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Identification of predictors and moderators of weight-related behaviors in college students.

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IDENTIFICATION OF PREDICTORS AND MODERATORS OF WEIGHT-RELATED BEHAVIORS IN COLLEGE STUDENTS

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M.S.N., University of Southern Indiana, 2005

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DEDICATION

This dissertation is dedicated to those who have supported and inspired me to continue my education. To my parents who taught me at an early age that anything is possible with hard work and determination. To Halle, Colin, and Gracie Owens who have always been the driving force behind my success. The love I have for them is what motivates me to perform each and every day. To Shawn Owens, my partner and confidant, his support has been central to my success.

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ABSTRACT

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March 31, 2016

College students are at increased risk for weight-gain and obesity compared to their non-student peers. Although many studies have confirmed these findings, few address the underlying causes of weight-related behaviors in college students. Associations between sleep behaviors (sleep duration and sleep quality), stress and weight-related behaviors (physical activity and food choices) have been identified, but studies have not adequately explored these associations among college students. Further, the influence of bioecological determinants of health cannot be overlooked when addressing health-related behaviors in diverse populations.

The purpose of this dissertation was to explore factors impacting sleep behaviors and weight-related behaviors in college students. Three manuscripts comprised this dissertation and included: a state of the science review of sleep behaviors in college students; a systematic review of instruments used to assess physical activity in college students; and a cross-sectional study identifying predictors and moderators of weight-related behaviors in college students.

A critical review of sleep behaviors in college students revealed that developmental changes occurring in older adolescents and young adults results in delayed

sleep times. Decreased sleep duration in this population is associated with poor health outcomes (weight-gain), higher risks for accident related death/disability, and academic underperformance. Findings from this review enforced the need for healthcare providers working with college students to assess for and educate students regarding the risks associated with inadequate sleep.

The second manuscript evaluated the psychometric properties of commonly used self-report physical activity measures used with college student populations. Three instruments including: the International Physical Activity Questionnaire; the Leisure Time Exercise Questionnaire; and the National College Health Assessment II, were identified as the most commonly used instruments used with college student populations. Results indicated that researchers must consider the physical activity domains of interest, the completion process, and the reliability and validity of instruments when selecting self-report instruments of physical activity for use in studies examining college students.

The third manuscript summarized a cross-sectional, quantitative research study designed to identify predictors and moderators of weight-related behaviors among college students to provide a better understanding of the association between sleep behaviors (sleep duration and sleep quality) and perceived stress and what role they play in predicting weight-related behaviors. The aims of the study were to (1) characterize sleep behaviors, perceived stress and weight-related behaviors in college students stratified by bioecological determinants of health and (2) identify predictors and moderators of weight-related behaviors in college students. Approximately 394 undergraduate nursing students were recruited to complete self-report instruments related to sleep behaviors, perceived stress, physical activity, fruit intake, vegetable intake, sugar sweetened

beverage consumption, fast-food consumption, and bioecological determinants of health (n=268). Data were analyzed to determine group differences in sleep behaviors, perceived stress and weight-related behaviors based on bioecological determinants of health. Next, path analysis was conducted to establish correlations and model fit. Finally, multiple group analysis was performed to identify the moderating effect of perceived stress. The findings indicated that having children/step-children and eating the majority of meals at home had significant indirect effects on physical activity and sugar-sweetened beverage consumption when mediated by sleep duration. Perceived stress was also found to moderate the predictive effect of bioecological variables and sleep behaviors on weight-related behaviors. Limitations of the study included limited interpretability of cross-sectional data, exclusive use of self-report data, a homogenous sample that limited generalizability, and a lengthy survey.

TABLE OF CONTENTS

LIST OF TABLES

TABLES PAGE

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The purpose of this dissertation was to identify predictors and moderators of weight-related behaviors among college students. An introduction, three manuscripts, and a conclusion chapter, synthesizing the findings, comprise the dissertation. First, a review of literature examining sleep behaviors in older adolescents and young adults was examined to identify developmental and bioecological considerations influencing sleep duration and sleep quality. Second, a systematic review of self-report instruments used to measure physical activity in college students was conducted and psychometric properties of each instrument were evaluated. Third, a bioecological model of weight-related behaviors among college students was tested to determine the mediating and moderating effects of sleep and stress. Finally, a synthesis of the findings from the three manuscripts is provided.

Approximately 21 million individuals are enrolled in degree-granting institutions in the United States (U. S.) and almost 42 percent of all 18 to 24 year olds attend college (National Center for Education Statistics, 2014). College entry is a time when emerging adults, aged 18 to 25 years (Arnett, 2000), face many opportunities, including the development of lifelong habits such as obtaining an adequate amount of quality sleep, participation in physical activity, and the selection of healthy food choices.

College students face many challenges that can act as distractions and constraints leading to unhealthy weight-related behaviors such as sedentary lifestyles and poor food choices. Poor sleep behaviors have also been found to be associated with obesity (Wirth et al., 2015). College students often sacrifice time that could be spent sleeping for other activities such as studying and socializing (Brown, Buboltz, & Soper, 2006). Research has shown that poor sleep quality or short sleep duration can lead to problems related to physical health (Jackowska & Steptoe, 2015), mental health (Koyanagi & Stickley, 2015), academic performance (Wald, Muennig, O'Connell, & Garber, 2014), social interactions (Beattie, Kyle, Espie, & Biello, 2014), and career attainment (Pikovsky, Oron, Shiyovich, Perry, & Nesher, 2013). Additionally, stress has been found to impact the physical (Pedersen, 2012), mental, and emotional health (Duan, Ho, Siu, Li & Zhang, 2015) of college students.

Chapter two outlines the current state of the science regarding sleep behaviors in older adolescents and young adults. The purpose of the review was to identify bioecological determinants of health associated with poor sleep in college students. Additionally, the importance of assessing for poor sleep behaviors in an effort to diminish negative health consequences at a crucial time when health promoting behaviors are being developed is explored.

College enrollment has been characterized as a period of declining levels of physical activity and other unhealthy weight-related behaviors (Kim et al., 2015). Deforche, Van Dyck, Deliens, and De Bourdeaudhuij (2015) found that active transportation and sports participation decreased among young adults entering college, and while some sedentary behaviors such as watching television and playing video games declined, students had increased levels of internet use and studying. Multiple variables have been explored to explain why physical activity declines among college students (Reed & Phillips, 2005) and several studies have suggested that students living on campus are more likely to engage in physical activity compared to students living off campus (Ajibade, 2011; King et al., 2013; Peachey & Baller, 2015; Small, Bailey-Davis, Morgan & Maggs, 2012). These findings provide insight into college students' decisions regarding energy balance, and may guide intervention studies aimed at increasing physical activity among young adults.

Young adults, particularly college-aged individuals, are frequently the focus of research aimed at identifying interventions that increase physical activity in an effort to meet American College of Sports Medicine (ACSM)/American Heart Association (AHA) recommendations (Plotnikoff et al., 2015). These interventions are multidimensional and include motivational (Buscemi, Yurasek, Dennhardt, Martens, & Murphy, 2011), psychosocial (Kim et al., 2015), technology-based (Yan et al., 2015), and educational interventions (Abu-Moghli, Khalaf,& Barghoti, 2010). Although promising, these studies have had mixed results in terms of the amount of increased physical activity and long-term maintenance of physical activity behaviors. Thus, studies aimed at identifying underlying predictors of weight-related behaviors may help to close the gap in understanding why interventions work for some individuals and not for others, or why some interventions are effective long term and others are not.

To develop and evaluate interventions aimed at increasing physical activity in college students, reliable and valid instruments that accurately measure physical activity must be identified. Chapter three is a systematic review of self-report instruments used to measure physical activity in college students. The purpose of the review was to identify instruments commonly used in studies measuring physical activity in college students and to compare the measurement design to ACSM/AHA physical activity recommendations. An evaluation of the psychometric properties and physical activity domain measures of the identified instruments was included.

Sleep behaviors and perceived stress have been found to contribute to weight gain in a variety of populations (Park, 2013; Vgontzas et al., 2014). Most of the literature examining these variables focused on the resulting physiological changes. Decreased insulin sensitivity, increased glucose and HbA1c, increased salivary cortisol and increased hyperphagia have been hypothesized to contribute to behaviors leading to weight gain. These behaviors, however, have not been thoroughly studied and there is no single model that takes both sleep and stress into account when examining weight-related behaviors. Tsenkova, Boylan, and Ryff (2013) also suggested that the reason weight loss interventions frequently fail is because they do not address the root cause of overeating. It is particularly important that the predictive nature of sleep behaviors and perceived stress be explored in a population susceptible to weight gain such as college students.

A study aimed at identifying predictors and moderators of weight-related behaviors in college students is presented in chapter four. The study's theoretical framework was developed using Bronfenbrenner's bioecological model (Figure 1). The bioecological model recognizes that behaviors are developed as a result of the environmental and social context of an individual's lived experience, as well as their biological make-up. The study's conceptual model identifies bioecological determinants of health that have been shown to be associated with weight-related behaviors (physical activity and food choices) in college students. Further, the model purports that sleep behaviors (sleep duration and sleep quality) mediate the relationship between the bioecological determinants of health and the identified weight-related behaviors. Finally, perceived stress is described as a moderating variable affecting the predictive nature of sleep on weight-related behaviors.

A cross-sectional, descriptive study was conducted to test the model of weight-related behaviors among college students to determine if the relationship between bioecological determinants of health and weight-related behaviors (physical activity and food choices) were mediated by sleep behaviors (sleep duration and sleep quality) and/or moderated by perceived stress. A sample of 268 college nursing students provided self-report data regarding bioecological determinants of health, sleep behaviors, perceived stress, physical activity, and food choices. Path analysis was used to test the hypothesized model. The findings were partially supportive of the model. Eating the majority of meals at home predicted increased physical activity and decreased sugar-sweetened beverages and was mediated by sleep duration. Similarly, having children/step-children was predictive of decreased physical activity and increased sugar-sweetened beverages, but sleep duration suppressed the negative effects of having children/step-children on weight-related behaviors. In addition, multiple-group model comparisons were conducted to determine if perceived stress moderated the predictive nature of sleep on weight-related behaviors. The results indicated that the hypothesized model fit the high-stress group extremely well, but data from the low-stress group did not fit the hypothesized model, suggesting that perceived stress moderated the association between sleep behaviors and weight-related behaviors.

Chapter five provides a synthesis of findings from chapter's two through four. An examination of relevant overlay is discussed and the interconnectedness of major concepts are considered. Finally, research and practice implications derived from the dissertation as a whole are explored.

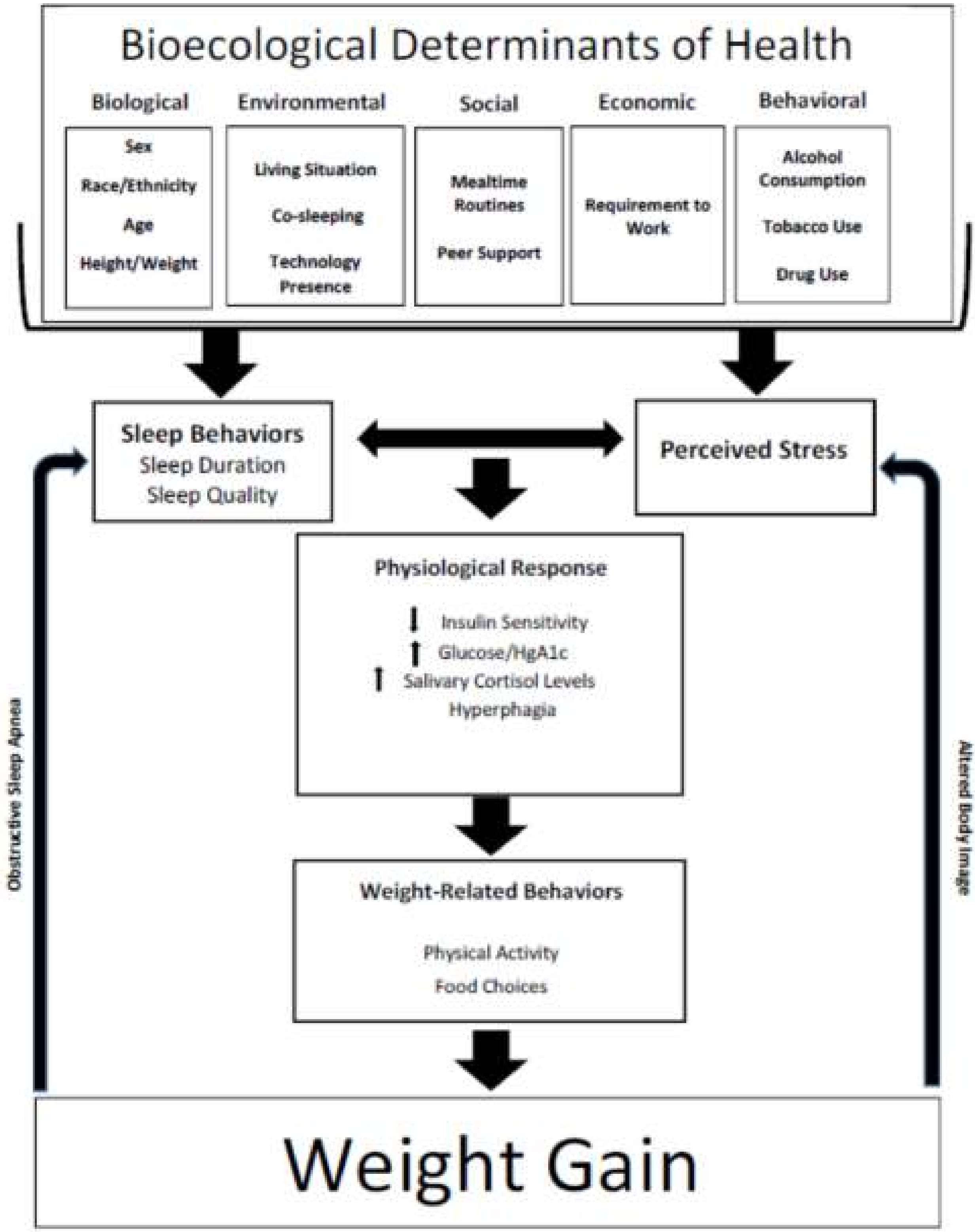

Figure 1. The conceptual model of weight-related behaviors in college students.

CHAPTER II

SLEEP BEHAVIORS IN COLLEGE STUDENTS: A STATE OF THE SCIENCE REVIEW

Introduction

Older adolescents and young adults often exhibit unhealthy sleep behaviors resulting in insufficient sleep quality, and/or insufficient sleep duration, and daytime sleepiness (Owens, 2014). This is particularly true for college students who are often balancing school, work, and social obligations. According to the Centers for Disease Control and Prevention (CDC) (2015), 50 to 70 million adults in the United States suffer from sleep or wakefulness disorders. Further, an increased research focus on sleep-related behaviors has linked sleep insufficiency to chronic diseases such as diabetes, heart disease, depression, and obesity, and an increased risk for accident-related fatalities and or disabilities (CDC, 2015). Yet, healthcare professionals caring for older adolescents and young adults often focus their assessment and education efforts on risk-taking behaviors such as alcohol/drug use and sexual activity, and rarely make sleep-related behaviors a primary focus. This is problematic given that the CDC (2015) has identified sleep insufficiency a public health epidemic. College students are creating life-long health behaviors with respect to poor sleep behaviors that may impact their long-term health outcomes.

Sleep behaviors of older adolescents and young adults are influenced by the social context and physical environment of their surroundings, their biologic make-up, and their naturally occurring developmental changes. Advancements in technology and diverse housing environments can impact sleep behaviors. Moreover, the use of technology during waking hours and the use of technology in bed via computers, tablets, and smartphones (e.g., texting, emailing, and gaming) have been associated with altered sleep behaviors and patterns (Allen, Howlett, Coulombe, & Corkum, 2015). Noisy and unsafe housing environments can lead to delayed and/or disturbed sleep patterns. In addition, an individual's biologic make-up and the physiological changes occurring in the body during development can impact sleep preferences and the ability to achieve a sufficient amount of quality sleep. Thus, healthcare providers need to adopt sleep and lifestyle behavioral assessment strategies based on a bioecological model of health (Bronfenbrenner & Morris, 2006) that considers the context in which college students live, work, and attend school.

Insufficient sleep in late adolescence and young adulthood can adversely affect an individual's health, safety, and academic success (Owens, 2014). The newfound independence and freedoms that often come with attending college can result in college students choosing to forgo sleep to enhance their social and work commitments. According to the Bureau of Labor Statistics (2015), 68.4 percent of the 2014 high school graduates attended college. Thus, healthcare providers working with college students in late adolescence and young adulthood have a unique opportunity to impact the health behaviors of a large section of the population. Sleep behavior assessments by healthcare providers targeting modifiable environmental and social influences may provide the basis for educating college students about how to obtain sufficient sleep based on their unique bioecological make-up. The purpose of this manuscript is to explicate the high-risk nature of poor sleep behaviors in college students and advocate for thorough assessments of sleep behaviors that examine bioecological influences to abate poor health outcomes, accident-related fatalities/disabilities, and academic underperformance.

Development Considerations

Sleep has been linked to cognitive functioning and development (Mindell & Owens, 2010) and is, therefore, a vital health behavior in the lives of older adolescents and young adults. This developmental stage is often a time when adolescents participate in health-risk behaviors that are critical to long-term health outcomes (Rew, 2005). Because this population is particularly susceptible to social influences and health-risk behaviors, healthcare providers would benefit by framing the care they provide to older adolescents and young adults around primary socialization theory (PST) (Parsons, 1959). PST is a social learning theory that recognizes the influence of the social context on learned behaviors (Oetting & Donnermeyer, 1998). Family, schools, religious organizations, and communities can influence behaviors among older adolescents and young adults to-promote and support healthy lifestyle behaviors (Rew, Johnson, Jenkins, & Torres, 2004).

Rew, Arheart, Thompson, and Johnson (2013) found that social connectedness with peers, regardless of peer behaviors, was a significant predictor of health promoting behaviors among older adolescents (mean age = 17 $\pm$ 0.7). Kuo, Updegraff, Zeiders, McHale, Umaña-Taylor, and De Jesús (2015), reported that among Mexican American youth (average age of 18), shorter sleep duration was associated with more time spent at school, work, and with peers, concluding that increased time spent outside a familial setting was inversely related to sleep duration.

Parental monitoring and parental behavior have been linked to health promoting behaviors in older adolescents and young adults (Pender, Murdaugh, & Parsons, 2010). The study conducted by Kuo et al. (2015) revealed that variability in sleep duration decreased as the quality of family relationships, especially with a mother, increased. Consequently, it is important for healthcare providers to understand the developmental influences and social context in which college students in late adolescence or young adulthood live, to fully assess sleep-related behaviors and other health promoting behaviors.

Sleep-Wake Patterns in Young Adults

Sleep-wake patterns change significantly as a child ages and develops into late adolescence and young adulthood. These changes can be attributed to both physiological and social influences. As a child enters adolescence, sleep times become more delayed as a result of physiological changes. Maximum sleep delays occur during young adulthood, at ages 19.5 years in females and 20.9 years in males (Roenneberg et al., 2004). The result is that older adolescents and young adults often do not receive the recommended 7 to 10 hours of sleep required for maximum health (Hirshkowitz, 2015).

The internal circadian clock begins to reset and levels of melatonin peak during later hours as older adolescents transform into young adults (National Adolescent and Young Adult Health Information Center, 2014). The homeostatic drive to sleep also changes and the drive to sleep after extended hours of wakefulness declines, taking older adolescents longer to fall asleep (Hagenauer, Perryman, Lee, & Carskadon, 2009). The result is that older adolescents and young adults go to sleep later and wake later, often compensating for shortened sleep on school days by sleeping longer hours on weekends (Millman, 2005). These physiological changes need to be understood and acknowledged by healthcare professionals when assessing sleep behaviors and patterns to assist older adolescents and young adults develop improved sleep behaviors and schedules.

Traditional college students frequently make independent decisions regarding time allocation without the guidance of parents or guardians for the first time in their young adult lives. Competing life demands such as work, family, social activities, and school can lead individuals to choose sleeping less in an effort to make time for other activities (Grandner, Patel, Gehrman, Perlis, & Pack, 2010). Older adolescents and young adults have more evening obligations as the result of increased academic requirements, opportunities for social interactions, and evening employment (Talbot, McGlinchey, Kaplan, Dahl, & Harvey, 2010). College students are commonly faced with competing demands and are often challenged to meet their work, family, social, and school obligations.

College students are transitioning from late adolescence to early adulthood, a time when they often participate in experimental risk-taking behaviors (Dworkin, 2005). According to Chasin (1997) and Lightfoot (1997), adolescents have a need to control their environment and seek out risks to create excitement and challenge. Risk-taking behaviors such as alcohol consumption, drug use, and energy drink consumption (Owens, Mindell, & Baylor, 2014) have been linked to altered sleep behaviors. These psychosocial influences lead to later sleep times, regardless of required wake times associated with school and work. Lytle and colleagues (2014) found that college students view adequate sleep as a luxury and are often unaware of the risks associated with insufficient sleep. Psychosocial influences, along with the physiological changes occurring in older adolescents and young adults, are commonly identified contributors to inadequate sleep-wake patterns and poor sleep behaviors in college students.

The Bioecological Model and Sleep

Sleep is a multifaceted behavior that develops in individuals over time. Sleep behaviors are influenced by an individual's biologic make-up, domestic interactions, social context, and physical environment. Urie Bronfenbrenner's bioecological model (2006) acknowledges that human's develop within a social context and that those interactions, in conjunction with a person's biologic make-up, result in behavioral development. Consequently, Bronfenbrenner's bioecological model is frequently used as a framework to study health-promoting behaviors such as sleep. The living environment, cultural influences, economic circumstances, and biologic make-up of an individual impacts one's ability to participate in health promoting behaviors, such as obtaining sufficient amounts of quality sleep.

Biologic Influences on Sleep

Biologic links to sleep patterns have been studied in a variety of populations. An individual's sex is one of the most notable biologic variables affecting sleep. Zhang and Wing (2006) examined 29 studies of sleep patterns with over 1.2 million participants and found a 1.41 risk ratio for females versus males indicating a predisposition for insomnia in females. Knutson (2007) also explored findings from studies specifically addressing sex differences in sleep and found that while women had more insomnia and poorer sleep quality on self-report, actigraphy measurements indicated longer sleep duration and better sleep quality in women. One possible explanation for this inconsistency is that women may be more comfortable reporting sleep disturbances than men due to gender roles.

A second biologic variable commonly reported in sleep studies is age. A meta-analysis of sleep studies by Ohayon, Carskadon, Guilleminault, and Vitiello (2004) found that slow-wave sleep was negatively correlated with age, and that sleep efficiency and total sleep time decreased with age. These findings were consistent with more recent studies indicating that sleep duration and sleep quality decline as a person ages (Moraes et al., 2014).

In addition to biologic make-up, the environment and social context of an individual are important in influencing a person's ability to obtain a sufficient amount of quality sleep. Several studies have linked environmental and social context to sleep quality and sleep duration. Gellis and Lichstein (2009) assessed the sleep behaviors of individuals who achieved adequate sleep compared to those who did not (*N* = 128 good sleepers, and 92 poor sleepers). Poor sleepers had inconsistent sleep schedules, were more likely to nap, participated in arousing, exciting or emotional activities before bed, thought about important matters in bed, and slept in environments that were noisy with uncomfortable temperatures.

Competing Social, Work, and School Demands Influencing Sleep

A wide range of competing demands contribute to older adolescents and young adults choosing not to make sufficient sleep a priority. Many of these pressures are related to social and developmental needs requiring peer connectedness (Rew, Arheart, Thompson, & Johnson, 2013) and the desire to forge intimate relationships (Erikson, 1968). Economic stressors and academic obligations can also play a role in choosing not to sleep the recommended 7 to 10 hours per day. Moreover, a large number of college students reported having to work at least part-time while in school. In 2013, 39.5 percent of full-time students enrolled in undergraduate programs reported being employed at least part-time and 25.1 percent reported working more than 20 hours per week (National Center for Education Statistics, 2014). The impact of working and/or volunteering on the health of over 70,000 undergraduate students from 179 colleges or universities that participated in the National College Health Assessment II was examined with findings suggesting that working and/or volunteering negatively affected sleep (Lederer, Autry, Day, & Oswalt, 2015). Teixeira et al. (2012) examined male college students who reported working and found that participants averaged less than six hours of sleep per night, concluding that the demand to work and attend school limits a college student's ability to obtain the recommended amount of sleep due to time constraints.

To manage academic, social, and work requirements, college students sometimes attempt to increase and enhance their waking hours through the consumption of energy drinks. Ishak, Ugochukwu, Bagot, Khalili, & Zaky (2012) define energy drinks as "a group of beverages used by consumers to provide an extra boost in energy, promote wakefulness, maintain alertness, and provide cognitive and mood enhancement" (p. 25). Malinauskas, Aeby, Overton, Carpenter-Aeby, and Barber-Heidal (2007) reported that among 496 randomly selected college students, 51 percent reported consuming more than one energy drink over the last month and 67 percent cited insufficient sleep as the motivation for consuming energy drinks. While the intended effect of consuming energy drinks is often to stay awake longer or to enhance wakefulness, young adults are often unaware that energy drinks can also cause disturbed sleep once sleep is desired (Owens, Mindell, & Baylor, 2014).

The Influence of Technology Use on Sleep

Technology use and the constant monitoring of social media and virtual communication have altered sleep behaviors in the U. S., especially among adolescents and young adults. According to Smith (2015), 85 percent of 18 to 29 year olds are smartphone owners and the Pew Research Center reported that nearly 24 percent of teens are online "almost constantly" (Lenhart, 2015). The use of smartphones in bed allows light to stimulate the reticular activing system, resulting in cerebral cortex stimulation that prevents the bulbar synchronizing region from taking over and inducing sleep (Jarvis, 2016). This leads to delayed sleep times in older adolescents and young adults who are already struggling with physiological alterations leading to insufficient sleep. Further, the use of smartphones and other types of technology in bed can result in intrusions into sleep resulting in poor sleep quality (Grandner, Gallagher & Gooneratne, 2013).

Hale and Guan (2014) performed a systematic literature review of 67 studies examining screen time (television, computers, video games, and mobile devices) and sleep among school-aged children and adolescents. In 90 percent of the studies cited, screen time was adversely associated with delayed or shortened sleep. Moreover, Gradisar et al. (2013) found that the use of interactive technology within one hour of bedtime resulted in reports of difficulty falling asleep and unrefreshed sleep. In a time when the use of mobile devices has proliferated every aspect of life, the negative impact these devices may have on a young adult's sleep behaviors cannot be overlooked.

Health Consequences of Poor Sleep

Significant health outcomes ranging from cardiovascular (Pepin et al., 2014) to psychological (Lovato & Gradisar, 2014) problems are associated with short sleep duration and/or poor sleep quality. While most health outcomes associated with short sleep duration and/or poor sleep quality do not present until later in life, Mezick, Hall, and Matthews (2012) suggest that the health consequences may present as early as adolescence. The broad nature and scope of short sleep duration and/or poor sleep quality make identifying and intervening in these conditions essential for healthcare providers. Without proper assessment of sleep quality and duration, these conditions may be overlooked and discounted in older adolescents and young adults vulnerable to risk-taking and unhealthy lifestyle behaviors.

Sleep Deficiency Linked to Weight Gain, Obesity, and Diabetes

Sleep deficiency has been linked to a number of hormonal changes affecting metabolic functioning including decreased insulin resistance (Pyykkönen et al., 2012), increased glucose (Benedict et al., 2012), and elevated glycated hemoglobin (HbA1c) (Hancox & Landhuis, 2012). The seminal study by Spiegel, Leproult, and Van Cauter (1999) found that individuals with shorter sleep duration had decreased glucose tolerance. Others have demonstrated that insulin resistance increases with habitual sleep duration less than 7 hours and/or poor sleep quality (Matthews, Dahl, Owens, Lee, & Hall, 2012). Hormones affecting metabolism have also been linked to sleep deficiency. Leptin and ghrelin, hormones that act as appetite suppressants and appetite stimulants, are associated with sleep duration and sleep quality. Spiegel, Tasali, Penev, and Van Canter (2004) found an inverse relationship in sleep duration and leptin levels among healthy young men with a positive relationship between sleep duration and ghrelin levels. These findings are consistent with other studies suggesting increased appetite with decreased sleep duration. This is a significant finding for healthcare providers working with college students who are already at a higher risk for weight-gain (Darden, 2014).

Sleep Duration and Hypertension

Sleep duration has been found to be strongly associated with hypertension. Fang, Wheaton, Keenan, Greenlund, Perry, and Croft (2012) found a U-shaped relationship between sleep duration and hypertension in adults when controlling for sociodemographics, behaviors, and health characteristics, including sex and age. Individuals who slept less than 7 hours per night and 10 or more hours per night, were more likely to suffer from hypertension. Mezick, Hall, and Matthews (2012) found similar results among black and white adolescents leading them to postulate that cardiovascular effects of short sleep duration may begin as early as adolescence.

The U. S. Preventative Services Task Force reports that the number of children and adolescents suffering from hypertension has increased over the last decade (Moyer, 2013), attributing this increase in hypertension to the increased number of overweight and obese children living in the U. S. It is estimated that approximately 11 percent of obese children are hypertensive (Moyer, 2013). This is particularly alarming given that in 2013 almost 1,000 deaths per day occurred in the U. S. as the result of hypertension (CDC, 2015).

Sleep and Psychological Stress

Stress can impact the physical, mental, and emotional health of college students. Lee, Wuertz, Rogers, and Chen (2013) examined the associations between perceived stress, sleep disturbances, depressive symptoms, and physical symptoms in female college students enrolled in health professions courses. To the surprise of the researchers, 56.3 percent of the participants scored >13.7 (range 0 – 40) on the Perceived Stress Scale (PSS), indicating a high level of global stress. Additionally, of the 103 participants that completed the study, 68 percent of them yielded scores on Pittsburg Sleep Quality Index (PSQI) classifying them as insomniacs. These results suggest that although stress and sleep alterations may be normal manifestations of academic demands and adjustments to college-life, there is a need for interventions that can assuage the severity of their impact.

The complex relationship that exists between stress and sleep is still unclear. Pervanidou and Chrousos's model of biologic and behavioral pathways links stress to obesity and the metabolic syndrome (2012). In their model, chronic stress precedes sleep disturbances in children and adolescents, suggesting that sleep disturbances are symptomatic presentations of stress-related disorders. Giese et al. (2013), found that while stress preceded sleep disturbances, the degree of sleep disturbance acted as a mediator of stress and brain-derived neurotrophic factor (BDNF), implying that sleep disturbance can result in increased stress vulnerability. Noland, Price, Dake, and Telljohann (2009) reported that adolescents who did not get enough sleep reported increased levels of stress as a response to inadequate sleep. The inconsistencies in findings related to the relationship between sleep and stress along with increased stress and decreased sleep quality reported in young adults, makes future inquiry with the young adult population particularly germane.

Safety Consequences of Sleep Insufficiency

Sleep insufficiency can lead to alterations in attention and reaction times. In fact, some of the world's most devastating disasters have been the result of sleep loss (Colten & Altevogt, 2006). Several studies have linked insufficient sleep in older adolescents and young adults to safety hazards such as pedestrian accidents (Davis, Avis & Schwebel, 2013), motor vehicle accident (Pizza et al., 2010), workplace and home accidents (Dahl & Lewin, 2002), as well as school violence-related behaviors (Hildenbrand, Daly, Nicholls, Brooks-Holliday, & Kloss, 2013).

The National Sleep Foundation reports that driving while drowsy can be as dangerous as driving under the influence of alcohol (n.d.). Adolescents (Pizza et al., 2010) and college students (Taylor & Bramoweth, 2010) report that sleepiness when driving is common. In addition, the effects of alcohol consumption are compounded in individuals suffering from insufficient sleep. Pack, Pack, Rodgman, Cucchiara, Dinges, and Schwab (1995) examined 4,333 traffic accidents and found that of those caused by sleepiness, and not associated with alcohol consumption, the majority (55 percent) involved drivers under the age of 25 with the most accidents occurring in 20 year olds. Thus, assessment of sleep behaviors in young adults is essential if accident related disabilities and fatalities are to be thwarted.

Academic Consequences of Sleep Insufficiency

Adequate sleep is necessary for optimal cognitive functioning (Benitez & Gunstad, 2012). Insufficient sleep can derail efforts of older adolescents and young adults enrolled in higher education and ultimately lead to student attrition by means of academic suspension or withdrawal. Gaultney (2010) examined college students at-risk for sleep disorders and found that among students who were academically underperforming (GPA < 2.0 out of 4.0), individuals at-risk for sleep disorders were overrepresented. Likewise, in a large nationally representative longitudinal study of adolescents, Asarnow, McGlinchey, and Harvey (2014) found that late school year bedtimes resulted in poorer educational outcomes during six-to-eight year follow-ups.

Educational attainment is related to individual's health. According the to the U. S. Department of Education (2015), employment levels were 72 percent in 2013 for young adults with a Bachelor's degree aged 25 to 34 compared to an employment rate of 62 percent in individuals of the same age with a high school diploma or equivalent. In addition, young adults with a Bachelor's degree earned more than twice the median income of young adults with a high school diploma or equivalent (U. S. Department of Education, 2015). Given that health is strongly and consistently predicted by socioeconomic status (Cockerham, 2012), educational attainment is fundamental to improving the health of an individual. Hence, healthcare providers must be cognizant of those factors that contribute to a young adult's academic success. Attempts to allay detrimental behaviors or conditions that might make academic success unachievable must be attended to if the goal of the healthcare professional is to improve the health of all individuals.

Discussion

Without adequate sleep, older adolescents and young adults are at-risk for poor health outcomes, accident related disabilities/fatalities, and academic underperformance. The reality of these consequences lends itself to immediate action by the healthcare community. The increased focus on sleep research has demonstrated that older adolescents and young adults in the U. S. are suffering from a health condition of epidemic proportions. Unfortunately, inadequate sleep is undiagnosed and under reported in older adolescents and young adults during a time when health-promoting behaviors are forming and the optimal window for intervention to prevent adverse long-term health consequences is closing.

Older adolescents and young adults experience physiological and developmental changes that interfere with their ability to obtain sufficient sleep. The demands of school, work, and social obligations drive them to sleep less, sometimes through the use of unhealthy alternatives such as consuming energy drinks. In addition, advances in technology have created an environment where individuals are focused on constant monitoring of social media and virtual communication that contributes to delayed and interrupted sleep. The result is that this population of older adolescents and young adults is more vulnerable to accidents, poor academic performance, and poor long-term health consequences.

The risks associated with insufficient sleep represent real danger. Pack et al. (1995) found that the fatality rates for sleep-related motor vehicle accidents (1.4%) was greater than any other non-alcohol-related type of crash. Studies have shown that insufficient sleep results in hypertension (Pepin et al., 2014), diabetes (Holliday, Magee, Kritharides, Banks, & Attia, 2013), and obesity (Vgontzas et al., 2014). These chronic health conditions are among the leading causes of death in the U. S. In addition, obesity in young adults can result in an array of financial and social consequences that impact communities such as lost work productivity (Janssens et al., 2012), higher insurance premiums (Van Nuys et al., 2014), lower wages (Han, Norton, & Stearns, 2009), and a reduction in armed forces recruits (Christeson, Taggart, & Messner-Zidell, 2010).

The consequences of obesity within the community have the potential to change the attitudes and ideology of the culture over time. The United Health Foundation (2014) reported that the national median of obese adults by state increased from 27.6 percent in 2013 to 29.7 percent in 2014. Thus, the identification and management of underlying predictors of weight-related behaviors could assist in curtailing the obesity epidemic. Insufficient sleep quality, and/or insufficient sleep duration has been linked to accident-related fatalities and disabilities (Pack et al., 1995), hormonal changes affecting appetite (Spiegel, Tasali, Penev, & Van Canter, 2004), and long-term chronic health conditions (Mezick, Hall & Matthews; Pepin et al., 2014; Vgontzas et al., 2014). Thus, prioritizing sleep assessments during routine physical exams, particularly in older adolescents and young adults, is imperative.

Clearly, the link between sufficient sleep and academic performance is supported. Older adolescents and young adults cannot perform optimally at school when insufficient sleep results in a lack of attention and generalized feelings of fatigue. As a result, many students who reported inadequate sleep are categorized as low performers in the academic setting. The significance of failing to complete college could be grave, inhibiting a student's ability to obtain gainful employment. Moreover, the predictive nature of poverty on health outcomes is consistent and strong (Cockerham, 2012). Sufficient sleep when attending college is essential to an individual's academic performance and their subsequent ability to obtain employment. Consequently, insufficient sleep could result in an individual failing academically, thereby placing them at-risk for unemployment, leading to adverse health outcomes associated with a lower socioeconomic status.

Conclusions

Healthcare professionals working with older adolescents and young adults often focus their healthcare assessments on high-risk behaviors. This is understandable given that older adolescents and young adults are at an increased risk for drug and alcohol related accidents and sexually transmitted diseases (STDs). According to the United States Centers for Disease Control (CDC), half of all newly diagnosed STDs (2014) are among 15 to 24 year olds and heroin use has more than doubled among 18 to 25 year olds between 2002 and 2013 (2015). These statistics highlight the importance of assessing for and educating about the risks associated with drug/alcohol use and sexual activity. However, lifestyle behaviors that will impact the health of older adolescents and young adults in their future often go unassessed. Sleep is an essential function that, if inadequate, may lead to, fatigue-related accidents, academic failure, underemployment, and negative long-term health outcomes. It is critical that healthcare professionals address these potential health-related outcomes and lifestyle behaviors associated with inadequate sleep in older adolescents and young adults with the same fervor as drug/alcohol use and sexual activity.

CHAPTER III

A SYSTEMATIC REVIEW OF INSTRUMENTS TO ASSESS PHYSICAL ACTIVITY IN COLLEGE STUDENTS

Background

College life is often characterized as a time when young adults exhibit sedentary behaviors (Darden, 2014). These behaviors are known contributors to weight gain and can establish patterns in individuals leading to future struggles with weight control. College students are transitioning between adolescents and young adulthood, a transition that involves forming a personal identity and beginning the process of establishing intimate relationships (Erikson, 1968). Thus, it is important that positive and healthy lifestyle behaviors are shaped if individuals are to fully advance in their development and progress into healthy adulthood.

Physical activity (PA) is a commonly measured phenomenon in healthcare research. PA measures may be used to assess an individual's routine behaviors or to evaluate the success of interventions aimed at improving health outcomes. It is widely accepted that participating in PA is beneficial in promoting psychological well-being (Windle, Hughes, Linck, Russell, & Woods, 2010), preventing obesity (Basu, Seligman, & Winkleby, 2014), and improving quality of life (Yohannes, Doherty, Bundy, & Yalfani, 2010). Increasing energy expenditure through PA is one mechanism to create a stable or negative energy balance aimed at sustaining or reducing weight (Raynor, Bond, Steeves, & Thompson, 2014). The obesity crisis in the United States (U. S.) has resulted in a multitude of studies interested in capturing the energy expenditure of individuals either as a means of evaluating weight loss interventions or to predict health outcomes.

To accurately ascertain an individual's true energy expenditure, it is imperative that reliable and valid instruments be used when measuring PA. There are currently a variety of objective and self-report measures available that purport to quantify intensity and/or quantity of PA. The large number of PA measurement instruments makes it important to evaluate whether measures are based on standardized recommendations, safeguarding against data that are uninterpretable across studies.

The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) published updated recommendations in 2007 (Haskell et. al) for intensity and duration of PA in adults and older adulthood (Table 1). These recommendations provide standards for quantifying PA and outline recommendations regarding minimum weekly and daily PA needs aimed at avoiding diseases associated with a sedentary lifestyle. The ACSM/AHA PA recommendations are widely accepted within the healthcare community. The U. S. Department of Health and Human Services (HHS) published guidelines for PA consistent with ACSM/AHA recommendations (U.S., 2008). It is important for researchers, healthcare providers, educators and the general public to be familiar with these guidelines since PA requirements change over the lifespan from childhood to older adulthood.

Young adults, particularly college-aged individuals, are frequently the focus of research measuring PA. Weight gain is an area of interest in this population because college students are susceptible to gain weight at a higher rate than their non-student peers (Darden, 2014). In addition, studies find that completion of college or leaving the college setting early does not result in compensatory weight-loss (Strong, Parks, Anderson, Winett, & Davy, 2008). Health promoting behaviors such as PA are often developing during this time period known as “emerging adulthood” (Arnett, 2000), therefore it is important to identify barriers and motivators of PA. These efforts should be coordinated and PA measures must be reliable and valid so that findings can be generalized and studies can be easily replicated. It is essential that PA instruments be critically appraised to assess their appropriateness and applicability in the young adult population.

Purpose

This paper critically reviewed and compared commonly used self-report measures of PA designed for use with U. S. college students to determine how well they measure PA based on ACSM/AHA PA recommendations. First, a review of the literature was completed to determine which instruments were most commonly used to measure PA in U. S. college students during the last five years to allow for comparison to the most recent ACSM/AHA PA recommendations. Second, instruments were critiqued based on content, completion process and psychometric properties. Lastly, recommendations regarding instrument quality and suitability with college student populations were provided.

Bioecological Model

Bronfenbrenner’s bioecological model (Bronfenbrenner & Morris, 2006) has guided much research focused on exploring health promoting behaviors. The bioecological model acknowledges that a variety of factors contribute to an individual’s decision and ability to maintain specific health promoting behaviors. The bioecological model is comprised of five levels of influence. The first level consists of components that make a person unique based on their biologic make-up. The second level is the microsystems in which an individual lives and works. The third level is the mesosystem and is the connecting level between the individual's immediate environment and the external environment. The exosystem, level four, includes the external environment or extended family and community, and the fifth level is the macrosystem. The macrosystem is comprised of the social and cultural ideals and values. The bioecological model provides an understanding of complex processes through evaluation of the biologic, environmental and social context. The bioecological model is a systems model that includes interactions between and among the different levels and may assist in explaining health promotion behaviors.

The complex nature of an individual's decision to participate in routine PA makes a bioecological perspective an obvious model to guide PA inquiry, particularly in college students. The environmental context of a college student is heavily dependent on a student's living situation. Moreover, the burgeoning relationships of college students also play a role in how much PA and in what type of PA they choose to participate.

Domains of Physical Activity

PA is a complex behavior that includes activities that span over multiple domains. These domains include recreation, transportation, occupation, and household (Kohl & Murray, 2012). PA domains are meant to be inclusive of all physical activities that a person might participate in and provide a means for measuring activity that may take place in unique settings or under specific circumstances.

The separation of PA into specific domains has resulted in PA self-report instruments that include items related to the environmental and social context of reported activities. This use of PA domains is beneficial when attempting to identify the nature of reported activities. It also may lead to more reliable self-report data because items presented by domain allow participants to recall activities more clearly and may prevent overestimates.

PA is commonly measured in terms of four components of voluntary movement, including frequency, intensity, time, and type (Barisic, Leatherdale, & Kreiger, 2011). These components of PA are often referred to via the acronym FITT. As a result, self-report instruments of PA often include questions related to how often individuals perform PA, intensity of the PA performed, time spent participating in PA, and the type of activity including the environmental or social context of PA. The FITT data are then used to calculate PA in terms of metabolic equivalents. A MET (metabolic equivalency) can be defined as roughly equivalent to the energy cost of sitting quietly (Ainsworth et al., 2000).

Methods

A systematic search was conducted for studies related to PA in U. S. college students (Figure 1). The Cumulative Index to Nursing and Allied Health Literature (CINAHL) database, the U. S. National Library of Medicine (PubMed) database, and the National Library of Medicine® (NLM®) journal citation database (Medline) were searched using the terms “College Students” and “Physical Activity” in the title, with filters set to English language and publication dates from January 1, 2010 to December 31, 2015. A total of 95 (CINAHL = 33, PubMed = 36 & MedLine = 26) citations were retrieved. Citation abstracts were reviewed for presentation abstracts (2) studies outside the U. S. (9), qualitative studies (2), systematic reviews (1) and duplications (40). Upon completion of the review, 41 quantitative studies examining PA in college students remained. The residual full-text articles were then assessed to determine whether or not PA was measured with a self-report questionnaire and if so, which ones. There were six studies that did not measure PA and instead focused on motivating factors for PA. One study did not list the measurement tool used to measure PA. Of the remaining 34 studies, the measurement of PA was assessed by: some form of the International Physical Activity Questionnaire (9), accelerometer (5), pedometer (2), uniquely created questions (4), Leisure Time Exercise Questionnaire (3), National Health Interview Survey (2), National College Health Assessment II (3), Youth Risk Behavior Survey (2), Behavioral Risk Factor Surveillance Survey (1), Student Physical Activity Habits (1), 7-day Physical Activity Recall (1), and the National College Health Risk Behavior Survey (1).

In summary, the International Physical Activity Questionnaire (IPAQ = 9), the Leisure Time Exercise Questionnaire (LTEQ = 3 and the National College Health Assessment II (NCHA-II = 3) were the most commonly used self-report survey instruments when measuring PA in college students. A review of literature was then conducted to evaluate the frequency and purpose of these instruments' use during the last five years. Each instrument was critiqued based on content, completion process and psychometric properties. Finally, recommendations regarding instrument quality and suitability with college students are provided.

Results

International Physical Activity Questionnaire (IPAQ)

Frequency of Use/Purpose. A search of CINAHL, PubMed, and Medline using the term "International Physical Activity Questionnaire" within the text and "College" in the title, was conducted with filters set to English language and publication dates from January 1, 2010 to December 31, 2015. The results produced a total of 27 articles. Once titles were reviewed for duplication, 21 articles remained. Articles were then reviewed to determine the country of origin for each of the studies. Five studies were conducted outside the U. S. with 16 articles retained for review.

Two studies did not use the IPAQ, one search result only included an abstract, and one article was unavailable for review. A total of 12 articles remained in the analysis. A review of the articles citing the IPAQ as a measurement tool when studying U. S. college students revealed that all studies used the IPAQ short form (IPAQ-SF) (Fernandes, Arts, Dimond, Hirshberg, & Lofgren, 2013; Culnan, Kloss, & Grandner, 2013; Hubbard-Turner & Turner, 2015; Grinnell, Greene, Melanson, Blissmer, & Lofgren, 2011; Wadsworth, & Hallam, 2010; Melton, Bigham, Bland, Bird, & Fairman 2014; Greene, et. al, 2011; Soyeur, Ünalan, & Elmali, 2010; Magoc, Tomaka, & Bridges-Arzaga, 2011) or select items from the short form (Quick et al., 2014). In addition, no articles reported psychometric properties for the IPAQ and instead cited Craig et al. (2003) as having established the tool as a reliable and valid measure.

Content/Completion Process. The IPAQ was developed in 1998 by an International Consensus Group in an effort to create a self-report measure that could be used across countries to assess population levels of physical activity (Craig et al., 2003).

The IPAQ can be administered via telephone interview or self-administration and was designed for young adults and adults, aged 15 – 69 years. There are two versions of the IPAQ. The IPAQ short form (IPAQ-SF) includes seven questions assessing the frequency (number of days) and duration (hours and minutes) of vigorous and moderate intensity physical activities, as well as walking and sitting during the last 7 days. Domain-specific frequency, time and type of moderate-intensity, and vigorous-intensity PA are computed. Domain-specific walking estimates are not calculated.

The IPAQ long form (IPAQ-LF) consists of 27 questions assessing the frequency (number of days), duration (hours and minutes), and intensity (light, moderate, vigorous) of PA, within 4 PA domains (job-related; transportation; housework, house maintenance, and caring for family; and recreation, sport, and leisure-time). Frequency and duration of sitting during a usual weekday and weekend in the last 7 days are also included. Metabolic equivalencies (METs) for light-intensity (walking), moderate-intensity, and vigorous-intensity PA is computed in each of the PA domains.

The IPAQ-LF results are first analyzed to determine the categorical variable for each individual for PA into low, moderate, or high levels of activity. In addition, continuous data can be calculated using the formula of MET level **x** minutes of activity **x** frequency per week (Craig et al., 2003). Additional MET formulas are used for the IPAQ-LF and indicate that individuals are assigned 3.3 METs for time spent walking. Three continuous variables may be calculated for each of the four domains and include METs for walking, moderate-intensity activity, and vigorous-intensity activity. In addition, total sitting time and average sitting total minutes/day may be calculated.

Reliability and Validity. The primary purpose for the development of the instrument was to create PA surveillance measures that could be used internationally. The collaborative efforts of PA researchers from across the world in developing the instrument resulted in a large number of psychometric studies (Craig et al., 2003). A 12 country, 14 site reliability and validity study was conducted in 2000 to evaluate the measurement properties of various forms of the IPAQ (Craig et al., 2003). Results reported here include U. S. data only, unless otherwise indicated. The U. S. study participants included approximately 41 percent males, mostly middle aged who reported higher educational levels compared to the average population. A summary of psychometric data for IPAQ test-retest reliability, concurrent validity and criterion validity are provided in Table 2.

Criterion validity was examined through a comparison of the IPAQ and the Computer Science and Application's Inc. (CSA) accelerometer, model 7164. Study participants wore the CSA accelerometer for seven consecutive days with data stored in one-minute intervals. It was noted that study participants from all countries were drawn primarily from convenience samples, but the large scale, international approach of the study provided a diverse sample in regard to age, education, income, and activity level. A total of 744 individuals (all countries) participated in the study comparing CSA to the IPAQ-LF. Results indicated good percentage agreement categorically, but poor total PA and sitting correlations (Table 2).

Concurrent validity examining the outcomes on two separate forms of the IPAQ administered simultaneously was conducted at multiple sites. Overall, strong correlations ($p = .75$-$.97$) were found internationally between the long and short forms of the IPAQ for categorizing individuals into “adequate physical activity” ($\geq$150 minutes of moderate physical activity per week) versus “inadequate physical activity” (<150 minutes of moderate physical activity per week) groupings. The IPAQ was also compared to the ACSM/AHA criteria to classify the PA profiles in adults. de Moraes, Suzuki, and de Freitas (2013) examined data from a large scale population-based epidemiological study that used the IPAQ-SF to collect PA data. IPAQ responses were reviewed and individuals were categorized as either meeting or not meeting the ACSM/AHA physical activity recommendation. Data were then analyzed to determine the reproducibility of PA categorization between the IPAQ and the ACSM/AHA criteria. The results indicated there was good to excellent reproducibility (K = .87 – 1.00) for both men and women (de Moraes, Suzuki, & de Freitas, 2013).

Leisure Time Exercise Questionnaire (LTEQ)

Frequency of Use/Purpose. A search of CINAHL, PubMed, and Medline using the term “Leisure Time Exercise Questionnaire” within the text and “College” in the title, was conducted with filters set to English language and publication dates from January 1, 2010 to December 31, 2015. A total of 12 articles were identified from the search. Review of the articles for duplications and studies outside the U. S. yielded nine remaining articles, with two duplications and one study of Iranian students.

Content/Completion Process. The LTEQ was developed by Godin and Shepard (1985) in an effort to establish a valid and reliable instrument to rapidly measure PA through self-report. The LTEQ assesses the leisure domain of and one subset of PA, exercise. The instrument creators were pursuing a method to assess patterns in exercise behavior during leisure time. The LTEQ includes two questions. The first question has three subsections that ask how many times in the last 7 days the respondent participated in mild, moderate, and strenuous leisure time exercise for more than 15 minutes. The second question addresses how many times in the last week participation in PA during leisure time caused sweating. Response options are often, sometimes, and never/rarely. A total score is calculated from question one using the formula (strenuous x 9 + moderate x 5 + light x 3). Godin and Shepard (1985) recommend a cut score of 24 be used as an indicator of meeting recommended PA guidelines, and that the 24 units included strenuous only, moderate only, or a combination of strenuous and moderate activity.

Reliability and Validity. Godin and Shepard (1985) assessed test re-test reliability during the initial development of the instrument. The test was administered to two groups, two weeks apart. The results indicated reliability coefficients for strenuous, moderate, light and sweat inducing exercise of 0.94, 0.46, 0.48 and 0.80 respectively. Several other studies examining test retest reliability of the LTEQ have resulted in similar findings (Table 3).

Criterion validity was assessed in Godin and Shepard's original study (1985) by comparing the LTEQ to maximum oxygen intake (VO2 max) percentile. Pearson correlation coefficient between the two measures was 0.38 ($p < .001$) for strenuous activity, the highest correlation between self-reported and objective data. Dishman, Rooks, Thom, Motl, and Nigg (2010) assessed concurrent validity by comparing the LTEQ and IPAQ over time, with walking included and excluded in the IPAQ scores. Interclass correlations were evaluated using Kappa statistics and ranged from 0.36 – 0.52 for moderate activity and 0.55 – 0.74 for vigorous activity without walking included in

IPAQ scores. Kappa statistics decreased, however, when walking was included and ranged from 0.25 – 0.35 for moderate activity and 0.35 – 0.49 for vigorous activity.

National College Health Assessment II (NCHA-II)

Frequency of Use/Purpose. A search of CINAHL, PubMed, and Medline using the term "National College Health Assessment" within the text and "College" and "Physical Activity" in the title, was conducted with filters set to English language and publication dates from January 1, 2010 to December 31, 2015. The term "Physical Activity" was added to the search because the National College Health Assessment is used to collect a diverse set of data related to the health of college students. Results without the term "Physical Activity" in the title yielded hundreds of articles, many not directly related to the collection of PA measures. The search conducted for this review produced 13 articles. Duplicates were removed and 11 articles remained.

Content/Completion Process. The NCHA-II is a national survey administered by the American College Health Association (ACHA) since 2000. It is administered annually to students attending institutions of higher education across the U. S. According to the ACHA, over 100,000 students participated in the NCHA-II during 2014 (n.d). The 66 item survey assesses a wide-range of health-related issues and can be administered by paper/pencil or online. One question asks about PA and is divided into three subsections related to moderate activity, vigorous activity, and muscle strengthening. This question asks college students how many of the past 7 days they did: (1) moderate-intensity exercise for at least 30 minutes; (2) vigorous-intensity exercise for at least 20 minutes; (3) 8-10 strength training exercises for 8 to 12 repetitions each (ACHA, 2011). Responses on the NCHA-II range from 0 to 7 days. The NCHA-II questions are consistent with current

ACSM/AHA PA recommendations and responses can be used to calculate categorical groupings for students who meet ACSM/AHA guidelines and those who do not. The purpose of the NCHA-II is to serve as a reference group database. Data obtained from the NCHA-II are stored by the ACHA and provides researchers with national normative data that can be obtained through open access or permission, to compare specific populations of interest.

Reliability and Validity. Reliability of the NCHA-II was assessed by the ACHA through a comparison of NCHA-II data to several other national data sets. These data sets included the National College Health Risk Behavior Survey (CDC, 1995), Harvard School of Public Health 1999 College Alcohol Study, U. S. Department of Justice: The National College Women Sexual Victimization Study 2000, ACHA-National College Health Assessment 1998, Spring 1999 and Fall 1999 Pilots and the ACHA-NCHA Spring 2000. The ACHA acknowledges that it is not possible to determine if the NCHA-II is a reliable and valid instrument and that the NCAH-II is to be used primarily as a reference data set meant to assist in planning programs and understanding health behaviors of college students (n.d). A search of the data revealed no studies that directly compared reliability of PA measures on the NCHA-II.

Conclusion

The measurement of PA in college students is an area of interest for many researchers. Thus, it is imperative that instruments used to measure PA in college students be critically appraised to determine the intended purpose of the instrument, the specific variable(s) and domains being measured, the completion process, and the reliability and validity of the instrument. The current review makes it clear that researchers must consider the specific use of PA measures when selecting instruments. A summary of findings is presented in Table 4. The IPAQ-LF includes measures of four PA domains, while the LTEQ only measures PA during leisure time and exercise. The NCHA survey does not address any PA domains and instead is a crude estimate of PA and other health-related behaviors intended to serve as a means for researchers to compare specific populations of interest to national norms.

The results of this review indicated that researchers must be clear when designing a study to select an instrument that measures the true variable of interest. Studies focused on college student activities occurring during leisure time only would be well served by the LTEQ. Likewise, research questions addressing whether a specific college student population meets AHA/ACSM PA recommendations at the same rate as a national sample might benefit from the use of a large national survey like the NCHA-II. Ultimately, however, it is recommended that the IPAQ-LF be used to measure PA in college students when frequency, duration, and intensity are of interest. The flexible administration methods, attention to time spent walking and correlation with ACSM/AHA recommendations make this instrument a viable alternative when more expensive forms or objective instruments of PA measurement such as accelerometer are not feasible. It is also recommended that further psychometric studies be conducted within the U. S. and with college students to ensure that the IPAQ-LF is appropriate for this population and that the construct of PA has not changed over time, requiring additional or different domain content.

The preferred use of the IPAQ-SF over the IPAQ-LF is evident when reviewing the literature. Study participant burden is always a concern to researchers so it is not surprising that the shorter version would be preferred. The original reliability and validity study, however, recommended that the IPAQ-SF be used for population surveillance and not for research requiring detailed information regarding the separate domains of PA. Therefore, there are benefits to increasing participant burden in favor of collecting more accurate and complete data.

It is crucial for researchers aiming to increase PA and/or reduce the number of individuals deemed to be overweight or obese, to use measures of PA that are appropriate for the variables of interest, suitable to the population of interest, reliable, and valid. Research focused on increasing physical activity has the potential to impact the United States' financial future by reducing the almost $147 billion annually spent on obesity related healthcare (Finkelstein, Trogdon, Cohen, & Dietz, 2009). Approximately 33 percent of adults and 17 percent of children in the United States are considered obese (Ogden, Carroll, Kit & Flegal, 2014). The complex nature of obesity requires that all facets of human behavior as well as the social and environmental contexts be examined to identify contributors to overweight and obesity. It essential when exploring the impact of interventions aimed at reducing obesity or when attempting to identify predictors of weight-related behaviors that researchers use instruments that measure the specific variable of interest, are appropriate to the purpose of the study, are easy to complete, and are reliable and valid.

Table 1

ACSM/AHA Physical Activity (PA) Recommendations for 18 – 65 year olds

Type of Activity	**Recommended Amount of PA**
Moderate-Intensity Aerobic Physical Activity	30 minutes x 5 days per week
Vigorous-Intensity Aerobic Activity	20 minutes x 3 days per week
Combination Moderate and Vigorous-Intensity Activity	MET x minutes = (450-740) per/week

Note: Meeting any one of the recommended amounts of PA is considered adequate. (Haskell et al., 2007)
MET = Metabolic Equivalency

Table 2

Reliability & Validity of the International Physical Activity Questionnaire (IPAQ)

Form/Comparison	**Site**	**Total PA**	**Sitting**	**Percentage Agreement Categorical**
	Test-Retest Reliability			
IPAQ-LF (past 7-days)	USA1 (v2-v3)	.87	.89	.96
	USA2 (v1-v2)	.72	.78	1.0
	USA2 (v2-v3)	.88	.89	.96
IPAQ-SF (past 7-days)	USA1 (v2-v3)	.81	.92	.96
	USA2 (v1-v2)	.88	.85	.93
	USA2 (v2-v3)	.66	.71	1.0
	Concurrent Validity			
IPAQ-LF(past 7-days)/	USA1	---	.69	.82
IPAQ-SF (past 7-days)	USA2	.78	.90	.93
	Criterion Validity			
IPAQ-LF (past 7-days)/	USA1	.05	.26	.31
CSA Total Counts	USA2	.32	.49	.81

Note. CSA = Computer Science and Applications, Inc., accelerometer, IPAQ-LF = IPAQ Long-Form, IPAQ-SF = IPAQ Short-Form

Table 3

Reliability & Validity of the Leisure Time Exercise Questionnaire (LTEQ)

Reference	Comparison	Light	Moderate	Strenuous	Total	Sweat
Test-Retest Reliability						
Godin & Shepard (1985)	---	0.48*	0.46*	0.94*	0.74*	0.80*
Sallis, Buono, Roby, Micale & Nelson (1993)	---	---	---	---	0.96*	---
Jacobs, Ainsworth, Hartman & Leon (1993)	---	0.24*	0.36*	0.84*	0.62*	0.69*
Eisenmann, Milburn, Jacobsen and Moore (2002)	---	---	---	---	0.62*	---
Concurrent Validity						
Miller, Freedson & Kline (1994)	NASA	---	---	---	0.54*	---
	Baecke	---	---	---	0.61*	---

Note. V02 Max (maximum oxygen uptake) = maximum amount of oxygen an individual can utilize during intense or maximal exercise, ARS = Activity Rating Scale, Kilocal/dL = kilocalorie per deciliter, Caltrac = Caltrac accelerometer
* $p < .05$

Table 3 (Continued)

Reliability & Validity of the Leisure Time Exercise Questionnaire (LTEQ)

Reference	**Comparison**	**Light**	**Moderate**	**Strenuous**	**Total**	**Sweat**
			Criterion Validity			
Godin & Shepard (1985)	VO2 Max	0.38*	0.03	0.04	0.24*	0.26*
	Body Fat	0.21*	0.08	0.06	0.13*	0.21*
Jacobs, Ainsworth, Hartman & Leon (1993)	VO2 Max	---	---	---	0.56*	0.57*
	Body Fat	---	---	---	- 0.43*	- 0.40*
Sallis, Buono, Roby, Micale & Nelson (1993)	ARS	---	---	---	0.32*	---
	Kilocal/dL	---	---	---	0.39*	---
Miller, Freedson & Kline (1994)	Caltrac	---	---	---	0.45*	---

Note. V02 Max (maximum oxygen uptake) = maximum amount of oxygen an individual can utilize during intense or maximal exercise, ARS = Activity Rating Scale, Kilocal/dL = kilocalorie per deciliter, Caltrac = Caltrac accelerometer
* $p < .05$

Table 4

Summary of Commonly Used Physical Activity Measures in College Students

Measurement Instrument	Intended Use	Participant Burden	Physical Activity Domains Measured	Types of Validity Testing	Types of Reliability Testing	Consistent with ACSM/AHA Guidelines
International Physical Activity Questionnaire (IPAQ)	Measure of physical activity that can be used internationally to assess population physical activity	27 questions	Work, Transportation, Domestic, Leisure & Sitting	Concurrent Criterion	Test-retest	Yes
Leisure-Time Activity Questionnaire (LTAQ)	Rapid measure of leisure time exercise physical activity	Two questions, three subsections for question one	Leisure (exercise)	Concurrent Criterion	Test-retest	Yes
National College Health Assessment – II (NCHA-II)	Physical activity measure that can used as a norm reference	One question, three sub-sections	Global Measure (No specific domain measure)	N/A	N/A	No

Note: ACSM = American College of Sports Medicine, AHA = American Heart Association

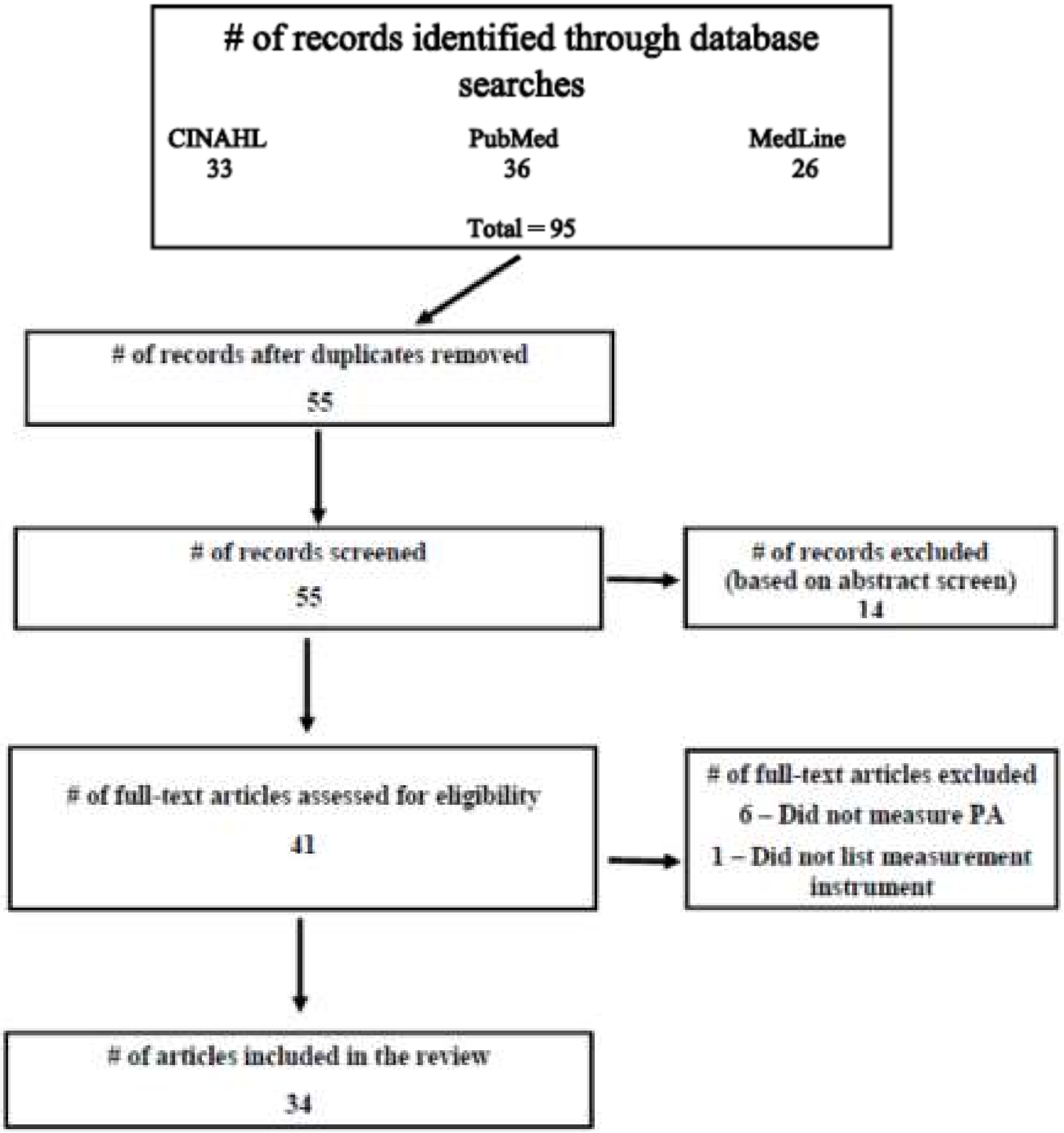

Figure 1. Flow Diagram of Physical Activity Instrument Search Results

CHAPTER IV

IDENTIFICATION OF PREDICTORS AND MODERATORS OF WEIGHT-RELATED BEAHAVIORS IN COLLEGE STUDENTS

Introduction

The freshman fifteen is a term commonly used to indicate "normal" weight gain experienced by students during their first year enrolled in college. The phenomenon itself is alarming given that approximately 30% of college students are considered overweight or obese (Sacheck, Kuder, & Economos, 2010). While students may not gain precisely 15 pounds during their first year of college, college students are at an increased risk for weight gain compared to their non-student peers (Darden, 2014). Weight gain in college students can be attributed to increased freedom regarding food choices (Smith-Jackson & Reel, 2012), access to unhealthy foods (LaCaille, Dauner, Krambeer, & Pedersen, 2011), decreased physical activity (Small, Bailey-Davis, Morgan, & Maggs, 2012), and altered life schedules, including late night snacking (Darden, 2014).

The American College Health Association (ACHA) has identified the need to increase the proportion of college students considered to be a healthy weight as a *Healthy Campus 2020* goal (2012). The importance of physical activity and food choices on energy balance and weight is understood (Hill, Peters, & Wyatt, 2009), and many intervention studies target these variables. The focus, however, is often on increasing awareness and promoting behaviors rather than addressing underlying predictors.

The association between body weight and sleep behaviors, including sleep quality and sleep duration, is a phenomenon that has recently gained interest among researchers. Poor sleep quality and/or short sleep duration are associated with higher Body Mass Index (BMI) scores (Quick, 2014), yet the link between these conditions has not been adequately addressed. Thus, an examination of the predictive nature of sleep behaviors on physical activity and food choices needs to be explored.

In addition, the bidirectional relationship between stress and sleep behaviors cannot be overlooked. Stress is known to affect sleep behaviors (Pervanidou & Chrousos, 2012; Pillai, Roth, Mullins, & Drake, 2014) and sleep behaviors can also impact an individual's response to stress (Giese et al., 2013; Noland, Price, Dake, & Telljohann, 2009). Consequently, an examination of the moderating effect of stress on the association between sleep behaviors and physical activity and food choices is needed.

Finally, it is important to acknowledge that bioecological determinants of health, such as sex, race, age, living situation, mealtime routines, employment status, alcohol consumption, and tobacco use have been documented to contribute to sleep behaviors. Subsequently, bioecological determinants of health should be controlled for when examining the impact of sleep behaviors on physical activity and food choices.

Currently, the relationship between sleep behaviors and stress is still unclear and the impact of these variables on weight gain in college students has not been adequately explored. This cross-sectional exploratory study assessed bioecological determinants of health that influence sleep behaviors in an effort to predict physical activity and food choices. The bioecological model acknowledges that individuals are biologically unique and that their development is influenced by the context and environment in which they live (Lichtenberger, 2012). The bioecological model, developed by Urie Bronfenbrenner (Bronfenbrenner & Morris, 2006), has helped explain the decision making processes students rely on when participating in health promoting behaviors, and guided this study. Three studies examining the associations between sleep, stress and weight (Davis, Stange, & Horwitz, 2012; Logue et al., 2012; Noland, Price, Drake, & Telljohann, 2009) also influenced development of the hypothesized model. Variables addressed in this study are outlined in Figure 1 and defined in Table 1.

Purpose

The purpose of this study was to identify predictors and moderators of weight-related behaviors among college students to provide a better understanding of the association between sleep behaviors (sleep duration and sleep quality) and perceived stress and what role, if any, they play in predicting weight-related behaviors in college students. The specific aims were to: (1) characterize sleep behaviors (sleep duration and sleep quality), perceived stress and weight-related behaviors in college students stratified by bioecological determinants of health, and (2) identify predictors and moderators of weight-related behaviors in college students. The hypotheses for aim two include:

- Hypothesis 1 – Sleep duration will mediate the relationship between bioecological determinants of health and physical activity.
- Hypothesis 2 – Sleep duration will mediate the relationship between bioecological determinants of health and food choices.
- Hypothesis 3 – Sleep quality will mediate the associations between bioecological determinants of health and physical activity.

- Hypothesis 4 – Sleep quality will mediate the associations between bioecological determinants of health and food choices.
- Hypothesis 5– Perceived stress will moderate the predictive effect of sleep behaviors on weight-related behaviors

Methods

A quantitative, exploratory research study design employing a cross-sectional survey of college students enrolled in undergraduate nursing courses was used. Weight-related behaviors were the primary outcome variables, and included physical activity, fruit and vegetable intake, sugar-sweetened beverage (SSB) consumption and fast food frequency. Institutional Review Board approval was obtained from the University of Louisville.

Sample/Setting

Participants were recruited from five cohorts of students enrolled in nursing courses at a large southeastern public university. The courses included undergraduate junior and senior level nursing courses (upper division) and undergraduate nursing prerequisite courses (lower division). Study eligibility required that students: (1) be enrolled in a nursing course; and, (2) be at least 18 years of age.

Sample size for the proposed study was calculated using Rweb 1.03. Root Mean Square Error Approximation (RMSEA) was set at .08 for the null hypothesis and .05 for the alternative hypothesis with power set at .80, as suggested by MacCallum, Browne, and Sugawara (1996). The results indicated that for the hypothesized model, a minimum sample size of 227 participants was needed to adequately fit the model. Approximately 394 students were recruited for the study and the sample size was 268 with a response rate of 68 percent. Participant and population characteristics were compared to identify if differences existed between those who chose to participate in the study and the population of interest. Similarities were found among study participants and the nursing student population in regard to race, sex and age (see Appendix C).

Measures

All data for this study were collected from college students via a self-report survey. The study survey included 100 questions from six different instruments. Psychometric data for study instruments were reviewed (Appendix A). Study instruments were compiled with instructions and a waiver of consent (Appendix B). The survey was pilot tested with 30 non-nursing college students, both undergraduate and graduate, for feasibility, clarity, and time requirements. The pilot test revealed an average completion time of 15 minutes and minor grammatical errors that were corrected prior to study implementation.

Bioecological Determinants of Health (Exogenous Variables). Sex, race, age, living situation, living with children/step-children, fraternity/sorority membership, employment status, alcohol consumption, tobacco use, and mealtime routines were assessed as predictors of sleep and weight-related behaviors. Sex, race, age, fraternity/sorority membership, employment status, and tobacco use data were collected via the demographic form. Questions related to tobacco use were derived from recommendations by the Global Adult Tobacco Survey Collaborative Group (2011). The variables of age ($\leq$25 years, >25 years), minority status (Caucasian, other), sex (male, female), fraternity/sorority membership (member, non-member), living with children/step-children (no, yes), and tobacco use (user, non-user) were transformed into dichotomous variables. Employment status was transformed into: unemployed, employed part-time, employed full-time.

Questions regarding a participant's living situation and mealtime routines were obtained from the "Nutrition Self-Assessment" questionnaire and alcohol consumption was assessed using the 15-item Beverage Intake Questionnaire (BEVQ-15). Living situation was an ordinal variable with six response options (1. On-campus, with a campus meal plan; 2. Greek housing; 3. On-campus without a campus meal plan; 4. Off-campus with family; 5. Off-campus housing, with friends; 6. Living alone). Alcohol frequency was calculated as a continuous variable using frequency scores for alcohol-specific items on the BEVQ-15. Mealtime routine questions were obtained from the Eating Habits Questionnaire created for a National Cancer Institute's Research-Tested Intervention Program (Bowen et al., 2009). Mealtime routines included the average number of meals eaten with household members and with non-household members per week and the location of where meals were typically eaten per week. Number of meals eaten with household members and number of meals eaten with non-household members were calculated as the average number of meals eaten with others per week. Meal location was calculated as where the majority of meals were reportedly eaten (away from home, at home).

Sleep Behaviors (Sleep Duration and Sleep Quality). The National Sleep Foundation (NSF) defines short sleep duration as less than 7 hours per day, normal sleep duration as 7 to 9 hours per day, and long sleep duration as greater than 9 hours of sleep per day in adults (2014). Harvey, Stinson, Whitaker, Moskovitz, and Virk (2008) define sleep quality as the compilation of three domains including: (1) the feeling of tiredness upon waking and throughout the day; (2) feeling rested and restored on waking; and, (3) the number of awakenings each night. Sleep quality and sleep duration were measured using the Pittsburgh Sleep Quality Index (PSQI). The PSQI consists of 19 items measuring seven subscales: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime drowsiness (Tomfohr et al., 2013). Reponses range from very good to very poor. Sleep quality was calculated by summing all subscales except sleep duration, with higher scores indicating poorer sleep quality (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Sleep duration was measured separately as the average number of hours slept per night. Reliability tests of the PSQI resulted in test-retest reliability of .87 (Backhaus, Junghanns, Broocks, Riemann, & Hohagen, 2002), and global internal consistency reliability of .80 (Carpenter & Andrykowski, 1998). Criterion validity between the PSQI and a Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) diagnosis of insomnia found a sensitivity of 98.7 and specificity of 84.4.

Physical Activity. The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) published updated recommendations in 2007 for measuring intensity, duration, and frequency of physical activity in adults and older adulthood. The International Physical Activity Questionnaire – Long Form (IPAQ-LF), a 27-item survey for measuring self-reported weekly physical activity, used in the current study has been found to be comparable to ACSM/AHA recommendations with kappa coefficients ranging from .72 to 1.00 for categorical agreement (De Moraes, Suzuki & de Freitas, 2013) (Table 1). One continuous variable for physical activity (Total METs) was calculated. A MET (metabolic equivalency) can be defined as roughly equivalent to the energy cost of sitting quietly (Ainsworth et al., 2000). Median METs were used to assess group differences since METs are not normally distributed in populations. Treatment of outliers and data cleaning were performed per the *Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire* (International Consensus Group for the Development of an International Physical Activity Questionnaire, 2005). Muscle strengthening was not measured.

Food Choices. Food choices included fruit and vegetable intake, SSB consumption, and fast-food frequency. The National Cancer Institute's (NCI) Fruit and Vegetable By-Meal Screener was used to measure fruit and vegetable intake (Table 1). Fruit intake and vegetable intake were calculated as separate continuous variables using the NCI (2013) scoring instructions on frequencies per day only. Consumption of SSB was collected using the BEVQ-15. SSB consumption was calculated as a continuous variable using frequency per week scores for SSB specific items on the BEVQ-15. Hedrick et al. (2012) reported internal consistency of the BEVQ-15 from .97 to .99 and concurrent validity correlation, when comparing the BEVQ-15 to a 24-diet recall, of .69. Fast-food frequency was measured using a question developed by Morse and Driskell (2009) from previous qualitative studies. Fast food frequency was calculated as an interval variable based on the average number of times a participant reported eating fast-food each week.

Perceived Stress. Perceived stress was measured as a general feeling of stress not associated with a specific event. Cohen's (Cohen & Williamson, 1988) 10-item perceived stress scale (PSS-10) was used to measure perceived stress (Table 1). Perceived stress is a global construct measured by a series of 10 items that cumulatively comprise a total perceived stress score. Perceived stress was calculated as a continuous variable by summing the 10 items on the Perceived Stressed Scale. Scores can range from 0 to 40, with higher scores indicating higher levels of perceived stress (Cohen & Williamson, 1988). Internal consistency for the PSS-10 has ranged from .78 to .91, and test-retest reliability ranged from .72 to .88 (Cohen & Williamson, 1988; Mitchell, Crane, & Kim, 2008; Reis, Hino, & Rodriguez-Añez, 2010; Remor, 2006; Wongpakaran & Wongpakaran, 2010). Criterion validity between the PSS-10 and the Medical Outcomes Study short form (MOS-SF36) mental component showed concurrent validity correlations of .70 (Mitchell, Crane, & Kim, 2008).

Procedures

Data were collected during November 2015. One course for each of the five student cohorts was visited by a graduate research assistants (GRA) for approximately 15 minutes to explain the purpose of the study, associated risks and benefits of participation, answer questions if necessary, and to administer the survey to those students who chose to participate. All students were provided with a paper/pencil study survey. Students were informed that participation was voluntary and that they could choose to complete the survey or submit the survey blank. All students were provided with a pocket calendar as an incentive when the survey was returned to the GRA whether or not the survey was completed. Surveys were returned to the investigator once data collection activities were complete.

Data Management

Data were manually entered into Statistical Package for the Social Sciences (SPSS) version 22 for the calculation of descriptive statistics and to stratify endogenous variables (sleep behaviors and weight-related behaviors) across bioecological determinants of health. Data entry reliability was evaluated through double entry by the principal investigator and GRAs. Comparison tables were created to verify coding agreement. Surveys were reviewed to correct for all mismatched data. Mplus software was used to perform path analysis and to test multiple-group models.

Missing data were assessed by determining the number of missing values per observation. A visual inspection of missing cases was conducted to identify patterns. Little's Missing Completely at Random (MCAR) test was assessed prior to imputation of missing data for each instrument and subgroup of data. No patterns were identified and MCAR tests were all non-significant, therefore data were considered missing at random and estimation maximization was employed to replace missing values (Enders, 2010). For each case, individual instruments that were at least 80 percent complete (N = 1072; 93.6 percent) were included and those with less than 80 percent complete (N = 69; 6.4 percent) were deleted. Scores for each instrument and associated subscales were calculated and transformed into new variables (see Appendix D).

Data Analysis

Descriptive statistics were analyzed and the assumptions of normality and homogeneity of variance were checked. An alpha level of .05 was considered significant for all tests to minimize type one errors. Evaluation of outliers included visual inspection of histograms and box plots and a review of standardized values, Cook's distance and centered leverage values. Collinearity was evaluated by variance inflation factors (VIF). Normal probability plots for regression residuals were assessed to validate linear relationships (Osborne, 2002).

Normality of the endogenous variables was assessed through a visual inspection of histograms and an analysis of skewness and kurtosis. Homogeneity of variance was evaluated with Levine's statistic. Analysis of variance (ANOVA) and t-tests were used to identify significant differences in sleep behaviors (endogenous variables) and weight-related behaviors (endogenous variables), stratified by bioecological (exogenous) variables. Kruskal-Wallis test was used to assess significant differences of non-normally distributed endogenous variables stratified by the exogenous variables.

Hypotheses one through four (Aim 2) were tested using path analysis to determine if the hypothesized path model (Figure 2) fit the data. The model was tested without consideration of direct effects per recommendations by Rucker, Preacher, Tormala, and Petty (2011) who advocated for testing the mediation effects of a hypothesized model without constraining analysis based on direct effects. The Chi-square test was assessed for non-significance, indicating the hypothesized model did not significantly differ from the data. Additional fit indices used to assess model fit included Bentler's Comparative Fit Index (CFI), root mean square error approximation (RMSEA) and the standardized root mean square residual (SRMR) (Bentler, 1990; Hu & Bentler, 1995).

Assumptions of maximum likelihood estimation include sufficient sample size, independence of residuals, multivariate normality of residuals and missing data missing at random. Linearity and perfect reliability are additional assumptions invoked by path models. The study design was such that independence of residuals could be assumed. Normality of residuals was assessed by visually inspecting the normal p-p plot of regression standardized residuals. Linearity was assessed through visual inspection of scatterplots and analysis of Pearson correlation matrices. Log transformation of variables that failed to meet the linearity assumption were employed.

Results

Participant Characteristics

The majority of participants (N = 268) were upper division students (84.2%) and more than half reported working at least part-time (67.7%). Participants were fairly homogenous in regard to sex, race and age. Females accounted for 87.7% of participants and the majority were Caucasian (82.1%). Participants ranged in age from 18 to 56 years with most falling in the 25 years of age or younger category (81.9%) (M = 23.5, SD = 5.7). Additional sample demographics are provided in Table 2.

Sleep Behaviors Stratified by Bioecological (Exogenous) Variables – Aim 1

Having children/step-children was associated with shorter sleep duration ($t(260) = 3.16$, $p < .01$). Participants who reported having children/step-children had shorter sleep duration (M = 6.02 hours, SD = 1.29) compared to those who did not (M = 6.90, SD = 1.00). Sleep quality scores ranged from 0 to 13 (M = 5.1, SD = 2.4), with higher scores indicating poorer sleep quality. Sleep quality was not found to be associated with any bioecological variables.

Stress Stratified by Bioecological (Exogenous) Variables – Aim 1

Significant differences in perceived stress were found based on sex ($t(266) = 2.25$, $p = .03$). Females reported higher levels of stress (M = 18.4, SD = 6.7) compared to their male counterparts (M = 15.5, SD = 7.4).

Weight-Related Behaviors (Endogenous) Stratified by Bioecological (Exogenous) Variables – Aim 1

Physical Activity. Physical activity ranged from 0 to 25,386 total METs with a median of 3,303.50 (IQR = 4691.94). A total of 52 cases reported exceeding the maximum value of 960 minutes (16 hours) of physical activity per day, and were excluded from the analysis. Log transformation was performed in an attempt to correct for positively skewed data, but the distribution was not improved. Differences in physical activity were associated with employment status ($\chi^2(2) = 11.41$, $p < .01$) and student status (upper division vs. lower division) ($\chi^2(1) = 4.70$, $p = .03$). Participants who reported working full-time had higher levels of physical activity compared to those who were unemployed or worked part-time (Table 2). Median work-related physical activity was significantly higher for full-time employees compared to part-time employees ($\chi^2(1) = 7.72$, $p = <.01$). Further analyses of the data revealed no significant median difference between employment groups for transportation-related physical activity, leisure-time physical activity, or domestic physical activity. Physical activity was greater for students in a lower division nursing course compared to those enrolled in an upper division nursing course.

Fruit Intake. Fruit intake (M = 0.61, SD = 0.54) was calculated as the average number of fruits eaten per day. Two bioecological (exogenous) variables were associated with fruit intake (Table 2). Tobacco use ($t(50.14) = 4.0$, $p <.01$) and eating the majority of meals away from home ($t(151.27) = 4.18$, $p <.01$) were both associated with significantly less fruit intake. Participants who reported eating a majority of their meals at home had higher levels of fruit intake.

Vegetable Intake. Vegetable intake (M = 0.79, SD = 0.62) was calculated as the average number of vegetables eaten per day. Bioecological (exogenous) variables associated with vegetable intake included location of meals (majority of meals at home vs. away from home) and student status (upper division vs. lower division). Students who reported being in upper division nursing courses consumed significantly more vegetables compared to those in the pre-nursing courses ($t(72.20) = 2.19$, $p = .03$) (Table 2). Likewise, participants who reported eating the majority of their meals at home had significantly higher vegetable intake ($t(141.16) = 4.17$, $p < .01$).

SSB Consumption. SSB consumption (M = 9.53, SD = 3.28) was calculated by adding how frequently participants reported consuming sweetened juice beverage, regular soft drinks, sweetened tea, tea or coffee with cream/milk and/or sugar, and energy or sports drinks per week. SSB consumption was found to be positively associated with eating meals away from home ($t(203) = 2.91$, $p < .01$), being a member of a sorority or fraternity ($t(231) = 2.21$, $p = .03$), and being employed either part-time or full-time ($F(2, 230) = 4.74$, $p = .01$).

Fast-Food Frequency. Fast-food frequency (M = 1.87, SD = 1.18) was calculated as the average number of days a participant reported eating at a fast-food restaurant per week. Location of meals ($t(233) = 4.65$, $p < .01$) and fraternity/sorority membership ($t(251) = 3.07$, $p < .01$) were associated with increased fast-food frequency.

Identification of Predictors of Weight-Related Behaviors – Aim 2, Hypotheses #1 - #4

To test hypotheses one through four (Aim 2), a total of 183 cases were included in the hypothesized path analysis (Figure 3) where sleep behaviors (sleep duration and sleep quality) mediate the predictive nature of bioecological variables on weight-related behaviors (physical activity, fruit intake, vegetable intake, SSB consumption and fast-food frequency). The model was over-identified and determined to be recursive in nature allowing for continued analysis. Correlations between the endogenous variables were reviewed prior to model testing (Table 3). For ease of interpretation, sleep quality parameter estimate and correlation directions were reversed (positive to negative, negative to positive), since higher sleep quality scores are interpreted as poorer sleep quality. Initially the model failed to converge with fast-food frequency included. Further review of the data revealed that fast-food frequency did not provide sufficient scale variability based on the item response options. Fast-food frequency was removed from the model and testing continued. The data did not fit the model with alcohol consumption, fraternity/sorority membership, and living situation included. The model was trimmed and all other variables were retained. The fit indices (χ^2(df) = 30.33, p = .17, RMSEA = 0.04, CIF = 0.96, SRMR = 0.03) indicated excellent fit of the final model to the data (Figure 3). Further attempts to remove bioecological variables with non-significant paths to sleep behaviors and/or weight-related behaviors resulted in a weaker model that failed to fit the data. Thus, the final model was considered the most parsimonious model.

The relationship between SSB consumption and having children/step-children was mediated by sleep duration. Figure 3 illustrates a significant partially standardized regression coefficient between having children/step-children and sleep duration, and between sleep duration and SSB consumption. The total standardized specific indirect effect of having children/step-children on SSB consumption mediated by sleep duration was significant ($\beta = 0.14$, $p < .01$) (Table 6). The relationship between eating a majority of meals at home and SSB consumption was also mediated by sleep duration. The total standardized specific indirect effect of eating the majority of meals at home on SSB consumption mediated by sleep duration was significant ($\beta = -0.06$, $p = 0.01$) (Table 6).

The predictive nature of having children/step-children and eating meals at home on physical activity was also mediated by sleep duration. The standardized specific indirect effect of having children/step-children on physical activity when mediated by sleep duration was significant ($\beta = -0.22$, $p < .01$), with having children/step-children predicting decreased physical activity (Table 6). Conversely, the standardized specific indirect effect of eating the majority of meals at home on physical activity mediated by sleep duration was significantly positive ($\beta = 0.09$, $p = .02$) (Table 6). The proportion of variance explained for the endogenous variables in the final model is provided in Table 4.

Fruit and vegetable intake regressed on bioecological variables did not support hypothesis two and four. Sleep behaviors did not mediate these relationships. Instead, results indicated that being over the age of 25 and being employed were both associated with increased fruit intake. Increased vegetable intake was predicted by having children/step-children and self-identifying as non-Caucasian (minority) (Figure 3).

Hypotheses three and four (aim 2) were not supported. Sleep quality did not mediate the predictive nature of bioecological variables on weight-related behaviors. Employment status and student status were associated with sleep quality. Improved sleep quality was predicted by being employed and being enrolled in upper division nursing courses. Sleep quality was not associated with physical activity or SSB consumption.

Identification of a Moderator (Perceived Stress) of Weight-Related Behaviors – Aim 2, Hypothesis #5

Perceived stress scores ranged from 12 to 45 (M = 18.05, SD = 6.86; Median = 18). A median split was used to categorize participants into a low-stress group with PSS scores ranging from 2 to 18, and a high stress group with scores ranging from 19 to 35. Multiple-group analysis was performed to test hypothesis five and assess the moderating effect of perceived stress. Model invariance was tested to determine if the model fit in the same way for individuals with lower perceived stress (equal or below median PSS-10 scores) compared to those with higher perceived stress (greater than median PSS-10 scores). Correlations among endogenous variables for each group are provided in Table 5. The final model was tested for each group independently in an effort to determine configural invariance (Kenny, 2011).

The model failed to converge for the low-stress group when sleep duration and sleep quality were allowed to co-vary. Solution propriety requires there be enough cases for the model to converge without improper solutions (Gagne & Hancock, 2006). Thus, splitting the complete group may have resulted in an insufficient sample size to test the final model. Testing continued for the low-stress group without allowing sleep behaviors to co-vary. The model poorly fit the low-stress group and no modification indices were provided. These results indicated that the model did not fit the low-stress group and analysis was stopped (Kenny, 2011).

The model was also tested with the high-stress group, allowing for sleep behaviors to co-vary. Results are provided in Table 7. The model demonstrated excellent fit for the high-stress group (Figure 4). The high-stress model revealed an increase in the number of significant relationships between the bioecological variables and weight-related behaviors. Fruit intake was negatively associated with being a male, eating meals with non-household members, and eating the majority of meals at home. Similar to the full model, being over 25 years of age and being employed was associated with increased fruit intake. Eating meals at home, tobacco use, and having children/step-children predicted increased vegetable intake, while being over 25 years of age predicted decreased vegetable intake. These findings suggest that bioecological variables may be more predictive of sleep behaviors and weight-related behaviors in individuals with higher perceived stress compared to those with lower perceived stress.

Discussion

The purpose of this study was to identify predictors and moderators of weight-related behaviors in college students. The results indicated that sleep duration mediated the predictive nature of having children/step-children and eating the majority of meals at home on SSB consumption and physical activity. Bioecological variables were not mediated by sleep behaviors in predicting fruit and vegetable intake. Results also revealed that data collected from participants categorized as having high stress fit the hypothesized model better than data obtained from those categorized as having lower levels of stress. This finding suggests that stress moderates the mediating effect of sleep on weight-related behaviors in college students.

Sleep Stratified by Bioecological (Exogenous) Variables

Differences in sleep behaviors stratified by bioecological variables were supportive of findings in the current literature. Students who reported having children/step-children had shorter sleep duration compared to those with no children/step-children. The Wisconsin Sleep Cohort Study also confirmed that having children/step-children resulted in shorter sleep duration (Hagen, Mirer, Palta, & Peppard, 2012). These findings have relevance given that the demographics of individuals entering college are shifting away from the once traditional (<25 years of age) college student. The National Center for Education Statistics has projected that from 2012 to 2023 the percentage of students entering college who are 25 years of age or older will outpace the number of students entering college who are under the age of 25 (U. S. Department of Education, 2015). Thus, educators and campus health programs need to acknowledge the challenges non-traditional students with children/step-children face when trying to obtain adequate sleep, and when attempting to maintain healthy weight-related behaviors.

Stress Stratified by Bioecological (Exogenous) Variables

In the current study, female participants reported higher stress levels than male participants. Higher stress in female students is consistent with Kulsoom and Afsar's (2015) findings that among medical students, females had higher rates of stress as measured by the Depression, Anxiety and Stress Scale – 21 compared to male medical students. Consequently, women who fail to get adequate sleep may be prone to decreased physical activity and increased SSB consumption based on findings from the current study. Therefore, interventions aimed at reducing stress such as biofeedback and mindfulness meditation may be particularly beneficial in rigorous programs such as nursing (Ratanasiripong, Park, Ratanasiripong, & Kathalae, 2015).

Weight-Related Behaviors (Endogenous) Stratified by Bioecological (Exogenous) Variables

Physical Activity. Participants who reported working full-time had higher levels of physical activity compared to those who were unemployed or worked part-time. Further analysis revealed that differences in physical activity were attributed to work-related physical activity only. These findings suggest that leisure-time activity, transportation-related physical activity, and domestic-related physical activity are similar for students regardless of employment status. Findings from this study indicated that students who are not required to work may not be using their leisure-time to participate in health promoting physical activity.

Physical activity was greater for students in pre-nursing courses compared to those enrolled in nursing courses. Differences in physical activity may be attributed to the increased demand for studying associated with upper division nursing courses. Timmins, Corroon, Byrne, and Mooney (2011) reported that nursing students are often faced with assignments and exams that require increased effort, often leading to increased stress and unhealthy lifestyle behaviors, as compared to other undergraduate students.

Fruit and Vegetable Intake. Tobacco use and eating the majority of meals away from home were associated with significantly less fruit intake. Lower division nursing students and participants who ate the majority of meals away from home also had significantly less vegetable intake. Seguin, Aggarwal, Vermeylen, and Drewnowski (2016) reported that consuming meals away from home was associated with lower fruit and vegetable intake. Staser et al. (2011) also found that individuals who reported eating the majority of meals at home were more likely to meet Centers for Disease Control and

Prevention (CDC) recommendations for fruit intake (odds ratio = 2.09). Kolodinsky, Harvey-Berino, Berlin, Johnson, and Reynolds (2007) reported an increased likelihood of meeting dietary recommendations among college students who had increased knowledge regarding dietary guidelines. Similarly in this study, students enrolled in nursing courses may have a greater understanding of dietary recommendations than those in pre-nursing courses resulting in increased vegetable intake.

SSB Consumption. SSB consumption was higher for participants who were employed, fraternity/sorority members, and those who ate the majority of their meals away from home. Larson, Neumark-Sztainer, Laska, and Story (2011) reported that eating at fast-food restaurants was associated with increased SSB consumption among young adults. Bleich, Wang, Wang, and Gortmaker (2009) also found that 20% of young adults reported consuming SSB at work, which could account for the increased SSB consumption among employed participants. Surprisingly, no studies to date have addressed increased SSB consumption among fraternity/sorority membership; however, participants in this study who reported being a member of a fraternity/sorority were more likely to eat fast-food which has been linked to increased SSB consumption.

Identification of Predictors of Weight-Related Behaviors

The mediating effect of sleep behaviors on SSB consumption and physical activity in college students is a notable finding. It has been well-established in the literature that college students are at an increased risk for weight-gain. The underlying causes for behaviors contributing to weight-gain, however, are not fully understood. Findings from this study provide further evidence that shorter sleep duration may be an important link between an individual’s bioecological uniqueness and their subsequent weight-related behaviors. These findings underscore the importance of implementing campus health programs that target health promoting behaviors such as obtaining adequate sleep when attempting to abate the problem of weight-gain among college students.

The moderating effect of stress on the conceptual model of weight-related behaviors in college students is also a significant finding. The relationship between sleep and stress is complex, to date no studies have examined the impact of both sleep and stress on weight-related behaviors in college students. Findings from the current study suggest that bioecological uniqueness and sleep behaviors are more predictive of weight-related behaviors in individuals with higher levels of stress. Therefore, campaigns aimed at reducing weight-gain in college students may benefit from acknowledging the importance of perceived stress prior to implementing targeted weight-related behavior modifications.

The Bioecological Model

The bioecological model was the theoretical framework that guided this study. The bioecological model is a systems model that includes interactions between individual's and the social context, while taking into account the biological and environmental uniqueness of an individual. Findings from this study support the use of the bioecological model when attempting to explicate the complex nature of weight-related behaviors in college students. Attempts to trim additional bioecological variables with non-significant paths to sleep behaviors and/or weight-related behaviors resulted in a weaker model fit, indicating that collectively, those variables contributed to the model in a way that was essential. Thus, the complex hypothesized model of weight-related behaviors in college students was supported, as was the bioecological model.

Limitations

The proposed study had several limitations. First, a cross-sectional study design limits the interpretation of findings. A statistical model of causal explanation was tested from data collected at one moment in time. Failure of respondents to answer items, either through error or because of the sensitive nature of topics, may have resulted in non-response bias. The simultaneous collection of data also required that the causal paths be specified a priori in an effort to control for various confounders. In addition, path models must be correctly specified since causal modeling only tests the strength of the relationships between variables and assumes that the model is true (Shadish, Cook & Cambell, 2002).

Second, self-report data are limited because it requires participants to recall information. Streiner and Norman (2008) noted that individuals often have difficulty recalling important events. It is even more difficult for individuals to recall information that fluctuates over time or minor life events (Streiner & Norman, 2008). This was especially true for items that required students to recall physical activity and serving sizes of fruit intake, vegetable intake, and SSB consumption. There were 52 students that reported more than 960 minutes of physical activity per day resulting in the cases being removed from analysis. Students did not have difficulty reporting frequencies for fruit or vegetable intake and SSB consumption but they often failed to provide the serving size of those items consumed (see Appendix E). As a result, scoring instructions for instruments that required serving size of vegetable or fruit intake or SSB consumption (NCIBMS &

BEVQ15) could not be used. Instead, only frequency of consumption could be calculated, thereby reducing accuracy of the measures and decreasing statistical power.

Third, the population of interest may be limiting. Nursing students in the U. S. are primarily female and may be more knowledgeable of health-related topics than non-nursing college students. Further, typically few nursing students participate in organized sports as a result of the rigor of the program and minorities are underrepresented compared to the university population within the U. S.. Therefore, findings may not be generalizable to an entire undergraduate student population.

Fourth, although the sample size was considered adequate for testing the hypothesized model (N=268), list-wise deletion during path analysis resulted in 183 cases included. In addition, the exogenous variables of fraternity/sorority membership, living situation, and alcohol use were removed from the model to allow for model convergence. This was most likely the result of an inadequate sample size. A total of 268 surveys were included in the analysis and exceeded the minimum number of cases needed to test the model, based on the power analysis. Mplus, however, employs listwise deletion for missing values which resulted in only 183 cases being included in the model fit testing. Simulated research has shown that approximately 200 cases are considered adequate for model testing (Hoogland & Boomsma, 1998). Multiple-group comparison required the sample to be split into groups with fewer cases than the recommended 200. The result was that the final model could not be fully tested for the low-stress group.

Fifth, the physical activity measure of total METs was not normally distributed and log transformation did not correct the distribution. Non-normally distributed data can inflate the chi square resulting in an increased risk for type 1 error. Non-normally distributed data may also inflate absolute fit indices also resulting in type 1 error.

Lastly, fast-food frequency was removed from the model as a result of poor measurement. The fast-food frequency scale was not appropriate for the selected statistical analysis. Thus, the hypothesized could not be fully tested in its' original form.

Recommendations for Future Research

Future research should consider the mediating effect of sleep behaviors on physical activity and food choices in college students. Findings from this study suggest that a limited analysis of the effects of bioecological determinants of health on weight-related behaviors may not fully explain the complex nature of weight gain in college students. It is also recommended that future studies employ objective, biophysical measures such as actigraphy and accelerometry to provide more accurate measures of sleep behaviors and physical activity. Food choice measures may also be improved through the use of electronic food diaries that provide pre-programed serving sizes. Finally, the moderating effect of stress on the conceptual model of weight-related behaviors in college students should be studied further. The complex relationship between stress, sleep, and weight-related behaviors was evident in the current study. Fully explicating the nature of this relationship may assist healthcare providers better understand barriers to weight-maintenance or weight-loss in college students.

Table 1

Variables of Interest and Data Collection Instruments

Variable		Conceptual Definition	Operational Definition	Instrument
Bioecological Determinants of Health (Exogenous Variables)		Biological and environmental factors that affect the health of an individual.	Sex, race/ethnicity, age, fraternity/sorority affiliation, employment status, and tobacco use Alcohol consumption Living situation Mealtime routines - Meal Location – Where the majority of meals are eaten. - # Meals eaten with household members - # Meals eaten with non-household members	Demographic Form Beverage Questionnaire Nutritional Self-Assessment
Sleep Behaviors (Endogenous Variables)	*Sleep Quality*	"a reversible behavioral state of perceptual disengagement from and unresponsiveness to the environment (Carskadon & Dement, 2011, p. 16)."	19 self-report questions. Scores range from 0 – 21 with higher scores indicating poorer sleep quality.	Pittsburgh Sleep Quality Index (PSQI)
	Sleep Duration		The average number of hours slept per night.	Pittsburgh Sleep Quality Index (PSQI)
Physical Activity (Endogenous Variable)		The use of muscles to produce movement resulting in energy expenditure (National Heart, Lung, and Blood Institute 2011; World Health Organization, 2014)	Metabolic Equivalents (MET) – calculated based on intensity, duration and frequency of physical activity as outlined in the *Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire* (International Consensus Group for the Development of an International Physical Activity Questionnaire, 2005)	International Physical Activity Questionnaire (IPAQ)

Table 1 (Continued)

Variables of Interest and Data Collection Instruments

Variable		Conceptual Definition	Operational Definition	Instrument
Food Choices (Endogenous Variable)	*Fruit and Vegetable Intake*		14 self-report questions regarding the frequency of fruit and vegetable intake. 11 questions related to intake that occurs during mealtimes and three questions regarding foods consumed any time of the day. Two continuous variables are calculated for an average number of fruits and vegetables consumed per day.	National Cancer Institute Fruit and Vegetable By-Meal Screener
	SSB Consumption	"frequent, multifaceted, situational, dynamic, and complex and lead to food behaviors where people acquire, prepare, serve, give away, store, eat, and clean up (Sobal & Bisogni, 2009, p. 37)."	15 self-report questions regarding consumption of SSB. One continuous variable calculated for average number of SSB consumed per day	Beverage Questionnaire
	Fast Food Consumption		8 self-report questions regarding the consumption of fast food. One continuous variable calculated for average number of fast-food meals per week.	Nutrition Self-Assessment
Perceived Stress (Exogenous Variable)		"the degree to which situations in one's life are appraised as stressful (Cohen, Kamark & Mermelstein, 1983, p. 385)."	A global construct measured by a series of 10 items that cumulatively make up a total perceived stress score. Scores can range from 0 to 40, with higher scores indicating higher levels of perceived stress.	Cohen's 10-item Perceived Stress Scale (PSS-10)

Note. SSB = Sugar-Sweetened Beverage

Table 2

Mean Group Differences for Sleep Behaviors and Weight-Related Behaviors (Endogenous Variables)

Bioecological Determinants of Health (n)	Group (%)	Sleep Duration/ Day (SD)	Sleep Quality (SD)	Physical Activity (METs) Median /Week (IQR)	Fruit Intake/ Day (SD)	Vegetable Intake/ Day (SD)	SSB Cons./ Week (SD)	Fast Food Frequency/ Week (SD)	PSS Score (SD)
Sex (268)	Female (87.7)	6.7(1.0)	5.1(2.4)	3623.9(4788.0)	0.6(0.6)	0.8(0.6)	9.5 (3.3)	1.9(1.2)	**18.4(6.7)***
	Male (12.3)	6.7(1.1)	5.2(2.9)	2909.25(1885.0)	0.6(0.5)	0.8(0.7)	10.1(3.4)	1.8(1.3)	**15.5(7.4)***
Age (265)	0-25 years (81.1)	6.8(1.0)	5.0(2.3)	3196.68(4699.4)	0.6(0.5)	0.7(0.6)	9.6(3.1)	1.9(1.2)	18.0(6.8)
	>26 years (18.9)	6.5(1.1)	5.7(2.9)	3361.62(4971.7)	0.7(0.6)	1.0(0.7)	9.7(4.1)	1.7(1.1)	18.1(7.2)
Race/ Ethnicity (268)	Non-minority (89.9)	6.7(1.0)	5.2(2.4)	3450.0(4582.7)	0.6(0.5)	0.8(0.6)	9.5(3.2)	1.9(1.2)	17.9(6.8)
	Minority (10.1)	6.6(1.2)	4.5(2.5)	2415.0(5058.9)	0.8(0.5)	0.9(0.5)	10.2(4.1)	1.5(1.2)	18.7(7.3)
Student Status (266)	Lower Division (15.8)	6.7(1.2)	5.4(2.6)	**4974.0(8150.4)***	0.5(0.5)	**0.6(0.4)***	9.7(3.5)	1.9(1.2)	19.9(6.1)
	Upper Division (84.2)	6.7(1.0)	5.1(2.4)	**3171.2(4434.6)***	0.6(0.6)	**0.8(0.6)***	9.5(3.2)	1.9(1.2)	17.7(7.0)
Tobacco Use (268)	Non-User (90.7)	6.7(1.0)	5.1(2.5)	3197.0(4667.6)	**0.6(0.6)***	0.8(0.6)	9.5(3.2)	1.9(1.2)	18.0(6.8)
	User (9.3)	6.4(1.3)	5.3(1.9)	5157.0(6520.5)	**0.4(0.2)***	0.7(0.5)	10.5(3.6)	2.1(0.8)	18.9(7.9)
Location of Meals (227)	Majority Outside Home (26.0)	6.6(1.2)	5.1(2.3)	2519.7(5194.2)	**0.4(0.4)***	**0.6(0.5)***	**10.4(3.2)***	**2.4(1.4)***	17.9(6.0)
	Majority Home (74.0)	6.7(1.0)	5.2(2.6)	3628.4(4334.5)	**0.7(0.6)***	**0.9(0.7)***	**8.9(3.1)***	**1.6(1.1)***	17.8(7.2)
Employment Status (268)	Unemployed (32.1)	6.8(1.0)	5.0(2.5)	**2613.6(3754.9)***	0.7(0.6)	0.9(0.7)	**8.6(3.2)***	1.6(1.2)	17.2(6.8)
	Part-Time (63.4)	6.7(1.1)	5.2(2.4)	**3361.3(4501.5)***	0.6(0.5)	0.7(0.6)	10.0(3.3)	2.0(1.2)	18.4(6.9)
	Full-Time (4.4)	6.6(0.8)	4.5(1.7)	**8503.5(13884.6)**	0.7(0.5)	0.9(0.6)	10.1(1.5)	2.2(1.6)	19.2(6.8)
Fraternity/ Sorority Affiliation	Non-Member (79.9)	6.7(1.1)	5.2(2.4)	3405.0(4431.2)	0.6(0.6)	0.8(0.6)	**9.3(3.2)***	**1.8(1.2)***	18.2(6.9)
	Member (20.1)	6.7(0.9)	4.9(2.5)	2693.3(6061.1)	0.5(0.4)	0.7(0.5)	**10.5(3.5)***	**2.3(1.2)***	17.4(6.5)
Children/Step-Children (268)	No (92.2)	**6.8(1.0)***	5.1(2.4)	3333.7(4646.9)	0.6(0.5)	0.8(0.6)	9.5(3.1)	1.9(1.2)	17.9(6.9)
	Yes (7.8)	**6.0(1.3)***	5.2(3.0)	2006.7(3504.00)	0.6(0.6)	1.0(0.7)	10.2(5.1)	1.5(1.5)	20.0(6.6)
Stress Group (268)	Low Stress (52.6)	**6.9(1.0)***	**4.2(2.0)***	3150.0(4157.5)	0.6(0.5)	0.8(0.6)	9.4(3.4)	1.8(1.1)	**12.9(4.3)***
	High Stress(47.4)	**6.5(1.1)***	**6.1(2.4)***	3750.0(5748.1)	0.6(0.6)	0.8(0.7)	9.7(3.2)	1.9(1.3)	**23.8(3.9)***

Note. *p < .05, SD = Standard Deviation, MET = Metabolic Equivalency, Medians presented for METS

Table 3

Correlation Matrix for Endogenous Variables (High-Stress & Low-Stress Groups Combined)

	Sleep Duration	Sleep Quality	Physical Activity	Fruit Intake	Vegetable Intake	SSB Consumption	Fast-Food Frequency
Sleep Duration	---	.32*	-.24*	.06	-.09	-.18*	-.17*
Sleep Quality	---	---	-.12	.05	.10	-12	-.28*
Physical Activity	---	---	---	.07	-.06	-.04	.02
Fruit Intake	---	---	---	---	.49*	-.23*	-.31*
Vegetable Intake	---	---	---	---	---	-.24*	-.25*
SSB Consumption	---	---	---	---	---	---	.20*

*p<.05

Table 4

Proportion of Variance Explained in the Endogenous Variables for the Final Model (High-Stress and Low-Stress Groups Combined)

Endogenous Variable	R^2	Standard Error	Standard Error of the Estimate	p Value
Sleep Duration	.37	0.06	6.62	<.01
Sleep Quality	.10	0.04	2.30	.02
Physical Activity	.20	0.05	3.68	<.01
Fruit Intake	.13	0.05	2.86	<.01
Vegetable Intake	.12	0.05	2.63	<.01
SSB Consumption	.08	0.04	2.03	.04

Table 5

Pearson Correlations of Endogenous Variables for Low-Stress and High-Stress Groups

	1. Sleep Duration	2. Sleep Quality	3. Physical Activity	4. Fruit Intake	5. Vegetable Intake	6. SSB Consumption	7. Fast-Food Frequency
1	---	.191*	-.029	-.120	.217*	-.303**	-.136
2	.335**	---	-.002	.088	-.175*	.090	-.270**
3	.078	-.007	---	-.083	-.076	.144	.060
4	.016	.034	-.072	---	.347*	-.211*	-.203*
5	-.011	.056	-.055	.581**	---	-.263**	-.217*
6	-.051	-.125	.198	-.241*	-.207*	---	.123
7	-.212*	-.277**	.148	.382**	-.267**	-.281**	---

Note. Correlations for the low-stress group are above the diagonal and are shaded; correlations for the high-stress group are below the diagonal.
*p < .05; **p < .01

Table 6

Specific Indirect Effects of Children/Step-Children and Meal Location to SSB Consumption and Physical Activity in the Final Model (High-Stress and Low-Stress Groups Combined)

Path	β	SE	p Value
Children/Step-Children → Sleep Duration → SSB Consumption	.14	.05	<.01
Children/Step-Children → Sleep Duration → Physical Activity	-.06	.03	<.01
Meal Location → Sleep Duration → SSB Consumption	-.22	.04	<.01
Meal Location → Sleep Duration → Physical Activity	.09	.04	.02

Table 7

Final Model Fit for Low-Stress and High-Stress Groups

	χ^2 (df)	p value	RMSEA	CFI	SRMR
Low-Stress Group (n = 97)	42.92(25)	.01	.09	0.85	.05
High-Stress Group (n = 87)	25.34 (24)	.39	.03	0.99	.04

Note. Degrees of freedom differ because of covariance between sleep duration and sleep quality

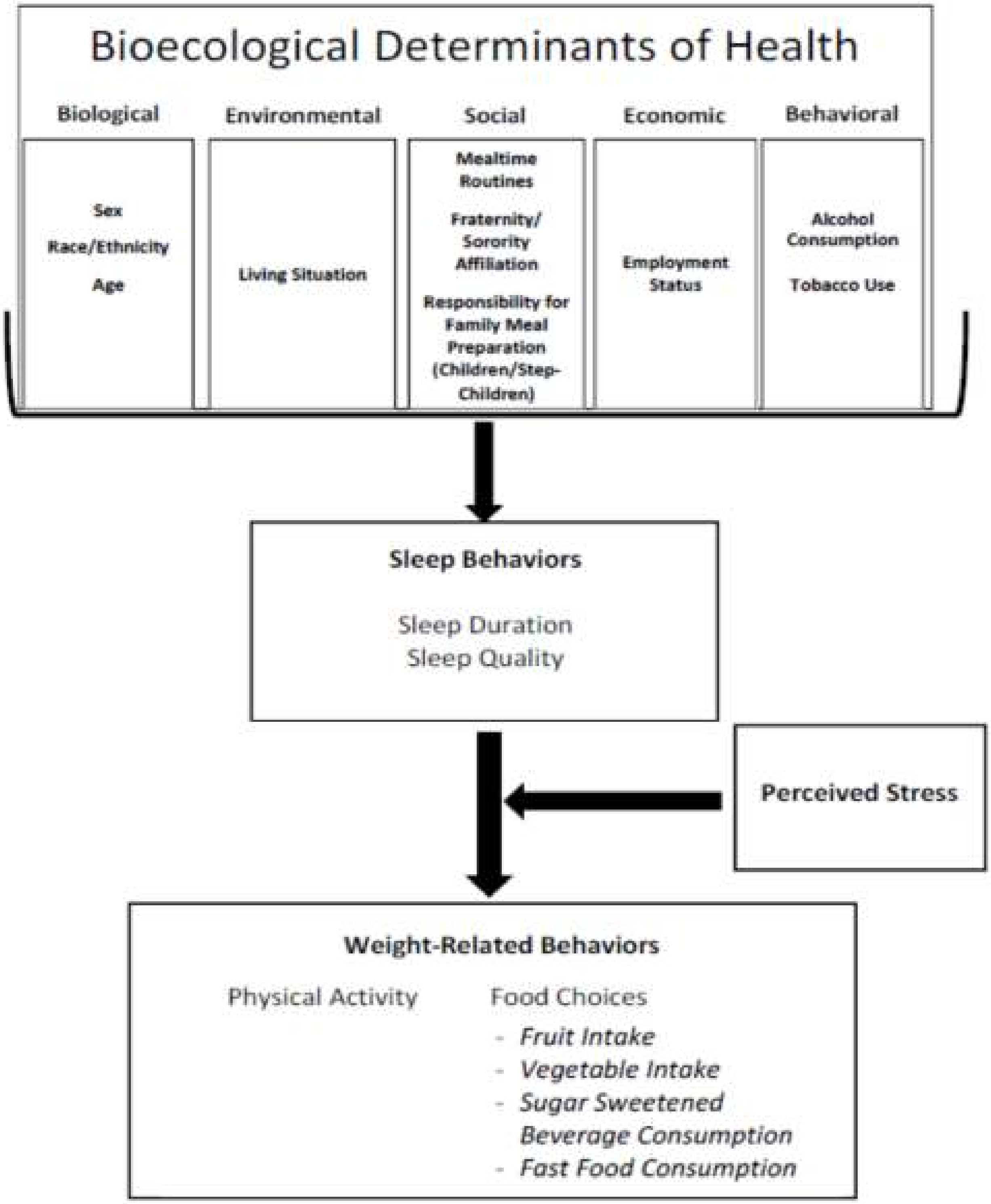

Figure 1. Operational model of the to identify predictors and moderators of weight-related behaviors in college students.

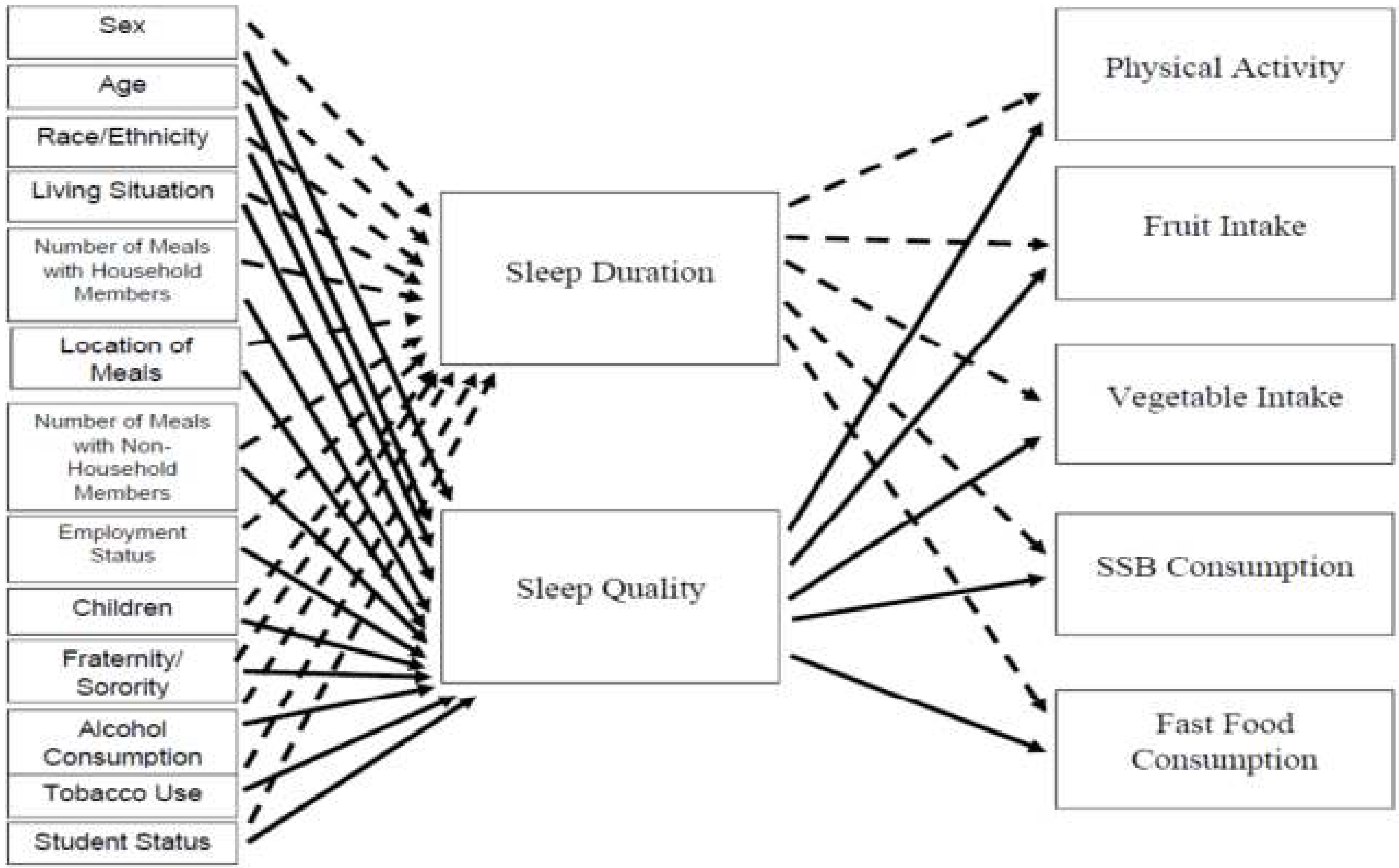

Figure 2. Hypothesized path model

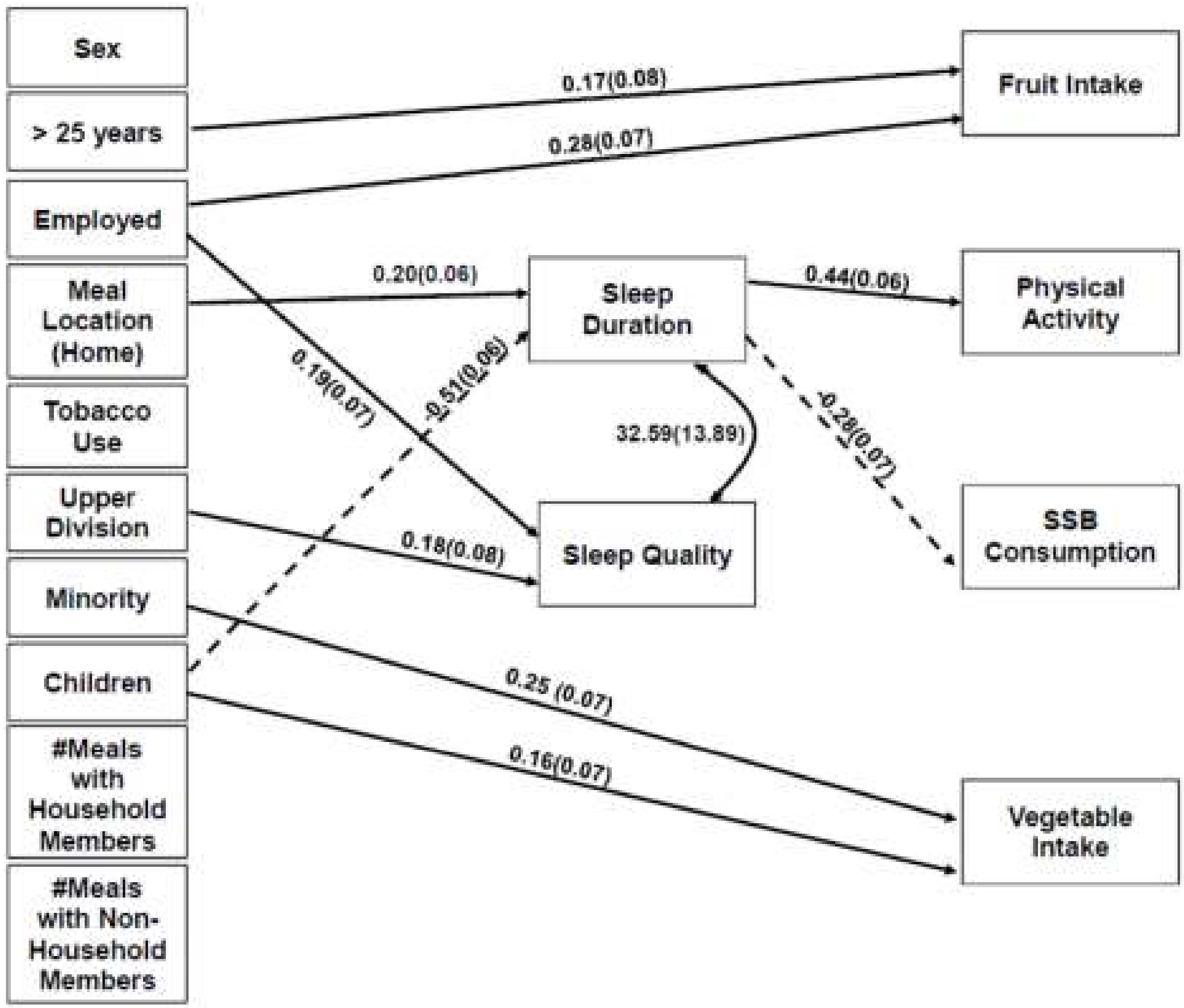

Figure 3. Final path model with partially standardized robust maximum likelihood parameter estimates. *p < .05

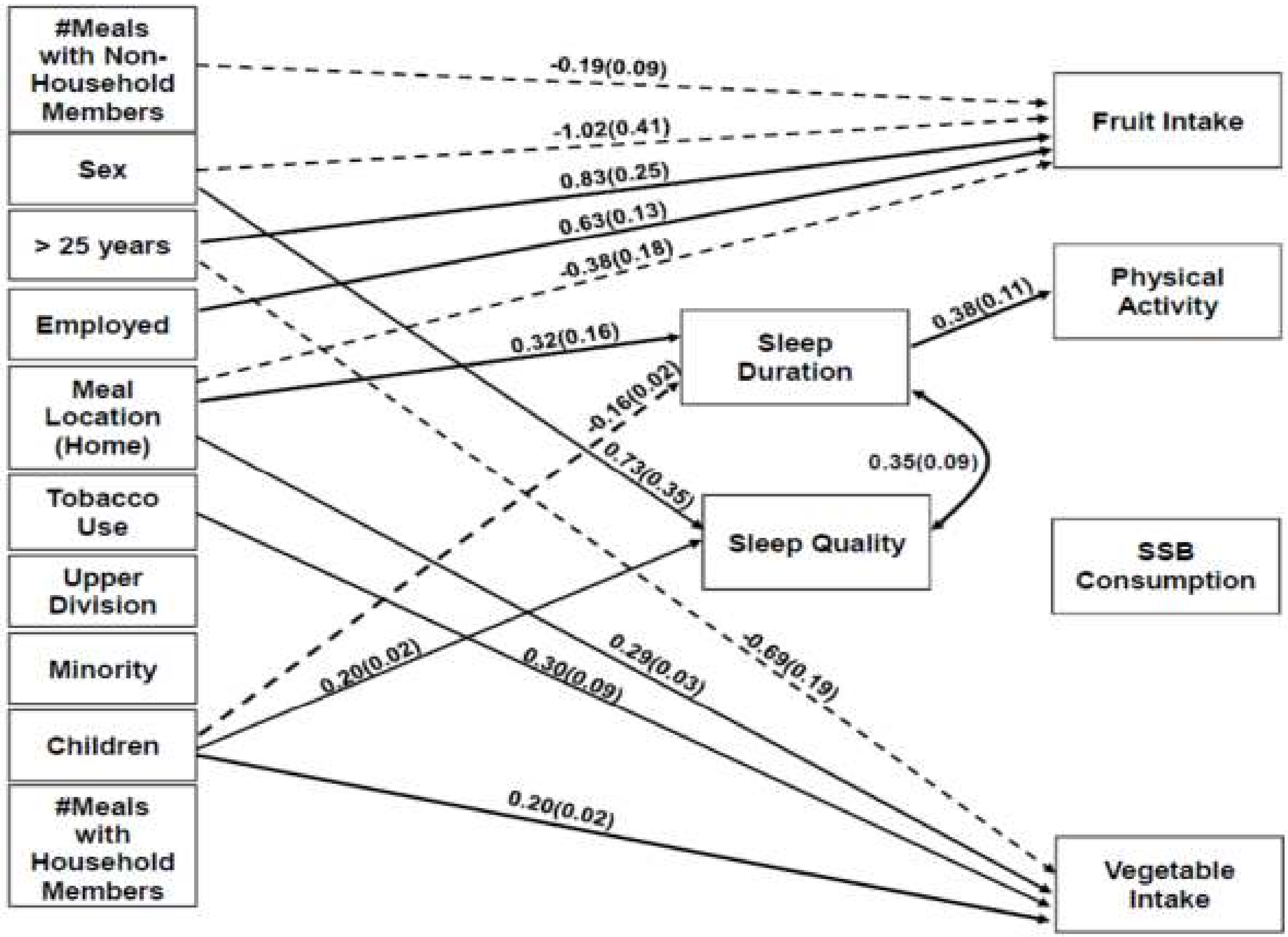

Figure 4. Final path model for high-stress group with partially standardized robust maximum likelihood parameter estimates. $*p < .05$

CHAPTER V

SYNTHESIS AND CONCLUSIONS

This dissertation served to: (1) provide a critical appraisal of the high-risk nature of poor sleep behaviors in college students and to advocate for thorough assessments of sleep behaviors that examine bioecological influences; (2) review and compare commonly used self-report measures of physical activity used with U. S. college students to determine how compatibly they measure physical activity based on American College of Sports Medicine (ACSM) and American Heart Association (AHA) physical activity recommendations; and (3) identify predictors and moderators of weight-related behaviors among college students to provide a better understanding of the associations between sleep behaviors (sleep duration and sleep quality) and perceived stress with weight-related behaviors.

Synthesis of Findings and Implications

A review of literature (Chapter Two) revealed that poor sleep behaviors in older adolescents and young adults are common (Owens, 2014) and are often associated with bioecological determinants of health. Failure to appropriately assess and treat inadequate sleep in this population can lead to poor health outcomes (Mezick, Hall, & Matthews, 2012), such as weight-gain (Wirth et al., 2015). Findings also revealed that the associations between sleep behaviors and stress are complex and inconsistent findings in the literature make it difficult to determine directional relationships. No studies were identified that examined the underlying nature of the relationships between sleep behaviors, stress, and weight-gain in college students. To assess weight-related behaviors in college students, studies routinely measure physical activity as an indicator of energy expenditure. Thus, the purpose of the systematic review of instruments to assess physical activity in college students (Chapter Three) was to: identify commonly used self-report physical activity instruments used with college students; compare physical activity instruments to American College of Sports Medicine (ACSM)/American Heart Association (AHA) recommendations; and identify important considerations that must be addressed when choosing a physical activity instrument for research. Finally, the associations between sleep behaviors and physical activity and food choices were examined in a cross-sectional study of 268 nursing and pre-nursing students (Chapter Four) to determine the role sleep behaviors play in mediating the relationship between bioecological determinants of health and weight-related behaviors in college students. In addition, the influence of stress on the mediating effect of sleep when predicting weight-related behaviors was examined.

The Role of Sleep Behaviors in College Students: Influences and Outcomes

Sleep duration and sleep quality have been linked to weight-gain (Vgontzas et al., 2014). The review of literature (Chapter Two) revealed that college students are particularly susceptible to changes in sleep behaviors that may have a detrimental effect on their overall health, including increased weight-gain. Future weight-related behavioral research needs to identify specific personal and environmental attributes that contribute to weight-gain in college students given that they are at an increased risk for weight-gain when compared to the general population (Darden, 2014). Research focused in this area will be essential for efficacious interventions aimed at preventing weight-gain in college students.

The review of literature (Chapter Two) explored weight-related behavioral research by identifying the underlying causes of sleep behavior changes in older adolescents and young adults. Developmental changes occurring in older adolescents and young adults result in physical and social factors affecting sleep behaviors. Sleep delays resulting from hormonal changes (National Adolescent and Young Adult Health Information Center, 2014) and competing social demands often lead to older adolescents and young adults sleeping fewer than the recommended 7 to 10 hours required to achieve optimal health (Hirshkowitz, 2015). Environmental influences such as requirements to work (Lederer, Autry, Day, & Oswalt, 2015) and the use of technology in bed (Grandner, Gallagher, & Gooneratne, 2013) negatively impact an older adolescent or young adult's ability to obtain adequate sleep duration and/or sleep quality.

In the cross-sectional study (Chapter Four) Bronfenbrenner's bioecological model guided the identification of predictors of sleep duration and sleep quality based on findings from the review of literature (Chapter Two). The cross-sectional study revealed that having children/step-children was associated with shorter sleep duration. No differences were found for sleep quality when stratified by bioecological variables. Failure to identify differences in sleep quality and sleep duration stratified by employment groups was surprising given that requirements to work had previously been linked to shorter sleep duration and poorer sleep quality (Lederer, Autry, Day, & Oswalt, 2015). Findings related to shorter sleep duration among individuals with children/step-children was not addressed in the literature reviewed in Chapter Two because most research related to college students considers “traditional students” are 18 to 25 years of age. However, the increasing enrollment of students over the age of 25 years (U. S. Department of Education, 2015) and findings from the cross-sectional study (Chapter Four) emphasize the need for further investigation regarding competing social demands that may influence sleep behaviors in non-traditional college students.

The imperative to advance weight-related behavioral research will require that studies consider the complex nature of weight-related behaviors and attempt to explain complex causal pathways with a large number of biological and social variables as described in the review of literature (Chapter Two). In addition to identifying differences in sleep behaviors stratified by bioecological variables, the cross-sectional study (Chapter Four) tested a hypothesized path model that moved beyond conventional regression analysis and instead considered the predictive nature of multiple bioecological variables when constraining specific paths. Sex, race, age, living situation, fraternity/sorority membership, employment status, alcohol consumption, tobacco use, and mealtime routines were entered into the model to determine whether or not they significantly predicted sleep duration and/or sleep quality, physical activity, fruit intake, vegetable intake, and sugar-sweetened beverage (SSB) consumption.

In the hypothesized path model, having children/step-children and location of meals predicted sleep duration, while employment status and student status (upper division vs. lower division) predicted sleep quality. Having children/step-children was associated with decreased physical activity and SSB consumption, two unhealthy weight-related behaviors. Increased sleep duration, however, was associated with increased physical activity and decreased SSB consumption, thus, suppressing the effect of having children/step-children on physical activity and SSB consumption. Eating the majority of meals at home was predictive of increased physical activity and decreased SSB consumption. The directions of the paths were the same for sleep duration and location of meals, resulting in larger parameter estimates to physical activity and SSB consumption. Interestingly, working full-time and enrollment in upper division nursing courses predicted better sleep quality. These findings contradict previous research where working (Lederer, Autry, Day, & Oswalt, 2015) and being enrolled in health sciences courses (Lee, Wuertz, Rogers, & Chen, 2013) were predictive of decreased sleep quality.

Measurement of Weight-Related Variables

The potential impact of sleep behaviors on weight-gain identified in the review of literature (Chapter Two) led to an examination of behaviors associated with weight gain in college students. Physical activity and food choices were identified as the primary behaviors affecting an individual's overall energy balance. Thus, the cross-sectional study (Chapter Four) examined the predictive nature of sleep behaviors on physical activity and food choices. Prior to implementing the study described in Chapter Four, a closer examination of self-report instruments used to measure physical activity and food choices was conducted. A systematic review of physical activity instruments (Chapter Three) outlined findings regarding commonly used self-report physical activity instruments in college students.

Physical Activity. Weight-related behavioral research frequently involves the measurement of physical activity. Physical activity is a multidimensional behavior that is often calculated as voluntary movement based on four components that include: frequency, intensity, time, and type (Barisic, Leatherdale, & Kreiger, 2011). Physical activity can be measured using objective electronic activity monitors or as self-report measures. Self-report physical activity measures are commonly used with college students, yet self-report measurement correlations to objective measures are generally low to moderate (Prince et al., 2008).

The systematic review of physical activity instruments (Chapter Three) revealed that three self-report surveys of physical activity are frequently used with college students. The types of physical activity captured by the instruments, however, and validity when compared to ACSM/AHA recommendations vary. The findings exposed significant disparities among instrument purpose or intent and among the domains of physical activity addressed. The International Physical Activity Questionnaire – Long Form (IPAQ-LF) was determined to be the most appropriate instrument to collect data regarding frequency, intensity and duration in all four domains of physical activity among college students and was used in the cross-sectional study (Chapter Four). Study participants who worked full-time reported higher levels of physical activity, but differences in physical activity were exclusively related to physical activity that occurred at work. These findings underscore the relevance of measuring physical activity across all four domains in an effort to fully understand variations in physical activity across diverse populations.

Fruit and Vegetable Intake. According to the National Cancer Institute (2014), underreporting of dietary intake is a consistent finding in studies aimed at monitoring food and nutrient intake. This problem is not specific to weight-related behavioral research, but it may create a significant barrier to moving the science forward if energy intake cannot be accurately measured. In the cross-sectional study (Chapter Four), the difficulty of measuring dietary fruit intake and vegetable intake was realized when using the National Cancer Institute's By-Meal Screener. Although a majority of participants could report the frequency of consuming fruits and vegetables with meals, less than 50 percent reported serving size. This commonly reported problem resulted in fruit and vegetable intake being calculated as a typical number of fruits or vegetables consumed each day without accounting for serving size. Nonetheless, eating meals away from home was associated with less fruit and vegetable intake, a finding supported throughout the literature (Larson, Neumark-Sztainer, Laska, & Story, 2011).

SSB Consumption. Weight-related behavioral research has identified SSB consumption as a contributor to weight-gain and obesity. The definition of SSBs and the accuracy of measuring exposure, however, have not been consistently applied in weight-related behavioral research (Torre, Keller, Depeyre, & Kruseman, 2015). The cross-sectional study (Chapter Four) measured SSB consumption using the 15-item Beverage Intake Questionnaire (Hedrick et al., 2012). In the study, SSB consumption was higher in participants who: ate the majority of their meals away from home, reported being a member of fraternity/sororities, and worked part-time or full-time. The measurement of SSB consumption included the consumption of sweetened juice beverage, regular soft drinks, sugar-sweetened tea, tea or coffee with cream/milk and/or sugar, and energy or sports drinks. Energy drink consumption was not measured separately and instead a global measure of SSB consumption was calculated. A review of the literature (Chapter Two) indicated that college students frequently reported insufficient sleep as a motivation for consuming energy drinks. Thus, failure to differentiate energy drink consumption from SSB consumption may result in an unclear understanding of the influence of sleep behaviors on SSB consumption. Motivating factors for SSB consumption need to be identified and captured in future research exploring this phenomenon if a true understanding of the impact of sleep on SSB consumption is to be achieved.

Stress as a Moderator of Weight-Related Behaviors

Weight-related behavioral research has linked stress to eating awareness, decreased physical activity and increased fast food consumption (Barrington, Ceballos, Bishop, McGregor, & Beresford, 2012). In the cross-sectional study (Chapter Four), females reported higher levels of perceived stress than males, a finding supported by Kulsoom and Afsar's (2015) study assessing stress in a group of medical students. To further expand weight-related behavioral research, testing of the conceptual model of weight-related behaviors in college students was conducted to determine if differences existed between students categorized as having high-stress compared to those categorized as having low-stress. The final path model for the low-stress group did not fit the data. The final path model was then tested with the high-stress group and the model fit the data extremely well with an increased number of significant paths from the bioecological variables to sleep behaviors and weight-related behaviors. These findings are supportive of current evidence suggesting that stress may play an important role in an individual's ability to maintain healthy eating awareness and recommended levels of physical activity (Barrington, Ceballos, Bishop, McGregor, & Beresford, 2012).

Research Implications

The cross-sectional study (Chapter Four) uncovered a gap in the availability of instruments used to measure dietary intake. Fruit and vegetable intake were not predicted by sleep duration or sleep quality in the hypothesized model. One possible explanation for these findings was the inability of participants to complete the survey questions related to serving size, thus decreasing statistical power. Students reported frequency of fruit and vegetable intake but more than 50 percent did not provide responses regarding serving size. Future research in this area may benefit from developing and testing instruments such as electronic trackers that may assist participants in estimating serving sizes.

The significant mediating effect of sleep duration on physical activity and SSB consumption was supportive of literature suggesting that short sleep duration may lead to weight-gain. Sleep quality, however, was not found to be related to any of the dependent variables. This finding was significant given that the Pittsburgh Sleep Quality Index (PSQI) is frequently used among researchers as a global sleep quality indicator. In the cross-sectional study (Chapter Four), sleep duration was removed from the PSQI instrument and was tested independent of the other sub-scales. In future weight-related behavioral studies sleep duration should be separated from the other sleep quality sub-scales when attempting to link sleep behaviors to physical activity and food choices using the PSQI.

The disparities among self-report instruments used to measure physical activity in college students makes it essential to identify instruments that accurately measure variables of interest. Researchers must also ensure that the intended use of data is appropriate for the selected instrument. The IPAQ-LF was found to be the most appropriate instrument regarding frequency, intensity and duration in all four domains of physical activity, but most studies reviewed in Chapter Three used the IPAQ-short form. The short form is much less burdensome to participants, but it was designed for surveillance purposes and it does not address the four domains of physical activity. Therefore, researchers should consider the specific variable of interest, the purpose of the study, and the reliability and validity of the instrument when measuring physical activity in college students.

Findings from this dissertation emphasize the need for continued research focused on identifying influences of sleep behaviors and the impact those behaviors on weight-related behaviors in college students. The review of literature revealed that poor sleep behaviors can lead to hormone changes related to metabolic functioning that affect feelings of hunger and satiety. The cross-sectional study (Chapter Four) contributes to this line of inquiry but findings were limited, possibly as a result of self-report measures that failed to fully capture the dependent variables of interest. Future research should focus on testing the model of weight-related behaviors in college students using biophysical measures such as actigraphy and accelerometry in an effort to improve measurement accuracy. In addition, electronic dietary intake logs should be used to capture frequency and serving size of food intake.

Practice Implications

A review of the literature (Chapter Two) emphasized the importance of assessing for sleep behaviors in older adolescents and young adults. The developmental changes affecting sleep behaviors, along with the high-risk taking nature associated with this time period (Rew, 2005), make the transition from high school to college a critical period for health related education. Nurses working with high schools students, such as school nurses, pediatric nurses, pediatric nurse practitioners, and family nurse practitioners need to educate students and parents on the importance of forming healthy sleep behaviors during high school. Students and parents should also be coached on how students can maintain healthy sleep behaviors when the freedom that comes with college life is realized. Further, nurses working with campus health programs need to recognize the importance of assessing for sleep behaviors in college students in an effort to assist students in maintaining an ideal weight. Nurses working with this population must also consider the assessment of sleep behaviors as a priority preventative care initiative targeting a reduction in accident-related fatalities/disabilities, poor health outcomes, and academic underperformance.

Participation in physical activity has been linked to psychological well-being (Windle, Hughes, Linck, Russell, & Woods, 2010), obesity prevention (Basu, Seligman & Winkleby, 2014), and quality of life (Yohannes, Doherty, Bundy & Yalfani, 2010), yet college life is often associated with decreased physical activity (Darden, 2014). Nurses working with college student populations need access to physical activity instruments that allow for thorough assessments of physical activity across all four domains. In addition, instruments must provide results that are easily comparable to ACSM/AHA recommendations. Nurses working with campus health programs may benefit from use of the IPAQ-LF as a screening tool for physical activity given that it addresses frequency, duration, and intensity of physical activity. Data collected by campus health programs could assist in driving campus health promotion agendas such as increased access to fitness centers, the development of green spaces for transportation related walking, running, and biking, and improved safe zones that encourage outdoor activities.

Healthcare providers working with college students would benefit from the findings presented in Chapter Four when attempting to implement weight-maintenance programs. Students with children/step-children may be at an increased risk for reduced physical activity and increased SSB consumption; however, obtaining adequate sleep may suppress these effects. Thus, educating students with children/step-children about the importance of adequate sleep is essential.

Findings related to meal location and weight-related behaviors are also important when providing obesity prevention education. In the cross-sectional study (Chapter Four), students who reported eating the majority of their meals at home had higher levels of fruit and vegetable intake. In addition, eating meals at home was predictive of increased physical activity and decreased SSB consumption. In a culture where eating meals away from home is often a part of everyday life, healthcare providers may need to provide education to students regarding the benefits of meal planning and purchasing, in an effort to avoid calorie dense food and SSBs which are often associated with meals away from home.

Finally, the differences obtained in the model fit testing between the low-stress group and high-stress group were revealing. The relationships between sleep, stress, and weight-related behaviors are known to be complex but the cross-sectional study (Chapter Four) revealed evidence to support the hypothesis that stress moderates the effects of bioecological variables and sleep duration on physical activity and food choices. Healthcare providers may need to assess perceived stress in college students prior to attempting any weight-related interventions and tailor interventions based on a student's level of perceived stress. Clearly, stress compounds the effects of an individual's biological and environmental uniqueness on their ability to participate in physical activity and healthy food choice behaviors.

Policy Implications

Higher education administrators need to invest in programs aimed at improving sleep behaviors among students. Campaigns targeting healthy sleep behaviors could lead to improved academic performance and higher retention rates. Specifically, education regarding limiting the use of technology in bed may raise awareness among a population that is almost constantly using technology (Lenhart, 2015). Not only would these programs potentially improve academic performance, but they might also improve the overall health of the student body by increasing physical activity and decreasing SSB consumption.

Cross-sectional study findings (Chapter Four) suggest that shorter sleep duration is predictive of SSB consumption. Students who fail to obtain a sufficient amount of sleep may turn to SSBs in an effort to stay awake and alert. Higher education administrators should consider the availability of SSBs on campus when developing healthy campus initiatives. In addition, the advantages and disadvantages of student health need to be weighed when establishing contracts with food vendors. A review of the literature and findings from the cross-sectional study support evidence that decreased fruit and vegetable intake and increased SSB consumption are associated with fast-food frequency. Higher education administrators should consider replacing unhealthy food vendor contracts with healthy alternatives. Currently, the farm to table movement is a viable alternative that could not only improve the healthy food options available to students but that may also help grow local industry and reduce transportation related carbon emissions (Pelletier, Laska, Neumark-Sztainer, & Story, 2013).

Summary

In this dissertation, testing of the conceptual model of weight-related behaviors in college students led to four noteworthy findings. First, having children/step-children predicted decreased physical activity and increased SSB consumption, however, increased sleep duration suppressed these negative effects. Second, eating the majority of meals at home was positively predictive of all four healthy weight-related behaviors (increased physical activity, decreased SSB consumption, increased fruit intake and increased vegetable intake). Third, the conceptual model of weight-related behaviors fit the data extremely well for the high-stress group, but not for the low stress-group, indicating that stress moderates the effect of sleep on weight-related behaviors. Fourth, the strength of the final model was dependent on the bioecological variables which was supportive of Bronfenbrenner's bioecological model. These findings support current evidence in the literature that sleep behaviors play an important role in weight-gain and contribute to a deeper understanding of the underlying predictors of physical activity and food choices in college students.

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APPENDIX A

Instrument Psychometrics

Instrument	Reference	Internal Consistency Reliability	Test Retest Reliability	Criterion Validity
International Physical Activity Questionnaire (IPAQ)	Craig et al. (2003)	N/A	Total PA - 0.91 Percent Agreement Categorically – 1.0	Computer Science and Application's Inc. accelerometer (CSA) Percent Agreement Categorically - 0.31 - 0.81
	de Moraes, Suzuki & de Freitas (2013)			ACSM/AHA Guidelines – 0.72 – 1.0
	Hagströmer, Oja & Sjöström (2006)			Manufacturing Technologies Inc. (MTI) Actigraph - 0.55
National Cancer Institute Fruit and Vegetable By-Meal Screener	Thompson et al. (2002)			24-hour recall • Men – 0.67 • Women – 0.53
Beverage Questionnaire (BEVQ-15)	Hedrick et al. (2012)	0.97 – 0.99		24 hour recall – 0.69

Instrument Psychometrics

Instrument	Reference	Internal Consistency Reliability	Test Retest Reliability	Criterion Validity
Pittsburgh Sleep Quality Index (PSQI)	Backhaus, Junghanns, Broocks, Riemann, & Hohagen, (2002)		0.87	PSQI Global Scores >5 with DSM-IV Diagnosis of Insomnia • Sensitivity – 98.7 • Specificity – 84.4
	Carpenter & Andrykowski (1998)	Global 0.80 Sleep Disturbance 0.70		Known Groups Correlations Sleep Problems – 0.69 – 0.77
Cohen's 10 Item Perceived Stress Scale (PSS-10)	Cohen & Williamson (1988)	0.78		
	Remor (2006)	0.82	0.77 (2 week interval)	
	Mitchell, Crane, & Kim (2008)	0.91		MOS-SF36 – Mental Component (.70)
	Reis, Hino, & Rodriguez-Añez (2010)	0.87	0.86 (7 day interval)	
	Wongpakaran & Wongpakaran (2010)	0.80 – 0.84	0.72 – 0.88 (4 week interval)	

APPENDIX B

Identification of Predictors and Moderators of Weight-Related Behavior in College Students

DATE

Dear Nursing Student:

You are being invited to participate in a research study by answering the attached survey about weight-related behaviors in college students. There are no known risks for your participation in this research study. The information collected may not benefit you directly. The information learned in this study may be helpful to others. The information you provide will assist in testing a model of weight-related behaviors in college students. Your completed survey will be stored at the school of nursing. The survey will take approximately 10 - 15 minutes to complete. You will be provided with a small incentive gift whether you choose to participate in the study or not.

Individuals from the Department of the school of nursing, the Institutional Review Board (IRB), the Human Subjects Protection Program Office (HSPPO), and other regulatory agencies may inspect these records. In all other respects, however, the data will be held in confidence to the extent permitted by law. Should the data be published, your identity will not be disclosed.

Taking part in this study is voluntary. By completing this survey you agree to take part in this research study. You do not have to answer any questions that make you uncomfortable or prosecutable by law. You may choose not to take part at all. If you decide to be in this study you may stop taking part at any time. If you decide not to be in this study or if you stop taking part at any time, you will not lose any benefits for which you may qualify.

If you have any questions, concerns, or complaints about the research study, please contact: Dr. Barbara Polivka at barbara.polivka@louisville.edu or (502) 852-3949.

If you have any questions about your rights as a research subject, you may call the Human Subjects Protection Program Office at (502) 852-5188. You can discuss any questions about your rights as a research subject, in private, with a member of the Institutional Review Board (IRB). You may also call this number if you have other questions about the research, and you cannot reach the research staff, or want to talk to someone else. The IRB is an independent committee made up of people from the University community, staff of the institutions, as well as people from the community not connected with these institutions. The IRB has reviewed this research study.

If you have concerns or complaints about the research or research staff and you do not wish to give your name, you may call 1-877-852-1167. This is a 24 hour hot line answered by people who do not work at the University of Louisville.

Sincerely,

Barbara Polivka, PhD, RN   Heather Owens, MSN, RN

Demographic Form

Please do not write your name on this form. All information will be stored in a secure location and your identity will be kept confidential. This information will allow us to provide an accurate description of the study sample.

For the following items, please select the *one* response that is most reflective of you or fill in the blank as appropriate.

1. **Sex:** Female ☐ Male ☐

2. **Age** ________

3. **Student Status:** Lower Division ☐ Upper Division ☐

4. **Race/Ethnicity (Select all that apply)**
   Black/African American ☐ Hispanic ☐
   White/Caucasian ☐
   Asian or Pacific Islander ☐ Native American ☐

5. **Do you currently smoke traditional cigarettes on a daily basis, less than daily, or not at all?**
   Daily ☐ Less than daily ☐ Not at all ☐

6. **Do you currently smoke e-cigarettes on a daily basis, less than daily or not at all?**
   Daily ☐ Less than daily ☐ Not at all ☐

7. **Do you currently use smokeless tobacco on a daily basis, less than daily or not at all?**
   Daily ☐ Less than daily ☐ Not at all ☐

Are you currently unemployed, employed part-time or employed full-time?
Unemployed ☐ Employed part-time ☐ Employed full-time ☐

8. **Are you a member of a fraternity or sorority?**
   No ☐ Yes ☐

Let's Talk Sleep

Instructions:

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

1. During the past month, what time have you usually gone to bed at night?
BED TIME ___________

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?
NUMBER OF MINUTES ___________

3. During the past month, what time have you usually gotten up in the morning?
GETTING UP TIME ___________

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)
HOURS OF SLEEP PER NIGHT ___________

For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you:
a) Cannot get to sleep within 30 minutes

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

b) Wake up in the middle of the night or early morning

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

c) Have to get up to use the bathroom

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

d) Cannot breathe comfortably

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

e) Cough or snore loudly

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

f) Feel too cold

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

g) Feel too hot

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

h) Had bad dreams

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

i) Have pain

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

j) Other reason(s), please describe (if none skip to question #6)__________

____

ja) How often during the past month have you had trouble sleeping because of this?

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

6. During the past month, how would you rate your sleep quality overall?

Very good ___________	Fairly good ___________
Fairly bad ___________	Very bad ___________

7. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

No problem at all __________ Only a very slight problem __________
Somewhat of a problem __________ A very big problem __________

10. Do you have a bed partner or room mate?

No bed partner or room mate _____ Partner/roommate in other room _____
Partner in same room, but not same bed _____ Partner in same bed __________

If you have a room mate or bed partner, ask him/her how often in the past month you have had . . .

a) Loud snoring

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

b) Long pauses between breaths while asleep

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

c) Legs twitching or jerking while you sleep

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

d) Episodes of disorientation or confusion during sleep

Not during the past month_____	Less than once a week_____	Once or twice a week_____	Three or more times a week___

e) Other restlessness while you sleep; please describe_____________________

____

How have you being feeling?

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, please indicate with a check how often you felt or thought a certain way.

1. **In the last month, how often have you been upset because of something that happened unexpectedly?**
☐ Never ☐ Almost never ☐ Sometimes ☐ Fairly often ☐ Very often

2. **In the last month, how often have you felt that you were unable to control the important things in your life?**
☐ Never ☐ Almost never ☐ Sometimes ☐ Fairly often ☐ Very often

3. **In the last month, how often have you felt nervous and "stressed"?**
☐ Never ☐ Almost never ☐ Sometimes ☐ Fairly often ☐ Very often

4. **In the last month, how often have you felt confident about your ability to handle your personal problems?**
☐ Never ☐ Almost never ☐ Sometimes ☐ Fairly often ☐ Very often

5. **In the last month, how often have you felt that things were going your way?**
☐ Never ☐ Almost never ☐ Sometimes ☐ Fairly often ☐ Very often

6. **In the last month, how often have you found that you could not cope with all the things that you had to do?**
☐ Never ☐ Almost never ☐ Sometimes ☐ Fairly often ☐ Very often

7. **In the last month, how often have you been able to control irritations in your life?**
☐ Never ☐ Almost never ☐ Sometimes ☐ Fairly often ☐ Very often

8. **In the last month, how often have you felt that you were on top of things?**
☐ Never ☐ Almost never ☐ Sometimes ☐ Fairly often ☐ Very often

9. **In the last month, how often have you been angered because of things that were outside of your control?**
☐ Never ☐ Almost never ☐ Sometimes ☐ Fairly often ☐ Very often

10. **In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?**
☐ Never ☐ Almost never ☐ Sometimes ☐ Fairly often ☐ Very often

Moving & Grooving

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** and **moderate** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. **Do you currently have a job or do any unpaid work outside your home?**

☐ Yes

☐ No ➡ ***Skip to PART 2: TRANSPORTATION***

The next questions are about all the physical activity you did in the ***last 7 days*** as part of your paid or unpaid work. This does not include traveling to and from work.

2. **During the *last 7 days*, on how many days did you do *vigorous* physical activities like heavy lifting, digging, heavy construction, or climbing up stairs *as part of your work*? Think about only those physical activities that you did for at least 10 minutes at a time. _____days per week**

☐ No vigorous job-related physical activity ➡ ***Skip to question 4***

3. **How much time did you usually spend on one of those days doing *vigorous* physical activities as part of your work?**

_____ hours per day

_____ minutes per day

4. **Again, think about only those physical activities that you did for at least 10 minutes at a time. During the *last 7 days*, on how many days did you do *moderate* physical activities like carrying light loads *as part of your work*? Please do not include walking.**
   _____ days per week

   ☐ No moderate job-related physical activity → ***Skip to question 6***

5. **How much time did you usually spend on one of those days doing *moderate* physical activities as part of your work?**
   _____ hours per day
   _____ minutes per day

6. **During the *last 7 days*, on how many days did you *walk* for at least 10 minutes at a time *as part of your work*? Please do not count any walking you did to travel to or from work.**
   _____ days per week

   ☐ No job-related walking → ***Skip to PART 2: TRANSPORTATION***

7. **How much time did you usually spend on one of those days *walking* as part of your work?**
   _____ hours per day
   _____ minutes per day

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

8. **During the *last 7 days*, on how many days did you *travel in a motor vehicle* like a train, bus, car, or tram?**
   _____ days per week

   ☐ No traveling in a motor vehicle → ***Skip to question 10***

9. **How much time did you usually spend on one of those days *traveling* in a train, bus, car, tram, or other kind of motor vehicle?**
   _____ hours per day
   _____ minutes per day

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the *last 7 days*, on how many days did you *bicycle* for at least 10 minutes at a time to go *from place to place*?

_____ days per week

☐ No bicycling from place to place → ***Skip to question 12***

11. How much time did you usually spend on one of those days to *bicycle* from place to place?

_____ hours per day
_____ minutes per day

12. During the *last 7 days*, on how many days did you *walk* for at least 10 minutes at a time to go *from place to place*?

_____ days per week

☐ No walking from place to place → ***Skip to PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY***

13. How much time did you usually spend on one of those days *walking* from place to place?

_____ hours per day
_____ minutes per day

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the *last 7 days*, on how many days did you do *vigorous* physical activities like heavy lifting, chopping wood, shoveling snow, or digging *in the garden or yard*?

_____ days per week

☐ No vigorous activity in garden or yard → ***Skip to question 16***

15. How much time did you usually spend on one of those days doing *vigorous* physical activities in the garden or yard?

_____ hours per day
_____ minutes per day

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the *last 7 days*, on how many days did you do *moderate* activities like carrying light loads, sweeping, washing windows, and raking *in the garden or yard*?

_____ days per week

☐ No moderate activity in garden or yard → ***Skip to question 18***

17. How much time did you usually spend on one of those days doing *moderate* physical activities in the garden or yard?

_____ hours per day

_____ minutes per day

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the *last 7 days*, on how many days did you do *moderate* activities like carrying light loads, washing windows, scrubbing floors and sweeping *inside your home*?

_____ days per week

☐ No moderate activity inside home → ***Skip to PART 4: RECREATION SPORT AND LEISURE-TIME PHYSICAL ACTIVITY***

19. How much time did you usually spend on one of those days doing ***moderate*** physical activities inside your home?

_____ hours per day

_____ minutes per day

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the ***last 7 days***, on how many days did you ***walk*** for at least 10 minutes at a time ***in your leisure time?***

_____ days per week

☐ No walking in leisure time → ***Skip to question 22***

21. How much time did you usually spend on one of those days ***walking*** in your leisure time?

_____ hours per day

_____ minutes per day

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the *last 7 days*, on how many days did you do *vigorous* physical activities like aerobics, running, fast bicycling, or fast swimming *in your leisure time*?

_____ days per week

☐ No vigorous activity in leisure time → ***Skip to question 24***

23. How much time did you usually spend on one of those days doing *vigorous* physical activities in your leisure time?

_____ hours per day
_____ minutes per day

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the *last 7 days*, on how many days did you do *moderate* physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis *in your leisure time*?

_____ days per week

☐ No moderate activity in leisure time → ***Skip to PART 5: TIME SPENT SITTING***

25. How much time did you usually spend on one of those days doing *moderate* physical activities in your leisure time?

_____ hours per day
_____ minutes per day

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the *last 7 days*, how much time did you usually spend *sitting* on a *weekday*?

_____ hours per day
_____ minutes per day

27. During the *last 7 days*, how much time did you usually spend *sitting* on a *weekend day*?

_____ hours per day
_____ minutes per day

What's on the Menu?

Instructions:

- Think about what you usually ate last month.
- Please think about all the fruits and vegetables that you ate last month. Include those that were:
  - raw and cooked,
  - eaten as snacks and at meals,
  - eaten at home and away from home (restaurants, friends, take-out), and
  - eaten alone and mixed with other foods.
- Report how many times per month, week, or day you ate each food, and if you ate it, how much you usually had.
- If you mark "Never" for a question, follow the "Go to" instruction.
- Choose the best answer for each question. Mark only one response for each question.

1. Over the last month, how many times per month, week, or day did you drink *100% fruitjuice* such as orange, apple, grape, or grapefruit juice? *Do not count* fruit drinks like Kool-Aid, lemonade, Hi-C, cranberry juice drink, Tang, and Twister. Include juice you drank at all mealtimes and between meals.

☐ Never (Go to Question #2) ☐ 1-3 times per month
☐ 1-2 times per week ☐ 3-4 times per week ☐ 5-6 times per week
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more (times per day)

1a. Each time you drank 100% juice, how much did you usually drink?

☐ Lesss than ¾ cup (6oz) ☐ ¾ to 1 ¼ cup (6-10oz)
☐ 1 ¼ to 2 cups (10-16oz) ☐ More than 2 cups (16oz)

2.* Over the last month, how often did you eat *lettuce salad (with or without other vegetables)?

☐ Never (Go to Question #3) ☐ 1-3 times per month
☐ 1-3 times per week ☐ 3-4 times per week ☐ 5-6 times per week
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more (times per day)

2a. Each time you ate lettuce salad, how much did you usually eat?

☐ About ½ cup ☐ About 1 cup
☐ About 2 cups ☐ More than 2 cups

3. Over the last month, how often did you eat *__French fries__* or *__fried potatoes__*?

☐ Never (Go to Question #4) ☐ 1-3 times per month
☐ 1-4 times per week ☐ 3-4 times per week ☐ 5-6 times per week
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more (times per day)

3a. Each time you ate *__French fries__* or *__fried potatoes__*, how much did you usually eat?

☐ Small order or less (1cup) ☐ Medium order (2cups)
☐ Large order (1 ½ cup) ☐ Super Size order or more (3 cups)

4.* Over the last month, how often did you eat *__other white potatoes__*? Count *__baked, boiled__*, and *__mashed potatoes, potato salad__*, and *__white potatoes that were not fried.__

☐ Never (Go to Question #5) ☐ 1-3 times per month
☐ 1-5 times per week ☐ 3-4 times per week ☐ 5-6 times per week
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more (times per day)

4a. Each time you ate these potatoes, how much did you usually eat?

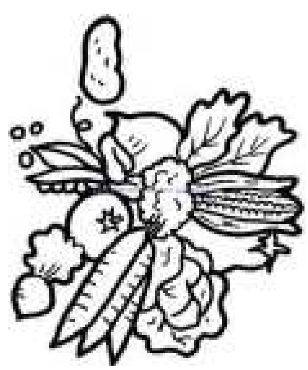
☐ 1 small potato or less (½ cup) ☐ 1 medium potato (½ to 1 cup)
☐ 1 large potato (1 to 1½ cup) ☐ 2 medium potatoes or more (1½ cup)

5. Over the last month, how often did you eat cooked dried beans? Count baked beans, bean soup, refried beans, pork and beans and other bean dishes.

☐ Never (Go to Question #6) ☐ 1-3 times per month
☐ 1-6 times per week ☐ 3-4 times per week ☐ 5-6 times per week
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more (times per day)

5a. Each time you ate these beans, how much did you usually eat?

☐ Lesss than ½ cup ☐ ½ to 1 cup
☐ 1 to 1½ cup ☐ More than 1½ cup



Now, divide your waking hours into three time periods:
• MORNING
• LUNCHTIME AND AFTERNOON
• SUPPERTIME AND EVENING
Please think about the foods you ate during each of those time periods over the last month.

MORNING

6. Think about all the foods you ate at your morning meal and snacks over the last month. On how many days did you eat fruit for your morning meal or morning snacks? Count any kind of fruit—fresh, canned, and frozen. Do not count juices.

☐ Never (Go to Question #7) ☐ 1-3 times per month
☐ 1-7 times per week ☐ 3-4 times per week ☐ 5-6 times per week
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more (times per day)

6a. When you ate *__fruit__* in the morning, what is the *__total__* amount of *__fruit__* that you usually ate in a morning?

☐ Lesss than 1 medium fruit ☐ 1 medium fruit
☐ 2 medium fruits ☐ More than 2 medium fruits

7. Think about all the foods you ate at your morning meal and morning snacks. On how many days did you eat *__vegetables__* for your morning meal or morning snacks?

DO NOT COUNT:
• Lettuce salads
• White potatoes
• Cooked dried beans
• Vegetables in mixtures, such as in sandwiches, omelets, casseroles,
• Rice

COUNT: • All other vegetables—raw, cooked, canned, and frozen

☐ Never (Go to Question #8) ☐ 1-3 days last month ☐ 1-2 days per week
☐ 3-4 days per week ☐ 5-6 days per week ☐ Every day

7a. When you ate *__vegetables__* in the morning, what is the *__total__* amount of *__vegetables__* that you usually ate in a morning?

☐ Lesss than ½ cup ☐ ½ to 1 cup
☐ 1 to 1½ cup ☐ More than 1½ cup

LUNCH AND AFTERNOON

8. Think about all the foods you ate at lunchtime and for your afternoon snacks last month. On how many days did you eat *fruit* at lunchtime or for your afternoon snacks? Count any kind of fruit—fresh, canned, and frozen. *Do not count* juices.

☐ Never (Go to Question #9) ☐ 1-3 days last month ☐ 1-2 days per week
☐ 3-4 days per week ☐ 5-6 days per week ☐ Every day

8a. When you ate fruit at lunchtime or for your afternoon snacks, what is the total amount of fruit that you usually ate then?

☐ Lesss than 1 medium fruit ☐ 1 medium fruit
☐ 2 medium fruits ☐ More than 2 medium fruits

9. Think about all the foods you ate at lunchtime and for your afternoon snacks. On how many days did you eat *vegetables* at lunchtime or for your afternoon snacks?

DO NOT COUNT:
- Lettuce salads
- White potatoes
- Cooked dried beans
- Vegetables in mixtures, such as in sandwiches, omelets, casseroles,
- Rice

COUNT: • All other vegetables—raw, cooked, canned, and frozen

☐ Never (Go to Question #10) ☐ 1-3 days last month ☐ 1-2 days per week
☐ 3-4 days per week ☐ 5-6 days per week ☐ Every day

9a. When you ate vegetables at *lunchtime* or for your *afternoon* snacks, what is the *total* amount of *vegetables* that you usually ate then?

☐ Lesss than ½ cup ☐ ½ to 1 cup
☐ 1 to 1½ cup ☐ More than 1½ cup

10. Think about all the foods you ate at suppertime and for your evening snacks last month. On how many days did you eat *fruit* at suppertime or for your evening snacks? Count any kind of fruit—fresh, canned, and frozen. *Do not count* juices.

☐ Never (Go to Question #11) ☐ 1-3 days last month ☐ 1-2 days per week
☐ 3-4 days per week ☐ 5-6 days per week ☐ Every day

10a. When you ate fruit at suppertime or for your evening snacks, what is the total amount of fruit that you usually ate then?

☐ Lesss than 1 medium fruit ☐ 1 medium fruit
☐ 2 medium fruits ☐ More than 2 medium fruits

11. Think about all the foods you ate at suppertime and for your evening snacks. On how many days did you eat *__vegetables__* at suppertime or for your evening snacks?

DO NOT COUNT: • Lettuce salads, White potatoes, Cooked dried beans
• Vegetables in mixtures, such as in sandwiches, omelets, casseroles,
• Rice

COUNT: • All other vegetables—raw, cooked, canned, and Frozen

☐ Never (Go to Question #12) ☐ 1-3 days last month ☐ 1-2 days per week
☐ 3-4 days per week ☐ 5-6 days per week ☐ Every day

11a. When you ate *__vegetables__* at suppertime or for your evening snacks, what is the *__total__* amount of *__vegetables__* that you usually ate then?

☐ Lesss than ½ cup ☐ ½ to 1 cup
☐ 1 to 1½ cup ☐ More than 1½ cup

12. Over the last month, how often did you eat *__tomato sauce__*? Include tomato sauce on pasta or macaroni, rice, pizza and other dishes.

☐ Never (Go to Question #13) ☐ 1-3 times per month
☐ 1-2 times per week ☐ 3-4 times per week ☐ 5-6 times per week
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more (times per day)

12a. Each time you ate *__tomato sauce__*, how much did you usually eat?

☐ Lesss than ½ cup ☐ ½ to 1 cup
☐ 1 to 1½ cup ☐ More than 1½ cup

13. Over the last month, how often did you eat *__vegetable soups__*? Include tomato soup, gazpacho, beef with vegetables.

☐ Never (Go to Question #14) ☐ 1-3 times per month
☐ 1-3 times per week ☐ 3-4 times per week ☐ 5-6 times per week
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more (times per day)

13a. When you ate vegetable soup, how much did you usually eat?

☐ Lesss than 1 cup ☐ 1 to 2 cups
☐ 2 to 3 cups ☐ More than 3 cups

14. Over the last month, how often did you eat *__mixtures that included vegetables?__* Count such foods as sandwiches, casseroles, stews, stir-fry, omelets, and tacos.

☐ Never ☐ 1-3 times per month
☐ 1-2 times per week ☐ 3-4 times per week ☐ 5-6 times per week
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more (times per day)

The Things You Drink

Instructions:

In the past month, please indicate your response for each beverage type by marking an "X" in the box for "how often" and "how much each time".

1. Indicate how often you drank the following beverages, for example, if you drank 5 glasses of water per week, mark 4-6 times per week.
2. Indicate the approximate amount of beverage you drank each time, for example, if you drank 1cup of water each time, mark 1 cup under "how much each time".
3. Do not count beverages used in cooking or other preparations, such as milk in cereal.
4. Count milk added to tea and coffee in the tea/coffee with cream beverage category, **NOT** in the milk categories.

	How Often (Mark One)						**How Much Each Time (Mark One)**				
Beverage	**Never or <1x/ week**	**1 times/week**	**2-3times/week**	**4-6x/ week**	**1times/day**	**3+ times/day**	**Less than 6oz or ¾ cup**	**8oz or 1 cup**	**12oz or 1½ cup**	**16oz or 2 cups**	**> 20oz or 2½ cups**
1. Water											
2. Sweetened Juice Beverage											
3. Whole Milk											
4. Reduced Fat Milk (2%)											
5. Low fat/ Fat free milk (Skim, 1%, buttermilk, Soy)											
6. Soft Drinks, Regular											
7. Diet Soft Drinks/Artifically Sweetened Drinks (Crystal Light)											
8. Sweetened Tea											
9. Tea or Coffee, with cream/milk and/or sugar (includes non-dairy creamer)											
10. Tea or Coffee, black with/without artificial sweetener (no cream or sugar)											
11. Beer, Ales, Wine Coolers, Non-alcoholic or Light Beer											
12. Hard Liquor (shots, rum, tequila, etc.)											
13. Wine (red or white)											
14. Energy & Sports Drinks (Red Bull, Rockstar, Gatorade, Powerade, etc.)											
15. Other (List):											

Food Questionnaire

Instructions: Check the answer that best describes your current situation.

1. **How would you describe your current living situation?**
   - ☐ on-campus, with a campus meal plan
   - ☐ Greek housing
   - ☐ on-campus without a campus meal plan
   - ☐ Off-campus with family
   - ☐ Off-campus housing, with friends
   - ☐ Living alone **(skip to #7)**

2. **Not counting yourself, how many adults 18 years of age and older are living in your household?**
   None ☐ 1 ☐ 2 ☐ 3 ☐
   4 ☐ 5 ☐ 6 or more ☐

3. **How many children under 18 years of age are living in your household?**
   None ☐ 1 ☐ 2 ☐ 3 ☐
   4 ☐ 5 ☐ 6 or more ☐

3a. **In relation to yourself, how would you classify the children under 18 years of age living in your household?**
   Siblings ☐ Children/Step-Children ☐ Other ☐

4. **In a typical week, how often do you eat the following meals with one or more members of your household?**

	0 – 1 days/week	2 – 3 days/week	4 – 5 days/weeks	6 – 7 days/week
Breakfast?	☐	☐	☐	☐
Lunch?	☐	☐	☐	☐
Dinner?	☐	☐	☐	☐

5. In general, how willing are most other members of your household to eat fruits?

Extremely willing				Not willing at all
1	2	3	4	5
☐	☐	☐	☐	☐

6. In general, how willing are most other members of your household to eat vegetables?

Extremely willing				Not willing at all
1	2	3	4	5
☐	☐	☐	☐	☐

7. In a typical week, how often do you eat the following meals with one or more friends or family not living in your household?

	0 – 1 days/week	2 – 3 days/week	4 – 5 days/weeks	6 – 7 days/week
Breakfast?	☐	☐	☐	☐
Lunch?	☐	☐	☐	☐
Dinner?	☐	☐	☐	☐

8. In a typical week, where do you eat most of your meals?

	Home	Outside Home	Don't eat Meal
Breakfast?	☐	☐	☐
Lunch?	☐	☐	☐
Dinner?	☐	☐	☐

9. **How much responsibility do you have for the following?**

	Little or none	About half of the time	Most or all of the time
Food Shopping	☐	☐	☐
Planning Meals	☐	☐	☐
Preparing Meals	☐	☐	☐

10. **Where do you typically eat meals?**
    - ☐ Fast food ☐ University cafeteria ☐ Home
    - ☐ Sit-down restaurant ☐ Dormitory room ☐ Other

11. **Individuals with whom you typically eat meals (select all that apply)**
    - ☐ Family member(s) ☐ Friend(s) ☐ Roommate(s)
    - ☐ Coworker(s) ☐ Significant other ☐ Alone
    - ☐ Other

12. **What sources of nutrition knowledge do you rely on? (select all that apply)**
    - ☐ Family ☐ Friends ☐ Classes
    - ☐ Internet ☐ Magazines/newspapers ☐ Books
    - ☐ Physician/registered dietitian/other health professional
    - ☐ Television ☐ Instinct ☐ other

13. **What are reasons you may choose to eat at fast-food restaurants (select all that apply)**
    - ☐ Never eat fast food ☐ Inexpensive and economical
    - ☐ Limited time ☐ Enjoy the taste
    - ☐ Eat with friends/family ☐ Other

14. **What do you consider your two favorite aspects of fast-food restaurants (select 2)**

☐ Free soda refills ☐ Drive thru options ☐ Value meal

☐ The taste of the food ☐ The variety of menu items ☐ Inexpensive

☐ Fast and convenient ☐ Easier than cooking for self ☐ Other

15. **How frequently do you eat at a fast-food restaurant**

☐ Never ☐ 1-3 times weekly

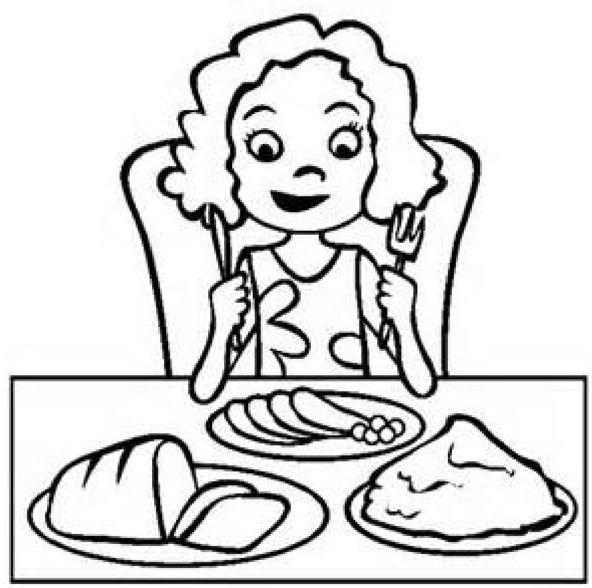
☐ 4-6 times weekly ☐ 7+ times weekly

16. **Do you typically consider the energy content (calories) of items on a fast-food menu when making your selections**

☐ I do not eat fast food ☐ No, I order what looks good

☐ Yes, but I order what looks good

☐ Yes, I order what I think to be my healthiest option



Thank you

Thank you for taking the time to participate in this study. Please return your survey to the graduate teaching assistant. You will receive a small incentive to compensate you for the time you spent completing the survey.

APPENDIX C

Demographics of Nursing Students July 1, 2013 – June 30, 2014 (N=373) Compared to Study Sample (N=268)

Demographics		Student Nurse Population		Study Sample	
		Male n(%)	Female n(%)	Male n(%)	Female n(%)
Race/ Ethnicity	White/Non-Minority	44 (11.8)	258 (69.2)	21 (7.8)	199 (74.3)
	Minority	7 (1.9)	64 (14.9)	12 (4.5)	36 (13.4)
Age	≤ 25	27 (7.2)	261 (70.0)	20 (7.5)	197 (74.3)
	>25	24 (6.4)	61 (16.4)	13 (4.9)	35 (13.2)

APPENDIX D

Study Variable	Variable Calculation
Sex	1 = Female, 2 = Male
Age	RECODE Age (SYSMIS=SYSMIS) (Lowest thru 25=0) (26 thru Highest=1) INTO Age_GP. VARIABLE LABELS Age_GP 'Age_GP'. EXECUTE.
Minority Status	RECODE Race (SYSMIS=SYSMIS) (1=1) (2=1) (3=0) (4=1) (5=1) (6=1) INTO Race_GP. VARIABLE LABELS Race_GP 'Race_GP'. EXECUTE.
Living Situation	1 = On Campus (meal plan), 2 = Greek Housing, 3 = On Campus (no meal plan), 4 = Off-Campus (with family), 5 = Off-Campus (with friends), 6 = Live Alone
#Meals with Household Members	RECODE FQ#4Breakfast (1=.5) (2=2.5) (3=4.5) (4=6.5) (SYSMIS=SYSMIS) INTO FQ#4BreakfastCalc. VARIABLE LABELS FQ#4BreakfastCalc 'FQ#4BreakfastCalc'. EXECUTE. RECODE FQ#4Lunch (1=.5) (2=2.5) (3=4.5) (4=6.5) (SYSMIS=SYSMIS) INTO FQ#4LunchCalc. VARIABLE LABELS FQ#4LunchCalc 'FQ#4LunchCalc'. EXECUTE. RECODE FQ#4Dinner (1=.5) (2=2.5) (3=4.5) (4=6.5) (SYSMIS=SYSMIS) INTO FQ#4DinnerCalc. VARIABLE LABELS FQ#4DinnerCalc 'FQ#4DinnerCalc'. EXECUTE. COMPUTE FQ#4_Total=(SUM (FQ#4BreakfastCalc + FQ#4LunchCalc + FQ#4DinnerCalc))/3. EXECUTE.
Location of Meals	RECODE FQ#8Breakfast (1=1) (2=0) (3=0) (SYSMIS=SYSMIS) INTO FQ#8BreakfastHome. VARIABLE LABELS FQ#8BreakfastHome 'FQ#8BreakfastHome'. EXECUTE. RECODE FQ#8Lunch (1=1) (2=0) (3=0) (SYSMIS=SYSMIS) INTO FQ#8LunchHome. VARIABLE LABELS FQ#8LunchHome 'FQ#8LunchHome'. EXECUTE.

	RECODE FQ#8Dinner (1=1) (2=0) (3=0) (SYSMIS=SYSMIS) INTO FQ#8DinnerHome. VARIABLE LABELS FQ#8DinnerHome 'FQ#8DinnerHome'. EXECUTE. COMPUTE FQ#8_HomeTotal=SUM (FQ#8BreakfastHome, FQ#8LunchHome, FQ#8DinnerHome). EXECUTE. RECODE FQ#8Breakfast (1=0) (2=1) (3=0) (SYSMIS=SYSMIS) INTO FQ#8BreakfastOutHome. VARIABLE LABELS FQ#8BreakfastOutHome 'FQ#8BreakfastOutHome'. EXECUTE. RECODE FQ#8Lunch (1=0) (2=1) (3=0) (SYSMIS=SYSMIS) INTO FQ#8LunchOutHome. VARIABLE LABELS FQ#8LunchOutHome 'FQ#8LunchOutHome'. EXECUTE. RECODE FQ#8Dinner (1=0) (2=1) (3=0) (SYSMIS=SYSMIS) INTO FQ#8DinnerOutHome. VARIABLE LABELS FQ#8DinnerOutHome 'FQ#8DinnerOutHome'. EXECUTE. COMPUTE FQ#8_OutHomeTotal=SUM (FQ#8BreakfastOutHome, FQ#8LunchOutHome, FQ#8DinnerOutHome). EXECUTE. IF (FQ#8_HomeTotal > FQ#8_OutHomeTotal) MealLoc_Home=2. EXECUTE. IF (FQ#8_HomeTotal < FQ#8_OutHomeTotal) MealLoc_Out=1. EXECUTE. COMPUTE MealLoc=SUM(MealLoc_Home,MealLoc_Out). EXECUTE.
#Meals with Non-Household Members	RECODE FQ#7Breakfast (1=.5) (2=2.5) (3=4.5) (4=6.5) (SYSMIS=SYSMIS) INTO FQ#7BreakfastCalc. VARIABLE LABELS FQ#7BreakfastCalc 'FQ#7BreakfastCalc'. EXECUTE. RECODE FQ#7Lunch (1=.5) (2=2.5) (3=4.5) (4=6.5) (SYSMIS=SYSMIS) INTO FQ#7LunchCalc. VARIABLE LABELS FQ#7LunchCalc 'FQ#7LunchCalc'. EXECUTE.

	RECODE FQ#7Dinner (1=.5) (2=2.5) (3=4.5) (4=6.5) (SYSMIS=SYSMIS) INTO FQ#7DinnerCalc. VARIABLE LABELS FQ#7DinnerCalc 'FQ#7DinnerCalc'. EXECUTE. COMPUTE FQ#7_Total=(SUM (FQ#7BreakfastCalc + FQ#7LunchCalc + FQ#7DinnerCalc))/3. EXECUTE.
Employment Status	1 = Unemployed, 2 = Part-time employed, 3 = Full-time employed
Children	RECODE FQ#3a (SYSMIS=0) (2=1) (1=0) (3=0) INTO Children. VARIABLE LABELS Children 'Children'. EXECUTE.
Fraternity/Sorority Member	1 = Non-member, 2 = Member
Alcohol Consumption	IF (SYSMIS(ATOHBEVQFreq_Missing80)) ATOH=SUM(BEVQ#11Freq_impute, BEVQ#12Freq_impute,BEVQ#13Freq_impute). EXECUTE.
Tobacco Use	RECODE Smoking (1=1) (2=1) (3=0) (SYSMIS=SYSMIS) INTO SmokingUse. VARIABLE LABELS SmokingUse 'SmokingUse'. EXECUTE. RECODE ECigarettes (1=1) (2=1) (3=0) (SYSMIS=SYSMIS) INTO ECigarettesUse. VARIABLE LABELS ECigarettesUse 'ECigarettesUse'. EXECUTE. RECODE SmoklessTob (1=1) (2=1) (3=0) (SYSMIS=SYSMIS) INTO SmoklessUse. VARIABLE LABELS SmoklessUse 'SmoklessUse'. EXECUTE. COMPUTE TobaccoUse=SUM(SmokingUse,ECigarettesUse,SmoklessUse). EXECUTE. RECODE TobaccoUse (0=0) (1=1) (2=1) (3=1) (SYSMIS=SYSMIS). EXECUTE.
Student Status	1 = Lower Division, 2 = Upper Division
Sleep Duration	RECODE PSQI#4 (SYSMIS=SYSMIS) (10 thru Highest=SYSMIS) (ELSE=Copy) INTO SlpHours.

	VARIABLE LABELS SlpHours 'SlpHours'. EXECUTE.
Sleep Quality	RECODE PSQI#5a (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#5b (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#5c (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#5d (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#5e (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#5f (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#5g (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#5h (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#5i (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#5ja (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#6 (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#7 (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#8 (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#9 (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#10 (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE.

	RECODE PSQI#10a (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#10b (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#10c (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. RECODE PSQI#10d (SYSMIS=SYSMIS) (1=0) (2=1) (3=2) (4=3). EXECUTE. IF (PSQI#5j >= 1) PSQI5jCOMMENT=1. EXECUTE. DO IF (PSQI5jCOMMENT = 1). RECODE PSQI#5ja (SYSMIS=SYSMIS) (0=0) (1=1) (2=2) (3=3) INTO PSQI#5ja_final. END IF. VARIABLE LABELS PSQI#5ja_final 'PSQI#5ja_final'. EXECUTE. COMPUTE PSQIDISTURB_TOTAL=SUM(PSQI#5b,PSQI#5c, PSQI#5d, PSQI#5e, PSQI#5f, PSQI#5g, PSQI#5h, PSQI#5i, PSQI#5ja_final). EXECUTE. RECODE PSQIDISTURB_TOTAL (SYSMIS=SYSMIS) (0=0) (1 thru 9=1) (9.01 thru 18=2) (18.01 thru Highest=3) INTO PSQIDIST. VARIABLE LABELS PSQIDIST 'PSQIDIST'. EXECUTE. RECODE PSQI#2 (SYSMIS=SYSMIS) (0 thru 15=0) (15.01 thru 30=1) (30.01 thru 60=2) (60 thru Highest=3) INTO PSQI#2_NEW. VARIABLE LABELS PSQI#2_NEW 'PSQI#2_NEW'. EXECUTE. COMPUTE PSQI#5a_PSQI#2NEW=SUM(PSQI#5a, PSQI#2_NEW). EXECUTE. RECODE PSQI#5a_PSQI#2NEW (SYSMIS=SYSMIS) (0=0) (1 thru 2=1) (3 thru 4=2) (5 thru 6=3) INTO PSQILATEN.

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VARIABLE LABELS  PSQILATEN 'PSQILATEN'.
EXECUTE.

COMPUTE PSQIDAYSDYS_TOTAL=SUM(PSQI#8, PSQI#9).
EXECUTE.

RECODE PSQIDAYSDYS_TOTAL (SYSMIS=SYSMIS) (0=0) (1
thru 2=1) (3 thru 4=2) (5 thru 6=3) INTO
    PSQIDAYDYS.
VARIABLE LABELS  PSQIDAYDYS 'PSQIDAYDYS'.
EXECUTE.

RECODE PSQI#6 (0=Copy) (1=Copy) (2=Copy) (3=Copy)
(SYSMIS=SYSMIS) INTO PSQISLPQUAL.
VARIABLE LABELS  PSQISLPQUAL 'PSQISLPQUAL'.
EXECUTE.

RECODE PSQI#7 (0=Copy) (1=Copy) (2=Copy) (3=Copy)
(SYSMIS=SYSMIS) INTO PSQIMEDS.
VARIABLE LABELS  PSQIMEDS 'PSQIMEDS'.
EXECUTE.

COMPUTE WakeTime_2400=(PSQI#3 + 2400) * 60.
EXECUTE.

COMPUTE BedTime_2400=(PSQI#1) * 60.
EXECUTE.

COMPUTE TIMEINBED=((WakeTime_2400 - BedTime_2400) /
60)/100.
EXECUTE.

IF  (TIMEINBED > 24) TIMEINBED_FINAL=TIMEINBED - 24.
EXECUTE.

IF  (TIMEINBED  <= 24) PSQIHSE=(TIMEINBED / PSQI#4) * 100.
EXECUTE.

COMPUTE PSQIHSEb=(TIMEINBED_FINAL / PSQI#4) * 100.
EXECUTE.

COMPUTE PSQIHSEab=SUM(PSQIHSE,PSQIHSEb).
EXECUTE.

RECODE PSQIHSEab (SYSMIS=SYSMIS) (85 thru Highest=0) (75
thru 84.99=1) (65 thru 74.99=2) (Lowest
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	thru 64.99=3) INTO PSQIHSE_FINAL. VARIABLE LABELS PSQIHSE_FINAL 'PSQIHSE_FINAL'. EXECUTE. COMPUTE PSQI_TOTAL=SUM(PSQIDURAT,PSQIDIST, PSQILATEN, PSQIDAYDYS, PSQISLPQUAL, PSQIMEDS, PSQIHSE_FINAL). EXECUTE. COMPUTE PSQITotal_NoDurat=SUM(PSQIDIST, PSQILATEN, PSQIDAYDYS, PSQISLPQUAL, PSQIMEDS, PSQIHSE_FINAL). EXECUTE.
Physical Activity	COMPUTE IPAQ#3Min=IPAQ#3 * 60. EXECUTE. COMPUTE IPAQ#5Min=IPAQ#5 * 60. EXECUTE. COMPUTE IPAQ#7Min=IPAQ#7 * 60. EXECUTE. COMPUTE IPAQ#9Min=IPAQ#9 * 60. EXECUTE. COMPUTE IPAQ#11Min=IPAQ#11 * 60. EXECUTE. COMPUTE IPAQ#13Min=IPAQ#13 * 60. EXECUTE. COMPUTE IPAQ#15Min=IPAQ#15 * 60. EXECUTE. COMPUTE IPAQ#17Min=IPAQ#17 * 60. EXECUTE. COMPUTE IPAQ#19Min=IPAQ#19 * 60. EXECUTE. COMPUTE IPAQ#21Min=IPAQ#21 * 60. EXECUTE. COMPUTE IPAQ#23Min=IPAQ#23 * 60. EXECUTE.

	COMPUTE IPAQ#25Min=IPAQ#25 * 60.
	EXECUTE.
	
	COMPUTE IPAQWork_TotalPA=SUM((8 * IPAQ#2 * IPAQ#3Min), (4 * IPAQ#4 * IPAQ#5Min), (3.3 * IPAQ#6 * IPAQ#7Min)).
	EXECUTE.
	
	COMPUTE IPAQTransp_TotalPA=SUM((6 * IPAQ#10 *IPAQ#11Min), (3.3 * IPAQ#12 * IPAQ#13Min)).
	EXECUTE.
	
	COMPUTE IPAQDomestic_TotalPA=SUM((8 * IPAQ#14 * IPAQ#15Min), (4 *IPAQ#16 *IPAQ#17Min), (4 * IPAQ#18 * IPAQ#19Min)).
	EXECUTE.
	
	COMPUTE IPAQLeisure_TotalPA=SUM((3.3 * IPAQ#20 * IPAQ#21Min), (8 *IPAQ#22 *IPAQ#23Min), (4 * IPAQ#24 * IPAQ#25Min)).
	EXECUTE.
	
	COMPUTE IPAQ_EXCEEDSMAX=SUM(IPAQ#3Min,IPAQ#5Min, IPAQ#7Min, IPAQ#9Min, IPAQ#11Min, IPAQ#13Min, IPAQ#15Min, IPAQ#17Min, IPAQ#19Min, IPAQ#21Min, IPAQ#23Min, IPAQ#25Min).
	EXECUTE.
	
	IF (IPAQ_EXCEEDSMAX > 960) IPAQ_MAXEXCEED=1.
	EXECUTE.
	
	IF SYSMIS(IPAQ_Missing80) IPAQ_TotalMET=SUM(IPAQWork_TotalPA,IPAQTransp_TotalPA,IPAQDomestic_TotalPA, IPAQLeisure_TotalPA).
	EXECUTE.
	
	IF (SYSMIS(IPAQ_MAXEXCEED)) TotalMET=IPAQ_TotalMET.
	EXECUTE.
	
	COMPUTE TotalMETs = TotalMET/10.
	EXECUTE.

Vegetable Intake	RECODE NCIFV#7 (SYSMIS=SYSMIS) (1=0) (2=0.067) (3=0.214) (4=0.5) (5=0.786) (6=1) INTO NCIFV#7_Convert. VARIABLE LABELS NCIFV#7_Convert 'NCIFV#7_Convert'. EXECUTE.

	RECODE NCIFV#9 (SYSMIS=SYSMIS) (1=0) (2=0.067) (3=0.214) (4=0.5) (5=0.786) (6=1) INTO NCIFV#9_Convert. VARIABLE LABELS NCIFV#9_Convert 'NCIFV#9_Convert'. EXECUTE. RECODE NCIFV#11 (SYSMIS=SYSMIS) (1=0) (2=0.067) (3=0.214) (4=0.5) (5=0.786) (6=1) INTO NCIFV#11_Convert. VARIABLE LABELS NCIFV#11_Convert 'NCIFV#11_Convert'. EXECUTE. DATASET DECLARE VegImpute. MVA VARIABLES=NCIFV#7_Convert NCIFV#9_Convert NCIFV#11_Convert /EM(TOLERANCE=0.001 CONVERGENCE=0.0001 ITERATIONS=25 OUTFILE=VegImpute). IF (SYSMIS(NCIFVFreq_Missing80)) VegCalc=SUM(NCIFV#7_Convert, NCIFV#9_Convert, NCIFV#11_Convert). EXECUTE. IF (SYSMIS(NCIFVFreq_Missing80)) Veg100=VegCalc * 100. EXECUTE. IF (SYSMIS(NCIFVFreq_Missing80)) VegRND=RND(Veg100). EXECUTE. IF (SYSMIS(NCIFVFreq_Missing80)) Veg=(VegRND) / 100. EXECUTE.
Fruit Intake	RECODE NCIFV#6 (SYSMIS=SYSMIS) (1=0) (2=0.067) (3=0.214) (4=0.5) (5=0.786) (6 thru 10=1) INTO NCIFV#6_Convert. VARIABLE LABELS NCIFV#6_Convert 'NCIFV#6_Convert'. EXECUTE. RECODE NCIFV#8 (SYSMIS=SYSMIS) (1=0) (2=0.067) (3=0.214) (4=0.5) (5=0.786) (6=1) INTO NCIFV#8_Convert. VARIABLE LABELS NCIFV#8_Convert 'NCIFV#8_Convert'. EXECUTE. RECODE NCIFV#10 (SYSMIS=SYSMIS) (1=0) (2=0.067) (3=0.214) (4=0.5) (5=0.786) (6=1) INTO NCIFV#10_Convert.

	VARIABLE LABELS NCIFV#10_Convert 'NCIFV#10_Convert'. EXECUTE. DATASET DECLARE FruitImpute. MVA VARIABLES=NCIFV#6_Convert NCIFV#8_Convert NCIFV#10_Convert /EM(TOLERANCE=0.001 CONVERGENCE=0.0001 ITERATIONS=25 OUTFILE=FruitImpute). IF (SYSMIS(NCIFVFreq_Missing80)) FruitCalc=SUM(NCIFV#6_Convert, NCIFV#8_Convert, NCIFV#10_Convert). EXECUTE. IF (SYSMIS(NCIFVFreq_Missing80)) Fruit100=FruitCalc * 100. EXECUTE. IF (SYSMIS(NCIFVFreq_Missing80)) FruitRND=RND(Fruit100). EXECUTE. IF (SYSMIS(NCIFVFreq_Missing80)) Fruit=(FruitRND) / 100. EXECUTE.
SSB Consumption	IF (SYSMIS(SSBBEVQFreq_Missing80)) SSB=SUM(BEVQ#2Freq_impute, BEVQ#6Freq_impute,BEVQ#8Freq_impute, BEVQ#9Freq_impute, BEVQ#14Freq_impute). EXECUTE.
Fast-Food Frequency	RECODE FQ#15 (SYSMIS=SYSMIS) (1=0) (2=2) (3=5) (4=7) INTO FFAVerage. VARIABLE LABELS FFAVerage 'FFAverage'. EXECUTE.
Perceived Stress Score	RECODE PSS#4 (SYSMIS=SYSMIS) (5=1) (4=2) (3=3) (2=4) (1=5) INTO PSS#4RS. VARIABLE LABELS PSS#4RS 'PSS#4RS'. EXECUTE. RECODE PSS#5 (SYSMIS=SYSMIS) (5=1) (4=2) (3=3) (2=4) (1=5) INTO PSS#5RS. VARIABLE LABELS PSS#5RS 'PSS#5RS'. EXECUTE. RECODE PSS#7 (SYSMIS=SYSMIS) (5=1) (4=2) (3=3) (2=4) (1=5) INTO PSS#7RS. VARIABLE LABELS PSS#7RS 'PSS#7RS'. EXECUTE.

	RECODE PSS#8 (SYSMIS=SYSMIS) (5=1) (4=2) (3=3) (2=4) (1=5) INTO PSS#8RS. VARIABLE LABELS PSS#8RS 'PSS#8RS'. EXECUTE. COMPUTE PSSscore=SUM(PSS#1,PSS#2, PSS#3, PSS#4RS, PSS#5RS, PSS#6, PSS#7RS, PSS#8RS, PSS#9, PSS#10). EXECUTE.
Stress Group	RECODE PSSscore (SYSMIS=SYSMIS) (Lowest thru 28=0) (29 thru Highest=1) INTO StressGP. VARIABLE LABELS StressGP 'StressGP'. EXECUTE.

APPENDIX E

Missing data (>80%) for Vegetable and Fruit Intake and Beverage Consumption Questions

Variable	Number	Percent
Vegetable Frequency	17	6.3
Vegetable Amounts	181	67.5
Fruit Frequency	14	5.2
Fruit Amounts	135	50.4
SSB Frequency	35	13.1
SSB Amounts	152	56.7

CURRICULUM VITAE

Heather Owens PhD Candidate, MSN, RN
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A. Education

PhD	Current	University of Louisville	Louisville, KY
MSN	2005	University of Southern Indiana	Evansville, IN
BSN	1999	Indiana University Southeast	New Albany, IN

B. Employment

University of Louisville, School of Nursing — July 2009 – Present
Assistant Professor

- Providing evidenced based teaching strategies in a variety of nursing courses within the BSN, RN-BSN & MEPN programs
- Developing innovative teaching strategies
- Participating in unit and university wide committees
- Promoting School of Nursing programs within the community
- Serving as a student advocate

Coordinator of Educational Simulation/Instructor — July 2006 – June 2009

- Administration of NCLEX prep program
- Management of the clinical learning lab budget
- Overseeing simulation and technical learning lab software
- Coordinating integration of electronic health record training
- Teaching in a variety of courses including Transitions to Practice, Leadership & Managment, Health Assessment, Community Health & Nursing Skills

Washington County Memorial Hospital — March 2005-July 2006
Director, Quality & Infection Control

- Updated administrative policies to reflect current hospital practice
- Developed & revised computerized nursing assessment to reflect required regulatory changes
- Provided routine nursing education seminars regarding regulatory trends in healthcare
- Conducted data collection for regulatory and reimbursement agencies (ie. Medicare & Anthem)
- Coordinated all physician committee meetings
- Worked with nursing directors to assist in developing policies and programs to improve patient care/safety (ie. falling star program, point of care testing, etc.)

Columbus Regional Hospital 2002-2005
Charge Nurse – Medical-Surgical Care

- Responsible for ensuring high quality patient care
- Maintained staffing matrix
- Selected member of the Studor project team
- Nursing education committee member

Schneck Medical Center 2001-2002
Coordinator, Medical Staff Services

- Responsible for credentialing of independent and contracted healthcare providers
- Coordinated all physician committee meetings including Medical Executive Committee
- Acted as the physician representative at hospital committee meetings
- Participated in data collection and process improvement with contract partners

Jewish Hospital 1997-2001
Registered Nurse/Charge Nurse

- Responsible for day to day care provided by the nursing team
- Participated in projects to improve the outcomes of transplant patients
- Selected to care for VIP patients and the first hand transplant patient

C. National Board Certifications and state RN Licensure

- Kentucky Board of Nursing Licensure 1999-Present
- Indiana Board of Nursing Licensure 1999-Present

D. Professional Memberships and Activities

- Sigma Theta Tau 1999-Present
- Midwest Nursing Research Society 2014-Present
- Preventative Cardiovascular Nursing Association 2015

E. Honors and Awards

- Faculty Favorite Nominee 2014-2015
- Ruth Voigner Excellence in Teaching Award Recipient 2014
- Faculty Favorite Nominee 2011-2012
- Ruth Voigner Excellence in Teaching Award Nominee 2007
- Alpha Chi Honor Society 1998
- National Who's Who Among Colleges and University's 1998

F. Committees and Service

a. University

- Faculty Senate 2014 – Present
- HSC Instructional Building Planning Group 2010 – 2012

b. School of Nursing

- Research & Evidence Based Practice 2015-Present
- Faculty Affairs 2011-2015
- Undergraduate Program Committee 2008-2015
    - Chair 2013-2014
- Curriculum Council 2010-2011
- Nominations Committee 2010 - 2012
- Faculty Organization Secretary 2012-2013
- Undergraduate Academic Affairs Committee 2006-2010

c. Community

- Preventative Cardiovascular Nursing Association
    - Community Outreach Coordinator 2015-Present
- Insights Into Nursing Coordinator 2011
- Kentucky Nurses Day Banquet Committee 2007-2008
- Sigma Theta Tau 1998 - Present

G. **Teaching** *Effectiveness Scoring (5=extremely high, 1=very low)*

- N463 – Nursing Leadership & Management 2010 -Present
    - **Course Coordinator** (80-100 students)

  - Spring 2015 effectiveness mean = 4.52
- N363 – Health Assessment 2012-Present
  - **Course Coordinator** (80 students)
  - Spring 2015 effectiveness mean = 4.52
- N385-50 – Nursing Leadership & Management (RN/BSN) 2014-Present
  - (18 students)
  - Summer 2014 effectiveness mean = 4.60
- N474 – Capstone Clinical 2012-Present
  - (5-10 students)
- N402 - Therapeutic Nursing Interventions (MEPN) Summer 2015
  - **Course Coordinator** (13 students)
  - Summer 2015 effectiveness mean = 4.91
- N360-50 - Health Status Assessment (RN/BSN) 2013-2015
  - (18 students)
  - Fall 2014 effectiveness mean = 4.00
- N364 – Therapeutic Nursing Interventions 2012 – 2014
  - **Course Coordinator** (60 students)
  - Summer 2014 effectiveness mean = 4.21
- N361 – Community Health Summer 2011
  - (40 students)
  - Evaluations unavailable – not listed as course faculty on evaluation
- N101 – S.T.A.T. for Nursing 2009 –2011
  - **Course Coordinator** (6 sections/210 students)
- N472 – Transitions to Nursing Practice 2008-2010
  - **Course Coordinator** (60 students)
  - Summer 2010 effectiveness mean = 4.5
- N351 – Nursing Care of the Adult Med/Surg Client 2008
  - (60 students)

H. Publications

Berger, J., Polivka, B. Smoot, E. A. & Owens, H. (2015). Compassion fatigue in pediatric nurses. Journal of Pediatric Nursing. In Print

Hern, M., Key, M., Goss, L. K. & Owens, H. (2015). Facilitating adoption of informatics and meaningful use of electronic health records with nursing faculty. Journal of Nursing Education & Practice. 5(3), In Print

I. Abstracts and Presentations

- *"A comparison of parental reports of children's sleep habits and bedtime routines"*
  PhD Poster Presentation
  2015 MNRS April 2015

- *"A comparison of parental reports of children's sleep habits and bedtime routines: Challenges encountered and lesson's learned when collecting survey data"*

Research Louisville Poster September 2014

- *"Interactive Electronic Health Record System/Sim Charting in an Undergraduate BSN Program"*
  10th Annual Faculty Development Workshop
  University of Kentucky, Lexington KY May 2014

- *"Developing Critical Thinking and Decision Making Skills through the Effective Use of Simulation Technology"*
  Celebration for Teaching & Learning
  University of Louisville, Louisville KY February 2012

- *"Using Technology to Increase Teaching Effectiveness"*
  7th Annual Faculty Development Workshop
  University of Kentucky, Lexington KY May 2011

- *"Improving Critical Thinking and Decision Making in Tech Savvy Students Through the use of Virtual Simulation in the Classroom"*
  AACN Baccalaureate Education Conference
  Orlando, FL November 2010

- *"Designing a Clinical Learning Lab for Tomorrow's Baccalaureate Nurse: During a time of budget cuts, faculty shortages & H1N1 fears"*
  AACN Baccalaureate Education Conference
  Chicago, IL November 2009

- "*Leveling Simulation for Student in a Baccalaureate Curriculum*"
  8th Annual International Nursing Simulation/Learning Resource Conference
  St. Louis, MO June 2009

- "*Simulation in Action: Student Focused Learning*"
  Eastern Kentucky University
  Richmond, KY September 2007

J. Grant Funding

- Hern, M., **Owens, H (co-investigator- 20%)**., Keihl, E., Mainous, R. & Goss, L. "Improving Nursing Through Clinical Informatics & Ehealth" Health and Human Services ($792,000)
  August 2010 – August 2012