispanic

d. American Indian/Alaskan native

e. Asian

f. Pacific Islander

g. Other _____

h. prefer not to answer

8. What is your gender?

a. male

b. female

c. prefer not to answer

Appendix F

Health Assessment Form

Health Assessment Directions
Please check YES if the following conditions pertain to you; Check NO if they do not.
Please describe more fully if you answered YES.

YES ___	NO ___	1. Do you have any current circulatory limitations (for example, heart problems, swelling, skin color/temperature)? If yes, please describe: _____
YES ___	NO ___	2. Do you have any current respiratory limitations (for example, lung problems, smoking, difficulty breathing)? If yes, please describe: _____
YES ___	NO ___	3. Do you have any current neurosensory limitations (for example, hearing, vision, seizures)? If yes, please describe: _____
YES ___	NO ___	4. Do you have any current nutrition limitations (for example, lactose intolerance, dietary, appetite, weight changes)? If yes, please describe: _____
YES ___	NO ___	5. Do you have any current elimination limitations (for example, bowel, bladder, or urinary)? If yes, please describe: _____
YES ___	NO ___	6. Do you have any current mobility limitations (for example, activity, musculoskeletal, broken bones)? If yes, please describe: _____
YES ___	NO ___	7. Do you have any current skin problems (for example, wound, sores)? If yes, please describe: _____
YES ___	NO ___	8. Do you have any current reproductive limitations (for example, hernia, pregnancy)? If yes, please describe: _____
YES ___	NO ___	9. Do you have any current endocrine limitations (for example, diabetes, thyroid problems)? If yes, please describe: _____
YES ___	NO ___	10. Do you have any motion sickness (for example, air sickness, sea sickness, anxiety)? If yes, please describe: _____

Height_____ Weight_____

Current Medications, supplements, and non-prescription drugs. If none, please state.

Medication	Dose	Time Taken	Reaction

Allergies (foods, dyes, other). If none, please state

Allergen	Symptoms	Treatment

Appendix G

Pittsburgh Sleep Quality Index (PSQI)

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

During the past month,

1. When have you usually gone to bed? _____
2. How long (in minutes) has it taken you to fall asleep each night? _____
3. When have you usually gotten up in the morning? _____
4. How many hours of actual sleep did you get that night? (This may be different that the number of hours you spend in bed) _____

5. During the past month, how often have you had trouble sleeping because you……	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three of more times a week (3)
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				
j. Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s)				
6. During the past month, how often have you taken medicine (prescribed or 'over the counter') to help you sleep?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or staying engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
	Very good (0)	Fairly good (1)	Fairly bad (2)	Very bad (3)
9. During the past month, how would you rate your sleep quality overall?				

Appendix H

Appetite Visual Analog Scale

APPETITE SURVEY

Directions: Please place an "X" on the line that corresponds to what you have felt like during this last study week for the following questions:

1. How has your appetite been during the last week?

   No appetite |_____| Large appetite

2. Have you had any cravings for certain foods?

   Not at all |_____| A great deal

3. Have you felt a desire to eat? No__ Yes__ To what extent has this affected your appetite?

   Not at all |_____| A great deal

4. Have you had hunger pains? No__ Yes__If yes, has this affected your appetite?

   Not at all |_____| A great deal

5. Have you felt hungry? No__ Yes
   To what extent has this affected your appetite?

   Not at all |_____| A great deal

6. Have you had an interest in eating during the last week? No__ Yes
   To what extent has this affected your appetite?

   Not at all |_____| A great deal

7. Have you had a feeling of fullness shortly after beginning to eat? No__ Yes
   If yes, has this affected your appetite?

   Not at all |_____| A great deal

8. Have you gotten nauseated after you ate? No__ Yes
   To what extent has this affected your appetite?

   Not at all |_____| A great deal

9. Have you had cravings to eat any non-food items? No__ Yes
   To what extent has this affected your appetite?

   Not at all |_____| A great deal

10. Did you eat any non-food items? No__ Yes__ To what extent has this affected your appetite?

    Not at all |_____| A great deal

Appendix I

Adolescent Sleep Hygiene Practice Scale

Adolescent Sleep Hygiene Practice Scale

Directions: using the choices below, choose how often the following things have happened *during the past week.*

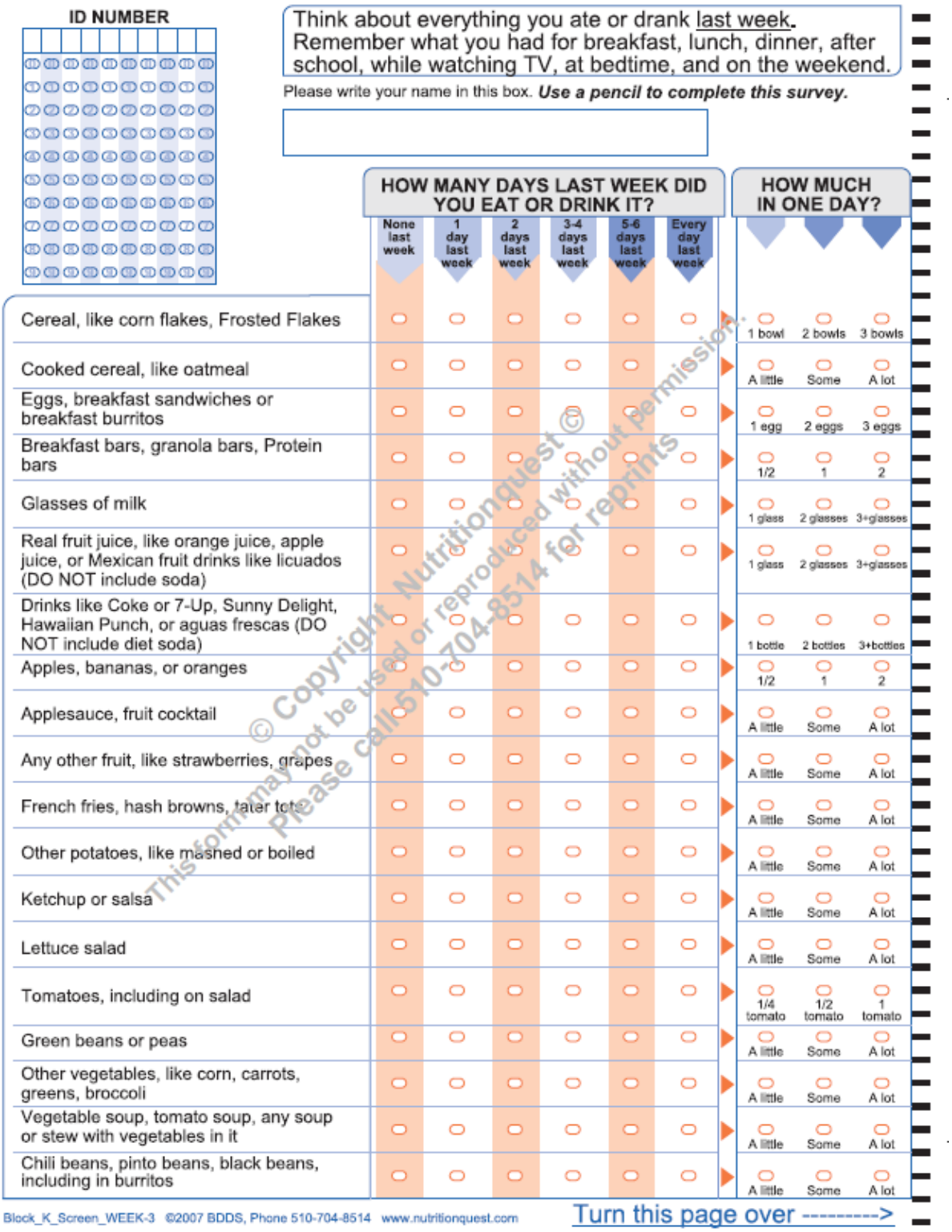
Never – this has not happened
Once in Awhile – happened 20% of the time
Sometimes – happened 40% of the time
Quite Often – happened 60% of the time
Frequently, if not Always – happened 80% of the time
Always – happened 100% of the time

	NEVER (0%)	ONCE In AWHILE (20%)	SOMETIMES (40%)	QUITE OFTEN (60%)	FREQUENTLY (80%)	ALWAYS (100%)
1. During the day I take a nap that lasts more than 1 hour.	1	2	3	4	5	6
2. During the day I play or exercise for more than 20 minutes	1	2	3	4	5	6
3. After 6:00 in the evening I have drinks with caffeine (cola, iced tea, coffee).	1	2	3	4	5	6
4. After 6:00 in the evening, I take a nap.	1	2	3	4	5	6
5. After 6:00 in the evening, I do some kind of physical activity (exercise, sports).	1	2	3	4	5	6
6. After 6:00 in the evening, I chew tobacco.	1	2	3	4	5	6
7. After 6:00 in the evening, I drink beer or other alcohol.	1	2	3	4	5	6
8. During the 1 hour before bedtime, I do things that make me feel calm or relaxed (take a hot bath/shower, read)	1	2	3	4	5	6
9. During the 1 hour before bedtime, things happen that make me feel strong emotions (sad, angry)	1	2	3	4	5	6

10. During the 1 hour before bedtime, I am very active (playing outside, running)	1	2	3	4	5	6
11. During the 1 hour before bedtime, I do things that make me feel very awake (play video games, watch TV).	1	2	3	4	5	6
12. During the 1 hour before bedtime, I drink more that 4 glasses of water.	1	2	3	4	5	6
13. I go to bed and do things in my bed that keep me awake (watch TV, read).	1	2	3	4	5	6
14. I go to bed and think about things I need to do.	1	2	3	4	5	6
15. I go to bed feeling upset.	1	2	3	4	5	6
16. I go to bed and replay the day's events over in my mind.	1	2	3	4	5	6
17. I go to bed and worry about things happening at home or school.	1	2	3	4	5	6
18. I go to bed with a stomachache.	1	2	3	4	5	6
19. I go to bed feeling hungry.	1	2	3	4	5	6
20. I fall asleep while listening to loud music.	1	2	3	4	5	6
21. I fall asleep while watching TV.	1	2	3	4	5	6
22. I fall asleep in a brightly lit room.	1	2	3	4	5	6
23. I fall asleep in one place and then move to another place during the night	1	2	3	4	5	6
24. I fall asleep in a room that feel too hot or too cold.	1	2	3	4	5	6
25. I sleep in a home where someone smokes cigarettes, cigars, or a pipe.	1	2	3	4	5	6
26. I get too little sleep.	1	2	3	4	5	6
27. I use a bedtime routine (bathing, brushing teeth).	1	2	3	4	5	6
28. I use my bed for things other than sleep (talking on the phone, doing homework, playing video games)	1	2	3	4	5	6
29. I check my clock several times during the night.	1	2	3	4	5	6
30. During the school week, I stay up more than 1 hour past my usual bedtime	1	2	3	4	5	6
31. During the school week, I sleep in more than 1 hour past my usual wake time	1	2	3	4	5	6
32. On weekends, I stay up more than 1 hour past my usual bedtime.	1	2	3	4	5	6
33. On weekends, I sleep in more than 1 hour past my usual wake time.	1	2	3	4	5	6
34. I keep my phone in my room at night	1	2	3	4	5	6

Appendix J

Block Kids Food Screener



ID NUMBER

Think about everything you ate or drank last week. Remember what you had for breakfast, lunch, dinner, after school, while watching TV, at bedtime, and on the weekend.

Please write your name in this box. ***Use a pencil to complete this survey.***

	HOW MANY DAYS LAST WEEK DID YOU EAT OR DRINK IT?						HOW MUCH IN ONE DAY?		
	None last week	1 day last week	2 days last week	3-4 days last week	5-6 days last week	Every day last week			
Cereal, like corn flakes, Frosted Flakes	○	○	○	○	○	○	1 bowl	2 bowls	3 bowls
Cooked cereal, like oatmeal	○	○	○	○	○	○	A little	Some	A lot
Eggs, breakfast sandwiches or breakfast burritos	○	○	○	○	○	○	1 egg	2 eggs	3 eggs
Breakfast bars, granola bars, Protein bars	○	○	○	○	○	○	1/2	1	2
Glasses of milk	○	○	○	○	○	○	1 glass	2 glasses	3+glasses
Real fruit juice, like orange juice, apple juice, or Mexican fruit drinks like licuados (DO NOT include soda)	○	○	○	○	○	○	1 glass	2 glasses	3+glasses
Drinks like Coke or 7-Up, Sunny Delight, Hawaiian Punch, or aguas frescas (DO NOT include diet soda)	○	○	○	○	○	○	1 bottle	2 bottles	3+bottles
Apples, bananas, or oranges	○	○	○	○	○	○	1/2	1	2
Applesauce, fruit cocktail	○	○	○	○	○	○	A little	Some	A lot
Any other fruit, like strawberries, grapes	○	○	○	○	○	○	A little	Some	A lot
French fries, hash browns, tater tots	○	○	○	○	○	○	A little	Some	A lot
Other potatoes, like mashed or boiled	○	○	○	○	○	○	A little	Some	A lot
Ketchup or salsa	○	○	○	○	○	○	A little	Some	A lot
Lettuce salad	○	○	○	○	○	○	A little	Some	A lot
Tomatoes, including on salad	○	○	○	○	○	○	1/4 tomato	1/2 tomato	1 tomato
Green beans or peas	○	○	○	○	○	○	A little	Some	A lot
Other vegetables, like corn, carrots, greens, broccoli	○	○	○	○	○	○	A little	Some	A lot
Vegetable soup, tomato soup, any soup or stew with vegetables in it	○	○	○	○	○	○	A little	Some	A lot
Chili beans, pinto beans, black beans, including in burritos	○	○	○	○	○	○	A little	Some	A lot

Block_K_Screen_WEEK-3

Turn this page over --------->

	HOW MANY DAYS LAST WEEK DID YOU EAT OR DRINK IT?						HOW MUCH IN ONE DAY?		
	None last week	1 day last week	2 days last week	3-4 days last week	5-6 days last week	Every day last week			
Refried beans	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Hamburgers, cheeseburgers	○	○	○	○	○	○	○ 1 small	○ 1 large	○ 2 large
Hot dogs, corn dogs, or sausage	○	○	○	○	○	○	○ 1	○ 2	○ 3
Lunch meat like boloney, ham, Lunchables	○	○	○	○	○	○	○ 1 slice	○ 2 slices	○ 3+ slices
Pizza or pizza pockets	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Spaghetti or ravioli with tomato sauce	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Macaroni and cheese	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Chicken, including nuggets, wings, tenders, also in sandwiches or stew	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Fish, fish sticks or sandwiches, tuna, shrimp	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Burritos or tacos	○	○	○	○	○	○	○ 1/2	○ 1	○ 2
Beef like roast, steak or in sandwiches	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Meat balls, meat loaf, beef stew, Hamburger Helper	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Pork, like chops, roast, ribs	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Popcorn	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Snack chips like potato chips, Doritos, Fritos, tortilla chips	○	○	○	○	○	○	○ A few	○ Small bag	○ Large bag
Ice cream	○	○	○	○	○	○	○ 1 scoop	○ 2 scoops	○ 3 scoops
Candy, candy bars	○	○	○	○	○	○	○ Mini	○ Small	○ Large
Cookies, donuts, cakes like Ho-Hos	○	○	○	○	○	○	○ A little	○ Some	○ A lot
Cheese. Remember cheese in sandwiches or nachos with cheese or quesadillas	○	○	○	○	○	○	○ 1 slice	○ 2 slices	○ 3+ slices
Whole wheat bread or rolls (NOT white bread)	○	○	○	○	○	○	○ 1 slice	○ 2 slices	○ 3 slices

What kind of cereal did you eat? (MARK THE ONE YOU ATE THE MOST OF)

- ○ Plain Cheerios, Grape Nuts, Shredded Wheat, Wheaties, Wheat Chex, Kix
- ○ Honey Nut Cheerios, Cap'n Crunch, Lucky Charms, Life, Golden Grahams, Frosted Mini Wheats, Raisin Bran
- ○ Other sweet cereals, like Frosted Flakes, Froot Loops
- ○ Any other cereal, like Corn Flakes, Rice Krispies

What kind of milk did you drink? (MARK ONLY ONE)

○ Whole milk ○ Reduced fat 2% milk ○ Low fat 1% milk ○ Nonfat milk ○ Chocolate milk ○ Soy milk ○ Lactaid milk ○ Don't know

Please tell us about yourself

Are you ○ Male ○ Female

How old are you? ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 ○ 11 ○ 12 ○ 13 ○ 14 ○ 15 ○ 16 ○ 17

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