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Cell phone use and Adolescent weight problems

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This is to certify that the doctoral dissertation by

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Walden University
2021

Abstract

Cell Phone Use and Adolescent Weight Status

by

Florence Njang

MA, Bowie State University, 2014

BS, University of Maryland, 2008

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

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Abstract

Overweight in adolescence increases the risk of obesity and many adverse health outcomes later in life. The purpose of this quantitative cross-sectional study was to investigate the association between cell phone use and weight status in adolescents, ages 14-17 years old, living in the United States. The socio-ecological model (SEM) was used to explain the link between cell phone use and overweight among adolescents. Three research questions were used to explore (a) the relationship between cell phone use and adolescent weight status after controlling for age, gender, and race; (b) the effect of cell phone use on overweight and normal weight statuses among adolescents aged 14-17 years after controlling for age, gender, and physical activity; and (c) the modifying effect of race on the relationship between cell phone use and adolescent overweight after controlling for age and gender. Secondary data from the 2017 Youth Risk Behavioral Surveillance System were analyzed using binary logistic regression to answer the research questions. High cell phone use significantly and positively predicted overweight in adolescents after controlling for age, gender, and race ($p < 0.001$). After accounting for age, gender, and physical activity, high cell phone use was a significant predictor of overweight ($p < 0.001$). Similarly, race had a significant modifying effect on the positive association between high cell use and overweight among adolescents ($p < 0.001$). The key positive social change implication of this study is the potential to integrate healthy cell phone use with existing obesity public health interventions that can reduce overweight and positively impact individuals, families, and communities.

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Dedication

This dissertation is dedicated to my deceased parents whose vision for education spurred my interest in higher learning. For my three children, siblings, cousins, and the African Christian Fellowship, thank you for all your support. With your encouragement, spiritual, and moral support and through God’s grace, I completed the PhD degree. My daughter’s selfless support for my academic pursuit has been overwhelming. She contributed immensely to this success by providing needed scholarly and technical assistance. My oldest son’s dedication to my family needs allowed easy transition between my role as a mother and a PhD scholar candidate. My sisters, brother, cousin, and friends all inspired my PhD study on smartphone use among adolescents.

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Chapter 1: Introduction to the Study

Introduction

Societal or technological factors such as cell phone use could substantially influence children's physiology and life course perspectives (Schneiderman et al., 2010; Volger et al., 2019; Wilkinson & Pickett, 2010). Unhealthy lifestyle behaviors could promote chronic conditions including but are not limited to overweight and obesity. (Hong et al., 2016). Excessive use of cell phones could lead to a sedentary lifestyle, which is linked to overweight and obesity (Hong et al., 2016). To effectively address sedentary lifestyle and its adverse health outcomes such as overweight, it is important to explore risk factors such as cell phone use (Domoff et al., 2019). In this study, I explored the relationship between cell phone use and its effect on overweight among adolescents ages 14-17 years who are living in the United States. The findings could inform areas of improvement on social and cultural changes such as increased physical activities to prevent and control unhealthy behavior and adverse health outcomes. The study problem statement, background, purpose, research questions, and theoretical framework, assumptions, limitations, and significance are covered in this chapter.

Background

The following articles provided information relating to public health and epidemiologic investigation about overweight. They were purposely selected to advance knowledge about the importance of this current study: Systematic reviews allow researchers to address multiple studies. In one systematic review, Volger et al. (2019) explored early childhood obesity prevention efforts through a lens of life course development. They emphasized the influence of race and low socioeconomic status on overweight among 2,180 preschoolers' records in the United States. Among 78% of the preschoolers, optimal weight (normal weight) and positive change in personal behavior was observed (Volger et al., 2019). There was uncertainty in the health outcomes implemented to curb obesity using childcare education (Volger et al., 2019).

Obesity in adolescence and lack of physical activity is a public health crisis. For instance, in a recent study, Heo and Wylie-Rosett (2020) found, among 13,583 adolescents, physical inactivity is statistically significantly associated with obesity. They conducted the analysis on a nationally representative population from the Centers for Disease Control and Prevention (CDC) Youth Risk Behavior Surveillance data. Additionally, the researchers found that diet restriction alone is not enough to address obesity. Instead, physical inactivity must be addressed as well (Heo & Wylie-Rosett, 2020). This research helps establish the immediacy of this public health problem.

The childhood obesity trend in the United States is of public concern. Cantarero et al. (2016) examined the trends in early childhood obesity in a large urban school district in the southwestern United States from 2007 to 2014. Using a longitudinal design involving 43,113 children, they showed that there was a reduction in weight among American Indians compared to Hispanic and non-Hispanic white children. Based on these findings, race was a moderating factor to obesity (Cantarero et al., 2016). Similarly, as it relates to Research Question 3 of this current study, I explored the mediating effect of race on cell phone use and overweight after accounting for age and gender.

The adoption of cell phone use as a means of communication is common among the public. Domoff et al. (2019) studied excessive use of mobile devices and children's physical health. In this review of 2,068 articles, the authors examined how frequently cell phone use and physical activity and obesity among children in the United States was assessed. They found an association between mobile device use and sleep deprivation. Of the studies they reviewed, 24% assessed the association between cell phone and physical activity. Domoff et al. suggested that additional safety recommendations on cell phone use should be explored and that further investigation on the association between excessive smartphone use and musculoskeletal pain and discomfort is needed. However, Domoff et al. did not explore cell phone use and overweight in adolescents using a cross sectional study. As indicated in Research Question 2 of the current study, I explored the relationship between cell phone use and overweight after controlling for age, gender, and physical activity.

The relationship between diet and body mass has been well established by several researchers. Kramer et al. (2016) explored the geography of adolescent obesity in the United States in the 2007-2011 period. Their focus was on the association between diet, activity, large social structure, and overweight among adolescent ages 10-17 years old. Using a cross-sectional design and multivariable Bayesian regression model, Kramer et al. showed association between geographical factors and weight among the participants. They suggested that future research should focus on implementing interventions that are geographically feasible (Kramer et al., 2016).

To minimize Social media impact a combination of diet and exercise must be utilized to achieve weight reduction. Robinson et al. (2017) evaluated the effects of screen media exposure on obesity in children and adolescents. Using an experimental randomized control design and a quantitative method, Robinson et al. showed that reduction in weight was effective with decreased food intake and increased exercise. The researchers suggested that future study should explore the effects of newer mobile phone usage and effective interventions to reduce adverse impacts of cell phone use. The adverse effect of my study is that cell phone use promotes inadequate sleep that serves as a precursor to adolescent overweight. The gap in knowledge is that as cell phone usage becomes more commonplace, smartphones exposure leads to obesity in adolescence. The study is necessary to understand exactly how cell phone use affects obesity status and potentially which intervention could mitigate the adverse effect of overweight in adolescents.

Problem Statement

Excessive weight gain is a severe public health burden among adolescents living in the United States (Pandita et al., 2016). Pandita et al. (2016) highlighted that obesity has an early onset. In many cases, children are vulnerable target population for diseases associated with long-term overweight (Hong et al., 2016). Obesity and overweight in adolescents are not a direct cause of death but a precursor to the leading causes of death such as hypertension, heart disease, and cerebrovascular accident, malignancies, respiratory diseases, psychiatric conditions, and orthopedic complications (Biener et al., 2017; Hruby & Hu, 2015). Though there is a myriad of overweight or obesity risk factors, lack of complete understanding persists regarding ways or approaches in which the risk factors interact with the outcome and other risk factors (Biener et al., 2017; Hruby & Hu, 2015). Overweight and obesity contribute to the disease prevalence, incidence, morbidity, mortality, and health care cost in the United States (Biener et al., 2017). Despite limited resources to address the rising weight epidemic in the United States, adolescents remain at an increased risk of harboring excessive body fat at infancy (Pandita et al., 2016). Cell phone use in its complexity interacts with other obesity risk factors, and subsequently, could substantially contribute to obesity in early life (Hruby & Hu, 2015). Some of the environmental factors are not limited to sociodemographic characteristics, social cohesion profiles, educational attainment, type of residential community, dietary lifestyle, and other lifestyle choices influence body weight or weight gain (Wong et al., 2018). Wong et al. (2018) examined environmental factors among different racial/ethnic groups. Non-Hispanic Asians living in low-income neighborhood with lower educational attainment had higher body mass index (BMI; Wong et al., 2018). Non-Hispanic Whites with lower educational level had higher BMI and consumed a higher number of sweetened beverages (Wong et al., 2018). Hispanics living within a community with access to fitness centers had lower obesity cases than those without fitness centers. Non-Hispanic African Americans who reported high consumption of fast food have higher obesity cases than those who consumed lower amounts of fast food (Wong et al., 2018). Therefore, the environment in which children grow plays a pivotal role in shaping daily exposures and life course perspective (CDC, 2020; Volger et al., 2019).).

Smartphone use facilitates sedentary behavior in many aspects of people's life and, thus, could implicatively promote obesity in adolescence (Hong et al., 2016; Sahoo et al., 2015). In addition, sedentary behavior and excessive consumption of unhealthy foods, portion size, inactivity, poor parental influence, lack of control, and poor self-esteem are all risk factors of obesity (Sahoo et al., 2015). Sahoo et al. (2015) suggested that nutrition and physical activity are the primary determinants of disproportionate weight problems.

Overweight and obesity in adolescence are also influenced by neighborhood structure or social determinants of health or built-in environment (CDC, 2020; Ribeiro et al., 2020; Roberts et al., 2015). Roberts et al. (2015) suggested that there is a lack of built-in environmental design model at local, regional, and national levels suitable for play area in all neighborhoods in the United States that promotes neighborhood-based physical activity environment. Phone use and internet adoption substantially promoted digital communication and learning processes (CDC, 2020; Forman & van Zeebroeck, 2019; Sahoo et al., 2015). However, the digital communication environment has facilitated the convenience in the lack of interest for routine physical activity as such decreased barriers to physical, social, and cultural behavior that promotes physical health (Sahoo et al., 2015). Often, with modern technology, people spend a large amount of time in sedentary behavior such as watching television or using cell phone, behaviors that promotes many physical health problems (CDC, 2020; Sahoo et al., 2015). Many preventative measures could avert increase in calorie consumption among children, and such intervention approaches should be adopted and supported by the community and policy makers (Robert et al., 2015). Electronic usage, nutrition, and physical inactivity substantially contributed to overweight, yet the effects of electronic devices have not been extensively explored among adolescents (AuYoung et al., 2016).

Therefore, it is in the interest of public health that policy makers, parents and school authorities engage in or implement comprehensive plans or strategies to reduce the duration of electronic device screen usage among adolescents and alternatively promote physical health (Domoff et al., 2019). Domoff et al. (2019) examined 2,068 articles and explored the association of smartphone use in children well-being in four domains: sleep, physical activity/obesity, musculoskeletal, and visual health. They found that a review of 60% of the articles showed that sleep had the most association to smartphone use, combined physical activity/obesity was 24%, musculoskeletal was 10%, and visual problem was 10%. Therefore, Domoff et al. suggested that future study was needed to examine the association of these problems to smartphone using an observational design. In this study, the gap identified was used to examine the effects of cell phone use on adolescent overweight status as suggested by Domoff et al. Additionally, a recent study on Japanese school children established the association between cell phone use and obesity (Wada et al., 2019). However, this association was not studied in a U.S. adolescent population, suggesting a research gap.

Purpose of the Study

The purpose of this study was to examine the relationship between cell phone use and its effect on overweight among adolescents ages 14-17 years who are living in the United States. The relationship was interpreted based on the measures of association such as odds ratio calculation. To address this stated research inquiry, I used quantitative research method driven by a cross-sectional design. Secondary data from the Youth Risk Behavioral Surveillance System (YRBSS) dataset was used to examine the association between cell phone use and child overweight.

Research Questions and Hypotheses

RQ1: What is the relationship between cell phone use and adolescent weight status after controlling for age, gender, and race?

$H_0$1: There is no relationship between cell phone use and adolescent weight status after controlling for age, gender, and race.

H_a1: There is a relationship between cell phone use and adolescent weight status after controlling for age, gender, and race.

RQ2: What is the effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years after controlling for age, gender, and physical activity?

$H_0$2: There is no effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years after controlling for age, gender, and physical activity.

H_a2: There is an effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years after controlling for age, gender, and physical activity.

RQ3: Does race have a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender?

$H_0$3: Race does not have a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender.

H_a3: Race has a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender.

Theoretical Framework: Socio-Ecological Model

The socio-ecological model (SEM) is a multilevel theoretical framework comprising of five socio-ecological factors: the intrapersonal, interpersonal, organizational, environmental, and public policy factors (Bronfenbrenner, 1977; Scarneo et al., 2019). The SEM is used to explain the interactions between independent variable (IV), dependent variable (DV), moderating variables, confounders, covariates, selected target population, and target location (Bronfenbrenner, 1977; Shoukat, 2019). The SEM, created by Bronfenbrenner in 1970 and formalized as theory in 1980, is an adaptable theoretical framework with interrelated socio-ecological constructs that influence human behavior (Bronfenbrenner, 1977; Kilanowski, 2017). The SEM theoretical framework was proposed initially to understand growth and development as it relates to social and changing environment (Bronfenbrenner, 1977). For this study, the interactions between cell phone use and overweight for Research Question 1, 2, and 3 while accounting for age, gender, race, or physical activities was explained by SEM constructs.

The five socio-ecological factors—the intrapersonal, interpersonal, organizational, environmental, and public policy factors—are unique. Study variables are not mutually exclusive to any of the SEM factors (Bronfenbrenner, 1977). In other words, a study variable can be explained by multiple SEM constructs/factors within a study setting. The intrapersonal level or construct explores and explains personal factors associated with individual self or unit (Bronfenbrenner, 1977). For instance, variables such as the age, gender, race, and weight of an adolescent would be considered intrapersonal level factors. Cell phone use behavior is both an interpersonal and intrapersonal level variable because it operates on the communication and personal levels. As it related to this study, at the organizational level, individuals or groups can be educated about cell phone use and overweight risks through which the individual or group could make informed healthy choices or lifestyle change adjustments.

At the environmental level, individuals live and survive within a societal environment. Each societal environment has unique cultural values, belief systems, and rules and regulation that makes it a cohesive environment. The selected cultural and physical environment for this study is the United States of America. At the policy level of the SEM, intentionally, policies are enacted to achieve a certain goal. As it is related to cell phone use for instance, in the United States, texting and talking on a non-hands-free cell phone device while driving is prohibited to safeguard highway users from unintentional accidents, and this policy is a state and national legislation (Scarneo et al., 2019). Policies are intended to establish, maintain, and implement socio-environmental best practices with the goal to improve societal integrity or reduce/discourage adverse societal events such as highway injuries and fatalities (Scarneo, et al., 2019).

Nature of the Study

I used a cross sectional design in this quantitative investigation. A cross-sectional design is primarily used in assessing the prevalence or risk of an exposure or outcome at a given point in time (Creswell, 2018; Kendra, 2019; Jeelani et al., 2014). I used random selection to sample participants included in the YRBSS secondary or surveillance data, but a random assignment of cell phone exposure or use was not used in the survey data collection process. The exposure or predictor factor is cell phone use and measured as an ordinal variable, whereas the outcome of interest under investigation is overweight and normal weight and categorized as a nominal variable. An individual with BMI value of 25 or greater is considered overweight (CDC, 2018). Cell phone use refers to time spent on cell phone for calls, texting, internet use, playing games, and any other activity.

The 2017 YRBSS code book dataset contained cell phone use and weight questions (YRBSS, 2018). In the 2017 YRBSS survey, youths both males and females were asked the following: "How do you describe your weight?" For the weight question, the response options are as follows: 1 (*very underweight*), 2 (*slightly underweight*), 3 (*about the right weight [normal weight]*), 4 (*slightly overweight*), and 5 (*very overweight*). The other weight categories were not relevant to the study and thus not included. The response options of interest for the weight question that are relevant in this study are normal weight, slightly overweight, and very overweight. The categories could not be included due to low frequencies. For this study, I grouped responses regarding the participants' weight status into two categories: (a) normal weight (included individuals who selected *about the right weight*) and (b) overweight status (included individuals who selected *slightly overweight* or *very overweight*). Hence, the weight group is a nominal variable.

For assessment of cell phone use, participants were asked, “On an average school day, how many hours do you use electronic device such as cell phone for something that is not schoolwork?” The response options for the cell phone question are as follows: 1 *(less than 1 hour per day)*, 2 *1 hour per day)*, 3 (*2 hours per day)*, 4 (*3 hours per day)*, 5 (*4 hours per day*), 6(*5 or more hours per day)*. For the purpose of this study, I grouped the responses into 3 categories as follows: 1 (No cell phone use will only include participants who selected *no cell phone use*), 2 (Low cell phone use will include individuals that selected, *less than 1 hour per day*, *1 hour per day*, and *2 hours per day*), and 3(high cell phone use will include individuals that selected *3 hours per day*, *4 hours per day*, and *5 or more hours per day*). YRBSS, 2018. Overall, cell phone use (no use, low use, high use) grouping is an ordinal level variable.

This is a self-reported survey and responses. It is therefore important to note that the self-reported information and the YRBSS dataset did not contain any clinical-based data to support the responses provided by the participants. A self-report technique may be imprecise due to over reporting or underreporting, which could be a product of misclassification bias or recall bias (Tapia et al., 2015). This study only involved adolescents ages 14-17 years living in the United States. De-identified data from 2017 YRBSS survey were used for this study. The 2017 YRBSS secondary data was downloaded from the public domain. I saved the downloaded data on a password-protected computer as well as on a flash drive, external hard drive, CDs, and the cloud as a backup. I periodically updated the backup throughout the data transformation and recoding processes.

The IV (cell phone) is an ordinal variable and the DV (overweight status and normal weight) is a nominal variable. I used binary logistic regression for the inferential statistical analysis to address the two research questions. Cell phone use was grouped into two categories: cell phone use (low cell phone use and high cell phone use) and no cell phone use (no). Low cell phone use and high cell phone use were combined in this study to represent individuals who indicated cell phone use in this study. Similarly, weight status was divided into two categories: overweight and normal weight (nominal) variables). The quantifiable variables were evaluated and described in detail in Chapter 3.

Definitions

BMI: The formula for BMI is an individual's weight in kilograms divided by the square of a person's height in meters squared (Mestanik et al., 2017). BMI calculator for adolescents measures the height and weight against the age. The units are in kg/m^2.

Cell phone: An electronic device used for a voice call, text messaging, internet and browsing to facilitate communication via the transmission of radio waves (NTP, 2016; Taylor et al., 2011).

Cell phone use: For this study, cell phone use includes use of any phone model (smart or non-smart phones) (NHTSA, 2011a, 2011b).

Indirect cost: The opportunity cost of lost productivity due to death and disease (Sonntag et al., 2016).

Overweight: Body fat that corresponds to age and height measurement using a BMI. Overweight BMI is between 25-29.9kg/m^2. In this current study, the 2017 YRBSS data set was used. The BMI captured in the 2017 YRBSS was not measured in percentages but was a calculation generated based on height and weight estimation (Mestanik et al., 2017).

Obesity: Excess body fat measured using BMI. A BMI equal or greater than 30kg is considered obese (Mestanik et al., 2017).

Physical inactivity: The inability to meet standard guidelines for physical workout Physical inactivity leads to sedentary behavior which is linked to overweight(Asvold et al., 2017).

Assumptions

Respondents who participated in the 2017 YRBSS survey could be biased towards the use of cell phone as the best means of communication and performing daily activities due to generational and cultural shift. Unfortunately, such bias was not recorded or evaluated. In other words, there is no question posed to assess whether the respondents are biased towards the use of cell phone. Another assumption is that the 2017 YRBSS secondary data are reliable and valid because the research and administration of the survey was conducted by a credible source, which in this case is CDC. Lastly, because the data are from a national survey, it is assumed that they are representative of the entire study population.

Scope and Delimitations

A secondary dataset was used for this study's analysis. The main source of secondary data was the U.S. YRBSS. In 1990, the YRBSS was developed to monitor priority health risk behaviors that are the leading causes of death, disability, and social problems among youth and adults in the United States (YRBSS, 2018). Some of the risk or behavior and areas of interest are unintentional injuries and violence, sexual behaviors, alcohol and other drug use, tobacco use, unhealthy dietary behaviors, inadequate physical activity, and health outcomes such as obesity and asthma (YRBSS, 2018). Over 1,100 separate YRBSS surveys have been collected from more than 3.8 million high school students in the United States from 1991 through 2017 (YRBSS, 2018). Thus, the scope of this study was limited to data reported in the 2017 YRBSS. This study includes only adolescents (boys and girls) between the ages of 14 and 17 years old.

The YRBSS was designed to assess the prevalence of health risk behaviors, trend health risk behaviors (increase or decrease, or no change over time), co-occurrence of health risk behaviors, comparability of the national, state, territorial, tribal, and local data among subpopulations of youth and monitor progress toward achieving the Healthy People objectives and other program indicators (YRBSS, 2018). The YRBSS includes representative samples of ninth through 12th grade students in public and private school systems in the United States (YRBSS, 2018). The YRBSS surveys are conducted biennially (every 2 years), mostly in spring semester (YRBSS, 2018). The YRBSS was conducted by CDC (YRBSS, 2018).

Three-stage cluster sample design is the common approach used by YRBSS to generate representative sample of ninth through 12th grade students (YRBSS, 2018). A weighting factor was used to adjust nonresponse and the oversampling of black and Hispanic students (YRBSS, 2018). Overall, the YRBSS data are designed as a surveillance database, which by happenstance contains information on the cell phone use, demographic characteristics, and health outcome events such as overweight under investigation. YRBSS is a self-reported survey, and there is no clinical data linked to the responses provided by the respondents. Also, the survey design was cross-sectional. YRBSS data in the public domain and only included de-identified data. However, before using the data from the YRBSS for this study analysis, I obtained Walden Institutional Review Board (IRB) approval. There was no generalization implied from the results obtained in this study because this study targets population with access to cell phone. The findings may not reflect children with limited access to cell phone or those living in other countries outside of the United States.

Limitations

This study has some inherent limitations in the data sources and the nature in which the information was obtained using a cross-sectional design. A cross-sectional research design inherently lacks spatiotemporal order of events leading to overweight especially for cell phone use or exposure (Creswell, 2018; Forthofer et al., 2007). Without establishing a direct spatiotemporal sequence between cell phone use and overweight in terms of which event occurs first, I was not able to conclusively determine the direct link between cell phone use and overweight among the study population. In other words, studies should be conducted to establish causality of the impact of cell phone use on overweight among the target population rather than a cross-sectional design, an investigation that is beyond the scope of this current study. It is, therefore, difficult to establish whether cell phone use behavior started before the individual became overweight or normal weight and vice versa in this study setting. Though I cannot show spatiotemporal sequence between cell phone use and overweight for this current study due to barriers inherent to a cross-sectional-based survey or questionnaire, the study was meaningful in addressing the correlational effects of cell phone use and overweight among adolescents ages 14-17 years old.

As a result, only correlational conclusion was drawn from this study about the effects of cell phone use on overweight among participants ages 14-17years old. No causal relationship was made because for such conclusion to be inferred would require the use of an experimental or quasi-experimental design (Creswell, 2018; Forthofer et al., 2007). In addition, no generalization will be inferred because this is not representative of all children in the United States. The correlational conclusion drawn in this current study was limited to the 2017 YRBSS participants and did not apply to children outside the dataset used. Recall bias and misclassification bias can be incurred in this study because it is a survey-based design (Creswell, 2018; Forthofer et al., 2007). Also, the YRBSS database is a public health surveillance system, thus, did not cover research-based areas such as collection of clinical data and diagnosis.

The 2017 YRBSS is a self-reported survey and could incur some level of bias as no clinical measures were obtained concurrently to support the reported information. The self-reported information from the 2017 YRBSS could not be verified using any clinical data. The respondents' true behaviors could not be validated because they are anonymous; as a result, it is possible that they can be misrepresented in the study, thus incurring participants, misclassification, and recall biases. Due to frequent use and adoption of cell phone, respondents could have been biased by providing information that reflected socially desirable trend on the use of cell phone, rather than their cell phone use behaviors. Misclassification bias could produce a Type I (false positive) or Type II (false negative) result in a study.

Significance

In this current study, I provided an array of evidence-based and scholarly information on the objective parameters of overweight outcome as it relates to cell phone use after accounting for age, gender, race, and physical activity. I examined the impact of age, gender, race, and physical activity risk factors as it relates to cell phone use and overweight status. The overall goal of this current study was to examine the relationship between cell phone use and weight. As much as cell phone use is beneficial in many aspects of our lives, it is also similarly important to understand the intricacies of its risk and possible adverse health effects especially among adolescent ages 14-17 years old. Additionally, no prior studies addressed the potential modifying effect of gender in the association of cell phone use and adolescent overweight status.

Results from the study provided invaluable evidence-based information that guided parents, public health practitioners, epidemiologist, childcare providers, health educators, cell phone industries, and policymakers in making informed decisions on better and improved application and safety of cell phone use. For instance, promoting health education on the predicament of cell phone use or use of other sedentary technologies could mitigate sedentary lifestyle behavior associated with overweight and other related chronic conditions. It is the hope that adolescents, public health professionals and practitioners, and social communities would provide social support and network system to facilitate positive social change on excessive cell phone use. In addition, it is intended to facilitate a proactive engaged environment/community to promote physical activity/health and weight reduction programs and improve community members' quality of life (Research Brief, 2015). Social or technological factors such as the increase in cell phone use trend is an acceptable social norm. Adoption of cell phone use as social norm of modern communication promotes discussion on age, gender, physical activity, and race of target population that are affected by adverse weight gain status to foster positive lifestyle change.

The economic burden of overweight and obesity is a growing public health issue. (Biener et al., 2017). The yearly medical expense of obesity in the United States is approximately $147 billion (Biener et al., 2017). The annual national productive fee for obesity and associated absenteeism was as high as $6.38 billion from $3.38 billion (Biener et al., 2017). Weight status plays a crucial role in the U.S. military recruitment processes (Spieker et al., 2015). For instance, many potential recruits exceed the U.S. military weight standards and as a result do not meet criteria for recruitment (Spieker et al., 2015). Overweight is the outcome variable which may lead to obesity in the current study and a financial burden if nothing is done to alleviate it.

The identified gap stated earlier was addressed and then lay the foundational work and identify areas in this current study for further investigation. Parents, health practitioners, and policymakers, may find the findings of this study useful to assist adolescents maintaining a healthy and active lifestyle with the goal of improving their quality of life. The findings of this study could provide additional evidence to support the need to promote tailored educational and need assessment resources about unique age groups or people at higher risk of overweight or weight problems driven mostly by cell phone use behaviors.

Summary

The 2017 YRBSS survey administered by the CDC was used as the secondary data source to evaluate the relationship between cell phone use and its effect on overweight among adolescents aged 14-17 years who are living in the United States. The SEM was used as the theoretical framework to explain the relationships between the study variables and observed outcomes. This model has been used specifically in behaviors relating to cell phone at different levels of the framework and forms the basis for use in the current study (Ssewanyana et al., 2018). Chapter 2 of this dissertation provides information that supports the literature search strategy, theoretical framework, and literature related to key study variables specified in the research questions.

Chapter 2: Literature Review

Introduction

Overweight among adolescents in the United States is steadily increasing (Schneiderman et al., 2010; Volger et al., 2019; Wilkinson & Pickett, 2010). Overweight conditions can lead to obesity and development of metabolic conditions as well as diabetes, high blood pressure, high blood cholesterol, cardiovascular disease, and many other adverse health conditions (Schneiderman et al., 2010; Wilkinson & Pickett, 2010). Understanding the risk factors that contribute to the onset of or sustained overweight is an essential process in designing or implementing effective intervention approach to address overweight and related health conditions. The purpose of this study was to explore the association between cell phone use and overweight among adolescents ages 14-17 years living in the United States. The findings will inform areas in lifestyle modification curricula in need of improvement to perhaps address the physical, psychological, and social health problems. The body of literature discussed in this section of the dissertation includes the background of overweightness, the prevalence of cell phone use, diabetes risk and sedentary lifestyle, lifestyle change modification, mortality related to inactivity, and cost of a sedentary lifestyle or obesity cost to productivity.

Literature Search Strategy

I conducted an electronic search on cell phone use, inactivity, and prevention of sedentary activities in adolescents for peer-reviewed articles. I performed the literature searches in EBSCO, PubMed, CINAUL, and Google Scholar. Most of the published peer-reviewed articles I selected are within the 5-year period of 2015 to 2020. Other inclusion criteria were articles that address topics such as adolescent, children, teenagers, screen time, electronic device, cell phone/smartphone, media use, and family health. I only selected articles published in English and used only the electronic version of selected articles. I did not limit my literature search or inclusion to studies conducted only in the United States. I excluded all articles that were over 15 years old except for articles covering methodology or the SEM. I also excluded non-peer-reviewed articles.

I selected articles I used in this literature review based on their relevance to my current topic. For instance, when I searched the phrase "smart phone use and adolescents," 150,000 literature results were generated in 0.07 seconds. However, a modified search, using that same search term but filtering to only include publications from 2015 to 2020, generated 17,400 articles in 0.07 seconds. For each search conducted, I randomly selected a few articles from the first two pages of the search engine. In some cases, I used the references list of articles I selected to identify other relevant articles that I needed for this literature review.

Theoretical Foundation: SEM

The SEM multilevel theoretical construct was used in this current study. SEM provides the framework to support the principle that individual or societal behaviors are affected by different levels of socio-ecological influences. The theoretical constructs of the SEM framework are the intrapersonal, interpersonal, organizational, environment, and policy level. The SEM is credited to Bronfenbrenner, who created the theory in 1970 (Kilanowski, 2017). The idea proposed by Bronfenbrenner (1977) is that to achieve an effective prevention and control measures for public health interventions all five level of influence should be influenced or affected. Over time, the SEM has been used to explore, address, and promote public health measures and other social determinants of health at multiple levels (Ssewanyana et al., 2018).). The SEM promotes a transitional approach from an individualistic perspective to a broader array of factors that project certain health outcomes (Scarneo et al., 2019). In this section, I provided a detailed explanation of SEM and how the study variables relate to the theoretical constructs.

At the intrapersonal level, individual knowledge, belief systems, and values are influencers of lifestyle and personal outcomes (Bronfenbrenner, 1977; Scarneo et al., 2019). In this study, intrapersonal factors are age, gender, race, and weight. The target population are adolescent boys and girls from different racial backgrounds between the ages of 14 and 17 years. These adolescents were selected from multiple school districts across the United States. Cell phone use is an individual choice. Cell phone use is also promoted or influenced by the current societal trend as it related to the usefulness of the device for communication and social interactions platforms/purposes. Cell phones are used to perform multiple functions, including school assignments, communication with friends and family, and engagement in physical activity via apps and social media platforms (Ssewanyana et al., 2018). An intrapersonal level intervention deals with changing an individual's perspective, knowledge, understanding, and lifestyle behavior to improve the quality of life (Bronfenbrenner, 1977; Scarneo et al., 2019). Implementing such action at this level among adolescents in the United States as it relates to cell phone use and how it may promote sedentary behavior that leads to weight gain is invaluable to public health practices and intervention approaches.

The key modulators at the interpersonal level are group members' support and reinforcement, which are generally informal and not mandated by a set of regulations (Bronfenbrenner, 1977; Scarneo et al., 2019). Such support may come from parents, care givers, and friends (Bronfenbrenner, 1977; Scarneo et al., 2019). Contrary to organizational support guided by membership rules and regulation, interpersonal system is informal (Bronfenbrenner, 1977; Scarneo et al., 2019). The family unit is the most common forum for interpersonal operation and intervention (Bronfenbrenner, 1977; Scarneo et al., 2019). In this current study, weight, race, and cell phone use behavior can be explained by the interpersonal level construct.

SEM has been used in many public health and epidemiological studies, for instance, Li et al. (2019) performed a study on depression and interpersonal trust as it relates to adolescent self-esteem and problematic cell phone use (PSU). In the study, Li et al. highlighted the concept that cell phone use promotes sedentary lifestyle, which consequently may lead to overweight in the adolescent population. Depression was shown to influence the association between self-esteem and PSU, and interpersonal trust modified the association between depression, self-esteem, and PSU (Li et al., 2019). The authors recommended that boosting self-esteem of adolescents may decrease PSU (Li et al., 2019).

At the organizational level, members of an institution, such as a school or other societal and cultural institution, provide the foundational backbone to promote education and awareness within the societal system and among individuals living in that society such as students. The education provided by such organizations includes multiple areas of life (Bronfenbrenner, 1977; Scarneo et al., 2019). Such organizations are governed by rules and regulation to maintain certain social and academic integrity and trust (Scarneo, et al., 2019). By establishing rules and regulations, organizational policies reinforce positive behavior and incentives for social integrity. Many learning institutions, such as schools, offer physical education classes to promote physical activities and healthy weight as well discourage negative or adverse behaviors (Ssewanyana et al., 2018) Based on the role the school setting plays in a society, in many cases, it serves as an enhancer of a non-sedentary lifestyle because the school system provides the curriculum and platform to promote healthy dietary behavior and even discourage the use of cell phone during specific school activities (Ssewanyana et al., 2018).

The environmental level consists of societal, physical, and cultural settings of the U.S. society. Acceptable cultural values, societal lifestyle, and norms guide the integrity of any cohesive community (Scarneo et al., 2019; Bronfenbrenner, 1977). In this study, the United States and school system from which these adolescents were selected using the YRBSS data were set as the target environment.

The policy level of the SEM promotes uniformity and adherence to community, organizational, school, and societal level rules, and regulations (Bronfenbrenner, 1977; Scarneo et al., 2019). Policies are enacted to promote for the safety of individuals, organizations, and the nation (Bronfenbrenner, 1977; Scarneo et al., 2019). To maintain the integrity of policies, in some cases, fines are assessed for violating a policy (Bronfenbrenner, 1977; Scarneo et al., 2019). For instance, in the United States, tickets and fines are imposed to individuals operating a moving vehicle while talking or using a non-hands-free cell phone device. This policy was mandated by law makers to minimize reckless driving and accidents. An effective policy should consider all levels of the SEM constructs (Bronfenbrenner, 1977; Scarneo et al., 2019). As it relates to this study, policies targeting cell phone use regulations and risk assessment description should be supported at the manufacturing and legislative level of leadership to inform and support responsible use of cell phone at all level.

Literature Review Related to Key Variables and Concepts

Prevalence of Overweight

Overweight or obesity condition is affected by multifactorial indicators (Hong et al., 2016; Pandita et al., 2016; Volger et al., 2019). Childhood overweight or obesity cuts across age groups, races, ethnicity, gender, and social conditions (Pandita et al., 2016). Overweight or obesity condition is projected to affect more than 20 million adolescents by 2023 (Agha & Agha, 2017). Adolescent overweight or obesity is likely to persist at adulthood if not controlled and managed (Pandita et al., 2016). Individuals with normal weight have lower risk of developing adverse health conditions that could shorten their life expectancy compared to those with overweight condition (Agha & Agha, 2017). Some of the adverse health conditions includes cardiovascular illnesses, endocrine, malignant cancers, musculoskeletal complications, respiratory and mental health diseases (Agha & Agha, 2017).

Dietary Lifestyle and Overweight

Alwattar et al. (2015) conducted a study to explore the effect of breakfast type and frequency of consumption on glycemic response in overweight/obese late-adolescent girls. They examined the response of a normal protein (12 g of protein) against an increased protein diet (32 g of protein) on adolescents who missed or skipped breakfast and those who habitually ate breakfast (Alwattar et al., 2015). For this semi randomized experimental longitudinal study, 35 adolescent girls from Columbia and Missouri were selected through advertisements, posters, and email recruitment processes (Alwattar et al., 2015). The girls completed a breakfast pattern for 4 days and 1 day of testing. Individuals in the normal protein (NP) group and high protein breakfast (HP) group consumed meals at home for 3 days and came to the center for testing on Day 4. To compare the habitual skipped breakfast (H-BS) group to the habitual breakfast consumption (H-BC) group, the within-group and between-group HP-NP differences were analyzed. The results showed that, for those who skipped breakfast, the inclusion of HP breakfast increased glucose concentration in the blood ($p < 0.05$) and may be detrimental to vital organs of the body such as the heart, pancreases, kidney, vision, and nerves (Alwattar et al., 2015). Those who were in the H-BS group and consumed a normal protein diet had an elevated insulin ($p < 0.05$) which will keep increased glucose in a homeostatic state (Alwattar et al., 2015). In the H-BC group the consumption of an HP diet decreased the morning and afternoon glucose in the blood ($p < 0.05$). There were no differences between the NP and HP insulin level (Alwattar et al., 2015). Between-group comparison of HP and NP showed no main effect. The idea of comparing individual breakfast patterns may help explore how to minimize meal skipping behavior (Alwattar et al., 2015). The study focus was on insulin, glucose, and plasma; as a result, other factors such as ketones, liver gluconeogenesis, and free fatty effect on altered glycemic response were not explored (Alwattar et al., 2015). Alwattar et al. concluded that nutrients added to morning meals have minimal impact on glycemic response observed in people who frequently skip breakfast. After meal hyperglycemia is a risk factor of cardiovascular and endocrine disorders (Alwattar et al., 2015). They suggest that adolescents who skip breakfast are at risk of overweight and increased risk of developing cardiovascular complications as well as Type 2 DM (Alwattar et al., 2015), an indicator of interest in this current study.

Health Literacy and Overweight

Alexander et al. (2018) investigated the link between asthma and overweight. They used a mixed method approach to explore the link between asthma and overweight among adolescents ages 13-18 years old in Michigan (Alexander et al., 2018). They selected 35 teenagers and conducted a semi-constructed phone interview (Alexander et al., 2018). Three-point Likert scale was used to score the 16 statements on providers weight and weight control questions (Alexander et al., 2018). The quantitative part of the interview was analyzed descriptively, and the qualitative components of the interview were thematized (Alexander et al., 2018). Calculations of frequencies, cumulative percent, mean, and standard deviation were calculated appropriately (Alexander et al., 2018). They concluded that all the teens interviewed were pleased with providers who devote time to talk about weight problems (Alexander et al., 2018). Half of the teens reported learning about the link between overweight and asthma from their providers (Alexander et al., 2018). The rest reported that they learned about the link between asthma and overweight from personal experiences (Alexander et al., 2018). Almost all participants highlighted the essential role providers play in initiating weight management discussion (Alexander et al., 2018). Overall, teenagers responded positively to weight reduction discussion and its impact on asthma control (Alexander et al., 2018).

Physical Activity and BMI

Herget, Reichardt, Grimm, Petroff, Käpplinger… Haase 2016; Schaefer et al., 2015) conducted a study to assess the association between intense interval physical activity and overweight among adolescents. Via text message, they administered a media-enhanced high-level interval physical activity with or without motivation to assess the rate of teen participation (Herget et al., 2016). In this study, 70 participants were randomly selected for the longitudinal design (Herget et al., 2016). The study was conducted in Germany and the participants were divided into two group categories (Herget et al., 2016). One group used media enhanced support and the other group had no media assistance (Herget et al., 2016). The participants, 28 adolescents ages 13-18, were followed for 6 months (Herget et al., 2016). Fourteen teens were randomized to both the intervention and the controlled group. 8 were unavailable for follow up, nine were former outpatient participants. Five participants enrolled via referral through friends, and three registered after reading a flyer, whereas five accepted participation through an advertised article (Herget et al., 2016). About 21% of the participants met the required one-hour daily exercise (Herget et al., 2016). Approximately, 43% of subjects were aware of the advantages of the decreased likelihood of disease, psychological wellness, and physical health (Herget et al., 2016). Participation and exercise programs decreased after the first 2 months from 75% to 65% (Herget et al., 2016). The standard deviation of the participant's BMI decreased from a baseline of 2.33 to 0.026 with a *p* value of 0.023 (Herget et al., 2016). Results showed that there was a positive correlation between internet-mediated exercise and weight status. Herget et al. suggested further research on the use of media-enhanced exercise with a powered study or a larger sample size, since the sample size used in the study was small. This study provided the basis on the importance of physical activity and how it could influence weight loss and reduction of cardiovascular disease events (Herget et al., 2016). These health benefits are also shared interest in this current study.

Blood Pressure and Overweight

Mestanik et al. (2017) examined the effect of elevated blood pressure and overweight on the inflexible artery with the use of the cardio-ankle measuring index using a quantitative method via a cross-sectional design approach. Similarly, Bussenius et al. (2018) surveyed elevated blood pressure using a hand mobile device. In Mestanik et al. (2017), the target location of the study was Scandinavia. The 140 participants who were selected for the study were grouped into four categories (Mestanik et al., 2017). The four groups are the normal weight and normal blood pressure, overweight and normal blood pressure, overweight white-coat hypertensives, and overweight essential hypertensives (Mestanik et al., 2017). Markers for vascular destruction measurements were taken from all the participants in all four groups (Mestanik et al., 2017). Those who were overweight had a lower risk of arterial stiffness and blood pressure elevation compared to adolescents with a normal weight and normal blood pressure (4.81± 0.64 vs. 5.33± 0.06, $p < .01$; Mestanik et al., 2017). The relationship between arterial stiffness and blood pressure values was significant (Mestanik et al., 2017). A linear regression analysis was used as well as BMI to predict arteriosclerosis and blood pressure risk (Mestanik et al., 2017). For the post hoc analysis, there was a decreased cardio-ankle vascular measurement for those who were overweight with normotensives in relation to normal weight normotensives, $p < .01$ (Mestanik et al., 2017). There was no statistical difference in the overweight essential hypertensives compared to normal weight with normal blood pressure, $p = 0.948$ (Mestanik et al., 2017). Participants with white-coat syndrome and idiopathic hypertension showed a higher risk for arterial stiffness compared to overweight normal blood pressures, $p < .05$ and $p < .01$ (Mestanik et al., 2017). There was no significant variation between those who were overweight, and hypertensive compared to the normal weight with normal blood pressure (Mestanik et al., 2017). The risk of arteriosclerosis was significantly higher in overweight idiopathic hypertensives in relation to overweight normal blood pressure, $p < .01$ (Mestanik et al., 2017). There was no difference in arterial stiffness between the overweight idiopathic hypertensives and normal body fat and normal blood pressure, $p = .878$ (Mestanik et al., 2017). The Brachial-ankle pulse measurement was significantly higher in those with an overweight white coat and idiopathic hypertension in relation to optimal weight, normal blood pressure, and normal weight, normal blood pressure, $p < .01$ (Mestanik et al., 2017). Arterial stiffness was increased in the group with idiopathic hypertension and no elevated blood pressure in a medical setting (Mestanik et al., 2017). The risk of arterial stiffness was higher with age and correlated with diastolic blood pressure (Mestanik et al., 2017). The blood pressure-independent index showed an elevation in idiopathic hypertension and no association with diastolic blood pressure and pulse pressure (Mestanik et al., 2017). Overall, there was a negative association between BMI and arteriosclerosis risk (Mestanik et al., 2017). Although this study was an investigation of the link between overweight and cardiovascular risk, I will explore the effect of cell phones use on overweight among adolescents.

Adolescent Obesity

Different theoretical framework has been applied to the field of adolescent obesity. For instance, Hidayanty, Bardosono, Khusun, Damayanti and Kolopaking (2016) examined the effect of social cognitive theory on eating behavior and sedentary lifestyle in overweight adolescents. In this study, social cognitive theory was used as a tool to reduce eating habits and inactive lifestyles in overweight students ages 11-15 (Hidayanty et al. The longitudinal design included randomly selected eight junior high schools in Makassar that consists of 232 healthy adolescents from the South Sulawesi who were not on weight loss medication (Hidayanty et al., 2016). The intervention was a 75-minute, 12-week session of dietary lifestyle change education intended to alter behavior for both the children and their parents (Hidayanty et al., 2016). The authors concluded that the intervention group had an increased reduction in BMI compared to those in the control group (those that did not receive lifestyle change dietary education), $p < .05$ (Hidayanty et al., 2016). The between-group differences showed a reduction in snacking behavior but not for a sedentary lifestyle (Hidayanty et al., 2016). There was enhanced self-efficacy for decreasing dietary habits (Hidayanty et al., 2016). The mean adherence rate was between 92 to 95% (Hidayanty et al., 2016). Overall, in this study, social cognitive theory predicted a decrease in eating behavior and weight reduction (Hidayanty et al., 2016). They recommended additional studies in a community setting and suggested accounting for the type of diet consumed and exercise behaviors. Hidayanty et al. (2016) supported the need for this current study because it informed the importance on the impacts of any sedentary behavior that prevents physical activities, and in this case high use of cell phone could possibly promote sedentary behavior.

School Demographics and Overweight

In China, Shi et al. (2017) explored uneven allocation of immigrant students in school systems. In the study, they examine the differences in overweight student distribution between private and public schools (Shi, Tan, Xie, Yang, Liu, Yu… Wang, 2017). The sample selection was performed via a multi-stage stratified cluster random method, which included 7th and 8th grade students (Shi et al., 2017). Students and parents (989 in total) participated and completed the questionnaires (Shi et al., 2017). Of the 989, roughly 452 were from public schools and 500 students were selected from the private institutions (Shi et al., 2017). Some of the students were overweight at birth (7.98%). The snacking time variation was similar among the two groups (Shi et al., 2017). The average time spent on television or computer games was 1.04 hours (Shi et al., 2017). Students from public schools come from affluent homes, with parents who have advanced degrees, and most of the participants from this group reported 3 or more exercise sessions per week (Shi et al., 2017). Majority of the students from the private school purchased food sold at school (Shi et al., 2017). The male to female variation in weight was larger in the public schools compared to private institutions. Students attending private school systems who were overweight at birth progressed to overweight at high school level (Shi et al., 2017). Logistic regression analysis was used to analyze the associations between the indicators of interest. They showed that there is a positive correlation between parental education and childhood overweight. They also found that students who infrequently consumed snacks had a lower risk of overweight, OR = 0.13, $p = 0.002$ (Shi et al., 2017). In addition, they found that children born to mothers of post-term delivery in private school had higher odds of overweight, OR = 4.50, $p < 0.0001$. Overall, they showed that there was a higher obesity rate among students in private than those in public institutions, $p = 0.021$ (Shi et al., 2017). Some of the risk factors such as age, gender and physical activities discussed here are confounders I accounted for in this current study, as such, this literature informed that area of my research.

Cell Phone Usage and Promotion of Maternal Health

Roberts, Birgisson, Chang, and Koopman (2015) explored the cell phone usage in maternal health education in the eastern region of Uganda. The observational cross-sectional study included 42 men and 41 women ages18-45 years old (Roberts et al., 2015). Participants were recruited through a random systematic sampling method by selecting every third home in the region (Roberts et al., 2015). They tallied number of participants that have cell phone and those that are interested in receiving information on childbearing via a cell phone (Domoff et al., 2019;Roberts et al., 2015). Among the participants interviewed, 45% of men and 44% of women had secondary education. About 79% of men and 42% of women reported ownership of a smartphone (Roberts et al., 2015). Roughly, 88% of women and 67% of men did not own a cell phone (Roberts et al., 2015). All the men (100%) and 98% of women who participated in this study reported interest in reading childbearing literature (Roberts et al., 2015). They suggested that future studies should focus on exploring how to increase the number of women who own a cell phone to assess the impacts of cell phone ownership and health information awareness (Roberts et al., 2015). In the study, cell phone was used as a tool to improve health education adherence and awareness, while in this current study cell phone use is similarly a tool that could predict an adverse outcome.

Cell Phone Use and Excessive Body Fat

According to Domoff, Borgen, Foley, and Maffett, 2019; Kramer et al., 2016) excessive telephone use and physical well-being in childhood is a public health concern. In the study, 2,068 articles were reviewed from Psycho-information regarding this topic, but only 42 articles met the selected inclusion criteria. The selected articles for the meta-analysis were published within 2007-2008 (Domoff et al., 2019). Many of the articles selected for the meta-analysis was a longitudinal investigation covering a variety of topics from physical health or smartphone use or cellular telephone use/app to physical well-being (Domoff et al., 2019). Based on the study, about 60% of the articles investigated the relationship between cellular phone and sleep (Domoff et al., 2019). Roughly, 24% of the article explored the relationship between exercise and excessive body fat (Domoff et al., 2019). Approximately, 10% of the articles explored the link between the cellular device and musculoskeletal problems (Domoff et al., 2019). Lastly, about 5% of the articles examined the link between ophthalmic problems and mobile devices (Domoff et al., 2019). Of 25 articles reviewed, 14 showed that mobile phone usage adversely affected all four sleep domains; duration, nighttime awakening, latency, and quality (Domoff et al., 2019). They also showed that there is a positive correlation between physical exercise and excessive body fat (Domoff et al., 2019). They showed that those who owned and operated a cell phone reported 5 days of exercise and engaged in physical education lessons than those with no cell phone (Domoff et al., 2019). One article showed no relationship between phone texting or cellular phone and adolescent/childhood overweight or increased risk of obesity (Domoff et al., 2019). Four articles showed a negative correlation between media hours/time or ownership and exercise or excessive body fat or obesity (Domoff et al., 2019). Hours of phone usage correlated with engagement in physical activity, but no relationship between media device usage and exercise, electronic texting, and childhood overweight (Domoff et al., 2019). One article showed that there are higher odds of excessive weight in youth who spent more than two hours on media devices (Domoff et al., 2019). Four articles showed that there is no relationship between smartphone use or mobile device and obesity. They suggested that future studies should focus on an observational study to assess/clarify the link between mobile devices and exercise (Domoff et al., 2019). Like this study, I will explore the impacts of cell phones on overweight but among adolescents.

Wada et al., 2018; Domoff et al., 2019; Robinson et al., 2017 assessed the influence of cell phone and screen usage with overweight in children. A cross-sectional design was used by the authors for this investigation (Wada et al., 2018). A total of 3,141 children ages 6-7 years old from Japan were included in the study (Wada et al., 2018). They used 2 versions of the parent-administered questionnaires to collect the demographic data as well as cell phone, screen time, health, and lifestyle information. One version was for Japanese indigenes and the other was for non-Japanese indigenes (Wada et al.,2018). One-way ANOVA, chi square, logistic regression, and Multivariate analyses were used in the study (Wada et al.,2018). They showed that children who were overweight were heavier at birth, consumed more calories, and had more playtime scores than children with a normal weight (Wada et al.,2018). After adjusting multiple variables, cell phone users had 1.74 odds of having excess body fat compared to non-users (Wada et al.,2018). Longer period of cell phone use was the contributory factor to overweight, p=*0.018* (Wada et al.,2018). Screen time activity was positively correlated with the risk of overweight, p=*0.003* (Wada et al.,2018). Also, longer hours of cell phone use and screen time were linked to inactivity with a strong correlation to overweight in school age children (Wada et al.,2018). Sleep quality and duration is impacted by cell phone use, but not as much as screen time, especially that of television (Wada et al.,2018). There is an inverse relationship between television watching and exercise, because as television watching increases, sports participation, and physical activity decreases (Wada et al.,2018). The information measured was obtained via the parental self-reported account and there was no clinical data to verify the self-reported information (Wada et al.,2018). The study was a cross-sectional design and thus was unable to establish causality (Wada et al.,2018). (Wada et al., 2018) emphasized that further studies are needed to examine new ways of using electronic devices, safely. Wada et al. (2018) study informed this current inquiry because they explored the link between cell phone use and overweight in a different setting as intended for this study.

Online Exercise and Physical Activity

Using a qualitative method, Sundar et al. (2018) explored experiences of children with online exercise program for physical activity. Adolescents ages 13-14 years old and living in Norway were enrolled in the study and participated in two interviews (Sundar et al., 2018). Twenty-one adolescents, 15 girls and 6 boys were interviewed (Sundar et al., 2018). The data was analyzed using a qualitative content or thematization analysis (Sundar et al., 2018). From the view of the participants, physical activity is a coordinated sport and vigorous activity is beneficial for well-being and produces entertainment with mastery of the performance (Sundar et al., 2018). Both boys and girls suggested that physical activity enhanced fitness (Sundar et al., 2018). Though the girls focused on different types of physical activity than the boys both reported that their motivation to participate in physical activities were often hampered by inclement weather such as rain and snow (Sundar et al., 2018). This study showed the benefit of online technology on enhancing quality of life and in this case maintaining healthy body weight among children (Sundar et al., 2018). Similarly, I will explore how smartphone technology affect body weight.

Injuries, Psychiatric Symptoms, and Cell Phone Use

According to Tao et a., 2016; National Highway Traffic Administration, 2011a; Kahn et al., 2015, psychiatric symptoms with unwanted injuries could be linked to cell phone use. The risk of cell phone use in psychopathological symptoms with unanticipated harm is plausible (Tao et al., 2016). In this quantitative cross-sectional study, roughly 6,715 boys and 7,509 girls from middle and high school were selected from four cities in

China (Tao et al., 2016). The manifestation of risky cell phone behavior and corresponding symptoms of mental illness on unwanted injuries is concerning (Tao et al., 2016). For assessment of the link between cell phone use and mental illness, a Chi square test and multivariate logistic regression was used (Tao et al., 2016). Mental illness included psychiatric symptoms and unwanted injury, or unanticipated harm included accidents (Tao et al., 2016). In all the four cities in China evaluated, risky cell phone use predicted psychiatric symptoms (Tao et al., 2016). No differences in risky cell phone use existed between boys and girls at the high school level, but there were differences reported between boys and girls in middle school level (Tao et al., 2016). Students in middle school and those with siblings have lower rates of problematic phone use (PMPU; Tao et al., 2016). Middle school students whose parents were of a low economic class had higher rates of PMPU and psychiatric symptoms (Tao et al., 2016). High school students with a perceived low parental economic class had higher rates of psychiatric symptoms as well (Tao et al., 2016). PMPU and psychiatric rates were highest in those with negative expectations on academic accomplishment (Tao et al., 2016). Middle school students with few friends reported a higher level of PMPU and symptoms of mental illness as well as those who drink and smoke (Tao et al., 2016). Self-reported episodes of PMPU and psychiatric symptoms were associated with harm in middle and high school (Tao et al., 2016). The result showed that there was a positive correlation between risky smart phone use and mental health symptoms (Tao et al., 2016). The odds of highway accident were three times more in middle school students who engage in risky cell phone behavior (Tao et al., 2016). Student who had psychiatric symptoms in middle school are similarly at risk of highway injury (Tao et al., 2016). Pedestrians with a risky cell phone behavior had two times the odds of car collision (Tao et al., 2016). The prevalence of risky behaviors with cell phone use was more common in girls than boys of middle and high school, $p < 0.05$ (Tao et al., 2016). There was decreased cell phone usage in students with siblings $p < 0.01$ (Tao et al., 2016). Students with no close friends had higher rates of risky cell phone usage and psychopathological symptoms (Tao et al., 2016). There is a positive correlation in both middle and high school for highway accidents (Tao et al., 2016). Middle school students who use cell phones have three times the risk of traffic accidents (Tao et al., 2016). High school students who engage in a risky cell phone behavior have three times the risk of road injuries (Tao et al., 2016).

Cell Phone Addictions and Problem Gambling

Similarly, Fransson et al., 2018;Haug et al., 2015 explored the addictive telephone behavior and problem gambling. They used the test of mobile dependence (TMD) test to examine the association between cell phone use and problem gambling (Fransson et al., 2018). A two-part questionnaire was used, which included 22 questions with five-point Likert scale responses to assess gambling problems and a second part that contained only two questions to measure addiction management (Fransson et al., 2018). There were 515 Swedish participants recruited through a convenience sampling via Facebook, Google, Email and Twitter for the study (Fransson et al., 2018). Based on the inherent limitations of a cross-sectional design and due to social desirability bias, the study sample selection is not representative of the total population, as a result, the findings is limited to the population used (Fransson et al., 2018). Statistical Package for Social Sciences (SPSS) was used for the descriptive and inferential analysis (Fransson et al., 2018). They used independent T-test, analysis of variance (ANOVA), and Mann Whitney test to evaluate the mean differences between participants (Fransson et al., 2018). The mean differences were computed based on scores on digital mobile use, gambling, age, and substance use treatment records (Fransson et al., 2018). Score below or above 80 is the standard for establishing test for mobile dependence (TMD) (Fransson et al., 2018). Binary regression analysis was used to assess the odds of generating scores below or above 80 on TMD (Fransson et al., 2018). More women answered the questionnaire with a difference in mean test scores than men, $p < 0.01$ (Fransson et al., 2018). Participants between the ages of 15 to 18 had the highest test values, $p < 0.01$ (Fransson et al., 2018). They showed that there was a relationship between TMD and problem gambling, $p = 0.001$ (Fransson et al., 2018). Nonetheless, majority of participants were females. They suggested that further studies should explore the associations of excessive cell phone use and other addictive behaviors (Fransson et al., 2018). As a result, the study informed this currents study because overweight in adolescents due to cell phone use could be as result of intermediary addictive behaviors or sedentary behaviors or lifestyle.

Haug et al., 2015 also conducted a study on cell phone addiction among youth. Cell phone use today has become increasingly unavoidable because it is used in various forms of communication, teaching, and entertainment purposes (Haug et al., 2015). The authors used a cross-sectional design for this research inquiry among students in vocational school across 4 states in Switzerland (Haug et al., 2015). Those who were excluded were either not willing to participate or did not own a cell phone (Haug et al., 2015). Those who were selected were deidentified (Haug et al., 2015). About 1,519 participants from 127 classes offered in vocational schools were selected for the study (Haug et al., 2015). Those selected indicated that they use cell phone and participated in a text message program for smoking cessation (Haug et al., 2015). They found that there is a strong compulsive and intense desire for cell phone use among 256 students (Haug et al., 2015). Most of the smartphone use was for social networking. Thus, they concluded that social networking was associated with smartphone addiction (Haug et al., 2015). They also concluded that strong compulsive use of cell phone was more prevalent in subjects within the ages of 15-16 years old compared with students ages 19 and older (Haug et al., 2015). A univariate analysis showed an association between compulsive use and smartphone addiction (Haug et al., 2015). A multivariate analysis showed that those who used cell phones for more than 60 minutes a day had 3 times the odds of engaging in social networking as the most used function (Haug et al., 2015). Similarly, the study informed the need for this current inquiry in context of its risk on overweight condition.

Cell Phone Use for Monitoring of High Blood Pressure

Hypertension is a risk factor for heart condition and stroke (Bussenius et al., 2018). Bussenius et al. (2018) examined the effects of cell phone use on monitoring hypertension in children and adolescents ages 3-18 years old. Further, explored the relationship between BMI and blood pressure (Bussenius et al., 2018). They used a quantitative descriptive analytical approach to evaluate the association between these factors and specified outcomes among 81 preschool and school age children in the United States (Bussenius et al., 2018). They used a smartphone surveillance system to monitor the level of blood pressure readings. Pedia blood pressure instrument was used, and the age, sex, height, and weight of the students were recorded (Bussenius et al., 2018). About 54.3% of the students had a normal blood pressure, 23.5% had hypertension, 13.6% had a Stage 1 and 8.6% had a Stage 2 hypertension (Bussenius et al., 2018). Almost half of the students had a healthy weight while 21% were overweight and 27% met the criteria for obesity (Bussenius et al., 2018). The study findings were limited to preschool and school age students (Bussenius et al., 2018). They suggested that further studies should include annual blood pressure screening for preschool and school age children (Bussenius et al., 2018). Just as hypertension could lead to cardiovascular disease conditions, the outcome variables in this current study, in this case overweight can lead to hypertension, obesity, diabetes and other metabolic conditions.

Driving Under the Influence of Cell Phone

Driving under the influence of cell phone use is a prevalent public health issue (Kahn et al., 2015; Tao et al., 2016). Kahn et al. (2015) explored the distracted driving behavior caused by cell phone use to offer an insight on how to prevent motor vehicle accidents. The target population used in the study was from Europe and the United States. The study was a cross-sectional design with a self-reported data (Kahn et al., 2015). The participants (5,315) were randomly selected. Texting, emailing, and talking on the phone while driving caused 385 deaths out of 3,331 deaths in 2011 on the U.S. highway according to the morbidity and mortality report (Kahn et al., 2015). Approximately, 21% of the deaths resulted in a crash due to distraction by cell phone in people ages 15-19 years (Kahn et al., 2015). The prevalence of mobile device usage in people ages 18-64 years old ranged from 20% in the UK to 69% in the United States (Kahn et al., 2015). More people used cell phones in the United States compared to Europe and more likely to have a higher highway collision and death (Kahn et al., 2015). Of 5,315 participants recruited, 70% completed the health styles survey. Two thirds of U.S. drivers within the ages of 18-64 years old drove and talked on the phone while operating a vehicle at least once in the previous 3 days or 1 month (Kahn et al., 2015). Those who read, texted, or used email while driving in the last 30 days increased from 15.1% to 31.4% in Spain, Portugal, and America (Kahn et al., 2015). In the United States, a larger number of people ages 25-44 years old talked, read, and texted while operating an automobile compared to those between the ages of 55-64 years old (Kahn et al., 2015). The authors suggested that further studies should explore mechanisms to decrease cell phone use while operating a moving vehicle to reduce highway collisions (Kahn et al., 2015). Kahn et al. (2015) informed this current inquiry because they covered and discussed how multiple applications of cell phone use can lead to adverse or negative outcomes. In this current study, overweight is an interesting adverse health outcome that is linked to many other adverse health conditions.

Psychological Impacts of Cell Phone Use

The psychological impact of cell phone usage has been explored by researchers. Sayegh et al., 2018;Tao et al., 2016 examined the influence of mobile phone support on psychosocial outcomes among youth diagnosed with HIV who are noncompliance to their medication. The study was conducted to assess the psychosocial impact on effective cell phone support to promote medication adherence (Sayegh et al., 2018). The randomized control trial pilot study was performed in California with 37 participants (Sayegh et al., 2018). Of the 37 participants, 19 received an intervention and 18 received regular care (Sayegh et al., 2018). The participants included in the study were between the ages of 15-24 years old with HIV positive and 90% noncompliant to antiretroviral (Sayegh et al., 2018). A non-parametric Kruskal Wallis and Fisher's exact test was used to compare adherence between the intervention and usual care groups (Sayegh et al., 2018). A mixed effect model as well as a linear regression was utilized to evaluate the intervention outcome through the study from 24 weeks to the end of 48weeks of intervention (Sayegh et al., 2018). About sixty two percent of the study participants were males while 70% were African Americans and 44% acquired HIV through risky behavior and 46% before, during and after childbirth (Sayegh et al., 2018). The mixed analysis model showed similarity between the intervention and control group from the beginning into week 24 and week 48 (Sayegh et al., 2018). The intervention group encountered fewer visits from healthcare workers in the beginning compared to the control group, $p = 0.01$ (Sayegh et al., 2018). Overall, there were no differences in the services rendered (Sayegh et al., 2018). The author was not able to quantitatively measure telephone services because it was built on the theories of social support (Sayegh et al., 2018). They also emphasized that the initial randomized trial was performed in 2010 and thus not useful to the analysis because HIV guidelines have changed since then and may be the reason for non-adherence to ART therapy (Sayegh et al., 2018). Kruskal- Wallis and Fisher exact test has less power than the mixed model and could not be effectively used to measure experiences at a single point in time (Sayegh et al., 2018). The researcher did not see any differences in telephone utilization between the groups and thus it is reasonable to suggest that everyone received a high level of clinical/personal support (Sayegh et al., 2018). The use of cell phone as a prompt to healthier behavior is informed by this study and similarly, this current study could provide information on how cell phone use informs the discipline on overweight.

Cell Phone Radiation and Brian Function and Injury

In a prospective cohort design, Foerster, Thielens, Joseph, Eeftens, and Roosli (2018) investigated the impact of radio frequency and electromagnetic field waves emitted via cordless phones on adolescent's brain functions. The two cohort groups used in this study were selected 2 years apart which included seventh to ninth grade students from 24 institutions in Switzerland (Foerster et al., 2018). The second cohort of seventh to ninth graders were from 22 schools (Foerster et al., 2018). A follow-up assessment was performed 1 year after the start of the study (Foerster et al., 2018). Roughly, 90 students were assigned a measuring device that scores the radio frequency electromagnetic field emitted via a cordless phone for 3 days (Foerster et al., 2018). Cognitive function was measured with a standardized test (Foerster et al., 2018). The positive coefficient from the continuous testing indicated an improvement in cognitive function from the start of the study to follow-up (Foerster et al., 2018). A negative association indicated a decline in memory function between baseline and follow-up period (Foerster et al., 2018). Memory development in adolescent depended on individual factors. The analysis was conducted using a linear regression analysis for text messages, length of phone usage, time of gaming, and time of wireless phone usage (Foerster et al., 2018). The cumulative phone usage was computed between the time of initiation and follow-up for two samples on three exposure and length of data traffic (Foerster et al., 2018). About 895 students were recruited for the study, 439 were selected in the first round and 456 in the second round (Foerster et al., 2018). There were higher values for verbal memory compared to figural memory from baseline to follow-up (Foerster et al., 2018).

Individual differences within the class showed a higher coefficient for figural memory than verbal memory (Foerster et al., 2018). There was no association between exposure and verbal values $p < 0.05$ (Foerster et al., 2018). The relationship between cumulative duration of data traffic with increase in spoken memory was not significant with change in interquartile range (IQR) from 0.34 to 54.4 min (Foerster et al., 2018). The relationship of figural memory values and cumulative brain dose was significant when analyzed in people with ride-sided brain use (Foerster et al., 2018). There was a negative association in verbal memory and operator sample (Foerster et al., 2018). The study provided ways to overcome barriers in epidemiological research on radio frequency- electromagnetic frequency radiation (Rf-Emf) (Foerster et al., 2018). The estimated Rf-Emf dose recorded operator’s information by calibrating self-reported calls, thus, decreased misclassification bias (Foerster et al., 2018). The analysis model provided a basis for examining the relationship between mobile phone use and Rf-Emf brain dose as well as extraneous factors such as lifestyle and behavior (Foerster et al., 2018). They suggested that further studies are necessary to investigate figural and verbal memory about left sided users of the operator sample. This is one form of adverse health outcome that could be induced via cell phone use, a study that also informed the need to evaluate cell phone use and its effect on overweight.

Diabetes and Sedentary lifestyle

According to Asvold., 2017; Sun et al., 2017 there are several factors associated with diabetes. Asvold et al. (2017) examined the effects of sitting time, leisure time, physical activity, and BMI on diabetes. They used a longitudinal study design to explore the link between these variables (Asvold et al., 2017). A total of 28,051 adults in Australia were selected for this study (Asvold et al., 2017). Total self-reported sitting time was recorded at baseline and at follow-up (Asvold et al., 2017). The logistic regression was used to evaluate the link between sitting time and diabetes after accounting for leisure, physical workout time, and BMI (Asvold et al., 2017). Of 28,051 participants, 1,253 had diabetes during the 11 years of follow-up (Asvold et al., 2017). More than 8 hours of sitting was linked to a 17% increased risk of diabetes compared with less than 4 hours of sitting (Asvold et al., 2017). There were variations between different strata of leisure, physical activity, and BMI in relation to sitting and risk for diabetes (Asvold et al., 2017). About 26-30% risk of diabetes was observed in low leisure physical activity than 2 hours of vigorous activity and 5-7 hours of sitting (Asvold et al., 2017). There was no correlation attributed to people with higher leisure time and physical activity (Asvold et al., 2017). There was no statistical evidence to support the association between period of sitting and diabetes to obesity (Asvold et al., 2017). They suggested that while total sitting period may have little impact on the risk of diabetes, prolonged sitting period may contribute to a greater risk of diabetes among those who are physically inactive (Asvold et al., 2017). Confounding factors such as eating patterns and snacks was not accounted for in the study (Asvold et al., 2017). Thus, a cautious application of the findings is warranted. Asvold et al. (2017) provided enough information to inform impacts of sedentary lifestyle on risk of diabetes due to physical inactivity (Asvold et al., 2017), it also informed primary objectives of this current study regarding the link between cell phone use and overweight.

Childhood Type 2 Diabetes and Diabetes in Adulthood

Children's weight and the burden of type 2 diabetes in adulthood is a public health concern in many countries(Bjerregaard et al., 2018;Sun et al., 2017). Bjerregaard et al., 2018 explored the link of childhood transition from overweight to early adulthood with diabetes type 2 among children living in Denmark. The study was a longitudinal design (Bjerregaard, et al., 2018). A total of 62,565 Danish boys within the ages of 7-13 years old were followed and evaluated at adulthood (Bjerregaard et al., 2018). Individuals with a type 2 diabetes from the national patient registry and school health registry database (CSHNN) (Bjerregaard et al., 2018). Of 62,565 boys recruited 6, 710 were diagnosed with type 2 diabetes at the time of follow-up (Bjerregaard et al., 2018). Hazard ratio analysis was used for the statistical evaluation (Bjerregaard et al., 2018). The overall overweight rate increased from 5.4% at age 7 to 8.2% at the adult age and subsequently increased the risk of type 2 diabetes (Bjerregaard et al., 2018). They concluded that overweight at any age was positively correlated with risk of type 2 diabetes (Bjerregaard et al., 2018). In other words, boys with overweight in early adulthood were at highest risk of type 2 diabetes (Bjerregaard et al., 2018). Similarly, boys who were overweight at age

7 years old with remission at age 13 years old and maintained an optimal weight as young men were also exposed to type 2 diabetes at age 30 to 60 years old (Bjerregaard et al., 2018).

The type 2 risk for diabetes among individuals diagnosed before age 60 was higher than those diagnosed after 60 (Bjerregaard et al., 2018). The risk of overweight in childhood is reversible than risk in adulthood (Bjerregaard et al., 2018). Among 501 boys who were obese at age 7 years old, 166 remained obese at adulthood, 156 became overweight, and 179 maintained optimal body weight (Bjerregaard et al., 2018). Boys who engaged in activity to decrease their BMI at early adulthood were exposed to half the risk of type 2 diabetes (Bjerregaard et al., 2018). Also, boys who decreased their BMI to normal had low risk of type 2 diabetes (Bjerregaard et al., 2018). Obesity in early adulthood is linked to increased risk of type 2 diabetes irrespective of the weight at age 7 years old (Bjerregaard et al., 2018). Also, overweight at age 7 years old and risk of type 2 diabetes could be minimized by lifestyle changes before puberty and early adulthood (Bjerregaard et al., 2018). Weight status during puberty is mostly affected by type 2 diabetes irrespective of overweight status at age 7 years old (Bjerregaard et al., 2018). Socioeconomic status was not accounted, however, the study provided adequate information on the risk of type 2 diabetes and weight status based on age, which also is critical information to support the need for this current study.

Lifestyle Behaviors and Type 2 Diabetes

Similarly, smoking, inactivity, excessive body fat, and alcohol consumption are risk factors of type 2 diabetes (Bertoglia et al., 2017; Lallukka et al., 2016). Bertoglia et al. (2017) examined the impact of risk factors such as obesity, sedentary lifestyle, tobacco, and alcohol on type 2 diabetes. The study was conducted in Chile and a cross-sectional design was used to randomly recruit 5, 293 participants ages 17 year and older, and a logistic regression was used for the statistical analysis (Bertoglia et al., 2017). Risk factor and the proportional reduction analysis in population illness or death was conducted to assess the attributable fractions (Bertoglia et al., 2017). They showed that type 2 diabetes was 9.5% attributable to obesity and inactivity (Bertoglia et al., 2017). Roughly, 2.4% of type 2 diabetes could be avoided if the participants did not have excess body fat (Bertoglia et al., 2017).

Overall, reduction of excess body fat could prevent 23% of type 2 diabetes. Also, about 64% of type 2 diabetes was attributable to inactive lifestyle and could be avoided with physical activity or physically active lifestyle (Bertoglia et al., 2017). Of the 4 factors (obesity, sedentary lifestyle, tobacco, and alcohol) evaluated, sedentary lifestyle had the highest attributable risk of 91.66% to developing type 2 diabetes (Bertoglia et al., 2017). The risk of an obese person developing a type 2 diabetes was 29.1% while lifetime smokers had a risk of 40%, and former smokers' risk is 19.36% (Bertoglia et al., 2017). The attributable risk of type 2 diabetes among individuals that consume alcohol was 14.72% (Bertoglia et al., 2017). Men had all four risk factors (Bertoglia et al., 2017). Obesity and sedentary lifestyle are risk factors among women, while sedentary lifestyle was the primary risk factor for type 2 diabetes among women (Bertoglia et al., 2017). The findings about the attributable effects of sedentary lifestyle strongly informed this currents study as excessive cell phone use could lead to sedentary behaviors.

Mortality

Social determinant of health such as the residential environment could have an adverse impact on heart disease and cardiovascular related deaths (Moreno-Lostao, et al., 2019;Ku et al., 2018;Kramer et al., 2016). Moreno-Lostao et al., examined the effects of urban and rural habitation on cardiovascular mortality and risky behavior before, during, and after intense financial hardship of 2008 in Spain. Some of the risk factors of cardiovascular related deaths are smoking, obesity, and decreased physical activity in urban areas. Three areas of residence were selected via a stratified multistage sampling (Moreno-Lostao et al., 2019). The yearly premature death from cardiovascular disease was computed for three periods during intense financial hardship (Moreno-Lostao et al., 2019). The average percentage in mortality for the 3year period was calculated using a linear regression (Moreno-Lostao et al., 2019). The association between places of residence and rate of premature death in each three-year period was summarized using a standard age death rate ratio (Moreno-Lostao et al., 2019). The confidence interval was calculated using Mantel-Haenszel method (Moreno-Lostao et al., 2019). In each place of residence, the standard age mortality for tobacco use, obesity, and exercise in 2006, 2011, and 2016 was calculated with the larger urban area as the reference (Moreno-Lostao et al., 2019). There are no significant variations in death count between the two urban regions among men (Moreno-Lostao et al., 2019).

The mortality rate ratio for rural region increased from 0.92 to 0.94 between 2013 to 2016 (Moreno-Lostao et al., 2019). No variation in death occurred between the rural and urban regions among women (Moreno-Lostao et al., 2019). The mortality rate ratio in small urban districts dropped from 1.11 to 1.06 within the period 2007 to 2016 (Moreno-Lostao et al., 2019). The prevalence of tobacco use, obesity and physical inactivity is noted to be low in rural region among men while obesity was observed among women (Moreno-Lostao et al., 2019). Also, there was no significant variations in tobacco use and physical inactivity by place of residence among women (Moreno-Lostao et al., 2019). Cardiovascular death in urban and rural areas were identical before and after financial hardship but women had tremendous death in small urban regions compared to large urban districts after severe hardship (Moreno-Lostao et al., 2019). Mortality data are a useful source of information used in performing cause of death analysis (Moreno-Lostao et al., 2019). The study provided useful analysis of the description of cardiovascular deaths in urban and rural residence areas (Moreno-Lostao et al., 2019). In this current study, overweight is the primary outcome variable of interest, and overweight is an established risk factor of heart diseases and other chronic conditions.

Sedentary Lifestyle and Risk of Deaths

Similarly, sedentary behavior could be indirectly linked to risk of death, as well as affect the quality of life (Ku et al., 2018; Lallukka et al., 2016). Ku et al. (2018) examined the duration of sedentary behavior and risk of mortality among adults ages 18-64 years old using a prospective cohort design. They also evaluated the impact in the differences of self-reported sedentary time and device recorded sedentary time (Ku et al., 2018). They found that more time spent in sedentary lifestyle was linked to higher risk of deaths (Ku et al., 2018). The studies with device-based results showed a stronger association between sedentary time (ST) and risk of death (Ku et al., 2018). Studies with self-report likely overestimated the ST findings (Ku et al., 2018). In this meta-analysis 19 prospective cohort studies were evaluated (Ku et al., 2018). The age of the subjects ranges from 37-63 years old.

Tobacco Use and Mortality

Lallukka et al. (2016) evaluated combined influence of tobacco use and physical inactivity on mortality in Finland. They used a retrospective cohort design and selected adults ages 40-60 years old (Lallukka et al., 2016). The data used for the study was from the Helsinki Health study (Lallukka et al., 2016). The baseline information was obtained from 2000-2002 (Lallukka et al., 2016). Follow-up occurred at the end of 2013 (Lallukka et al., 2016). A total of 6,390 was randomly selected (Lallukka et al., 2016). Approximately, 79% women with a response rate of 67% was included in the study. Among smokers, the risk of death was higher in those who were physically inactive (Bertoglia et al., 2017; Lallukka et al., 2016). Mortality was not associated with non-smokers who were physically active (Lallukka et al., 2016). There was a notation of increased risk for those who were inactive and nonsmokers during working years with a hazard ratio of 1.54 (Lallukka et al., 2016). The joint effect of smoking and physical inactivity was linked to risk of death (Lallukka et al., 2016). They recommended further studies to assess the effects of smoking and physical activity to mortality at baseline (Lallukka et al., 2016).

Mental Health and Cell Phone Use

Risky cell phone use could promote adverse mental health conditions, accidental injuries, and even deaths (Tao et al., 2016; Haug et al., 2015). A cross-sectional design was used by Tao, Wu, Wan, Zhang, Hao, and Tao (2016) to assess the impact of cell phone use on morbidity and mortality. A total of 14,221 students were randomly selected for this study from 32 schools in China (Tao et al., 2016). Of 14,221 students, 6,915 were middle schoolers and 7,306 were high schoolers (Tao et al., 2016). There were 6,712 boys and 7,509 girls (Tao et al., 2016). A chi-square test and multivariate logistic regression were used to evaluate the rates of unintentional injuries leading to mortality (Tao et al., 2016). Similarly, the chi-square test was used to evaluate the association between individual attributes and risky cell phone, mental health symptoms, and accidental injuries (Tao et al., 2016). The multivariate logistic regression was used to measure multiple variables and their interaction such as a risky cell phone use and mental health symptoms, accidental cases between problematic phone usage and psychiatric symptoms with unwanted harm (Tao et al., 2016). The three types of injuries most prevalent among middle and high schoolers are pedestrian collision (16.2%), falls (10.1%), and highway traffic injuries (4.9%) (Tao et al., 2016). The occurrence of unwanted accidents was higher in students with risky smartphone use and psychiatric symptoms (Tao et al., 2016).

Overall, they showed that mental health symptoms were positively correlated with increased probability of unintentional injuries for students with problematic cell phone use compared to those who did not engage in risky cell phone practices (Tao et al., 2016). Students with problematic cell phone use are those who drive, walk, and ride bicycles to school with more chances of accidents (Tao et al., 2016). This study informs the need to prevent risky cell phone use behaviors to prevent associated adverse outcomes. As such, risky behavior could also include excessive cell phone use that induces or encourages sedentary behaviors.

Cost of Overweight and Obesity/Loss Productivity

Public health significance of effective health promotion measures is an important delivery vehicle for population-based driven interventions. Sun, You, Almeida, Estabrooks, and Davy (2017) evaluated the cost effectiveness of lifestyle and nutritional importance of diabetes prevention. Sun et al. (2017) conducted a meta-analysis on 69 articles from the Cochrane Library, PubMed, Education Resources Information Center, CAB Direct, Science Direct, and Google Scholar specifically on diabetes intervention. Articles covering dietitian versus non-dietitian and personal versus media approach were evaluated (Sun et al., 2017). The systematic review showed that intervention with a nutritionist teaching had a weight reduction of 2.07kg at 12 months (Sun et al., 2017). The meta-regression evaluation showed a larger weight reduction in dietitian instructed approach than non-dietitian method (Sun et al., 2017). The findings did not show that delivery method of intervention was a significant predictor of weight reduction (Sun et al., 2017). The cost of dietitian directed approach was lower than non-dietitian method and thus dietary intervention are more cost-effective to promote weight reduction compared to non-dietary measures (Sun et al., 2017). They suggested that data on program cost is important in enhancing cost-effectiveness of specific intervention models.

Clinical Cost-Effectiveness of Physical Activity and Nutrition

In a different study setting, Li et al., (2019) investigated obesity in primary school among children to evaluate the clinical and cost effectiveness of physical activity and nutrition in China. The children were randomized in a controlled trial (Li et al., 2019). About 40 states funded elementary schools from an urban region in China were included in the study (Li et al., 2019). A total of 1,642 first year students participated at baseline (Li et al., 2019). The intervention group included 20 schools comprising of 832 students, 55.6% of which were boys (Li et al., 2019). The control group had 809 students, consisting of 53.3% boys (Li et al., 2019). The intervention program was 12 months long and included 4 schools (Li et al., 2019). The key intervention was physical activity, and healthy eating habits disseminated through teaching and practical workshop to enhance food supply and school workout (Li et al., 2019). The girls were more compliance to physical activity and nutrition teaching than the boys (Li et al., 2019). The interventions were 95% cost effective than usual care (Li et al., 2019). The nutrition evaluation tools used were not validated (Li et al., 2019).

Healthcare Cost of Overweight

Lette., 2016 investigated the impacts of overweight in European healthcare in terms of the cost of overweight in 4 European nations. The tool used in computing cost related to overweight was a top-down and a prevalence method that has 4 steps (Lette et al ; Hens et al., 2018). Step 1 identifies diseases associated with overweight (Lette et al., 2016). Step 2 involves data collection process that is age and sex-specific for the current state of disease (Lette et al., 2016). Step 3 involves assessment of a population attributable prevalence (PAP) to estimate of diseases that may lead to overweight (Lette et al., 2016). Step 4 involves computation of the healthcare cost that is linked to disease attributable to overweight (Lette et al., 2016). The cost of diseases that have contributed to overweight ranges from 20-26% of health care cost (Lette et al., 2016). The disease with the highest cost includes diabetes, endometrial malignancy, and osteoarthritis (Lette et al., 2016). The total healthcare expenditure related to diseases caused by overweight is 2 to 4% (Lette et al., 2016). The study was performed using a cross-sectional design approach (Lette et al., 2016). About 51% of women and 49% of men were included in the study (Lette et al., 2016) . Based on the BMI distribution across age groups, overweight increases with age between (20-74 years old) (Lette et al., 2016). The absolute prevalence of overweight is most elevated at ages 55-74 years old (Lette et al., 2016). The study is limited in that the prevalence-based approach does not provide a long-term effect of overweight and a specific action that may decrease the problem of weight (Lette et al., 2016). They suggested that further studies should are needed to outline the consequence of overweight using the prevalence-based approach and adding indirect cost to the calculation (Lette et al., 2016). Cost is a current issue informed by this study as a result, if cell phone use is associated with overweight it is likely to increase healthcare cost because the prevalence of overweight will increase due to added cell phone risk factor.

Overweight and Obesity Cost of Lost of Productivity

Similarly, Goettler., 2016; Hens et al., 2018 evaluated the indirect cost of lost productivity resulting from overweight and obesity. The assessment included literature review from eight electronic databases (Goettler et al., 2016; Lette et al., 2016). Only articles published within 2000-2017 with information about the monetary evaluation of indirect financial cost of overweight and obesity were selected (Goettler et al., 2016). Of 3,626 articles populated, 50 were selected and included in the analysis (Goettler et al., 2016). Absenteeism and Presenteeism contributed to increase indirect cost (Goettler et al., 2016). Cost increase ranged between $54 and $161 for overweight and $89 and $1586 for obesity (Goettler et al., 2016). There is also a short and long-term cost of adverse health conditions associated with overweight (Goettler et al., 2016). The presenteeism cost of overweight and obesity combined is between $611-$1,669 per person (Goettler et al., 2016). Annual insurance claims of $189 were from individual workers compensation and obesity grade 1-111 lectures cost $525-$707. Short and long-term lifetime disability cost estimate and retirement fund is $31,037 for overweight and 32,668 annually for obesity (Goettler et al., 2016).

The cost of premature death from overweight and excess productivity was $29 while obesity grade 1-111 was $212 to $1,170 per person (Goettler et al., 2016). The cost of obesity is projected to increase from $1.8 billion in 2003 to $3.6 billion in 2020 (Goettler et al., 2016). In the United States, the annual adolescent obesity expense is estimated to increase from $954 million in 2020 to $36 billion in 2050 (Goettler et al., 2016). The cost increase will continue until drastic change is made to reduce the prevalence and incidence of overweight in the United States (Goettler et al., 2016). Publication bias in which articles with a positive or anticipated outcome were likely to be published than articles with unexpected or negative results promotes publication of positive results. Of 50 studies 47 had higher cost due to overweight and obesity (Goettler et al., 2016). Only studies written in English and German were published, thus could produce a selection bias (Goettler et al., 2016). Health or medical cost is an essential factor that determines the level of the well-being or health quality of a given population Cell phone use will substantially add to the cost if found to predict overweight.

Monitory Burden of Health Conditions

Computation of expense not causally linked to overweight and obesity in children is important in understanding the monetary burden of the health conditions (Biener et al., 2017; Sonntag et al., 2016). As a result, Sonntag et al. (2016) explored the lifetime expense of childhood/adolescent overweight and excessive body fat. They employed a cross-sectional study design for this purpose and administered a survey to randomly selected households in Germany (Sonntag et al., 2016). The indirect cost of overweight and obesity of children as well as obesity prevalence was estimated using the Markov method (Sonntag et al., 2016). The Markov approach is a cohort simulation that was used to assess the long-term likelihood of illness or death associated to cost among the cohort (Sonntag et al., 2016). The Markov model consists of 2 parts (Sonntag et al., 2016). Model I included children/adolescents within the ages of 3-18 years old and Model II contained adults ages 18 and older (Sonntag et al., 2016). They used the prevalence data of 14,747 German children from the German interview and Examination survey (Sonntag et al., 2016). For the adult population, they used micro census data from the German Federal Statistic Sector (Sonntag et al., 2016). The Markov model is a top-down estimation approach in understanding the population attributable fraction (Sonntag et al., 2016). They used relative risk calculation to evaluate the impact cost on weight (Sonntag et al., 2016).

They found that boys who were overweight or obese in childhood either remain the same or have an optimal weight as an adolescent or at early childhood (Sonntag et al., 2016). A portion of overweight children at adolescence or early adulthood maintain a normal weight (Sonntag et al., 2016). Proportion of adults with a BMI of more than 25 were overweight or obese as children or adolescents (Sonntag et al., 2016). People who were overweight and obese at childhood had a higher lifetime cost compared to those who maintained a normal weight (Sonntag et al., 2016). With a 3% discounted cost in the future, boys have three times higher expenses (Sonntag et al., 2016). Girls have almost five times higher costs related to overweight and obesity (Sonntag et al., 2016). Individual cost was 4,209 Euro for boys and 2,445 Euro for girls (Sonntag et al., 2016). The lifetime expense total cost was 145 billion euros in Germany (Sonntag et al., 2016). They concluded that excess body fat during childhood has a substantial cost at a later age (Sonntag et al., 2016). The estimates of lifetime costs were compared between a cross-sectional and longitudinal survey in other nations but not in this study (Sonntag et al., 2016). There was missing long-term mortality data of adults in this study (Sonntag et al., 2016). The study informed public health discipline in areas of child health.

Overweight and obese prevalence among women is a public health concern which also affects infant health especially among pregnant women (Hens et al., 2018; Pandita et al., 2016). Hens et al. (2018) examined the link between overweight and obese premenopausal non-diabetic women. They conducted an observational study with a randomized control trial approach (Hens et al., 2018). A total of 62 premenopausal women with no medical complications from overweight or excessive body fat in Antwerp were selected for the study (Hens et al., 2018). An RCT hidden cost-of-disease approach, self-report, diary recorded expense were used to evaluate the distinct comorbidities and the link to the direct and indirect expenses (Hens et al., 2018).

Health Expense and Health Benefits

The European Quality-of-life-5D questionnaire approach was used to discuss health status and a matching utility index (Hens et al., 2018). They found that the average health expense and health benefits observed were comparable with the Flemish sample (Hens et al., 2018). Also, 15% of the subjects had five or more concomitant conditions leading to an elevated average expense and lower health benefit (Biener et al., 2017; Hens et al., 2018). The productivity among the selected subsample was low due to a high rate of absenteeism and that contributed to a total expense for the nation (Hens et al., 2018). There was a statistically significant negative association between societal cost and self-reported health state (Hens et al., 2018). Health benefit was negatively correlated with comorbidity, age, and BMI but significant (Hens et al., 2018). The utility was adversely and significantly correlated with comorbidity, expense, absenteeism, and costs from various perspectives and BMI is adversely related to age with $p < 0.05$ (Hens et al., 2018).

The connection between comorbidities and BMI was positive and statistically significant (Hens et al., 2018). The number of concomitant conditions had a positive association with patient cost ($p < 0.05$) and expense for insurer and society ($p > 0.05$)

and the cost for absenteeism was $p > 0.05$ (Hens et al., 2018). In the prospective cohort study, there was a high response rate (Hens et al., 2018). Intangible cost derived from illness was not reported. Thus, they suggested that further studies should examine the economic burden of overweight and obesity as it relates to the intangible costs (Hens et al., 2018). Lifetime cost, intangible cost, and mortality risk assessment are extreme measures of life expectancy and quality of life as body weight plays a crucial role in these two areas, cell phone use may play a bigger role if it is connected to overweight cases and thus, could increases lifetime cost.

Critique of Existing Literature

The body of literature reviewed in Chapter 2 were mostly quantitative studies. A range of topic were covered in the body of the literature including smartphone use, overweight, and obesity. Some of the authors used a cross-sectional design which aligns with this current dissertation study design. The study topic area synthesized in the literature review include prevalence, risk factor assessment, incidence, exposures, costs, mortality, and other health outcomes.

For a non-experimental study design one inherent weakness is lack of random assignment of risk factors or exposures, thus causality cannot be established (Bertoglia et al., 2017; Bussenius et al., 2018; Hong et al., 2016; Hruby & Hu, 2015; Kramer et al., 2016; Mestanik et al., 2017; Research Brief, 2015; Roberts et al., 2015; Robinson et al., 2017). A cross sectional study provides a snapshot of the incidence and prevalence of a risk factor or exposure and it is subject to participant, researcher, recall and selection biases, etc. and assignment of risk factors was not possible (Creswell, 2018). With a longitudinal prospective design, there was also no assignment of risk during any period of the follow-up processes as well (Alwattar et al., 2015;Asvold et al., 2017; Foerster et al., 2018; Ku et al., 2018; Lallukka et al., 2016). All the research design and research method used in the literature that I reviewed and synthesized are in alignment with the posed research questions the authors addressed in their studies. For all the studies where the researchers used a non-experimental or non quasi experimental design, they rightfully concluded that cause and effect could not be established, rather for those where there was significant observation, correlational conclusion were made (Bjerregaard et al. 2018; Cantarero et al., 2016; Domoff et al., 2019; Robinson et al., 2017; Lette et al., 2016). For the experimental designs, the authors used a randomized control trial process and assigned patients to exposure or treatment and control grouped in a randomized selection process (Li et al., 2019, Hidayanty et al., 2016). With an experimental design, the researchers were able to confidently draw or not draw a cause-and-effect conclusion and for multi-site studies with large sample size, generalizations were made (Bertoglia et al., 2017; Bjerregaard et al., 2018; Cantarero et al., 2016; Hens et al., 2018; Hong et al., 2016; Ku et al, 2018).

Summary and Conclusions

In this chapter, I discussed synthesized literature related to cell phone risk assessment, misuse, and overweight in the adolescent population. I explored the risk factors for overweight and individuals that were at risk for overweight, related mortality, cost of lost productivity, sedentary lifestyle, diabetes risk, and problematic cell phone use. Similarly, I discussed how the SEM was used to explain the interaction or relationships between the variables under investigation in this study. The highlighted message is that high unsafe cell phone use is a public health concern. Through the findings of this current study, the work of the public health officials, school authorities, parents, and health care providers in promoting preventative measures could be reassured and reinforced. Synthesis of relevant literature discussed here provided the basis to further explore the methodology described in Chapter 1 as it will be expanded in detail in Chapter 3.

Chapter 3: Research Method

Introduction

The purpose of this cross-sectional study was to explore the relationship between cell phone use and its effect on overweight among adolescents ages 14-17 years living in the United States. In Chapter 3 of this dissertation, I describe the research design, rationale, methodology, and variables. I also describe the study population, sampling technique, data collection, and data analysis. Threats to validity and ethical consideration are also discussed in this chapter.

Research Design and Rationale

I used a cross-sectional research design for this study. According to Creswell (2018), a cross-sectional research design is used to explore the incidence, risk, and prevalence of health conditions. Research findings generated via a cross-sectional study can only be used to infer correlational associations between the exposure factors or independent variables or confounders and the dependent variables or outcomes (Creswell, 2018). A dataset from the 2017 YRBSS was the source of the secondary data for this current study. The 2017 YRBSS was collected by the CDC using a cross-sectional design (YRBSS, 2018).

Investigators applying a cross-sectional design can get a snapshot of the incidence, prevalence, and risk factor (Creswell, 2018). Nonetheless, a cross-sectional research design is prone to researcher, participation, selection, rumination, recall, and misclassification biases (Creswell, 2018). Most importantly, in the absence of an experimental or a quasi-experiment design to support the finding observed using a cross-sectional design, no causal relationship can be inferred (Creswell, 2018). In other words, in a situation when the only findings available for an outcome or exposure is generated using a cross-sectional design, only a correlational inference or conclusion could be made (Creswell, 2018). Since the 2017 YRBSS, a cross-sectional data was used for this current study to investigate the relationship between cell phone use and its effect on overweight among adolescents ages 14-17 years who are living in the United States, a correctional conclusion was made to either support the null hypothesis or reject the null hypothesis. In terms of access to the 2017 YRBSS, there is no expectation of constraint or restriction to deidentified data intended for this study because the dataset is publicly available in the YRBSS website.

Methodology

The YRBSS monitors six categories of health-related behaviors that are the leading causes of death and disability among youth and adults (YRBSS, 2018). The six categories included a(unintentional injuries and violence), b (unintended pregnancy and sexually transmitted diseases, including HIV infection), c (alcohol and other drug use), d (tobacco use), e (unhealthy dietary consumption), and f(inadequate physical activity). These categories contribute to mortality and disability among youth. YRBSS data are also used to measure and monitor the prevalence of obesity, asthma, other health-related behaviors, sexual identity, and sexual behaviors.

Population

YRBSS is a national school-based survey conducted by the CDC and state, territorial, and tribal government (YRBSS, 2018). The local surveys are conducted by state, territorial, and local education and health agencies and tribal governments (YRBSS, 2018). In more than 1,900 separate surveys from 1991 through 2017, the YRBSS has collected data from more than 4.4 million high school students in the United States.

For this research, the target population of interest included in this study was participants between the ages 14-17 years old living in the United States. The 2017 YRBSS school-based surveys included representative samples of ninth through 12th grade students, and for the national surveys, it included public and private school systems in the United States (YRBSS, 2018). The surveys, conducted at the state, territorial, tribal government, and local levels by the departments of health and education, cover mostly public high school students in each jurisdiction. The YRBSS survey is conducted biennially, usually during the spring semester.

Sampling and Sampling Procedures

The YRBSS uses a three-stage cluster sample approach to select a representative sample of ninth through 12th grade students (YRBSS, 2018). The target population included all public, Catholic, and other private school students within the specified grade levels (YRBSS, 2018). To adjust for nonresponse and oversampling of Black and Hispanic students, a weighting factor was applied to each student record (YRBSS, 2018). The overall weights were scaled proportionately to the total sample size, and the weighted proportions of students in each grade matched population projections for each survey year. A statistical software package was used to calculate sampling variance appropriately due to the complexity of the cluster sampling design (YRBSS, 2018).

For the 2017 YRBSS, of 192 sampled school, 144 schools participated, which is about 75% response rate (YRBSS, 2018). Of 18,324 students sampled, 14,956 submitted questionnaires, thus representing 81% response rate. The overall response rate is 60% (School response rate * Student response rate [75% * 81% = 60%]).

As indicated in Chapter 1 of this dissertation, with an effect size of 1.3, the estimated sample size needed to generate a statistical power of 80% is 721. 14,956 students responded in this survey, which is about 20.7 times the minimum sample size required for this study. As such, I used all the samples with complete information for my study. By using all the sample, I substantially minimized Type I or Type II error in this study. To select adolescents ages 14-17 years old from the 2017 YRBSS data that met age inclusion criteria, I stratified the record by age and excluded participants outside of age range between 14-17 years old. As described in Chapter 1, the minimum statistical power and beta value for Type II error required for this study are 80% and 20%, respectively. Also, the predetermined test statistics for the confidence level and alpha value (Type I error) was set at 95% (0.95) and 5% (0.05) respectively. The confidence and alpha levels were used for the inferential analysis to evaluate the scope of statistical significance of the association between cell phone use (high school, college, and post-college) and overweight versus normal weight after accounting for age gender, race, and physical activity.

Table 1 shows the estimate of the minimum sample size required to generate an 80% statistical power based on 1.3 effect size for binary regression analysis. At minimum, data for 721 adolescents ages 14-17 years old were used in this study for the inferential analysis. The 2017 NHIS data contained 14,956 participants, which exceeded the minimum sample size required to generate a statistical power of 80%. All complete data that met the inclusion criteria was included in the analysis.

Table 1

Minimum Sample Size Estimation

z tests - Binary regression			
Options:	Large sample z-Test, Demidenko (2007)		
Analysis:	A priori: Compute required sample size		
Input:	Tail(s)	=	Two
	Odds ratio	=	1.3
	Pr(Y=1|X=1) H0	=	0.2
	α err prob	=	0.05
	Power (1-β err prob)	=	0.80
	R^2 other X	=	0
	X distribution	=	Normal
	X parm μ	=	0
	X parm σ	=	1
Output:	Critical z	=	1.9599640
	Total sample size	**=**	**721**
	Actual power	=	0.8001115

Procedures for Recruitment, Participation, and Data Collection

Thousands of school children from grade ninth through 12th were recruited in this 2017 YRBSS survey to gather data about many health behaviors or determinants and outcomes (YRBSS, 2018). Participant sampling for the cross-sectional survey design was a cluster approach. Participation was voluntary and collected data were de-identified and available in the CDC YRBSS public website (YRBSS, 2018).

The YRBSS is a biennial survey conducted by the CDC and state or tribal territories across the United States (YRBSS, 2018). The 2017 YRBSS was fielded by trained staff. Institutionalized children were excluded from the study; only non-institutionalized children living in the United States were surveyed. Each participant received a survey questionnaire containing these six categories' areas (i.e., unintentional injuries and violence; unintended pregnancy and sexually transmitted diseases, including HIV infection; alcohol and other drug use; tobacco use; unhealthy dietary consumption; inadequate physical activity).

The 2017 YRBSS data are saved in different file formats: a column delimited text (ASCII) and a comma-separated values (CSV), PDF, SAS, and SPSS versions (YRBSS, 2018). Each version is formatted in a compressed ZIP file with a unique file name. This archived 2017 YRBSS secondary data were used to address the research questions and hypothesis posed in this study. Before the archived 2017 YRBSS data set was downloaded from the CDC website into a password-protected personal computer, I requested IRB approval from the Walden University. After IRB approval (10-23-20-0513085), I uploaded the 2017 YRBSS and transformed the dataset to align with level of measurement for all my variable of interest indicated in Tables 1 and 2. I deleted or excluded all fields that did not meet the inclusion criteria of the research questions.

Instrumentation and Operationalization of Variables

In this study, the operationalized variable are cell phone, overweight, normal weight, age, gender, race, and physical activity. Cell phone use was grouped into an ordinal level (no use, low use, and high use). Overweight status was grouped into a nominal variable, "yes" for slightly overweight and very overweight and "no" for those who indicated that they are about the right weight. Participants who considered themselves of normal weight indicated in the survey that they are normal weight. Age of adolescents was grouped into two intervals (14-15 and 16-17 years old, see Table 2). Gender is a nominal variable (male or female). Race was grouped into five racial groups (White, Asian, Black/African American, American Indian/Alaska Native, and Native Hawaiian or Other Pacific Islander) while physical activity was grouped into three intervals (0 day, 1-4 days, 5-7 days). See Table 2 for more detail.

Table 2

Study Variable and Unit of Analysis

RQs	Independent variable	Dependent variable	Confounders / covariates	Key research comparison criteria	Key unit of analysis inclusion criteria
RQ1	Cell Phone Use	Overweight Status	Age, Gender and Race	Prolonged Use vs. Short-Term Use	Adolescents ages 14-17 years old
RQ2	Cell Phone Use	Overweight vs. Normal Weight Status	Age, Gender and Physical activity	Cell Phone Use	Adolescents ages 14-17 years old

Table 3

Study Variables and Levels of Measurements

Variables Name	Level of Measurement	Survey Questions	Response Options
Cell Phone Use	Ordinal	On an average school day, how many hours do you use smart phone for something that is not schoolwork? (Q81)	No, Low, and High
Weight Status (Overweight and Normal weight)	Nominal	How do you describe your weight? (Q68)	Yes (slightly overweight and very overweight) or No (normal weight)
Age	Interval	What is your age?	14-15 years old and 16-17 years old
Gender	Nominal	What is your gender?	Male or Female (boy or girl)
Race	Categorical	What is your race? (Q5)	White, Asian, Black/African American, American Indian/Alaska Native, and Native Hawaiian or Other Pacific Islander
Physical Activity	Interval	During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? (Q79)?	0 day, 1-4 days, 5-7 days

Data Analysis Plan

I used SPSS software (Version 23) to conduct both the descriptive and inferential analyses. The data from the logistic regression predicted the occurrence of overweight as well as explained the odds of overweight with the use of cell phone. The descriptive analysis included the frequency, count, and percent distribution of all the variables listed in Table 4. The inferential analysis focused on the assessment of the significance of research question 1 and 2. The following research questions were addressed in this study:

RQ1: What is the relationship between cell phone use and adolescent weight status after controlling for age, gender, and race?

H_0**1**: There is no relationship between cell phone use and adolescent weight status after controlling for age, gender, and race.

H_a***1***: There is a relationship between cell phone use and adolescent weight status after controlling for age, gender, and race.

RQ2: What is the effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years old after controlling for age, gender, and physical activity?

H_0***2:*** There is no effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17years old after controlling for age, gender, and physical activity.

H_a***2:*** There is an effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17years old after controlling for age, gender, and physical activity.

RQ3: Does race have a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender?

H_{03}: Race does not have a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender.

H_a3: Race has a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender.

Significance of the study findings was based on *p*-value estimates via an inferential analysis for all 3 research questions. The alpha value of 0.05 (5%) is the reference that helped in determining the finding was significant or non-significant under this study conditions. In other words, if the estimated *p*-value is less than the predetermined alpha value of 0.05 (5%) [$p < 0.05$], the finding is statistically significant, in that case, the null hypothesis was rejected. If on the other hand, the *p*-value is greater than the predetermined alpha value of 0.05 (5%) [$p > 0.05$], the estimated p-value for the study finding is not significant and therefore, I did not reject the null hypothesis. Under these conditions, the level of confidence for all the estimated *p*-values is 95%, which means that all the estimated *p*-values had a 95% level of confidence that the findings did not occur at random.

In this study, I used odds ratio (*OR*) to quantify or measure the magnitude of effect or public health significance of the study findings. *OR* estimation is generated using the ratio of the odds of exposure and non-exposure. In that case, an *OR* value of 1.00 indicate that there is no difference in the risk of the event among individuals exposed compared to the non-exposed group. If the estimated *OR* value is greater than

1.00, the risk of the exposed group is greater than and positively linked to the outcome than would be observed among those not exposed to the risk factors. However, if the estimated *OR* value is less than 1.00, then the exposed group has lower risk of the outcome associated with the exposure and in that case, is a protective or inhibitory factor.

Threats to Validity

To ensure informed quality control and assessment in research, threat to validity of a study must be examined. Multiple areas in the study process, variables, designs, rationale, and methodology could be affected by validity threats (Creswell, 2013; Forthofer et al., 2007). Consistency and accuracy of study procedures such as sampling and subject selection are important component of process validation (Creswell, 2013; Forthofer et al., 2007). Internal and external validity processes could be influence negatively or positively by sample selection or selection bias (Creswell, 2013; Forthofer et al., 2007). In this study, I considered, examined, and discussed key factors that influences internal and external validity for this current study.

Internal Validity

External validity is unlikely to be established in a study if the internal validity is lacking (Creswell, 2013; Forthofer et al., 2007). The internal validity process identifies other factors besides the primary known predictor variables that influence outcomes (Creswell, 2013; Forthofer et al., 2007). Data quality could be influenced by operationalization of the study instruments and instrument consistency, procedural design, and sample methods used in a study (Creswell, 2013; Forthofer et al., 2007). Similarly, construct validity focuses on the contextual integrity aspect of an operation or process (Creswell, 2013). A measuring instrument with low precision will produce unintended spurious data, which could create distortion in data (Creswell, 2013; Forthofer et al., 2007). Recall bias and other biases are examples of validity issues that can occur in a study. The 2017 YRBSS responses are self-reported and not clinically validated. A self-reported response could incur biases (recall, researchers, participants, system, selection, rumination, and misclassification) (Creswell, 2013; Forthofer et al., 2007). The 2017 YRBSS was a surveillance system and was not designed specifically for this study. In addition, risk factors such as cell phone use and time spent on cell phone during use were not randomly assigned to the participants selected in the 2017 YRBSS. Random assignment of risk factors is a barrier to cross-sectional design (Creswell, 2013; Forthofer et al., 2007). Insufficient statistical power or sample size, effect size estimation, confidence level estimation distorts the study findings and may produce a Type I or Type II error, however, this issue did not occur in this study, because there was a large sample size for this study.

External Validity

The extent to which generalization of the event or outcome could be made in different settings beyond the study population from which the findings originated provides information on the level of external validity of that findings (Creswell, 2013; Forthofer et al., 2007). Several data collection validation processes were used to address the internal and external validity in the 2017 YRBSS dataset. The 2017 YRBSS sample population within each school from several states in United States were randomly selected, though the time spent on cell phone was not assigned to participants (YRBSS, 2018). Hence, this study can only be used for a correlational inference in a cross-sectional design setting (YRBSS, 2018). A cross-sectional design lacks causality precision and predictor-outcomes' spatio-temporal sequence (Creswell, 2013; Forthofer et al., 2007).

Variability in participants demographic profiles could influence uniformity of how each participant understood the questions (Creswell, 2013; Forthofer et al., 2007). To limit this variability errors, YRBSS piloted the survey to assess the integrity and clarity of the survey questions (YRBSS, 2018). Content or clarity issues observed in the pilot test were corrected and addressed (YRBSS, 2018).

Ethical Procedures

CDC controls and administers the YRBSS questionnaires (YRBSS, 2018). All YRBSS participants and confidential information were de-identified (NCHS, 2018). YRBSS only uploaded de-identifiable data in their website for public use (YRBSS, 2018). Publicly available data files are not linked to individually identifiable data (YRBSS, 2018). All YRBSS data users are expected to comply to CDC data use agreements stated in YRBSS website (YRBSS, 2018). YRBSS staff provided informed consent agreement to participants before recruitment and only participants that agree to the terms of the informed consent are included in the study (YRBSS, 2018). The 2017 YRBSS informed consent was approved by the CDC IRB (YRBSS, 2018). I requested for Walden University IRB approval before downloading the dataset for analysis. The downloaded 2017 YRBSS data was stored in a password protected computer for a period of 10 years. Only people such as my chair, committee members, and Walden statistics unit were provided access to the data as needed.

Summary

In this cross-sectional quantitative study design, I examined the association between cell phone use and overweight condition for adolescents ages 14-17 years old. I examined race to find out if it has a modifying effect on the impact of cell use and overweight condition for adolescents ages 14-17 years old. The methodology intended to apply for the data analysis in this study was described in this chapter. Binary logistic regression was used for the data analysis. In Chapter 4, I provide detail information about the results of this study and in Chapter 5, I provide interpretation of the results or findings.

Chapter 4: Results

Introduction

The purpose of this was to investigate the association between cell phone use and weight status in the adolescent population between the ages of 14-17 who reside in the United States. The research questions and hypotheses for this quantitative cross-sectional study were as follows:

RQ1: What is the relationship between cell phone use and adolescent weight status (defined as self-report of normal vs. overweight) after controlling for age, gender, and race?

$H_0$1: There is no relationship between cell phone use and adolescent weight status after controlling for age, gender, and race.

H_a1: There is a relationship between cell phone use and adolescent weight status after controlling for age, gender, and race.

RQ2: What is the effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years old after controlling for age, gender, and physical activity?

$H_0$2: There is no effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years old after controlling for age, gender, and physical activity.

H_a2: There is an effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years old after controlling for age, gender, and physical activity.

RQ3: Does race have a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender?

$H_0$3: Race does not have a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender.

H_a3: Race has a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender.

In the subsequent sections, I will describe the changes in the data collection and present the results in the format of univariate analyses. The next section includes the bivariate and multivariate analyses which were organized by research question.

Table 4

Study Variables and Variable Type

Variables	Variable types
Weight Status (Overweight)	Dependent Variable
Weight Status (Normal Weight)	Dependent Variable
Cell Phone Use	Independent Variable
Age	Confounder
Gender	Confounder
Physical Activity	Confounder
Race	Modifier/Confounder

Data Collection

The secondary data used for this study were collected by the CDC and published on the YRBSS public website (YRBSS, 2018). The data collection occurs biennially during the spring semester at the state, territorial, tribal government, and local levels by the health department from all 50 states (YRBSS, 2018). The CDC collected these data from noninstitutionalized children who reside in the United States (YRBSS, 2018). The survey was performed on adolescent boys and girls within the age range of 14-17 years as self-reported data. The gender distribution in the sample was 51% female versus 49% male. The age distribution of adolescents is 43% 14-15 years old and 57% 16-17 years old. These percentage distributions are reflective of the general population. This information reflects the generalizability of the data.

The data were collected as a national survey through a probabilistic cluster sampling method from a credible organization and are assumed to be representative of the population of interest. After IRB approval, I downloaded the 2017 YRBSS data and recoded the variables to represent the level of measurement.

I changed the research questions due to a discrepancy between how I anticipated the variables were classified and what I found to be true after opening the dataset. Additionally, the research question needed to better align with the gap in the literature. I changed the research question by providing clarity on the weight status and the dichotomous nature of the variable.

Results

In this section, I report the descriptive statistics for the study variables and the results of inferential analysis for the three research questions.

Descriptive Analysis of weight status

The weight (normal and overweight) distribution of boys and girls included in this analysis are shown in Table 5 and Figure 1. The total number of boys and girls surveyed was 14,765. Of this total, 3,064 (20.8%) either did not report their weight status or are not within the weight criteria (normal and overweight statuses) selected for this study, and thus, were excluded from the analysis as "missing system." Of the 11,701 (79.2%) individuals between 14 and 17 years old who met the weight inclusion criteria and were included in the analysis, 7,320 (62.6%) reported a normal weight status, whereas 4,382 (37.4%) participants were overweight.

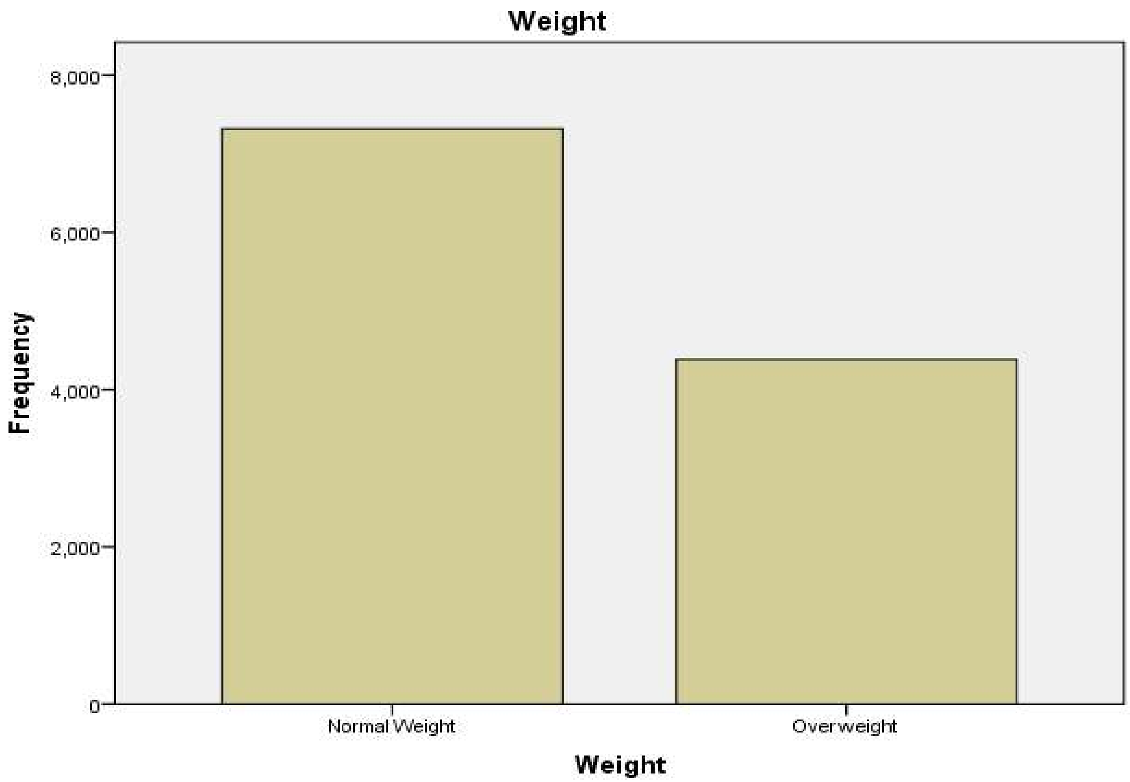
Table 5

Weight (Normal Weight and Overweight) Distribution

Weight Status		Frequency	Percent	Valid percent	Cumulative percent
Valid	Normal weight	7,320	49.6	62.6	62.6
	Overweight	4,381	29.7	37.4	100.0
	Total	11,701	79.2	100.0	
Missing	System	3064	20.8		
Total		14,765	100.0		

Figure 1

Weight Distribution of Boys and Girls



Cell Phone Use

Cell phone use (no use, low use, and high use) distribution among boys and girls included in this analysis are shown in Table 6 and Figure 2. Of the 14,765 boys and girls surveyed, 926 (6.3%) either did not report their cell phone use status or did not meet the cell phone use criteria (e.g., outside of the age criteria) selected for this study and, thus, were excluded from the analysis as "missing system." Of the 13,839 (93.7%) participants ages between 14-17 years old who met the weight inclusion criteria and were included in the analysis, 2,878 (20.8%) do not use a cell phone, 4,977 (36.0%) are low cell phone users, and 5, 984 (43.2%) are high cell phone users.

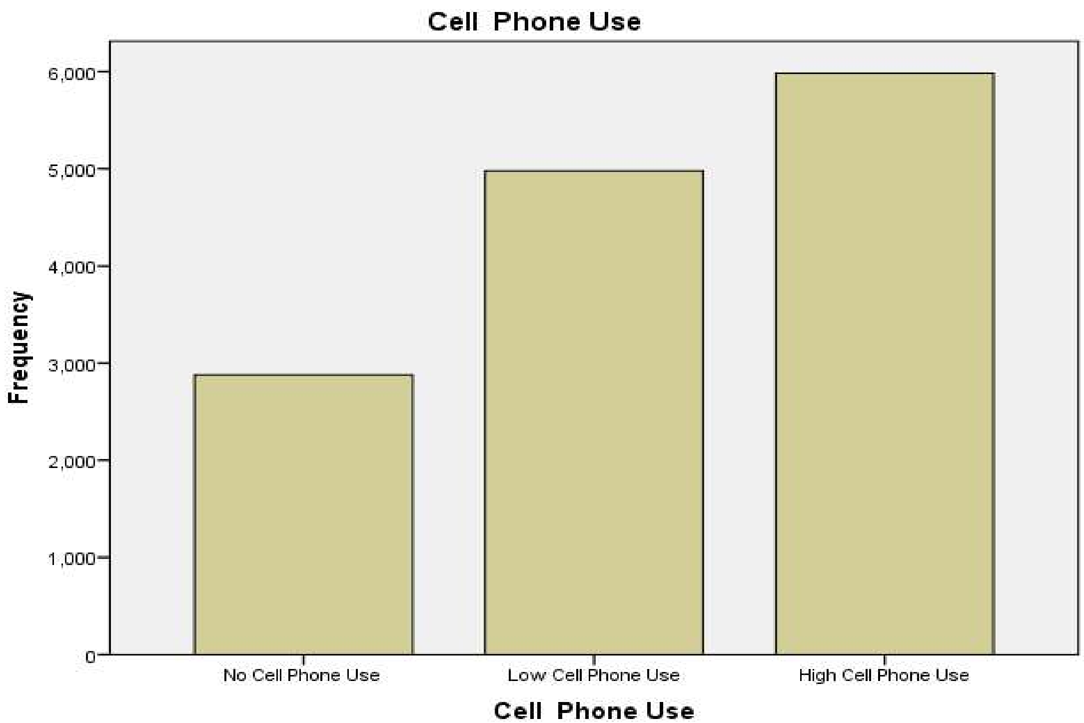
Table 6

Cell Phone Use Distribution Among Boys and Girls

Cell Phone Categories		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Cell Phone Use	2,878	19.5	20.8	20.8
	Low Cell Phone Use (<1 hr./day to 2 hrs./day)	4,977	33.7	36.0	56.8
	High Cell Phone Use (3 hrs./day to ≥5 hrs./day)	5,984	40.5	43.2	100.0
	Total	13,839	93.7	100.0	
Missing	System	926	6.3		
Total		14,765	100.0		

Figure 2

Cell Phone Use Among Boys and Girls

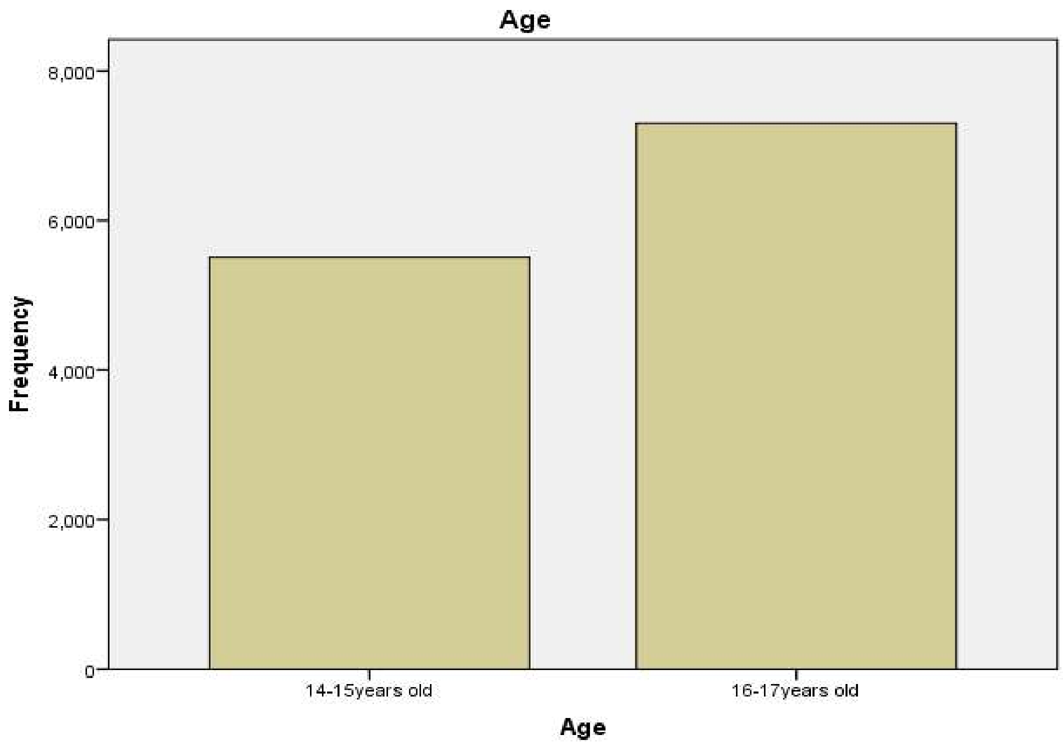


Age

The age distribution of boys and girls included in this analysis are shown in Figure 3. Of the 14,765 boys and girls surveyed, 1,958 (13.3%) either did not report their age or are not within the age criteria (14-17 years old) for this study and were therefore excluded from the analysis as “missing system.” Of the 12,807 (86.7%) who met the age inclusion criteria and were included in the analysis, 5,508 (43%) were between the age of 14 and 15 years old, whereas 7,299 (57%) participants were 16-17 years old.

Figure 3

Age Distribution of Boys and Girls

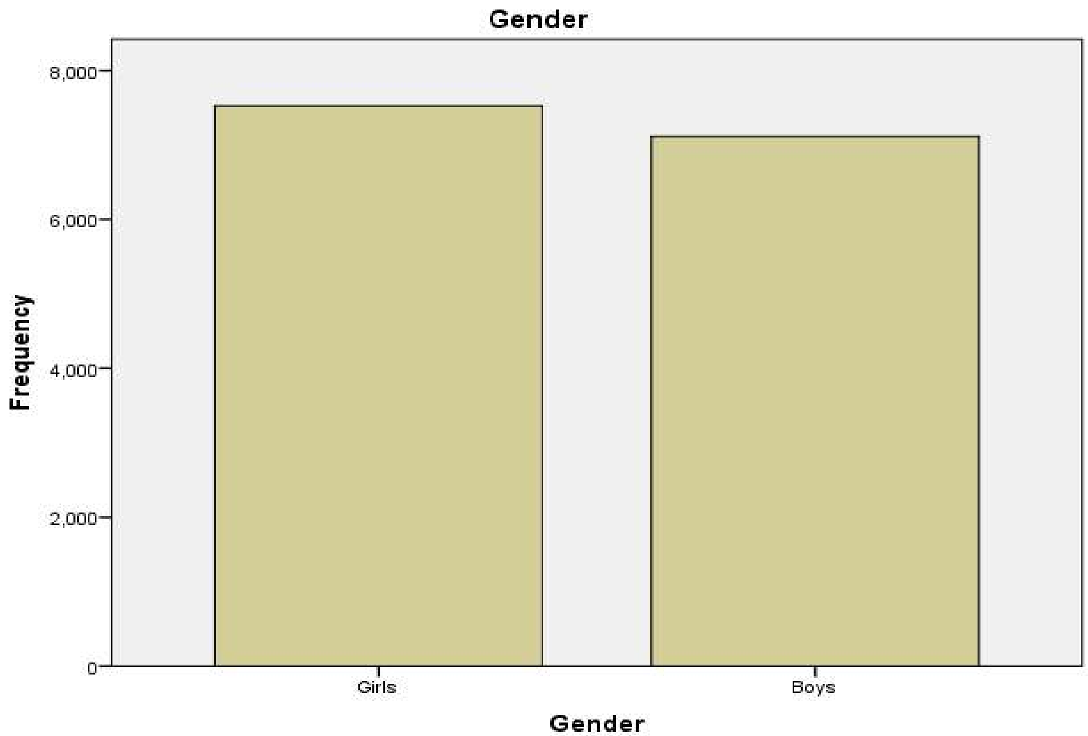


Gender

Gender distribution of participants included in this analysis are shown in Figure 4. Of the 14,765 boys and girls ages 14-17 years old surveyed, 127 (0.9%) did not report their gender for this study, so they were excluded from the analysis as "missing system." Of the 14,638 (99.1%) who met the inclusion criteria and were included in the analysis, 7,526 (51.4%) girls and 7,112 (48.6%) boys were between the ages of 14-17 years old.

Figure 4

Gender Distribution of Boys and Girls

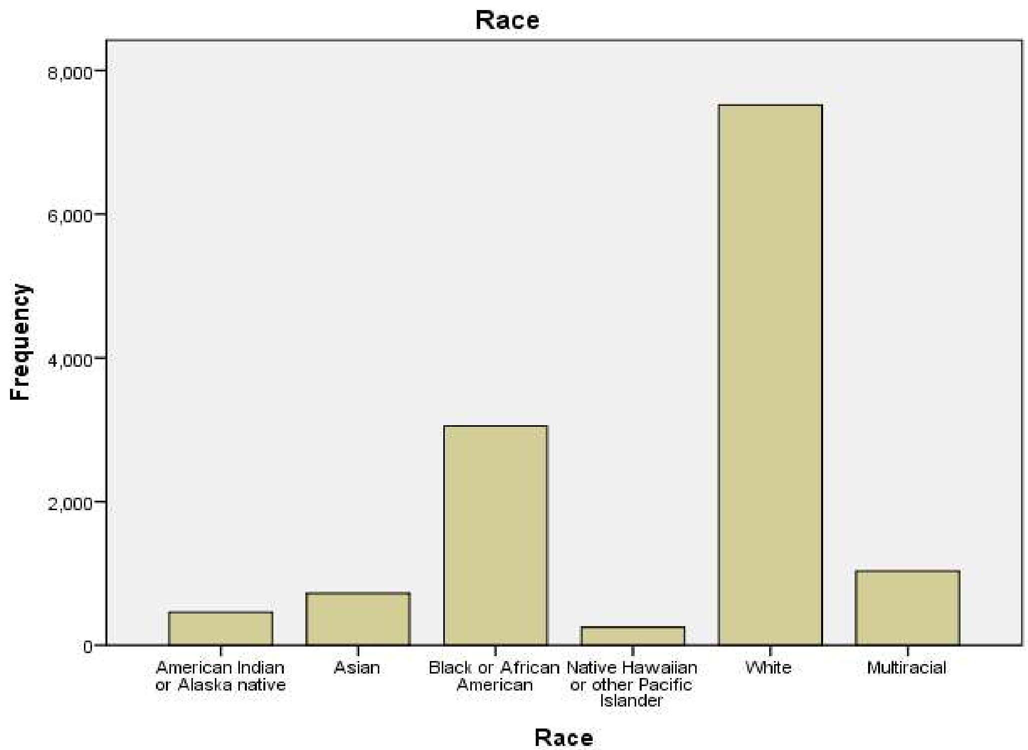


Race

Race categories distribution of boys and girls included in this analysis are shown in Figure 5 below. The total number of boys and girls surveyed was 14,765. Of this 14,765 surveyed, 1,728 (11.7%) either did not report their race or did not met the inclusion criteria (example, outside of the age criteria) selected for this study, and thus, were excluded from the analysis as 'missing system'. Of 13,037 (93.7%) participants ages between 14-17 years old, 458 (3.5%) American Indian or Alaska Native, 725 (5.6%) Asian, 3,053 (23.4%) Black or African Americans, 252 (1.9%) Native Hawaiian or Other Pacific Islander, 7519 (57.7%) White, and 1030 (7.9%) Multiracial boys and girls ages 14-17 years old were included in this descriptive analysis.

Figure 5

Race Distribution of Boys and Girls



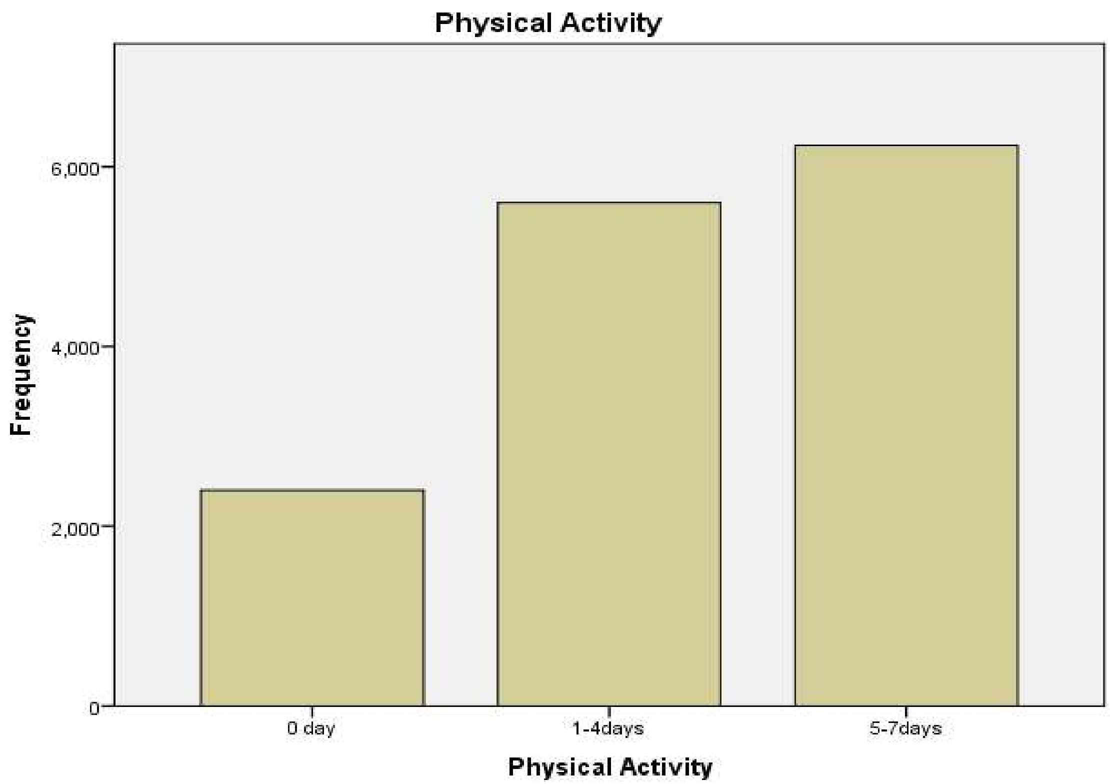
Physical Activity

Race categories distribution of boys and girls included in this analysis are shown in Figure 6 below. The total number of boys and girls surveyed was 14,765. Of this 14,765 surveyed, 527 (3.6%) did not report their physical activity or did not met the inclusion criteria (example, outside of the age criteria) selected for this study, and thus, were excluded from the analysis as 'missing system'. Of 14,238 (96.4%) participants ages between 14-17 years old, 2,400 (16.9%) do not participate in any physical activity. Among boys and girls who reported participation in physical activity, 5,600 (39.3%)

were physically active 1-4 days per week while 6,238 (43.8%) were physically active 5-7 days per week.

Figure 6

Physical Activity Distribution Among Boys and Girls



Inferential Analysis for RQ1

RQ1: What is the relationship between cell phone use and adolescent weight status (defined as self-report of normal vs. overweight) after controlling for age, gender, and race?

$H_0 1$: There is no relationship between cell phone use and adolescent weight status after controlling for age, gender, and race.

*H*a1: There is a relationship between cell phone use and adolescent weight status after controlling for age, gender, and race.

RQ1 Analysis Unadjusted for Age, Gender, and Race

The total number of boys and girls included in the unadjusted analysis for research questions 1 was 11,448 (77.5%). A total of 3,317 (22.5%) of participants surveyed were excluded from the analysis for research question 1 because they did not report either information about weight status, cell phone use, age, gender, race, or did not met the age or weight inclusion criteria (example, excluded if outside of the age criteria [14-17 years old] or underweight or obese) and thus, were considered as 'missing cases' (Table 7).

Table 7

Unadjusted Case Summary of Boys and Girls

Unweighted Cases		N	Percent
Selected Cases	Included in Analysis	11,448	77.5
	Missing Cases	3,317	22.5
	Total	14,765	100.0
Total		14,765	100.0

a. If weight is in effect, see classification table for the total number of cases.

In this study, Table 8 shows the unadjusted model summary for boys and girls ages 14-17 years old with overweight status as predicted by cell phone use. The unadjusted Cox and Snell R square model suggested that only 0.7% of the overweight status reported could be explained by the cell phone use without accounting for age, gender, and race. The Nagelkerke R square model suggested that 1.0% of overweight outcomes could be explained by cell phone use.

Table 8

Unadjusted Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	15074.326[a]	.007	.010

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

RQ1: Overweight versus Normal Weight Unadjusted Analysis

For the unadjusted analysis, boys, and girls ages 14-17 years old who are low and high cell phone users were compared to those that do not use cell phones (reference group), adolescents who are low cell phone users had 7% lower odds of being overweight than adolescents who do not use cell phones (*OR = 0.934, p = 0.205, 95% CI [0.840, 1.038])*. In contrast, those that that are high cell phone users had a 36% significantly higher odds of being overweight than adolescents who do not use cell phones (*OR = 1.360, p*** < 0.001, 95% CI [1.229, 1.505])*. Therefore, without accounting for age, gender, and race, high cell phone use was a statistically significant predictor of overweight among boys and girls ages 14-17 years old (*p*** < 0.001)*, Table 9.

Table 9

Unadjusted Variable in the Equation

		B	S.E.	Wald	df	Sig.	Odds Ratio (OR)	95% C.I. for EXP(B) Lower	Upper
Step 1[a]	No Cell Phone Use			82.857	2	.000			

Low Cell Phone Use	-.069	.054	1.609	1	.205	.934	.840	1.038
High Cell Phone Use	.308	.052	35.466	1	.000	1.360	1.229	1.505
Constant	-.619	.043	208.442	1	.000	.538		

a. Variable(s) entered on step 1: Cell Phone Use.

RQ1 Analysis Adjusted for Age, Gender, and Race

Of 14,765 boys and girls surveyed, 8,854 (60%) were included in the adjusted analysis for research questions while 5,911 (40%) participants were missing and excluded in the analysis. because they did not report their weight status, cell phone use, age, gender, race, or did not met the age or weight inclusion criteria (example, excluded if outside of the age criteria [14-17 years old] or underweight or obese) and thus were considered as 'missing cases' (Table 10). The number of valid cases is less in the adjusted than the unadjusted because not all respondents answered each of the questions.

Table 7

Adjusted Case Summary of Boys and Girls

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	8,854	60.0
	Missing Cases	5,911	40.0
	Total	14,765	100.0
Unselected Cases		0	.0
Total		14,765	100.0

a. If weight is in effect, see classification table for the total number of cases.

Table 11 shows the age, gender, and race adjusted model summary for boys and girls ages 14-17 years old with overweight status as predicted by cell phone use. The adjusted Cox and Snell R square model suggested that 1.7% of the overweight status reported could be explained by cell phone use without accounting for age, gender, and race. The Nagelkerke R square model suggested that 2.3% of overweight outcomes could be explained by cell phone use.

Table 8

Adjusted Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	11434.284[a]	.017	.023

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

RQ1: Overweight versus Normal Weight Adjusted Analysis

With the age, gender, and race adjusted analysis, boys, and girls ages 14-17 years old who are low and high cell phone users were compared to those that do not use cell phones (reference group), adolescents who are low cell phone users had a 2.1% but non-significant slightly higher odds of being overweight than adolescents who do not use cell phones (Table 12). High cell phone users had a 46.2% significantly higher odds of being overweight than adolescents who do not use cell phones ($\beta = 0.380, W(1) = 38.924, OR = 1.462, p^{***} < 0.001$, *95% CI [1.297, 1.647])*. Adolescents ages 16-17 years old and are high cell phone users had a 9.3% significantly higher odds of being overweight than adolescents of the same age who do not use cell phones ($\beta = 0.089, W(1) = 3.833, OR = 1.093, p = 0.050$, *95% CI [1.000, 1.195])*. Girls ages 16-17 years old who were high cell phone users had a 46.3% significantly higher odds of being overweight than boys of the same age who do not use cell phones ($\beta = 0.380, W(1) = 68.832, OR = 1.463, p^{***} < 0.001$, *95% CI [1.337, 1.600])*. Similarly, African Americans ages 16-17 years old who were high cell phone users had a 33.6% significantly lower odds of being overweight than American Indian or Alaska Native of the same age who do not use cell phones (β =-*0.410, W(1) = 9.917, OR = .664, p = 0.002, 95% CI [.514, .857])*. Therefore, after accounting for the predictor of overweight (*p***<0.001*), specifically among girls ages 16-17 years old, high cell phone use and African American race were statistically significant.

Table 9

Adjusted Variables in the Equation

		B	S.E.	Wald	df	Sig.	OR	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	No Cell Phone Use			66.460	2	.000			
	Low Cell Phone Use	.020	.064	.102	1	.749	1.021	.901	1.157
	High Cell Phone Use	.380	.061	38.924	1	.000	1.462	1.297	1.647
	16-17 years old	.089	.045	3.833	1	.050	1.093	1.000	1.195
	Girls	.380	.046	68.832	1	.000	1.463	1.337	1.600
	American Indian or Alaska Native			21.480	5	.001			
	Asian	-.118	.155	.580	1	.446	.889	.656	1.204
	Black or African American	-.410	.130	9.917	1	.002	.664	.514	.857
	Native Hawaiian or Other Pacific Islander	-.033	.206	.026	1	.872	.967	.646	1.448
	White	-.221	.124	3.155	1	.076	.802	.629	1.023
	Multi-Racial	-.136	.144	.890	1	.346	.873	.658	1.158
	Constant	-.392	.134	8.524	1	.004	.676		

a. Variable(s) entered on step 1: Cell Phone Use, Age, Gender, Race.

Inferential Analysis for RQ2

RQ2: What is the effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years old after controlling for age, gender, and physical activity? (Answered in Table 13)

$H_0$2: There is no effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years old after controlling for age, gender, and physical activity.

H_a2: There is an effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17years old after controlling for age, gender, and physical activity.

RQ2 Analysis Adjusted for Age, Gender, and Physical Activity

The results of the analysis from research question 2 is in Table 13. However, out of all the respondents, 9,897 (67%) were included in the adjusted analysis while 4,868 (33%) were missing and excluded in the analysis for research question 3 because they did not report their weight. Similarly, adolescents excluded are outside of the age criteria [14-17years old] or underweight or obese and thus, were considered ′missing cases.

Age, gender, and physical activity were adjusted in model summary for boys and girls ages 14-17 years old. The adjusted Cox and Snell R square model suggested that 2.8% of the overweight status reported could be explained by cell phone use after accounting for age, gender, and physical activity. The Nagelkerke R Square model suggested that 3.9% of overweight outcomes could be explained by cell phone use after accounting for age, gender, and physical activity.

After accounting for age, gender, and physical activity adjusted analysis, boys, and girls 14-17 years old who are low and high cell phone users were compared to those that do not use cell phones (reference group), adolescents who are low cell phone users had a 7.5% non-significantly higher odds of being overweight than adolescents who do not use cell phones (Table 13). High cell phone users had a 40.6% significantly higher odds of overweight status than adolescents that do not use cell phones (β=*.341, W(1)=35.159, OR=1.406, p***<0.001, 95% CI [1.256,1.574*]). Adolescents ages 16-17 years old who are high cell phone users had 3.8% non-significantly higher odds of overweight status than adolescents of the same age group who do not use cell phone (β *=.037, W(1) =.740, OR =1.038, p =0.390, 95% CI [.954, 1.129*]). Girls who are high cell phone users had a 32% significantly higher odds of overweight status than boys who do not use cell phones (β=*.276, W(1) =39.332, OR=1.317, p***<0.001, 95% CI [1.209,1.436]*). Among adolescents ages 16-17 years old who are high cell phone users and participate in 1-4 days per week of physical activity had an 11% significantly lower odds of overweight status than those who do not participate in any physical activity (β = -.117, *W* (1) = 3.678, *OR* =.890, *p* = .055, 95% CI [.789-1.003]). Adolescents ages 16-17 years old who are high cell phone users and participate in 5-7 days per week of physical activity had a 44.9% statistically significant lower odds of overweight status compared to those who do not participate in physical activity (β =*-.595, W (1) =91.231, OR= .551, p***<0.001, 95% CI[.488, .623)*]. Overall, after accounting for age, gender, and physical activity, among girls, high cell phone use was a statistically significant predictor of overweight (p*** <0.001) (Table 13).

Table 10

Adjusted Variable in the Equation

		B	S.E.	Wald	df	Sig.	OR	95% CI. for EXP(B) Lower	Upper
Step 1[a]	No Cell Phone Use			49.348	2	.000			
	Low Cell Phone Use	.072	.061	1.433	1	.231	1.075	.955	1.211
	High Cell Phone Use	.341	.057	35.16	1	.000	1.406	1.256	1.574
	16-17 years old	.037	.043	.740	1	.390	1.038	.954	1.129
	Girls	.276	.044	39.3	1	.000	1.317	1.209	1.436
	0-day Physical Activity/week			138.8	2	.000			
	1-4 days Physical Activity/week	-.117	.061	3.7	1	.055	.890	.789	1.003
	5-7 days Physical Activity/week	-.595	.062	91.2	1	.000	.551	.488	.623
	Constant	-.573	.081	50.030	1	.000	.564		

a. Variable(s) entered on step 1: Cell Phone Use, Age, Gender, Physical Activity.

Inferential Analysis for RQ3

RQ3: Does race have a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender?

$H_0$3: Race does not have a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender.

H_a3: Race has a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender.

RQ3 Analysis Adjusted for Age, Gender, and Race

Table 14 reflects this analysis. After controlling for age and gender, American Indians (Race 1) with high cell phone use show a significant relationship between cell phone use and adolescent overweight with *OR* = 2.361, *p**** < 0.001, 95% CI [1.232,4.526]. Race 1 has a statistically significant higher odds of overweight from high cell phone use than low cell phone users. There is no statistically significant relationship among Asians (Race 2),African Americans (Race 3), Native Hawaiian(Race 4) and multiracial (Race 6). In Caucasian (Race 5) with high cell phone use there is a statistically significant relationship between cell phone use and overweight with OR = 1.546, *p* = 0.0001, 95% CI [1.259,1.899]. Caucasians have a statistically higher odds of overweight with high cell phone use.

Table 14

Analysis of likelihood estimates and Odds Ratio.

Variables	Estimates	SE	Sig.	OR	95% CI	
American Indian or Alaska Native						
Low Cell phone Use	0.5922	0.3157	0.0690	1.808	0.953	3.432
High Cell Phone Use	0.8593	0.3205	0.0111	2.361	1.232	4.526
No Cell Phone Use	Ref.					
Age	0.2769	0.2160	0.2039	1.323	0.853	2.051
Asian						
Low Cell phone use	-0.1805	0.4452	0.6875	0.835	0.338	2.061
High Cell phone Use	0.0149	0.4821	0.9755	1.015	0.381	2.701
Age	-0.2237	0.2991	0.4596	0.800	0.436	1.468
Black or African American						
Low Cell phone use	-0.0733	0.2033	0.7206	0.929	0.615	1.404
High Cell phone use	0.1513	0.2322	0.5189	1.163	0.726	1.864
Age	-0.0877	0.1753	0.6198	0.916	0.642	1.308
Native Hawaiian or Other Pacific Islander						
Low Cell phone use	-0.1547	0.7265	0.8326	0.857	0.196	3.744
High Cell phone use	1.1636	0.8681	0.1887	3.202	0.550	18.651
Age	0.0682	0.4075	0.8680	1.071	0.468	2.449
White						
Low Cell phone use	0.1507	0.1027	0.1512	1.163	0.944	1.432
High Cell phone use	-0.4357	0.1012	0.0001	1.546	1.259	1.899
Age	-0.0413	0.0809	0.6131	0960	0.814	1.131
Multiracial						
Low Cell phone use	0.0306	0.2574	0.9062	1.031	0.611	1.739
High Cell phone use	0.6266	0.3297	0.0656	1.871	0.958	3.654
Age	0.2003	0.2999	0.5084	1.222	0.665	2.246

Summary

The aim of this chapter was to answer three research questions by examining the relationship between cell phone use and weight status in adolescent ages 14-17 while accounting for age, gender, race, and physical activity. Race was further examined as a modifying factor to the association between cell phone use and weight status in the same population while controlling for age and gender. The binary logistic regression was used to evaluate these associations. The independent variable was cell phone use, the dependent variable was weight status and confounders in the model were age, gender, race, and physical activity.

The use of IBM SPSS software statistics standard version 23.0 and a sample size of 14,956 yielded the following results. For RQ1 there was a statistically significant relationship $p < 0.050$ between high cell phone use in adolescent ages 16-17 and overweight. Girls 16-17 with high cell phone use had a statistically significantly higher risk of overweight compared to boys with $p^{***} < 0.001$. In RQ2, even after controlling for different levels of physical activity (a known predictor for obesity), high cell phone use was statistically significantly associated with overweight status when compared with no cell phone use $p^{***} < 0.001$. RQ3 results show a statistically significant relationship for American Indians $p^{***} < 0.0111$ and Caucasian adolescents $p^{***} < 0.0001$ with high cell phone use and overweight when age and gender were controlled. Based on the results of Chapter 4, the null hypothesis for the first two research questions were rejected. For the third research question, the null hypothesis was only partially rejected. In Chapter 5, the interpretation of findings, limitation to the study, recommendation and social change implications are discussed.

Chapter 5: Interpretations

Introduction

Adolescent overweight is a public health threat in the United States. Overweight can lead to chronic conditions such as obesity, prediabetes, diabetes, high blood pressure, cardiovascular disease, and chronic kidney disease. Many overweight risk factors among adolescents focused mostly on nutrition and other determinants. The risk of cell phone use on overweight has not been thoroughly explored. Cell phone use could potentially lead to sedentary behavior, thus increasing the risk of overweight among adolescents. The use of a mobile device for communication and social network systems is overwhelmingly trending among adolescents. Therefore, in this study, I examined the association between cell phone use and weight status among adolescents ages 14-17 years old living in the United States. Age, gender, and physical activity were controlled as confounding factors in the study. Race was used as a moderating variable.

In this study, adolescents ages 14-17 years old who do not use cell phone or are low cell phone users had a lower risk of overweight compared to high cell phone users. Among different race groups Americana Indians adolescent between ages 14-17 years old who are high cell phone users had a statistically significantly higher risk of overweight compared to other race groups. Caucasian adolescents in the same age group had a statistically significant lower odds of overweight compared to other race groups.

Interpretation of Results

The results from the current study are consistent with previous studies. The percentage of boys to girls who were surveyed in this study were 48.6% and 51.4%, respectively (YRBSS, 2018). Age distribution recorded for adolescents 14-15 years old was 43% and for those 16-17 years old was 57%. About 16.9% adolescents had 0 days of physical activity, 39% had 1-4 days, and 43.8% had 5-7 days of physical activity per week. In terms of racial distribution, 57.7% White, 23.4% Black or African American, 7.9% multiracial, 5.6%, Asian, 3.5% American Indian or Alaska native, and 1.9% Native Hawaiian or other Pacific Islander were represented in the study.

RQ1: What is the relationship between cell phone use and adolescent weight status (normal weight vs. overweight) after controlling for age, gender, and race?

$H_0$1: There is no relationship between cell phone use and adolescent weight status after controlling for age, gender, and race.

H_a1: There is a relationship between cell phone use and adolescent weight status after controlling for age, gender, and race.

There was a statistically significant relationship between cell phone use and overweight in adolescents after controlling for age, gender, and race. The association between cell phone use and overweight was statistically significant among girls ages 16-17 years old compared to boys of the same age group ($p^{***} < 0.001$; see Table 12). Therefore, the null hypothesis was rejected. Among the racial groups represented in the study, adolescents ages 14-17 years old who identified as Caucasians had lower odds of overweight compared to those of other race categories in the same age group. American Indian adolescents had a statistically significantly higher odds of overweight compared to the other race groups. This supported Wada et al.'s (2018) findings that suggested cell phone users had higher risk of overweight among children ages 6-7 years old compared to non-users; however, cell phone use among adolescents was not explored in Wada et al.'s study. Wada et al. (2018) also showed a positive correlation between screen time and risk of overweight. Cell phone users had 1.74 greater odds of having excess body weight compared to non-users, but in this current study the odds ratio was 1.46. Wada et al. indicated that children who used cell phone for a longer period were more likely to be overweight, so cell phone use was considered a contributory factor. Similarly, the findings of this current study supported the prevalent use of cell phones described in Tao et al. (2016). Tao et al. noted that there was a correlation between high cell phone use and psychiatric health in middle school, yet the authors did not explore the association between cell phone use and overweight or address overweight as it relates to cell phone use in their study. This current study shows cell phone use and its possible impacts on overweight status among adolescents ages 14-17 years after controlling for age, gender, and race as predictors of overweight status.

RQ2: What is the effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years old after controlling for age, gender, and physical activity?

$H_0 2$: There is no effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years after controlling for age, gender, and physical activity.

$H_a 2$: There is an effect of cell phone use on overweight status versus cell phone use on normal weight status among adolescents ages 14-17 years after controlling for age, gender, and physical activity.

After accounting for age, gender, and physical activity, high cell phone use among girls was a statistically significant predictor of overweight (p*** < 0.001), as shown in Table 13. Therefore, the null hypothesis was rejected. All adolescents who were low cell phone users had a 7.5% non-significantly higher odds of overweight than adolescents who did not use cell phones. High cell phone users had a 40.6% significantly higher odds of overweight status than adolescents that did not use cell phones (*OR* = 1.406, p*** < 0.001, 95% CI [1.256,1.574]). However, adolescents ages 16-17 years old who were high cell phone users had 3.8% non-significantly higher odds of overweight status than adolescents of the same age group who did not use cell phone (*OR* = 1.038, p = 0.390, 95% CI [.954, 1.129]). Girls who were high cell phone users had a 32% significantly higher odds of overweight status than boys who did not use cell phones (*OR* = 1.317, p*** < 0.001, 95% CI [1.209,1.436]). Adolescents ages 16-17 years old who were high cell phone users and participated in 1-4 days per week of physical activity had an 11% non-significantly lower odds of overweight status than those who did not participate in any physical activity (*OR* = .890, p = .055, 95% CI [.789-1.003]). Adolescents ages 16-17 years old who were high cell phone users and participated in 5-7 days per week of physical activity had a 44.9% statistically significant lower odds of overweight status compared to those who did not participate in physical activity (*OR* = .551, p*** < 0.001, 95% CI [.488, .623)]. The findings from this current study were unique as they related to the results described by Sundar et al. (2018) as suggesting that physical exercise via phone app promotes physical fitness. Similarly, according to

Sayegh et al. (2018), under certain environmental and demographic factors, repeated use of telephone reminder calls improved healthy behavior on medication adherence.

RQ3: Does race have a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender?

$H_0$3: Race does not have a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender.

H_a3: Race has a modifying effect on the relationship between cell phone use and adolescent overweight after controlling for age and gender.

For research question 3, race was analyzed as a mediating factor on the effect of cell phone use and overweight after controlling for age and gender. Adolescents who are American Indians low cell phone users had 18% higher odds of overweight status than those that do not use cell phone, yet not statistically significant. On the other hand, high cell phone users had a 23.6% statistically significant higher odds of overweight status than adolescents who do not use cell phones (*OR* = 2.361, $p^{***} < 0.001$, 95% CI [1.232, 4.526]), as shown in Table 14. Therefore, the null hypothesis was rejected; race has a modifying effect on cell phone use and overweight status among adolescents in this study (see Table 14). This finding was consistent with Cantarero et al.'s (2016) findings on excessive body fat in different racial subgroups. Cantarero et al. showed that there was no significant interaction between some racial subgroups but concluded that overweight was highest among American Indians and Hispanic students than their non-Hispanic white counterparts. Similarly, the current study supported Wong et al.'s (2018) findings suggesting that race moderates weight status due to build environment. In Wong et al.'s study, non-Hispanics and African Americans were mostly affected with overweight due to inaccessible recreational environment and low socioeconomic standard.

Interpretation in the Context of SEM

The five levels of SEM that made up the theoretical constructs explained the current study variables. The intrapersonal or personal level explained age, gender, race, and weight. The interpersonal level also explained weight, race, and cell phone use behavior. At the organizational level members of an institution such as schools and other society and cultural institutions provide and promote learning resources including offers to improve physical education classes to promote physical activities and healthy weight as well discourage negative or adverse behaviors (Ssewanyana et al., 2018). In many cases, improved awareness promotes non sedentary lifestyle and healthy dietary behaviors and even discourages the use of cell phone during specific school activities (Ssewanyana et al., 2018). The environmental level includes the United States as the primary target society. The policy level promotes uniformity and adherence to community, organizational, school, and societal level rules, and regulations (Bronfenbrenner, 1977; Scarneo et al., 2019). For instance, in the United States, tickets and fines are imposed on individuals operating a moving vehicle while talking or using a non-hands-free cell phone device because of the potential hazard of cell phone use while operation moving vehicle.

Limitations of the Study

The findings of this dissertation expand knowledge on adolescent overweight problem. Nevertheless, limitations were observed in this current study. The 2017 YRBSS secondary data used for this study were obtained through a cross-sectional design. The dissertation findings do not depict a causal relationship but rather a correlational association between cell phone use and weight status after accounting for age, gender, race, and physical activity. Only adolescents within the ages of 14-17 were included in the study thus, limiting this study findings to only adolescents within the U.S. school regions selected in the 2017 YRBSS. The 2017 YRBSS question on cell phone use was not uniquely and exclusively tailored for cell phone devise, but rather included some other electronic devices. It is possible that the effect of cell phone use is overestimated or perhaps, underestimated. Also, adults and other weight categories such as underweight and obesity were not included in the study analysis, as it is not the primary focus of the study. It is important to consider the effect of cell phone use on adults and other weight statuses.

Recommendations

The study age group was limited to 14-17 years old. It is important to consider cell phone use impacts on younger age group and older adults. Thus, further tailored studies are needed on cell phone use and weight status among adolescents and adult population in the United States. Similarly, it is important to consider a longitudinal prospective cohort design to further investigate the spaciotemporal relationship between cell phone use and weight status. Overweight in adolescence is an early onset condition, so including younger age groups is crucial in expanding scientific knowledge in this area and possibly promote effective public health intervention to reduce the prevalence and incidence of obesity. Since the 2017 YRBSS questions on the use of electronic devices is not specific to cell phone alone, it would be important moving forward for YRBSS to create a specific question on cell phone use. Based on the combined analysis findings described in Chapter 4 and 5, it is also important to invest in health disparity bridge efforts to reduce the overweight impact among American Indian and Alaska Natives. Also, there should be a tailored effort to implement comprehensive policy that will address cell phone risks at the intrapersonal, interpersonal, organizational, and environmental levels.

Implications

The social implications associated with this study will be described in a multi perspective lens. The family, school authorities, adolescents, adults, and public should not just continue to be educated on the risks of excessive cell phone use and overweight, but the public concerns should be considered in the redesign and safety assessment of cell phone moving forward. In public health perspective, early preventive measures on reducing the adverse effects of cell phone use and overweight could improve quality of life, lifespan, and decrease untimely death. The adverse health effects of cell phone use are preventable or amendable risk factors. Public health officials should also focus on age, gender, and race among individuals at risk of adverse health impacts of excessive cell phone use to provide evidence-based and informed resources to guide early interventions. Furthermore, local communities should be informed by local public health departments and stakeholders on appropriate approaches necessary to implement comprehensive and effective intervention program based on the results of this research. A comprehensive approach will include intrapersonal, interpersonal, organizational, environmental, and policy strategies.

Conclusion

I explored the association between cell phone use and weight status among adolescents ages 14-17 years old in the United States after controlling for age, gender, race, and physical activity. Several studies have been conducted on adolescent cell phone use, but none addressed the impacts of cell phone use and weight status among adolescents. Three research questions and hypotheses were addressed in this study all around cell phone use and weight status. For all the three research questions and hypotheses, the null hypotheses were partially rejected. Non-Hispanic White individuals and Native Americans had a significant relationship between cell phone use and weight status.

Evaluation of risk factors in this study is important to inform successful implementation of public health interventions to address adverse health impacts of cell phone use. At the public health level, adolescents should receive informed education and awareness on adverse health impacts of high cell phone use especially as it relates to overweight. All five levels of the SEM play a role in the prevention of unhealthy behavior of excessive cell phone use. As described in the study, cell phone use is trending higher among adolescents. Nevertheless, there are negative consequences associated with its use. Therefore, it is essential for adolescents to understand the risks associated with high cell phone use to facilitate effective targeted intervention. The key positive social change is to integrate healthy cell phone use with an existing obesity public health intervention among individuals, families, and communities (Su, 2015).

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