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Health-Risk Behaviors and BMI percentiles

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Health- Risk Behaviors and Body Mass Index (BMI) Percentiles.

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This work is dedicated to three individuals including my mother Sarah Kigozi, who made sure I went to school from day one. Without my friend and colleague Micky Kaufman and my ex-wife La'Dorian Montgomery, I wouldn't have started this journey.

Abstract

This study examined the relationship between Body Mass Index (BMI) percentile and health risk behaviors of physical activity, dietary behaviors and sleep among high school students from the Youth Risk Behavioral Survey. The study used the 2013 National Youth Risk Behavioral Survey data from the U.S. Center for Disease Control and Prevention (CDC). The researcher used data for 9^{th} to 12^{th} graders to examine the associations between physical activity, dietary behavior, sleep and BMI percentiles among those participants using a measure of Spearman's Rho correlation and Multiple Linear Regression analysis.

There were significant indirect associations between physical activity, dietary behavior and sleep with BMI percentiles in high school boys but not girls. Healthier behaviors were associated with lower BMI percentiles in boys but not in girls. The impact of the three health-risk behaviors on BMI percentiles was not significantly different between White /Caucasian and Black/African American racial/ethnic groups. Future research should consider other mechanisms that might explore differences in health risk behaviors that could inevitably lead to designing better strategies and recommendations for maintaining healthy BMI Percentiles ranges among the U.S. adolescent school population.

Chapter 1: Introduction

From 1976 to 2003 the obesity rate of children and adolescents in the United States increased from approximately 5% to 17%. Results from the United States Center for Disease Control and Prevention (CDC, 2014), collected with the National Health and Nutrition Examination Survey (NHANES, 2010), indicate that this 17% obesity rate has been stable since 2003. While this might seem like good news, an obesity rate of 17% is alarmingly high. Children and adolescents at or above the 95^{th} percentile of the BMI percentile range on the CDC sex-specific growth chart, are considered obese (Ogden, Carroll, Kit, & Flegal, 2014). In 2013, the American Medical Association suggested that obesity was now a disease and attention to the topic of childhood obesity was heightened. Hence, this high obesity rate among children remains a great health concern for the United States.

In response to concerns over this high obesity rate, there have been numerous efforts from policy makers and schools to provide better nutrition through healthy meals. Toward this end, the National School Lunch Program (NSLP) and the School Breakfast Program (SBP) were implemented (USDA, 2016). The NSLP was initially established by the National School Lunch Act of 1945 while the SBP started as a pilot project in 1966, and became permanent in 1975. These programs not only address hunger and provide food security to school aged children, but also offer health and nutritionally balanced meals. According to the United States Department of Agriculture (USDA), the National School Lunch Program provides lunches to about 31 million children each day. Interestingly, Millimet, Tchernis and Husain (2010) suggested that the SBP and NSLP might be *contributing* to the childhood obesity problem. In particular, NSLP may exacerbate the current obesity epidemic.

Why would programs designed to address pitfalls in nutrition and hunger reduction actually become harmful? According to Millimet et al. (2010) SBP and NSLP may increase food consumption. They continue to suggest the need for an improvement in food consumption practices that are necessary to positively impact health in children, especially for those participating in both school breakfast and lunch. They also argue that, student participation in both federal school breakfast and lunch programs provides an income benefit to their households due to an upsurge in consumption of items rather than the *intended* food. It is from such a theoretical increase in consumption that increased concerns on health consequences are arising. They argued that Supplemental Nutrition Assistance Program (SNAP) participants relied heavily on solid fatty foods, alcoholic beverages and other foods that were rich in added sugar as their energy source, compared to their counterparts, especially those in high income economic status. Most of those items consumed by SNAP participants are calorie- laden.

The United States Department of Agriculture (USDA) set standards for SBP and NSLP that began in the 2012-13 school year. These standards are aligned with the most recent Dietary Recommendations for Americans (2015-2020) and address nutrition in school-aged children as well. Yet, there are other food assistance programs that are not covered by tight regulations or are easily manipulated by the intended beneficiaries. Hence, there are questions about how positively school nutrition programs actually affect nutrition challenges they were designed to address. Much more information is needed about how the amount and quality of food provided through school meal programs impacts childhood obesity.

While nutrition is an important aspect in tackling the overweight and obesity problem, other aspects including obtaining the required amount of physical activity have constantly been in the obesity prevention discussions. According to the U.S. Department of Human Services (2008), children aged 6-17 require 60 minutes or more of daily physical activity (USDHS, 2008). In addition, most of those 60 and more minutes should be either moderate or vigorous intensity for at least three times a week, in addition to engaging in bone and muscle strengthening activities should be part of the 60 and more minutes of daily activity on those three or more days a week. Despite those recommendations, many families, schools and communities find themselves unable to provide opportunities for such activities to occur.

Another key issue that is gaining attention recently is sleep. Attention is not only focused on the total number of sleep hours, but also other aspects of sleep in relation to overweight and obesity such as quality of sleep. Total number of sleep hours per night is likely to be affected by lifestyles that encourage social media usage, increased television viewing and more time on computers and other internet powered games or devices. Cauter and Knutson (2008) cite epidemiological studies that point towards chronic sleep deprivation as a contributor to overweight and obesity.

Conceptual Framework

Allensworth and Kolbe (1987) are credited with conceptualizing the Integrated Comprehensive Model that can be applied to school health practices. Their model was the basis for the Coordinated School Health Program that was promoted by CDC in the early 1990s. The Integrated Comprehensive Model suggests that it is important to identify and examine the influence of factors related to *energy balance.* Further, this comprehensive model, which has now been updated by the new Whole School, Whole Community, Whole Child approach advocates for families, schools, and community partnerships. Families like schools, represent the most important component for the preventive efforts in child and adolescent obesity (Dietz & Gortmaker, 2001). The Whole School, Whole Community, Whole Child model has ten interacting components. Among those the current study places emphasis on the Nutrition Environment and Services and Physical Education and Activity components. While this model accounts for those two components that reflect the variables of physical activity and dietary behaviors, it does not account for self-reported hours of sleep. Studies like the one conducted by Patel and Hu (2008) are linking short sleep duration to the obesity risk in adolescents. Such aspects of health behaviors are sometimes beyond either the family or the school's control.

Figure 1.

The Whole School, Whole Community, Whole Child Model.

Reprinted from CDC with permission.

Story (1999) suggested the Integrated Comprehensive model that builds upon the Comprehensive School Health Program model in the schools. Story argues that the challenges of helping young people to change their eating patterns and increase physical activity regularly, in order to achieve healthier weights, is impossible if only carried out through schools or other organizations. Rather it is a communal effort. Efforts to address unhealthy adolescent behaviors have been spearheaded by the CDC through numerous elements of the Youth Risk Behavioral Surveillance System (YRBSS). Most important is the Youth Risk Behavior Survey (YRBS). According to Foti et al. (2011), the YRBS has been used to describe risk behaviors and school health policies and practices, inform professional development, support health-related legislative initiatives as well as seek financial support for future surveys.

Purpose of the Study

The CDC has been collecting Youth Risk Behavioral Survey (YRBS) data every two years since the early 1990s. Data from these surveys have been extensively utilized by states to communicate trends in many targeted unhealthy behaviors, including those that promote overweight and obesity nationwide. Available data could be further analyzed to determine BMI percentiles associations with a number of health-risk behavioral factors in adolescents. Determining weight status among children and adolescents is based on the CDC’s growth charts that take BMI percentiles into account.

Examining data on physical activity, dietary behavior and sleep might demonstrate the impact of factors such as required physical education, active lifestyle, consumption of healthy foods and adequate sleep on one's BMI percentile, and thus their weight status. The latter is important in overweight and obesity prevention in adolescents. The purpose of this study is to conduct this examination for survey data collected in 2013.

Research Questions

1. Is there a relationship between physical activity and BMI percentiles among high school boys and girls?

2. Is there a relationship between dietary behaviors and BMI percentiles among high school boys and girls?
3. Is there a relationship between sleep duration and BMI percentiles among high school boys and girls?
4. Is the relationship between the three health risk behaviors and BMI percentiles stronger for Whites than Blacks or African Americans as reflected by the regression coefficients?

Hypotheses

This study will test the following hypotheses;

- Higher levels of physical activity among high school boys and girls are associated with lower BMI percentiles.
- Healthier dietary behaviors are associated with lower BMI percentiles in high school boys and girls.
- The longer the sleep duration by high school boys and girls, the lower their BMI percentiles.
- The relationship between the three health- risk behaviors and BMI Percentiles is stronger for Whites than Blacks or African Americans as reflected by the regression coefficients.

Need for Study

While the conceptual framework emphasizes a communal approach to preventing overweight and obesity, schools play a center role in promoting healthy lifestyles and preventing obesity. According to USDA, improving childhood nutrition is key to the Healthy, Hunger-Free Kids Act (HHFKA) of 2010, which emphasizes USDA's nutrition guidelines that address school nutrition under the SBP and NSLP. Other supplemental nutrition programs that also benefit children outside school or the school year include the Women Infant and Children (WIC), the Child and Adult Care Food Programs and the Summer Food Service Program, which are also addressed in the new USDA guidelines. Since its inception, The HHFKA has enabled USDA to attempt to promote drastic changes to school nutrition by enforcing real reforms and guidelines that address not only food portions, but also nutrient content. In order to effectuate a successful model that represents an improvement in the school nutrition services, addressing issues in SBP and NSLP is required. In turn, these improvements likely will impact dietary behaviors. Yet, physical educators are challenged to provide adequate physical activity and nutrition education as school time is diverted to areas such as mathematics and reading that are addressed in high stakes, standardized testing programs. Dietary behavior and physical activity are both aspects of adolescent lifestyles that potentially impact weight status.

Healthy school nutrition programs are not as easy to implement as might be thought. Social stigma is frequently an issue for implementation. Moore et al. (2007), indicated that often students do not participate in school nutrition programs because they are afraid of being labeled “low-income”. Suggestions have been made to allow these students to have breakfast in their classrooms as a class so students can feel safe in a social environment (Moore et al., 2007). However, no similar suggestions have been made for lunch in classrooms. More information about social stigma as a barrier to healthy nutrition in schools is needed.

Home-packed lunches could be an alternative for students concerned about the social stigma associated with provided school lunches, but home-packed lunches are banned in some public schools. A Gallup Poll (Saad & Busteed, 2013) showed that parents are concerned about the ban against home packed lunches in public schools. Secondly, 79 % of public school parents and 82% of nonpublic school parents reject the idea that children have to eat school provided meals. Thirdly, these restrictions create a question of whether some of those parents would retaliate by sending or sneaking additional food to their children through all means possible. Finally, Hastert and Babey (2009) found out that adolescents who consumed home- packed lunches were more likely to engage in positive dietary behaviors practices than their counterparts who consumed meals from other sources. The Gallup Poll results also indicated that 67% of adults favored federal guidelines on school-based foods while 75% of public school parents and 64% of nonpublic school parents favored such guidelines.

In 2009, USDA suggested that an extension of the SBP to all U.S. children is a great benefit to them. This benefit is intended for food security and overall health of all students. Guthrie, Newman, Prell, Ollinger and Ralston (2012) argue that, although originally designed to address nutrition, school breakfasts and lunch programs, may now fuel overconsumption in children and thus promote childhood obesity in the U.S. They continue their argument based on the perception that these meals encourage overeating, due to the fact that they are cheap and readily available in the form of free or reduced meal plans. However, their research concluded that there was no available evidence that school lunch participation promoted childhood obesity.

On the other hand, Guthrie et al. (2012) also reviewed other studies that compared body weight status of school lunch program participants and nonparticipants and found that participants were more likely to be overweight. This in turn implies that more free/reduced lunch may mean more poverty, and less healthful living, with more doctor visits and hence more overweight and in some cases obesity. Several studies have attempted to control for age, income, gender and ethnicity, as well as social economic status associated with likelihood of participating in NSLP, and found differences in obesity rates. Gibson (2004) and Jones et al. (2003) indicated differences in their findings. In the 2004-05 school year, school meals served were less likely to meet nutrient requirements for total and saturated fat than other nutrient sources such as protein, vitamins and minerals (Story, 2009). However, in recent years, more emphasis on school nutrition, has been placed on food service, as required by the new USDA guidelines. The Food and Drug Administration (FDA) has also revised and set new guidelines for nutrition labels on all packaged foods sold in the U.S. (Guidelines Available at http://www.fda.gov/downloads/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/UCM502019.pdf).

Conversely, instead of only focusing on nutrition behaviors, there is also need to study the role of insufficient sleep in higher risk of obesity among children. Cauter and Knutson (2008) noted that there is expeditiously increasing information on chronic partial sleep from both epidemiological and clinical studies indicating its link to obesity risk and weight gain. Patel and Hu (2006) conducted a review of literature that supports this finding. Unlike the two studies above, Lowry, Eaton, Foti, McKnight-Eily, Perry and Galuska (2012) conducted an analysis of national YRBS data and examined the association between self- reported obesity and self reported sleep duration and found results to exhibit gender differences with girls having significant association between sleep and obesity compared to boys, who had no significant association. They also cautioned abrupt sleep adjustment without further studies.

Finally, with the 2015 introduction of the USDA dietary guidelines, many questions still remain about physical activity and education, participation in activity among high school students, and in particular less opportunity for physical activity considering the pressing emphasis on resources devoted to improving scores in reading and mathematics. U.S. Department of Health and Human Services' 2008 Physical Activity Guidelines for Americans (Guidelines are available at www.health.gov/paguidelines) clearly outline specific modes and durations for physical activities necessary to promote good health among different groups of Americans. These guidelines also emphasize physical education literacy and activity for children and adolescents and align with the Society of Health and Physical Educators of America (SHAPE America) standards for K-12 physical education that aim at developing individuals who are knowledgeable and confident with skills to fully enjoy a lifetime of physical activity.

The results of this study provide insight into the trend of health lifestyles. National, local, school, and state administrators are informed about how students' behaviors impact their health status. Policy makers are able to devise means of either revising the nutrient requirements and design policies that encourage healthier food service during after school activities and parties, or push for counter measures such as required daily physical activity, exercise at school, or discouraging snacking of high salt, high sugar and fatty foods. In addition there should be a debate the shortening or lengthening of the school day for meaningful purposes of increasing physical activity time, parents would benefit from the study by understanding the role of factors such as sleep duration, in children's weight status.

Limitations and Assumptions

This study relied on data collected by the Center for Disease Control and Prevention and a partnering contractor who is responsible for the survey and its sample design. The CDC provides an oversight to the contractor. National YRBS data depends on the respondents' truthfulness due to the nature of the reporting. Secondly, the school-based surveys only apply to school aged adolescents, and are not representative of non-school attendees in this age range.

Also, there are limitations and assumptions with using bivariate correlation and regression analysis. Even though bivariate correlation determines the relationship between two variables, a positive correlation doesn't necessarily imply causation. Correlation is used on the assumption that the relationship is linear, and the joint distribution is bivariate normal. There are also a number of assumptions with using multiple regression analysis. These assumptions are further discussed in chapter 4.

Chapter 2: Review of Related Literature

This chapter provides an overview of current literature on socio-economic and demographic factors surrounding dietary behavior in schools, school lunch programs, food consumption choices and other after school lifestyle behaviors among high school students. Also reviewed are other factors within the Coordinated School Model, and the new Whole Child, Whole School and Whole Community Model, that might play an important role in determining quality healthy lifestyles among adolescents. This chapter also reviews literature on physical education, physical activity and sleep.

Sleep, Lifestyle and Food Consumption

U.S. and global obesity prevalence rates have drastically increased with two-thirds of adults in the U.S overweight or obese. According to the World Health Organization (WHO), 39% of adults 18 years of age and over were overweight in 2014. Also 13 % of the adults worldwide were obese [Available at http://www.who.int/mediacentre/factsheets/fs311/en/]. The WHO also reports that the prevalence of obesity is highest in the Americas. In all WHO regions, men were less likely to be obese than women in 2014. Like many other studies, obesity is strongly linked to insufficient levels of meaningful physical activities on a regular basis, in addition to poor dietary practices that often encourage high caloric consumption. This is mainly evident in the wealthiest nations rather than many poor ones. A study conducted by Mendis, Puskar and Norrving (2011) found that the prevalence of sufficient physical activity was much higher in poor countries than in wealthy western nations. The National Health and Nutrition Examination Survey (2012) indicated that the prevalence of obesity was levelling off in children of ages between 2-5 years at 8.4 %, but not among children 12-19 years who increased from 14.8% in 2000 to 20.5 % in 2012.

Ogden, Carrol, Kit and Flegal (2014) conducted a study that provided some of the most recent childhood obesity estimates between 2003 and 2012, as well as providing a trend analysis among adults. With the help of the National Health and Nutrition Examination Survey (NHANES) data, the study provided room for follow up on adult estimates. However, Ogden et al. (2014) indicated that due to lack of trends in overweight prevalence between 1960 and 2010, the overweight prevalence for those decades are more descriptive rather than analytical.

Often, a lifestyle that centers around hours of television viewing, engagement in social media, texting, internet surfing, and so on results in shorter sleep times and increased tendencies to snack. Obviously, physical activity levels suffer as engagement in these sedentary behaviors increases. Sedentary behaviors are often linked to an increase in snacking. Many of the snacks children consume are high in trans-fat and saturated fat and high in sodium content. High saturated fat-containing foods are known to increase cholesterol levels and promote heart disease, stroke and many cancers.

These interrelated threats to good health differentially influence those from low-income households. Appelhans, Fitzpatrick, Li, Cail, Waring, Schneider, Whited, Busch and Pagoto (2014) suggested that childhood obesity disproportionately affects children from low-income households. They examined ways in which socio-physical home environments might promote overweight and obesity in poor households. The researchers collected health behaviors data of households, in which 48 homes had normal weight children and 55 households whose children were predominantly overweight/obese. These children were aged 6-13 years and had caregivers who assisted to jointly report on child sleep duration, screen time, and dietary intake. They concluded that home-environmental aspects influence childhood weight status indirectly through television and other device usage and duration of sleep, especially in poor children.

On this note, aspects of sleep beyond duration should be considered. Jarinn, McGrath and Drake (2013) conducted a study of about 240 healthy children and adolescent with an average age of 13 years. They looked at other factors beyond sleep duration such as sleep disturbances as well as sleep quality and patterns, and subjectively measured them. Sleep duration was significantly associated with obesity; however, the link depreciated after adjustments of covariates. Their results suggested that these other aspects of sleep might indicate or suggest influences that drive the negative associations between sleep deprivation and obesity more precisely. The researchers recommended that more longitudinal and prospective research designs be used in future research.

Cauter and Knutson (2008) also noted that changes in traditional lifestyles, including diet and decreased physical activity, do not completely explain an obesity epidemic. It has also been recently proposed that among other behaviors thought to be linked to this epidemic is sleep curtailment. Yet, Cauter and Knutson (2008) note that sleep duration is usually subjectively measured using self-reports. From the evidence, sleep reduction in young adults resulted in adjustments in both endocrine and metabolic functions. This behavior appeared to have escalated in the recent five decades and are now highly prevalent, particularly among Americans. In addition to the laboratory evidence, Cauter and Knutson (2008) identified a rapidly increasing number of epidemiological studies that indicate positive relations among overweight and obesity and chronic partial sleep loss.

Among the epidemiological studies is one by Patel and Hu (2008) that presented more critical evidence on short sleep and its impact on the obesity risk that appears greater in children than individuals at other stages of the lifespan. Results from a 2006 U.S. survey conducted by U.S. National Sleep Foundation, with self-reported sleep times, showed a steady decrease in sleep at critical ages of 11-12 years and at 17-18 years. This decrease in sleep duration was not fueled by early wakeups but instead the habitual late bedtimes among respondents who were knowledgeable of the insufficiency in total sleep. This form of intricate lifestyle might be linked to a number of factors beyond the children's control such as parents working late or even homelessness.

Lytle, Murray, Laska, Pasch, Anderson and Farbakhsh (2013) conducted a longitudinal study that included 723 adolescents from Minnesota with an average age of 14.7 years at baseline. Their 24- hour recall of food intake, activity levels and sedentariness were among the behaviors assessed in both boys and girls, whose average body composition measures and sleep duration decreased slightly at the end of two years. This study suggests that the decline is sleep duration has less impact on obesity, and is contrary to other studies.

Drescher, Goodwin, Silva and Quan (2011) investigated the association between sleep duration and obesity risk factors among 319 Caucasian and Hispanic children aged 10-17 years. Lifestyle factors were measured through surveys that included electronic screen time, dietary and caffeine intake exercise and sleep habits as reported by parents. In addition, they also recorded anthropometric measures such as height and weight from which BMI could be calculated. Parental input in reporting sleep times was a factor for Hispanic participants, where ethnicity was significantly associated with lower reporting in terms of sleep duration and BMI z score. Age group differences were also evident, especially between younger and older adolescents in relation to dietary and sedentary behaviors. Caffeine consumption factored in sleep duration among older adolescents whereas young adolescents were more affected by electronic screen time.

Other studies have linked lack of sleep to adolescent and adult weight issues. Cappuccio, Taggart, Kandala, Currie, Peile, Stranges and Miller (2008) conducted a meta-analysis of short sleep duration using a literature search and found an “increased risk of obesity amongst short sleepers in children and adults”. Lowry, Eily, Foti, Galuska, Eaton, and Perry (2012) suggested that in order to recommend sleep time alterations as a remedy for addressing the adolescent weight problem, better knowledge on factors regarding the obesity and sleep duration relationship is warranted. To thoroughly investigate healthy eating among high school students, studies like Lowry et al. (2012) suggested that sleep education should be considered, particularly in this technological and social media era. Teaching adolescents about topics such as late night snacking would be an addition to other healthy related topics such as the importance of daily breakfast.

Perhaps more studies on other health risk behaviors, such as unhealthy dietary behaviors among school children, is also warranted. USDA (2000) noted that a number of studies have analyzed data from the School Nutrition Dietary Assessment (SNDA-1) and the School Nutrition Dietary Assessment (SNDA-IV) databases. In these studies, random samples of school meals and childrens’ diets were analyzed. These studies provided an assessment of the school nutrition programs, the most common nutrition programs being

NSLP and SBP. Gleason and Suitor (2003) found that breakfast availability was not associated with a higher urge for its consumption and that lunches under the NSLP exceeded their recommended nutrient requirements from fats. Gordon, Devaney and Burghardt (1995) also discovered that both school lunch and breakfast programs exceeded the required nutrient guidelines, especially in regards to fats, cholesterol and sodium. However, there were observable differences in the nutrient surplus between lunch and breakfast. The 24-hour dietary recall on both program participants also revealed that there were associations between fat intake and some nutrient benefit.

Missing school breakfast is common among late comers, especially when breakfast is served prior to the first school period. Students who commute after missing the school bus would in most cases fall into a category of students who might have slept late or awakened late or both. Missing breakfast often disrupts the body’s metabolism and leads to weight fluctuations. This is possible especially when parents assume that children eat breakfast at school. Pinard, Byker, Harden, Carpenter, Serrano, Schober and Yaroch (2014) conducted a study on food consumption among English and Spanish families. They sought to understand a link between food away from home and obesity. These bilingual school aged children were interviewed on away from home dietary practices. From this study, family decision making, especially on menu ordering between parent and child is intricate. Other children and adolescents may deliberately skip breakfast due to peer pressure and social influence. Therefore, it is important to consider such factors when studying dietary behavior and impact on health status.

Sociocultural Pressures

Food consumption among children, especially in preadolescence and adolescence is getting increasing attention as a factor that has been linked to weight management in those age groups. Family eating behavioral practices and peer pressures are continuously reported to influence eating behavior. Yet, the relationship between hunger and food consumption is still a mystery. Sociocultural pressures with eating in absence of hunger (EAH) among 90 adolescents were studied using parental reporting of child dietary practices. In this same study the adolescents completed a series of questionnaires and self assessments. Eating in absence of hunger was especially when surfeit eating occurred (Reina, Shoemaker, Mooreville, Courville, Brady, Olsen & Yanovski, 2013). Control factors such as body composition, were found to have a greater association with EAH. "Appearance orientation and preoccupation with becoming overweight mediated links between sociocultural pressures and EAH" (Reina et al, 2013, pg. 1). The findings of Reina et al. (2013) also support the link between social cultural pressures and body image, and how this impacts eating behaviors in adolescences. EAH both at school and in homes therefore provides a sketchy but not valid linkage between eating habits and peer or family role in such behavior. Reina et al (2013) also found a strong positive correlation between EAH and media pressure. However, mediations between other factors were evident, including appearance orientation, preoccupation with becoming overweight, social cultural pressures, and not-hungry eating.

Jones and Crawford (2006) studied gender and body mass variations. They asked an almost similar number of girls and boys in the 7th or 10th grade to self-report their experiences. The experiences were organized into three categories: appearance culture among friends, peer evaluation, and peer acceptance concerns. These experiences included diet/muscle talk, appearance teasing, and peer appearance comparison. There were gender differences with conversations related to body appearance common among girls while teasing and pressure due one’s appearance were common among boys. The males reported having peer conversation on building muscles more than females conversed on dieting. BMI indicated distinct gender variations and were largely attributed to appearance culture among females who were overweight compared to their counterparts whose BMIs were differently associated for both underweight and overweight males.

Even with the above evidence between sociocultural pressures and eating patterns, more in-depth studies need to be conducted on various sociocultural pressures and their immediate indicators. On the other hand, school nutrition programs continue to gain attention not due to the peer pressure between program participants and non-participants, but due to their associations to weight gain and the controversial school reimbursements. There is evidence of gender differences in sociocultural pressures surrounding eating.

Economics of Food Programs

Several studies, including the one conducted by Millimet, Husain and Tchernis, (2010), have found a link between supplemental nutrition programs and obesity in children. Families in need of government support qualify for assistance through the Supplemental Nutrition Assistance Program (SNAP) and/or Women Infant and Children (WIC). Although these food assistance programs seem to be helpful, they have been linked to excessive meat, sugar and fat consumption, all of which are linked to excessive weight gain if unaccompanied by at least the recommended levels of physical activity for Americans. Pelican, Proulx, Wilde and Del Vecchio (1995) found that, compared to non-participants, SNAP participants consumed almost similar amount of foods from plant produce, but more from animal produce and processed foods than nonparticipants.

Although research findings for children and some other populations have been equivocal on the relationship of food programs on body weight, there is an evidently stronger link in low income women but not necessarily low income men (Gibson, 2006). Previously, Gibson (2004) had also suggested that low income women who participated in food stamp program were at a higher risk for current obesity. Children from these low income households were more likely to enroll in after school care. Gibson (2004) found that an additional year of SNAP participation was positively linked to overweight among young girls, but negatively related to overweight among young boys. In contrast, Jones, Jahns, Laraia, and Haughton (2003) have refuted Gibson’s findings. They found no link between school program participation and obesity, in either young girls or young boys. Other studies have attempted to address the food consumption issue in schools by examining consumption of competitive foods and beverages. Kakarala, Keast and Hoerr (2010) excluded a la carte consumption in their study and only targeted other competitive foods/ beverages in the schools that competed with United States Department of Agriculture (USDA) meal program offerings. Though this paves the way for more understanding of these complexities, eliminating al carte consumption can be somewhat deceiving on the overall children's diet quality.

The economics of food programs in schools have attracted much attention in recent years with many questions lingering around federal funded food programs and the reimbursements to schools, and contractors that accompany them. It is important that future studies examine the economic advantage and disadvantages to various stakeholders including how their choice affects the availability of other food options in schools.

Parental and Community Involvement

According to a 2009 poll of physical education teachers, "31% of the physical education instructors perceive increased interest and support from parents regarding students' physical activity; and 27% perceive increased interest/support from parents regarding students' physical education" (NASPE, 2009, pg. 7). Nearly 95% of parents polled by Action for Healthy Kids in 2003 think "Physical education should be a part of school curriculum for all students in K-12" (NASPE, 2011, pg. 5). There has also been an increase in community involvement with nonprofit organizations that offer before and after school programs across the nation according to the Center for Disease Control (CDC). Community and school based programs should follow these guidelines in encouraging lifelong physical activity for children and adolescents. These guidelines address policy related aspects on health and physical education as well encourage parental involvement in extracurricular activities, both at school and in the community (NASPE, 2011). Various public, private, and non-profit organizations are increasingly getting involved in before and after school programs, some of which provide foods to students during or after activities. The question is whether all organizations are following the newest USDA guidelines. Every organization that feeds children can employ these dietary strategies (Wiecha, Hall, Gannett & Roth, 2012). Barlow (2007) notes that The

American Academy of Pediatrics advocates for healthy breakfast that consists of a variety of daily fruits and vegetables in addition to a whole family inclusion in designing and maintaining these healthy habits.

Another important factor is one of parental employment, especially maternal employment. Recent studies suggest that family grocery shopping and cooking are affected by maternal employment in addition to increasing the probability of purchasing prepared foods (Cawley & Lui, 2012). It should be noted however, that parental unemployment might benefit children in afterschool programs. One major obstacle involving parental participation in afterschool programs stems from the inability to correctly determine the effect of their participation in the programs. Thomas (2006) conducted a review of four studies that yielded inconclusive results of the primary studies in regards to dietary improvements and physical activity level increments as a remedy for obesity prevention programs for children and youth. Thomas also found out that the effectiveness of parental involvement in those programs was unclear.

Luckily, many schools are still encouraging parental volunteering in their before and after school activities. Even with this continued community support for providing physical activity programs, not all students fully participate due to many factors including waivers and exemptions among many that limit children's participation.

Physical Activity and Education

A number of schools and school districts across the U.S., often contemplate ways of dealing with budgetary challenges especially during difficult economic times (SHAPE America, 2014). Suggestions to reduce or cut programs often point towards eliminating

Physical Education (PE) programs, which becomes the victim of unforeseeable budgetary shortfalls. Even though Physical Education has been emphasized as a critical and needed investment in our nation's youth, decision makers regularly pay no attention. U.S. department of Health and Human Services Guidelines for physical activities are in line with the national PE standards and guidelines for children and adolescents.

The Society of Health and Physical Educators of America (SHAPE America) emphasizes the adoption of a framework that promotes high-quality physical education in addition to meeting the physical activity and education standards, including a minimum of 150 minutes of weekly instructions in elementary school and 225 minutes in middle and high schools. The above recommendations are in line with those that are necessary for high-quality health when physical educators provide programs that follow a developmental sequence. Many of the designed programs encourage an increase in duration of physical activities albeit whether that increase elicits change that would be necessary to impact obesity rates is still questionable. In some cases, the necessary recommendations for daily moderate to vigorous physical activity for all children are not being met.

Yeh, Chen, Ku and Chen (2015) studied a group of over 8000 boys and girls in 5^{th} to 9^{th} grade in Taiwan from 2007 to 2008. 51 percent of these participants were girls, and 49 % were boys. They investigated the relationship between physical activity and overweight by considering internal factors. They designed an internal factor bivariate probit model that was estimated by the maximum likelihood method. Yeh et al (2015) found out that the relationship between overweight and physical activity was significantly negative in this model compared to the external factors model. Their results suggest that the emphasis should be placed on external factors and how they impact overweight and obesity in children.

Carlson, Crespo, Sallis, Patterson and Elder (2012) studied a group of 6-9 year olds in a two year longitudinal study that reported on both diet-related and physical activity predictors of obesity. About 48% of the respondents were Latinos out of the 227 participants. The findings suggested that there was an interrelatedness of the factors. Moreira et al. (2010) also studied food patterns, physical activity, and sleeping in Portuguese children. This study reported those factors on 1,976 children aged 5-10 years of age. From their study, television viewing, and longer sleep hours were associated with consumption of fast food and the lack of a vegetables and fruit-rich diet.

Minematsu et al. (2015) recruited 302 Japanese children aged 9-12 years and asked them to wear 3-D speed sensors. They used techniques such as bioelectrical impedance analysis to measure body composition. Daily and weekly caloric expenditures were recorded. Minematsu et al. (2015) concluded that 40 minutes of moderate to vigorous exercise and more than 11,000 steps per day were necessary for preventing obesity in children. Their results support the fact that sedentary behaviors among children increase the childhood obesity risk.

Laguna, Ruiz, et al. (2013) sought to conduct both accurate and non-subjective measures of movement patterns in Spanish children and adolescents based on demographics and weight status of participants in the European Youth Heart Study. Using anthropometric measures of height, weight and BMI, as well as measurement of physical activity on six consecutive days using a GT1M accelerometer, they discovered variations in activity levels across different weight status categories, especially at 9 years of age. Normal weight boys also engaged in more vigorous physical activity than overweight/obese boys. Children engaged in more physical activity on weekends than weekdays. Overall, the levels were insufficient for all children.

The reduction of physical education in many schools appears to be a new norm in the U.S. From the results of the 2006 School Health and Policies study, this institution has continued to impact full participation in physical education and activities at elementary, middle and high schools countrywide. Yet, there is mounting evidence that suggests that children need meaningful daily physical activity participation. "School-age youth should participate daily in 60 minutes or more of moderate to vigorous physical activity that is developmentally appropriate, enjoyable, and involves a variety of activities" (Strong et al. 2005, pg. 732).

Standard Two of the Society of Health and Physical Educators states that "The physically literate individual applies knowledge of concepts, principles, strategies and tactics related to movement and performance" (SHAPE America, 2014, pg. 26). Specifically, this standard integrates health and physical education theory with practical experiences outside of the classroom. Usage of skills and knowledge in individually chosen activities is recommended to enable school aged children and youth to attain at least 60 minutes per day of moderate to vigorous physical activity" (SHAPE America, 2014; Strong, et al., 2005; USDHHS, 2008). Though Physical Education programs provide some physical activity time, it is just a mere portion of the necessary time and is not sufficient to have significant impact. It is therefore due to this reasoning, in addition to the development of positive life skills, that student participation in more physical activity and education in communities and schools should be emphasized. The lesser the time provided for physical education in schools, the longer the period of out-of-school activity needed, especially if a school's physical education program doesn't provide for five classes per week.

Unfortunately, despite these recommendations, there are schools that are moving towards reciprocating physical education with alternative programs. Yet, it is important to track physical education class time and amount of activity time in those classes when studying obesity and overweight. Lounsbery et al. (2014) compared the outcomes from two groups with one engaging in physical education time versus another engaged in Junior Reserve Officer Training Corps (JROTC), a commonly used alternative for PE time. There were significant differences in instruction time, content and context, with students engaging in more moderate to vigorous physical activity during Physical Education than JROTC.

Summary

The literature shows children's lifestyle factors have been determined by a wide range of factors fueled by an uncoordinated approach to healthy lifestyle promotion. However, the research has also yielded equivocal findings between genders and among groups. By far, understanding new strategies could help policy makers, educators and medical professionals address the lifestyle problems leading to an addition to the current strategies. Additional research is also necessary to further understand the direct link of BMI on school nutrition and physical activity programs to other determinants of health lifestyles, without forgetting the family and community factors as well, since factors such as sleep might be beyond the schools' control.

Chapter 3: Methodology

Chapter three describes the methods that were used for this study. The 2013 National YRBS data from CDC was analyzed for relationships between BMI percentiles and three health risk behaviors, physical activity, dietary behavior and sleep, among adolescents based on the self-reported responses from the national sample. Then, relationship were examined between all the above variables and BMI percentiles while controlling for gender and race/ethnicity.

Participants and Sample

The data used was from responses to YRBS items about physical activity, food and other related health topics for 9th to 12th grade high school students drawn from the 2013 national sample that was determined using a three-stage cluster sample design by the CDC. Participants were from selected private and public schools that were in the representative pool. Some of the schools chosen for the national sample might also have participated in the statewide YRBS and others might not. Initially 15,480 students were sampled. Of those 13,633 submitted their questionnaires and after data editing 13,583 were usable. In this study, elimination of missing cases was by listwise as well as removing outliers at three standard deviations from the mean where necessary. The participants were both boys and girls from the 9th and 12th grade classes that had a varying racial and ethnic make-up. YRBS samples estimates are set at a ±5% range at the 95% confidence level. The response rate for the 2013 National YRBS was 77% for schools, 88% for students and an overall response rate of 68%.

Study Design

This study was non-experimental, multivariate correlational design, using secondary data collected as part of the national YRBS administered in 2013 using a national representative sample. That national sample was created using a three stage cluster sample design of high school students in both private and public high schools in all states and the District of Columbia (CDC, 2013). The sample did not include U.S. territories.

Procedures

Approval for conducting the study was obtained from the University of Missouri – St. Louis Institutional Review Board. The CDC availed the researcher with the YRBS data for further analysis. However, since there were no human participants to be engaged directly for this study, there was no need for informed consent to conduct the study, since the study only involves analysis of an existing database.

Instrument

The 2013 YRBS, a self- reported questionnaire, is a national survey (available at http://www.cdc.gov/healthyyouth/data/yrbs/data.htm) and was administered by the CDC through partnering schools in different states, territories, and school districts within the United States. The YRBS is a school classroom based survey developed by the CDC for high school students to report health risk behaviors among students in 9th through 12th grades (CDC, 2013). The national YRBS is conducted by the CDC, whereas local and state surveys are conducted by their health and education departments (CDC, 2013). The survey is administered every two years. From time to time, updates have been made to; questionnaire content, operational procedures, sampling and weighting. The survey is comprised of 87 multiple-choice questions that track prioritized youth health risk behaviors, including; 1) tobacco usage; 2) alcohol and drug abuse; 3) sexually transmitted diseases and infections; 4) physical activities; 5) unintentional injuries; and 6) dietary behaviors (CDC, 2013). Physical activities and dietary behaviors were the categories of interest in this study.

Internal reliability checks only identified low and acceptable percentages of untruthfulness among respondents. The CDC argues that truthfulness is based on the students' perception that the survey is important and that they are knowledgeable of devised measures to protect their privacy and allow anonymity. Test retest reliability tests were conducted on the 1991 to 1999 questionnaire versions after the questionnaires were subjected to laboratory and field testing. Brener et al. (2003) conducted reliability and validity tests on self-reported variables of height, weight and sleep from YRBS. Flisher et al. (2004) conducted a two week test- retest on reliability adolescent behaviors on two occasions within two weeks, and found consistency in the measures of agreement and thus reliable reporting. Though the self reported sleep and the measures of BMI were very reliable, there were some discrepancies especially in estimating overweight in youth populations from the self reported height and weight as measures of BMI. This was due to underreporting of weight and over-reporting of height that are common in many self-reported data. Brener et al. (2002) also conducted reliability tests using the kappa statistic on the 1999 YRBS items and found that most of the YRBS questions were reliable. The physical activity and dietary behavior questions were also reliable with kappa values greater than .60. Items that had very weak kappa values have since been replaced from the recurring YRBS. Landis and Koch (1977) argued that the higher the kappa value, the more reliable the question. On the other hand, Troped et al. (2007) insisted that YRBS questions underestimate the actual physical activity involvement in middle school children. But according to Brener et al. (2002), high school students were more likely to reliably report on health risk behaviors.

Table 1.

Health- Risk behaviors and 2013 YRBS questions

Dietary Behavior	i) "how many days 100% juice in past 7 days" ii) " how many times fruit 7 days" iii) "how many times green salad 7 days" iv) "how many times carrots 7 days" v) "how many times other vegetable 7days" vi)"how many times drink soda (not diet soda)" vii) " how many glasses of milk 7 days" viii)"how many days eat breakfast 7days"
Physical Activity	i)"how many days in last 7 days physically active over 60 minutes per day" ii)"how many days strengthen and tone muscle exercise" iii)"how many hours watch TV" iv)"how many days go to PE classes" v)"how many hours play video games or computer" vi) "On how many sports teams 12 mos."
Sleep	i) "how many hours of sleep average"

Variables

BMI Percentile was the dependent variable and this study examined its relationship with health- risk behaviors of physical activity, dietary behavior and sleep as shown in Table 1, while controlling for gender and race/ethnicity. The researcher assigned a numerical value ranging from 1 to 7 (where applicable) from the lowest to the highest response of the YRBS questionnaire. This assignment was similar to the numerical responses in the YRBS data. However, these responses were then assigned a positive or negative numerical value 1 to 7 or -1 to -7 for categories for physical activity and dietary behaviors depending on whether they are positive or negative behaviors. Behaviors such as drinking non- diet soda, watching TV, and playing video game were assigned a negative numerical value whereas behaviors such as daily participation in 60 minute of physical activity were assigned a positive value. The question on “how many times did you eat potatoes” was dropped from the dietary behaviors variable computation. The positive and negative behaviors were then summed for a score. The researcher then grouped: physical activity into three categories (Nearly Always/ Often, Occasional and Little/No Physical Activity); dietary behavior into three categories (Frequent Consumption, Moderate Consumption, Little /No Consumption); and hours of sleep into three categories (Recommended, Close to Recommended and Far Less than Recommended) as follows:

Table 2**.**

Categorization for Physical Activity

Score Categories	Frequency	Type
4 to 17: Nearly Always/Often (5-7 days)	5465	Positive behvaior
-9 to 3: Occasional (3-4 days)	7666	Negative behavior
-14 to -10: Little/No (2 days or less)	202	Negative behavior

Since YRBS questions on physical activity were mainly reported based on the frequency of their occurrence, this study categorized these responses based on the SHAPE America Physical Activity guidelines for adolescents that require daily participation in Physical activity (SHAPE America, 2014). Activities that occurred 5-7 days a week were categorized as occurring Nearly always /Often, whereas activities that occurred 3-4 days a week were categorized as occasional and activities occurring for 2 or less days were categorized as occurring Little/No. In regards to the number of sports teams, the more teams one participated on, the higher the Physical Activity (PA) score. The more the hours of TV and video game the more one yielded a negative score. However, from the physical activity categories, considering Nearly Always/Often as the positive behavior would in fact imply that occasional is a negative behavior. Yet, individuals who would engage in 3-4 days a week of physical activity would have participated in more physical activity than those in Little/No category.

Table 3.

Categorization for Dietary Behaviors

Score Categories	Frequency	Type
30 to 49: Frequency Consumption (5-7 days)	849	Positive behvaior
6 to 29: Moderate Consumption (3-4 days)	11958	Negative behavior
-7 to 5: Little/No Consumption (2 days or less)	240	Negative behavior

Since YRBS questions of dietary behaviors were mainly reported based on the frequency of their occurrence, the study categorized these responses based on the USDA Dietary Guidelines for Americans (2015-2020). These guidelines support the recommendations that require frequent/daily consumption of nutritious foods across all food groups by children and adolescents. Using the same approach of assigning a positive or negative numerical value, a score that represented Frequent, Moderate and Less /No consumption as categories of Dietary behavior was determined. Participants who participated consumed nutritious items on 5-7 days a week were assigned in the Frequent Consumption category. Their dietary scores were also affected by their frequency of consumption of other items, which were deemed non-nutritious. A similar approach was applied for 3-4 days of consumption of nutritious items for the category of moderate consumption, and for 2 or less days for Little/No Consumption. Similarly, this would imply that Frequent Consumption was a positive behavior and Moderate Consumption and Little/No Consumption as negative behaviors. However, the score range of 6 to 29 for Moderate Consumption was not appropriately compatible with a negative behavior characterization.

Table 4.

Categorization for Sleep

Score Categories	Frequency	Type
5 to 7: Recommended (8-10+ hours)	3771	Positive behvaior
4: Close to Recommended (6 <8 hours)	6119	Negative behavior
< 4: Far less than Recommended (< 6 hours)	2445	Nrgative behavior

The National Institute of Health (NIH) recommendations for adolescent health are in line with the CDC recommendations for healthy sleep. According to Hirshkowitz et al (2015), The National Sleep Foundations (2015) has recommendations for teenage health at 8-10 hours of sleep daily. This study categorized sleep into three categories of 8-10+ as recommended sleep, between 6 and less than 8 as close to recommended and less than 6, as far from recommended. Based on those categories, sleep durations of 8-10+ were scored 5 to 7 sleep score; sleep duration between 6 hours and less than 8 hours were scored as sleep score 4, and the duration of sleep less than 6 hours was scored as less than 4. From the above characterization of the different sleep categories, Recommended would be considered as the positive behavior while labelling Close to Recommended and Far less than Recommended as both negative behaviors. This would totally misrepresent the difference between someone sleeping for 7.5 hours on a school night and someone who habitually sleeps for 5 hours, since both would be characterized as engaging in a negative behavior.

Therefore, categorization of physical activity, dietary behaviors and sleep as positive and negative, yet in three groups, would be challenging and inappropriate.

Gender and Race/Ethnicity

This study was interested in two forms of gender (Male or Female) and two predominantly large Race/Ethnicity groups (White, Black/African American).

Unlike in adults where weight status is determined by BMI, the child or adolescent weight status is determined from growth charts ranges that differ by gender. Table 1 indicates CDC weight status ranges for children and adolescents aged 2-20 years.

Table 5.

Weight Status Categories for Children and Adolescent BMI According to CDC.

Category	Range
Underweight	$< 5^{th}$ percentile
Normal or Healthy Weight	5th $< 85^{th}$ percentile
Overweight	85th $< 95^{th}$ percentile
Obese	$\geq 95^{th}$ percentile

Reprinted from CDC

Data Collection

National data was collected from sampled schools following similar protocols for state, territorial, tribal and large urban districts. Certain schools used active permission, requiring parents to return a response whereas others used passive permission, meaning that parents who objected to their children's participation would return the form. Trained data collectors guided participating students using a script that introduced the survey and also recorded classroom and school demographics that were used later for sample verification and data weighting.

Like all YRBS, the 2013 survey was anonymous and voluntary. Students were encouraged to complete the survey in a single class period and to record their responses directly on a computer readable answer sheet. In some instances, in order to increase privacy desks, were spread out farther in the classroom. Students were also allowed to use extra piece of paper to provide detailed answers where necessary. Students were asked to seal their envelopes containing their completed questionnaires. Students who were absent on that day were also allowed to complete the questionnaires on another day as long as their privacy could be maintained. This was important to increase the response rate. The makeup data-collections were sometimes conducted by the data collectors and sometimes by designated school personnel. Data were collected and then processed through a collaboration effort between CDC and its contractor, ICF Macro, Inc., who carried out the preparation and analysis of the initial CDC data.

The 2013 National YRBS data is available for further analysis from the CDC. National YRBS data files are downloadable at http://www.cdc.gov/healthyyouth/data/yrbs/data.htm

Chapter 4: Results

This chapter presents the results of the study. Chapter One introduced the study, and outlined the three main health-risk behaviors of physical activity, dietary behaviors and sleep, as predictors of Body Mass Index (BMI) Percentiles. Chapter Two provided a detailed review of related literature. Chapter Three described the study participants, methods, and procedures that were used to collect the data. This chapter describes data analysis, its techniques, assumptions, and the results from the analyses.

Data Analysis

Using Statistical Program for Social Sciences (SPSS), a statistical software tool, bivariate correlations and multiple linear regressions of BMI percentile, physical activity, dietary behavior, and sleep response data from the 2013 National YRBS, the study hypotheses were tested.

Bivariate Correlation

To examine the first three research questions and hypotheses, Spearman Rho correlation, a bivariate measure of correlation for non-parametric data was used. Spearman Rho correlation is used in instances where the independent variables of Physical Activity (PA) score, Dietary Behavior (DB) score and Sleep score.

Correlation coefficients values, *r*, range from 0 to 1, meaning no relationship to perfect positive linear relationship or 0 to -1, implying no relationship to perfect negative linear relationship. Positive correlations indicate a direct relationship, whereas negative correlation coefficients indicate an inverse relationship. The implication for a positive correlation coefficient is that as one variable increases, the other increases as well. On the other hand, for a negative relationship one variable increases while the other variable decreases. Correlation coefficient values closer to zero represent a weak association between the two variables, values between 0.30 and 0.49 represent a moderate association, values between 0.50 and .79 represent a strong association, values higher than 0.8 represent a very strong association. This is true for both positive and negative correlations. Significance levels were set at $p < 0.05$.

Multiple Regression Analysis

Multiple linear regression is an extension of simple linear regression, just with many variables. The term multivariate linear regression is also used. The multiple linear regression equation is written as follows;

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots\ldots \beta_n X_n + \text{error}$$

Multiple linear regression assumes an error value of 0.

Therefore, the estimate value E, of the dependent variable Y (BMI percentile), for this study was given by the mathematical equation;

$$E(Y) = \beta_0 + \beta_{pa} PA + \beta_{db} DB + \beta_s S + \beta g,$$

Where Y is the predicted, expected or estimated dependent variable of BMI percentile, PA is Physical Activity, DB is Dietary Behavior, and S is Sleep, all independent predictors or variables whereas β_0 is the constant, β_{pa}, β_{db} and β_s, and β_g for physical activity, dietary behavior, sleep and gender respectively. Multiple linear regression analysis allows for building a model to estimate this continuous dependent variable with multiple corresponding continuous independent variables. In this case, BMI percentile is the dependent variable while independent variables of physical activity, dietary behaviors and sleep are the predictor variables of interest, coded as dummy variables. With multiple linear regression, some of the variables were eliminated based on their lack of significance and they were excluded from the model. A model that accounted for a higher variance in the prediction was more reliable, and would be more acceptable.

For both males and females, emphasis was placed on the two groups of Race/Ethnicity (White and African American/Black) that were used as categorical independent variables in this study. The above were therefore assigned dummy variables. Gender (Male=1, Female = 0), and Race/Ethnicity (White = 1, African American or Black = 0).

Multiple regression analysis could be used to assess the extent to which race/ethnicity moderates the relationship of the independent variables with BMI percentile. A multiple regression equation was estimated that relates the outcome or dependent variable of Y (BMI Percentile) to each independent variable of Physical Activity (PA), Dietary Behavior (DB) and Sleep (S) and their product, while checking for interactions and confounding for gender and race/ethnicity. These were expressed as:

Physical Activity and Race/Ethnicity= PA by Race/Ethnicity Interaction Variable (PA.RE)

Dietary Behavior and Race/Ethnicity = DB by Race/Ethnicity Interaction (DB.RE)

Sleep and Race/Ethnicity = Sleep by Race/Ethnicity Interaction (S.RE).

To examine the fourth hypothesis, a multiple linear regression equation that also accounts for the interaction in the fourth hypothesis is indicated below.

The relationship between the three health risk behaviors and BMI Percentiles is stronger for Whites than Blacks or African Americans as reflected by the regression coefficients.

$$E(Y) = \beta_o + \beta_{pa}PA + \beta_{db}DB + \beta_s S + \beta_{paxre}PA.RE + \beta_{dbxre}DB.RE + \beta_{sxre}S.RE.$$

Assumptions

Linear regression assumes four principal assumptions that are a justification for its usage, in model prediction (Mendenhall & Sincrich, 2012).

Assumption 1: Linearity of the relationship between dependent and independent variables

This is an assumption of the existence of a straight-line function of each independent variable and the dependent variables. Under this assumption, there is either a positive or a negative linear relationship between variables. Any violation to this assumption will lead to non-linearity. Several researchers including Pedhazur (1997) and Cohen and Cohen (1983) suggest ways to examine lack of this linear relationship. Common sense, theoretical knowledge and previous research are among the few that informs current analysis on simple relationships. Many previous researchers might have ignored this in examining non-linear relationships. Also, an examination of residual plots, scatter plots is another method used to detect linearity or non-linear relationships. In addition, the incorporation of curvilinear components has also been used as linearity detection.

Assumption 2: Normality of the error of distribution

Normality of the distributions is another assumption under multiple linear regression analysis. Variables that are unevenly distributed can greatly affect the relationships among each other and distort the results of the tests, in terms of skewed significances. In order to detect non-normally distributed distributions, a researcher must visually inspect data plots, histograms, and skew, kurtosis, and P-P plots. In addition, the researcher should attempt to run the Kolmogorov- Smirnov test for normality to confirm the visual inspections. A Kolmogorov –Smirnov statistic for normally distributed data should be greater than .05.

Assumption 3: Independence of Errors

Understatements of relationships arise from misinterpretation of data due to unreliable measures that increases the risks of Type II errors (Osborne, 2002). Osborne (2002) also emphasizes that unreliably measured covariates often lead to distorted effect sizes due to overestimation, especially when the effects of the covariates are not excluded from the data. The errors produced by this assumption indicate that the outliers are not independent of one another. Also, outliers may be determined using the data’s z-scores, frequency distributions and histograms. “Bivariate and multivariate data cleaning is helpful” (Tabachnick & Fidell, 2007, p. 139). According to Osborne (2002), exclusion of outliers reduces the chance of statistical errors and therefore improves the accuracy of estimates.

Assumption 4: Assumption of Homoscedasticity

Osborne (2002) suggests that the existence of similar variance of error across all levels of the independent variable indicates homoscedastic data, whereas differences indicate heteroscedasticity data. Berry and Feldman (1985) and Tabachnick and Fidell (1996) acknowledge that some form of heteroscedasticity has a very slight impact on significance. However, without caution, this situation can lead to serious distortions of accuracy and increase the probability for errors (Osborne, 2002). Osborne further states that visual examination of residual plots can be indicative of heteroscedasticity or homoscedasticity. Homoscedasticity is evident when the residuals are distributed along the line, and idealistically indicate an even distribution in the data. Uneven scattering of residuals along the regression line is an indication of heteroscedasticity.

In most cases for results from a multiple linear regression analysis to be perfectly reliable, the above assumptions need to be met. In certain instances, remedies might be devised to address violations of any or all the assumptions. Finally, when violations of regression analysis occur, researchers have attempted to devise remedies that are deemed appropriate.

Remedy procedures in case of violations of assumptions

To ensure that the researcher addressed the violations of these four assumptions, data transformation took place. This study used common data transformation in the case of all assumptions included logarithmic transformation and the square root of the dependent variables. In the case of the assumption of linearity, if the researcher finds that the data is not on a linear trend, application of non-linear data transformations of the dependent variable, independent variable, or even both, is possible. The researcher may also try to add another regression that is a nonlinear function of one of the other variables.

There were violations of normality in this study, and were with transformation of variables, which can be employed as an attempt to solve the issues. In some cases, the problem with the residual distribution is mainly due to one or two very large errors. The researcher closely examined the data values to determine if they are true data points or if they are unique errors. If the extreme values are due to error, data transformations are a necessity. However, if the researcher finds circumstances in which the extreme values may provide useful information about the study, the extreme variables are considered.

In the case of violations to the assumption of independence of errors, small cases of positive correlations among the outliers may indicate that there should be a refinement in the regression model. However, if there are correlations that are more negative there may be cause to examine the variables selected for the regression model.   A Durbin-Watson statistic that falls below 1.0 indicates a structural problem in the model. Hence, a data transformation among both the dependent and independent variables is crucial.

Lastly, violations of the assumption of homoscedasticity may arise due to the inflation effects' increase in the data. If this violation is found, the researcher will create data logging to attempt to alleviate the inconsistencies in variance. Heteroscedasticity can also indicate a linearity violation. Therefore, the researcher could attempt to solve violations to one or both to determine if this will be the remedy to the violations of this assumption.

Testing Assumptions

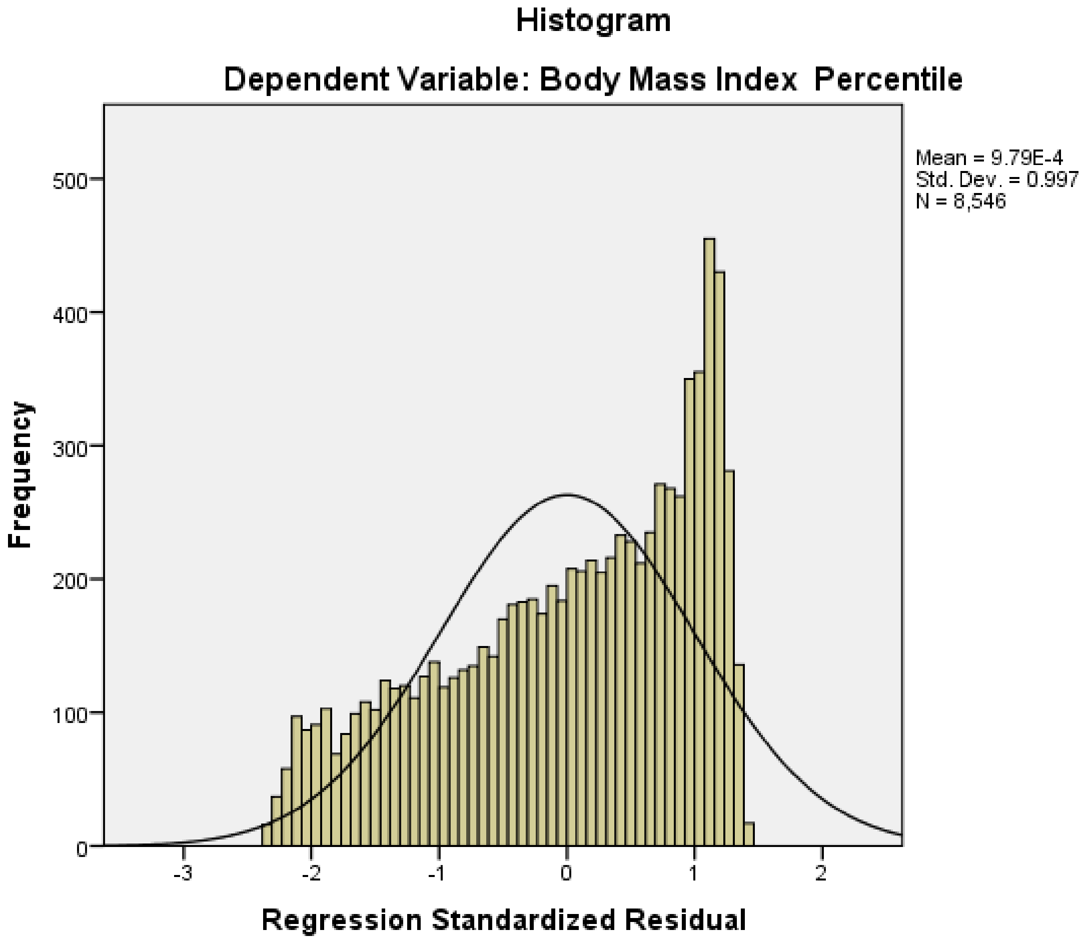

Figure 2.

Histogram testing normality of BMI percentile

Data transformations were necessary to fulfill the assumption of normality under multiple linear regressions. This due to the lack of normality as depicted in figure 2 above. Square root and natural logarithmic transformation of BMI Percentile was a remedy for determining a less non-normal distribution. In addition, the visual inspection of the normal curve, supported by a Kolmogorov- Smirnov statistic was vital in establishing normality or lack of normality. For this BMI percentile distribution, the Kolmogorov-

Smirnov statistic of .101, $p = .000$ implied that this data is non-normal. Therefore, it was necessary to perform transformations.

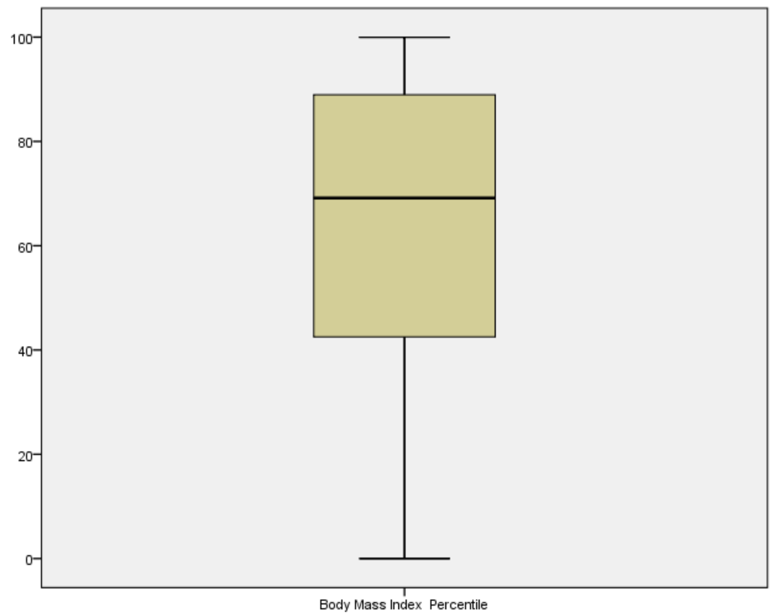

Figure 3.

Box Plot for testing for outliers in BMI percentiles

From the results in figure 3, there were no outliers present in BMI percentile data as depicted by the box plot above.

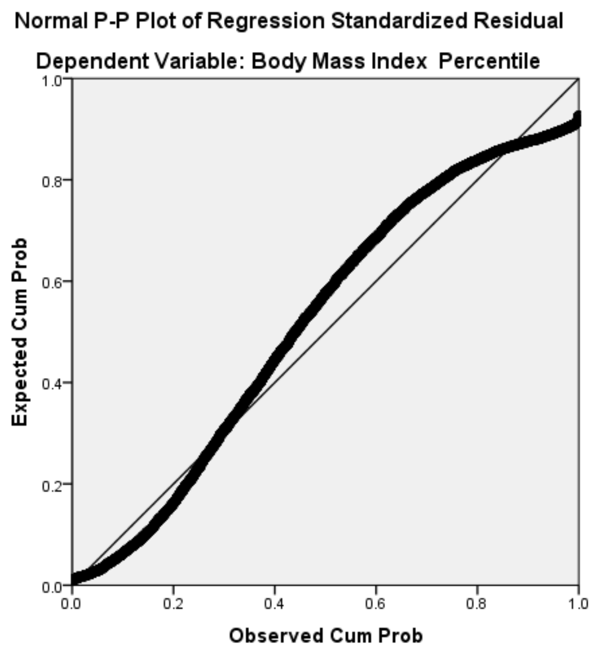

Figure 4.

P-P plot for BMI percentile

The plots of standardized residual in figure 4 test for linear relationship.

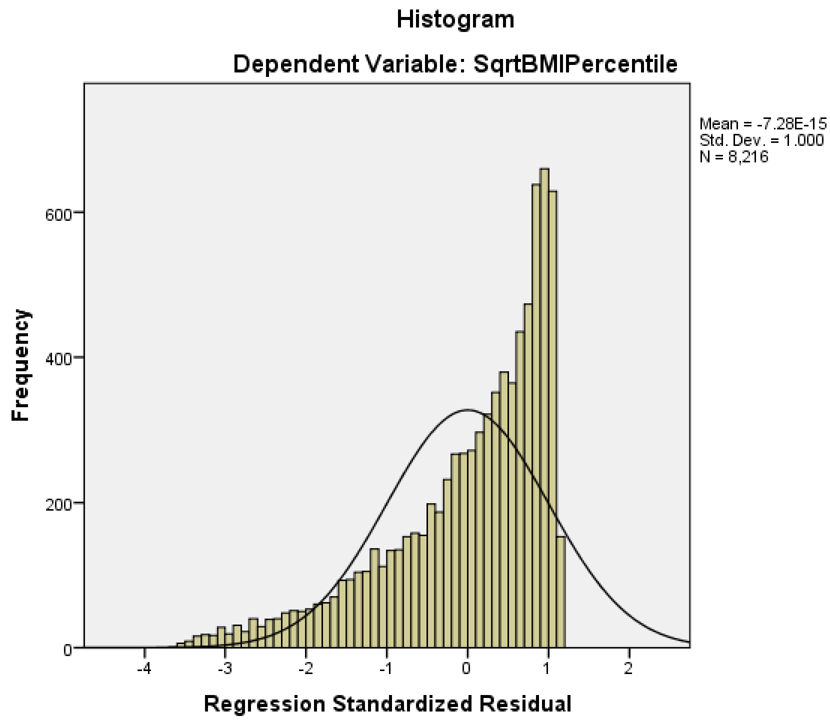

Figure 5.

Negatively skewed histogram of Square root of BMI percentiles.

Upon applying transformations of the dependent variable of BMI percentiles to square root of BMI percentiles, the results in figure 5 above indicate lack of normality in the transformed dependent variable. The Kolmogorov yielded a statistic for the above transformation of the square root of BMI percentiles at .144. This result also affirms that the transformed data were also non-normal. Therefore, a transformation into natural logarithm of BMI percentile was warranted.

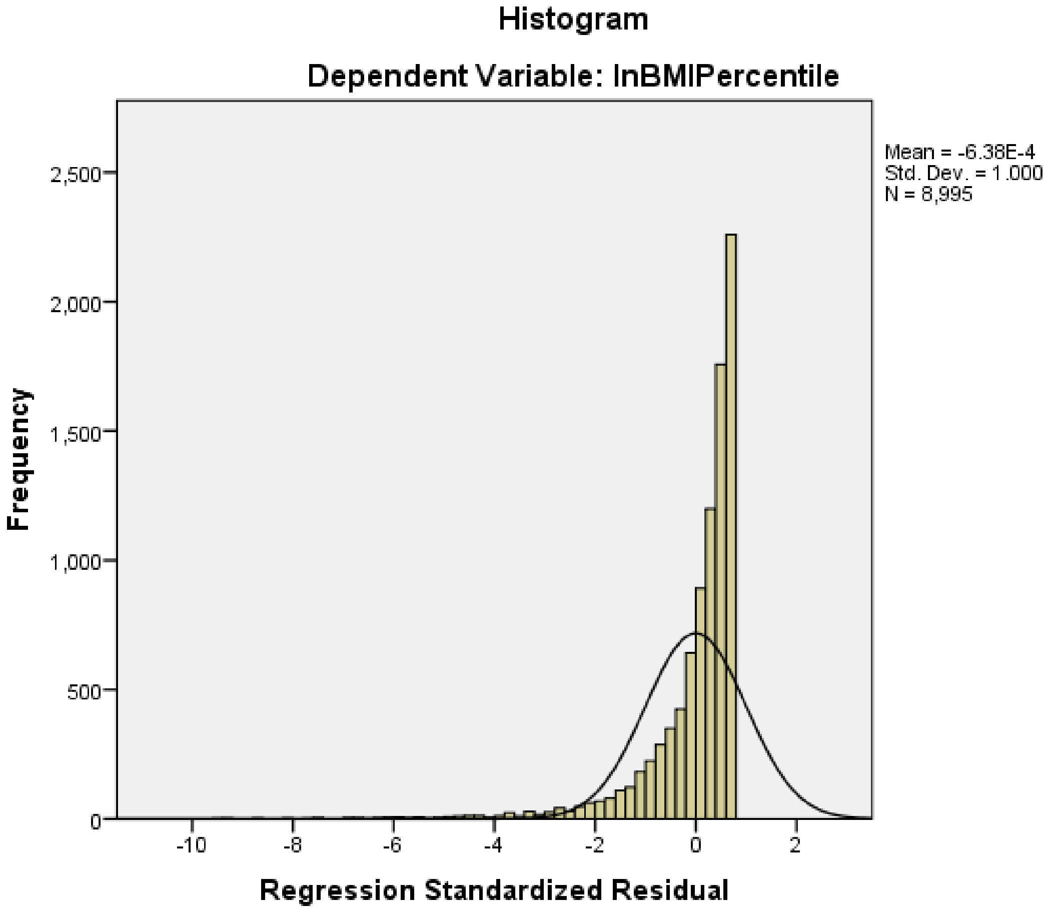

Figure 6.

Negatively Skewed histogram of Natural Logarithms of BMI Percentiles

After considering the natural logarithmic transformations, figure 6 indicates similar results of lack of normality and a Kolmogorov Smirnov statistic test for normality yielded a value of .203. In this case, the best option was to consider to the less non-normal distribution of the dependent variable.

Therefore, upon comparing the Kolmogorov-Statics for BMI percentile and the two transformations (logarithm and square root of BMI Percentile), it was evident that distribution for BMI percentiles were less non-normal with a Kolmogorov Smirnov statistic of .101. In order to establish whether all the independent variables met the assumptions for both correlation analysis and multiple linear regression, it was necessary to explore those assumptions and establish the findings.

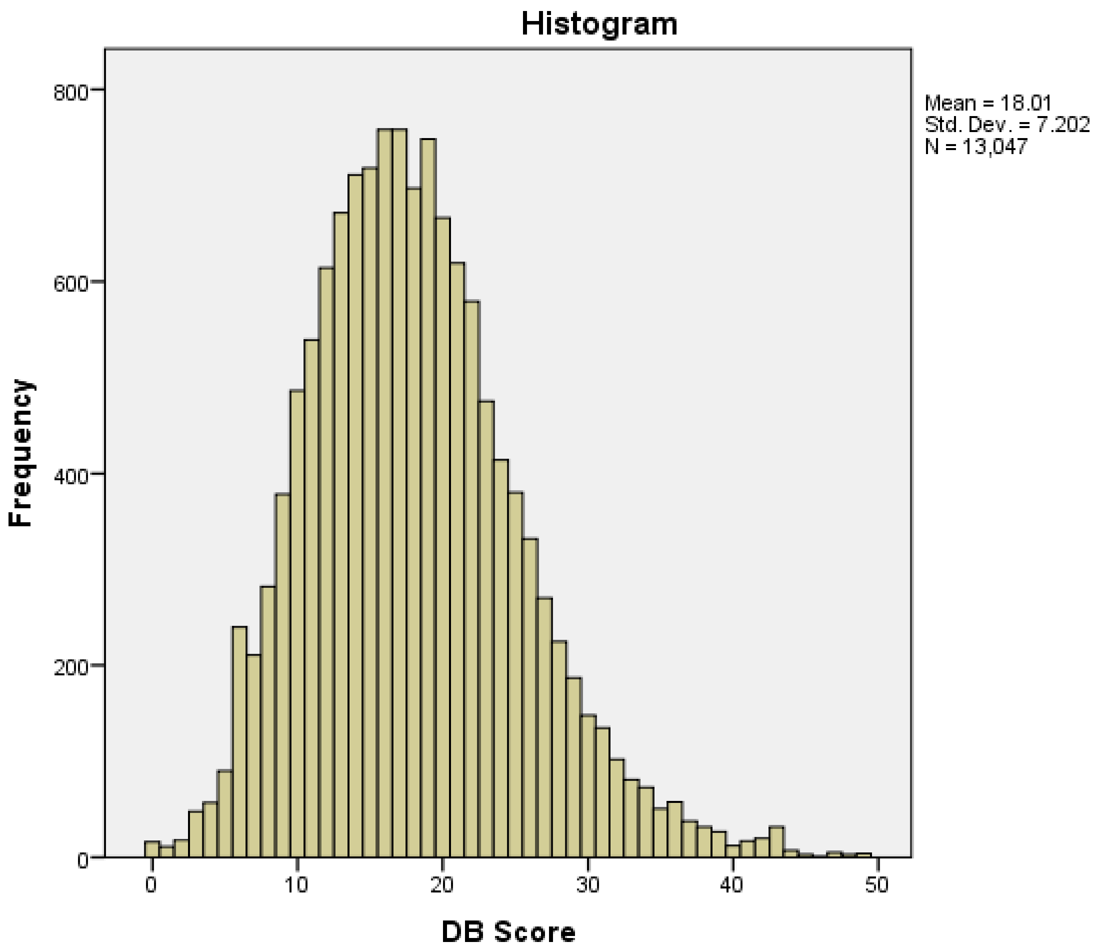

Figure 7.

Positively skewed Histogram testing normality of DB scores

Visual inspection of the histogram in figure 7 above indicates lack of normality, with a positive skew of the DB score.

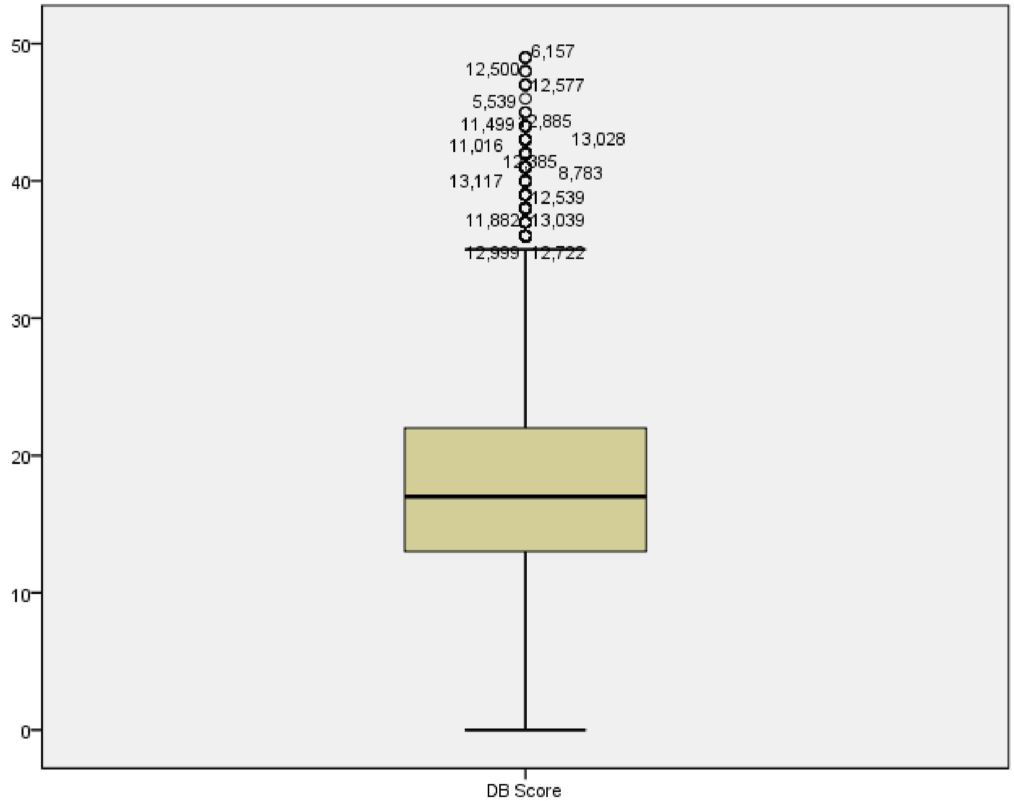

Figure 8.

Box plot testing for outliers in DB scores

The box plot in figure 8 shows the presence of outliers in the distribution of DB scores. It was therefore necessary for trimming or removal of those outliers as suggested by Osborne (2002). These outliers are evident in the upper tail of the DB score distribution. Removal of the outliers within three standard deviations from the mean is normally acceptable (DB score > 39.6). However, at this level, there were outliers still evident. Outliers were finally removed at the highest DB score of 34 (2.7 SD from the mean) as indicated in figure 11.

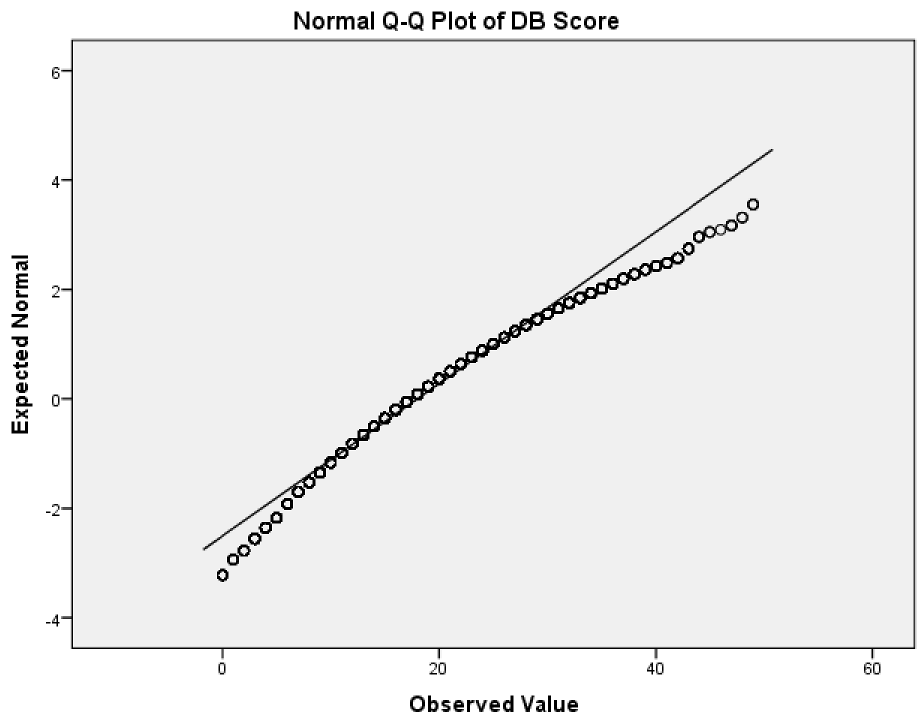

Figure 9.

Q-Q plot for DB score before removing outliers

The Q-Q plot in figure 9 does not indicate a perfect linear relation for the DB score distribution. This, in addition to the presence of outliers suggests the need to remove outliers. Upon removing the DB score outliers, figures 10, 11, and 12 of histograms, box plots as well as the P-P plots indicate the fulfillment of the assumptions of normality, lack of errors and linearity.

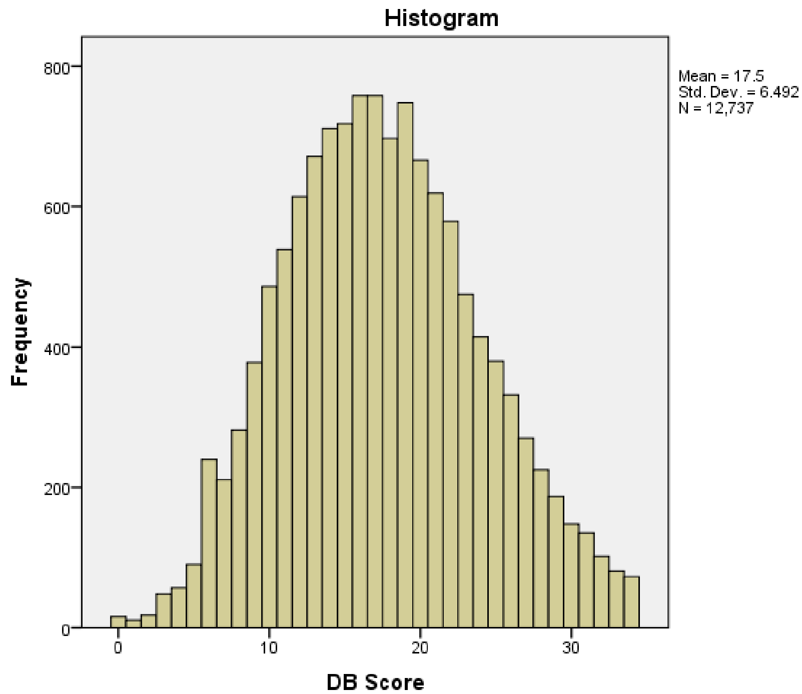

Figure 10.

Histogram testing for normality in DB scores upon eliminating outliers

The histogram in figure 1o shows a normal distribution of the dietary behavior scores. This is an indication that the assumption of normality was met for this particular independent variable.

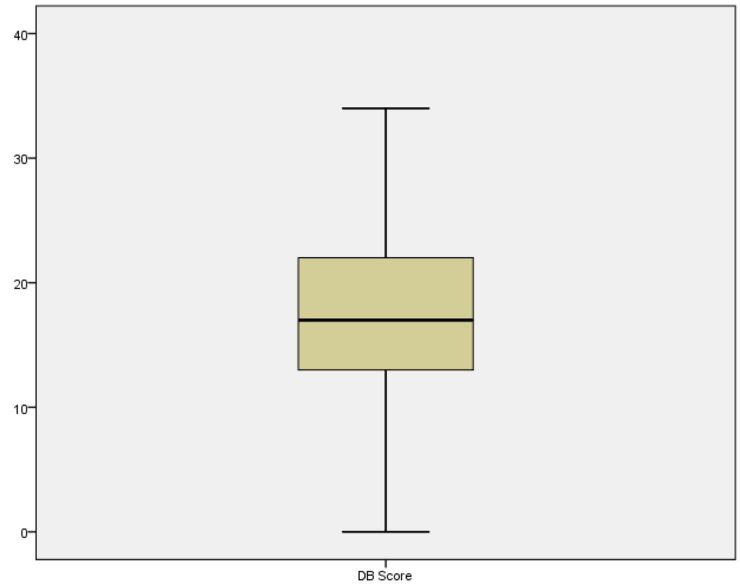

Figure 11.

DB scores box plot upon eliminating outliers

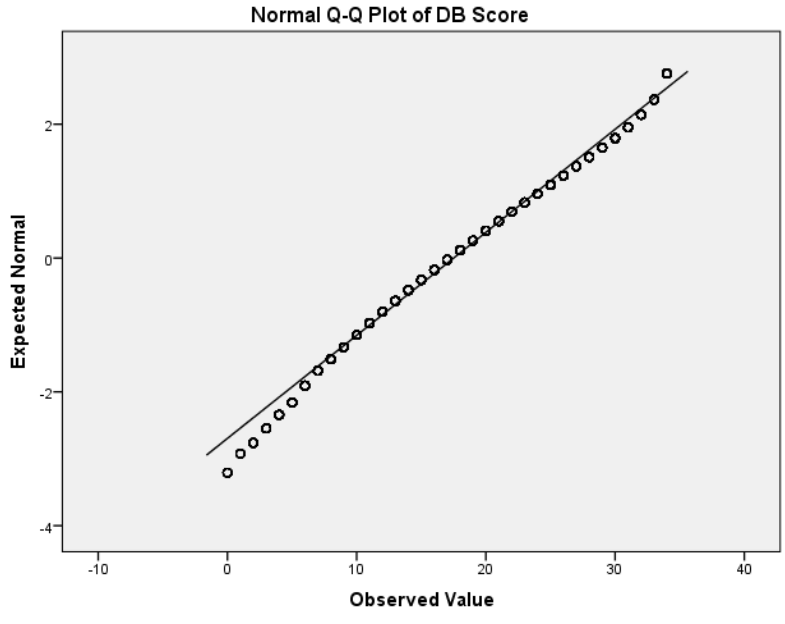

Figure 12.

Q-Q plot for DB score upon removing outliers

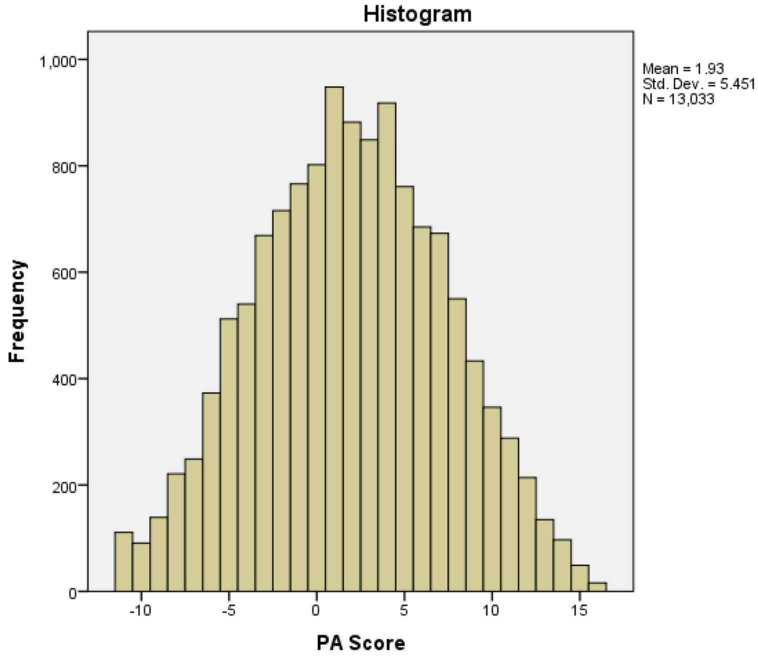

Figure 13.

Histogram testing for normality in PA scores

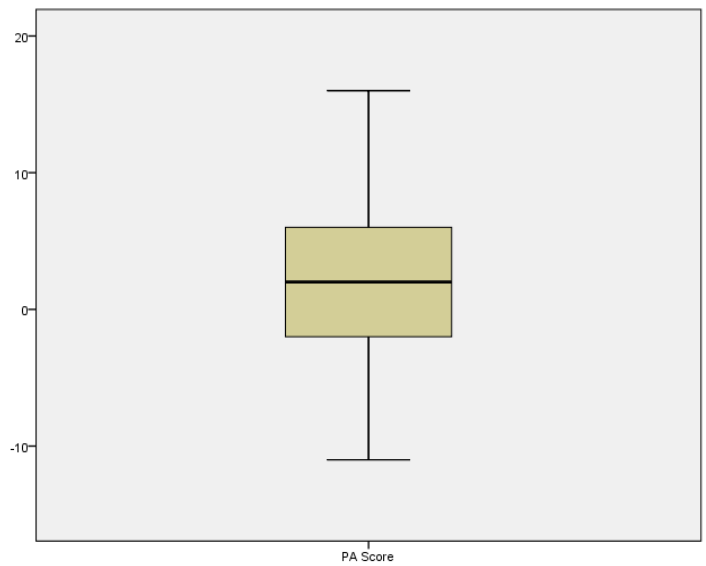

Figure 14.

Box plot testing for outliers in PA scores

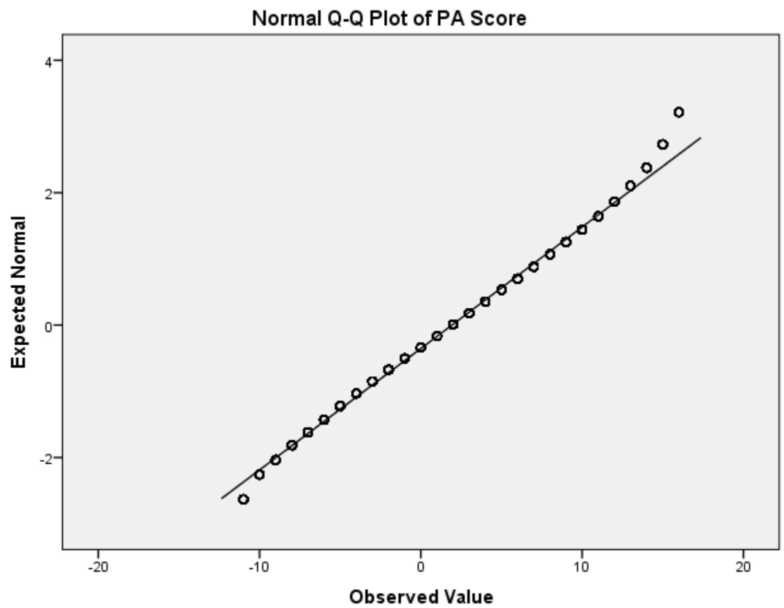

Figure 15.

Q-Q plot for PA scores

Figures 13, 14 and 15 indicate fulfillment of the assumptions of normality, absence of outliers and linearity in PA scores.

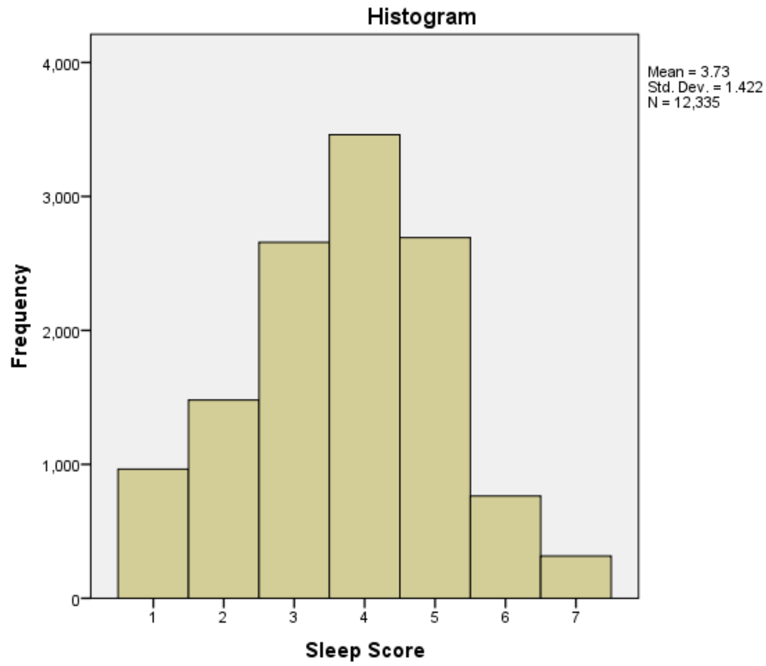

Figure 16.

Histogram testing for normality in Sleep scores

The histogram of sleep score in figure 16 above shows a normal distribution. This was an indication that the assumption of normality was met for this particular indiependent variable.

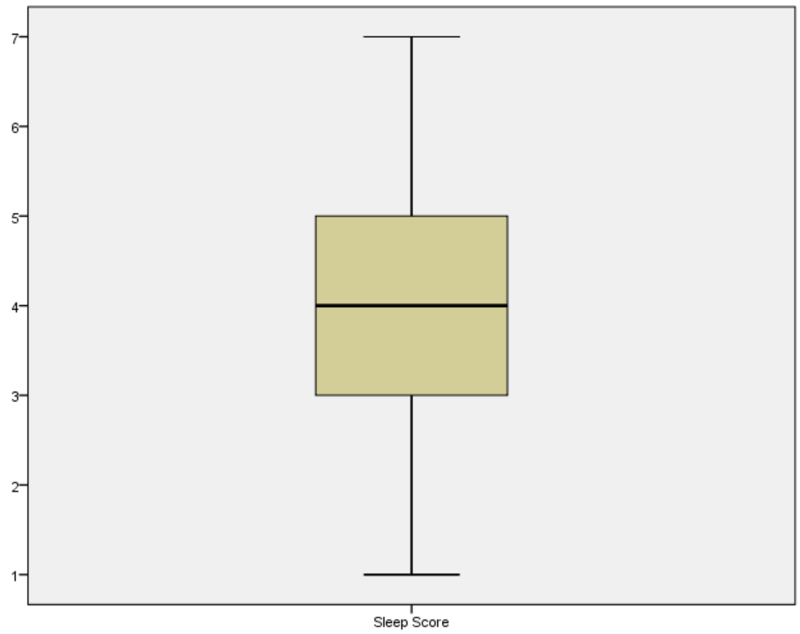

Figure 17.

Box plot testing for outliers in Sleep scores

Figure 18.

Normal Q-Q Plot for Sleep score

Figures 16, 17 and 18 indicate that normality, lack of outliers and linearity assumptions were met.

Study Hypotheses

Hypothesis One:

- Higher levels of physical activity among high school boys and girls are associated with lower BMI percentiles.

To test this hypothesis, bivariate correlations were calculated. First, Spearman's Rho correlations were computed for all high school students, then between boys and girls.

Table 6.

Spearman's Rho Correlation between Physical Activity(PA) Score and BMI Percentile.

			PA Score
	Body Mass Index Percentiles	Correlation Coefficient	-.031
		Sig. (2-tailed)	.001
N = 12,118			

Spearman's Rho yielded a significant, negative correlation with physical activity score among high school students (r = -.0.31, p = .001). The results above indicate that the higher levels of physical activity among high school students, the lower the BMI percentiles.

To better understand the relationship between BMI Percentiles and PA score across gender, the data set were split between male and female high school students, to accommodate the differences between boys and girls.

Table 7**.**

Spearman's Rho Correlation between PA score and BMI Percentile in High School Boys and Girls.

Gender			PA Score
Male	BMI Percentile	Correlation r	-.074
		Sig (2-tailed)	.000
N = 5,396			
Female	BMI Percentile	Correlation *r*	.000
	Spearman's Rho	Sig (2-tailed)	.958
N 5,424			

Spearman's Rho correlation between PA score and BMI percentile was found to yield a significant, but weak negative correlation among high school boys (r = - .074, p = .000) and a weak negative but non significant correlation among high school girls (r = .001, p = .958). Consequently, higher levels of physical activity were found to be associated with significantly lower BMI percentiles in high school boys and not significantly associated in high school girls. Table 8 shows the correlation comparisons for boys and girls.

Table 8.

Correlations comparisons between PA score and BMI Percentile.

Independent variable	Spearman's Rho Correlation	
	-.031	
	p = .001	
	Girls	Boys
PA score	-.001	-.074
Sig (p < .05)	*p = .958*	*p = .000*

From the table above, there are significant negative correlations between PA score and BMI percentiles among high school students, but especially in boys. Hypothesis one suggested that higher levels of physical activity among high school boys and girls are associated with lower BMI percentiles.

Hypothesis Two:

- Healthier dietary behaviors are associated with lower BMI percentiles in high school boys and girls.

To test hypothesis two, bivariate correlations were calculated after removing outliers from the DB scores by trimming within three standard deviations from the mean DB score. First, correlations were considered for all high school students and then by gender.

Table 9.

Spearman's Rho Correlation between Dietary Behavior (DB) Score and BMI Percentile.

			DB Score
Spearman's rho	Body Mass Index Percentiles	Correlation Coefficient	-.022
		Sig. (2-tailed)	.015
N = 10,820			

Spearman's Rho yielded a weak negative correlation between DB score and BMI Percentiles as shown in the table above (r = -.022, p = .015). This correlation was, however, significant at $p < .05$. To account for any differences between boys and girls, Spearman's Rho correlations were computed after splitting the sample by gender. The results from the correlation analysis with gender considerations are in Table 10.

Table 10.

Spearman's Rho Correlation between DB score and BMI Percentile in high school boys and girls.

Gender			DB Score
Male	BMI Percentile	Correlation *r*	-.032
		Sig (2-tailed)	.014
N = 5,396			
Female	BMI Percentile	Correlation *r*	-.015
		Sig (2-tailed)	.167
N = 5,424			

Spearman's Rho yielded a weak negative correlation between DB score and BMI Percentiles among high school boys (r = -.032, p = .014). This result was significant at $p < .05$. Spearman rho also yielded a weak negative correlation between DB score and BMI Percentiles among high school girls (r = -.015, p = .167). However, this correlation was nonsignificant at the set p- value. These results suggest that, higher DB scores are associated with lower BMI Percentiles in high school boys but not in high school girls.

Table 11.

Correlations comparisons between DB score and BMI Percentile.

Independent variable	Spearman's Rho Correlation	
	-.023	
	p = .017	
	Girls	Boys
DB score	-.015	-.036
Sig (p < .05)	*p = .167*	*p = .009*

From the table above, there are significant negative correlations between DB score with BMI percentiles in boys and non-significant positive correlations in girls. Therefore, this study suggests that higher dietary behavior scores are associated with lower BMI percentiles in high school boys but not in girls. Hypothesis two suggested that higher dietary behavior scores were significantly associated with lower BMI percentiles in boys but not in girls.

Hypothesis Three:

- The more hours of sleep averaged by high school boys and girls, the lower their BMI percentiles.

In order to test hypothesis three, Spearman's Rho correlations were performed. First for the high school general population, irrespective of gender, and afterwards gender categories of male and female to account for boys and girls.

Table 12.

Spearman's Rho Correlation between Sleep score and BMI Percentile.

			Sleep Score
Spearman's rho	Body Mass Index Percentiles	Correlation Coefficient	-.031
		Sig. (2-tailed)	.001
N = 11,481			

Spearman's Rho yielded an inverse, negative and weak correlation, but yet significant at the set p value (r = -.031, p = .001). This result suggests that the longer the sleep duration, the lower the BMI percentiles of high school students. In order to examine this association for boys and girls, the data were split by gender. The results are in table 13.

Table 13.

Spearman's Rho Correlation between Sleep score and BMI Percentile in high school boys and girls.

Gender			Sleep Score
Male	BMI Percentile	Correlation *r*	-.047
		Sig (2-tailed)	.000
N = 5,656			
Female	BMI Percentile	Correlation *r*	-.019
		Sig (2-tailed)	.148
N = 5,825			

There were gender differences evident between boys and girls in the results yielded from Spearman's Rho correlation for the relationship between sleep score and BMI percentile. For boys, higher sleep scores were associated with lower BMI percentiles ($r = -.047$, $p = .000$) and in girls, though there was a similar relationship, the results were not significant ($r = -0.19$, $p = .148$). The differences in correlations between boys and girls were tested for significance of the difference using a z-test, and at a p value of 0, this result is significant at $p < .05$. The results implied that the longer the sleep duration by high school boys, the lower their BMI percentiles, unlike their female counterparts.

Hypothesis three suggested that the longer the sleep duration by high school boys and girls, the lower their BMI percentiles.

Table 14.

Correlations Comparisons between DB score and BMI Percentile.

Independent variable	Spearman's Rho Correlation	
	-.031	
	p = .001	
	Girls	Boys
Sleep score	-.019	-.047
Sig (p < .05)	*p = .148*	*p = .000*

From the table above, there are significant negative correlations between the sleep score with BMI percentiles in boys. In addition, there are nonsignificant negative correlations between in girls. Hypothesis three suggested that longer sleep durations in high school boys and girls were associated with lower BMI percentiles.

Hypothesis Four:

- The relationship between the three health risk behaviors and BMI Percentiles is stronger for Whites than Blacks or African Americans as reflected by the regression coefficients.

To test this hypothesis, and examine the relationship between the two racial ethnicities of White and African American or Black, multiple linear regressions was used initially, and an interaction effect included depending on the whether the interaction was significant for the independent variables as selected by the regression model. The variables of PA score, DB score and sleep score and BMI percentiles were examined for multicollinearity (Variance Inflation Factor, VIF in table 15). This study examined if any interaction was significant at the set *p* value of .05. The table below shows results before considering any interaction effects.

Table 15.

Regression Coefficients.

	Unstandardized Coefficients	Standardized Coefficients				*Collinearity Statistics*	
	β	Std. Error	Beta	*t*	Sig.	*Tolerance*	*VIF*
Constant	68.124	1.581		43.095	.000		
PA Score	-.001	.064	.000	-.010	.992	.854	1.171
Sleep Score	-.607	.239	-.029	-2.535	.011	.956	1.046
DB Score	-2.033E-5	.053	.000	.000	1.000	.888	1.126
Race/ Ethnicity	-4.421	.714	-.072	-6.191	.000	.959	1.042
Gender	.329	.656	.006	.500	.617	.970	1.031

a. Dependent Variable: Body Mass Index Percentile

Racial ethnicity and sleep score were the best predictors in the multiple regression model above. The other variables were excluded from the model. For these two predictors, their beta weights showed significance at $p < .05$. The beta weights for race/ethnicity indicate that Race/Ethnicty and sleep are significant variables in explaining this relationship between the independent variables [Race/Ethnicity β_0= -4.421 (p =.000) and Sleep Score β= -.607 (p = .011)]. From the values of the Variance Inflation Factor (VIF) in table 15 above, there is evidence of homogeneity of variances.

Table 16.

ANOVA Table 1 of 4

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	39891.900	5	7978.380	9.845	.000[b]
	Residual	6282339.7	7752	810.415		
	Total	6322231.6	7757			

a. Dependent Variable: Body Mass Index Percentile

b. Predictors: (Constant), Gender, Race/Etnicity, Sleep Score, DB Score, PA Score

Table 17.

Model Summary 1 of 4

Model	R	R Square	Adjusted R Square	Std. Error of the Estmate	Durbin-Watson
1	.079[a]	.006	.006	28.468	1.972

a. Predictors: (Constant), Gender, Race/Ethniccity, Sleep Score, DB Score, PA Score

b. Dependent Variable: Body Mass Index Percentile

From the regression analysis results in table 15, it was necessary to include the interaction effect between sleep score and racial ethnicity. A significant *p* value for the interaction would make it possible for model inclusion as part of the determinants. Therefore, the study tested the interaction between race ethnicity and the product of all the deviations of each of the centered values of physical activity, dietary behavior and sleep scores. The tables 18 through 26 depict the multiple linear regression results after the inclusion of the three interactions and their corresponding Analysis of Variance (ANOVA) and model summaries.

Table 18.

Regression Coefficients upon including Interaction (PA Scores)

	Unstandardized Coefficients	Standardized Coefficients				*Collinearity Statistics*	
	β	Std. Error	Beta	*t*	Sig.	*Tolerance*	*VIF*
Constant	68.079	1.581		43.048	.000		
PA Score	.090	.112	.017	.810	.418	.281	3.564
Sleep Score	-.601	.240	-.029	-2.508	.012	.956	1.046
DB Score	.002	.053	.001	.042	.966	.886	1.129
Race/ Ethnicity	-4.543	.725	-.074	-6.271	.000	.932	1.073
Gender	.298	.657	.005	.454	.650	.968	1.033
ProductREdevPA Score	.131	.132	.021	.590	.320	.298	3.355

a. Dependent Variable: Body Mass Index Percentile

This Race/Ethnicity and Physical Activity interaction in table 18 above was non-significant at $p < .05$. based on the value of $p = .320$.

Table 19.

ANOVA Table 2 of 4

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	40694.780	6	6782.463	8.369	.000[b]
	Residual	6281536.8	7751	810.416		
	Total	6322231.6	7757			

a. Dependent Variable: Body Mass Index Percentile

b. Predictors: (Constant), Gender, Race/Etnicity, Sleep Score, DB Score, PA Score, ProductREdevPA Score

Table 20.

Model Summary 2 of 4

Model	R	R Square	Adjusted R Square	Std. Error of the Estmate	Durbin-Watson
1	.080[a]	.006	.006	28.469	1.972

a. Predictors: (Constant), Gender, Race/Ethniccity, Sleep Score, DB Score, PA Score, ProductREdevPA Score

b. Dependent Variable: Body Mass Index Percentile

From the results in table 20 above, a Durbin- Watson statisc of 1.972 is close to the acceptable value of 2 that indicates the lack of auto correlation. However, considering the results in tables 18, 19 and 20, it was necessary to examine the interaction effect between Race/Rthnicity and Dietary behavior. Tables 21, 22 and 23 indicate the results form that examination.

Table 21.

Regression Coefficients upon including Interaction (DB Scores)

	Unstandardized Coefficients	Standardized Coefficients				*Collinearity Statistics*	
	β	Std. Error	Beta	*t*	Sig.	*Tolerance*	*VIF*
Constant	66.335	1.964		33.780	.000		
PA Score	.005	.064	.001	.081	.936	.851	1.175
Sleep Score	-.614	.239	-.030	-2.562	.010	.956	1.046
DB Score	.115	.091	.026	1.253	.210	.297	3.367
Race/ Ethnicity	-4.528	.717	-.073	-6.312	.000	.950	1.052
Gender	.279	.657	.005	.424	.671	.968	1.033
ProductRE devDB Score	.167	.109	.031	1.536	.125	.307	3.259

c. Dependent Variable: Body Mass Index Percentile

This interaction was non-significant at $p < .05$.

Table 22.

ANOVA Table 3 of 4

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	41803.650	6	6967.275	8.599	.000[b]
	Residual	6280428.0	7751	810.273		
	Total	6322231.6	7757			

d. Dependent Variable: Body Mass Index Percentile
e. Predictors: (Constant), Gender, Race/Etnicity, Sleep Score, DB Score, PA Score, ProductREdevDB Score

Table 23.

Model Summary 3 of 4

Model	R	R Square	Adjusted R Square	Std. Error of the Estmate	Durbin-Watson
1	.081[a]	.007	.006	28.465	1.973

a. Predictors: (Constant), Gender, Race/Ethniccity, Sleep Score, DB Score, PA Score, ProductREdevDB Score

b. Dependent Variable: Body Mass Index Percentile

From the examination of the Race/Ethnicty and Dietary Behavior interaction, the interaction was non-significant as depicted in table 21. It was necessary to examine the Race/Ethnicity and Sleep interaction . The results are shown in tables 24 to 26.

Table 24.

Regression Coefficients upon Including Interaction (Sleep Scores)

	Unstandardized Coefficients	Standardized Coefficients				*Collinearity Statistics*	
	β	Std. Error	Beta	*t*	Sig.	*Tolerance*	*VIF*
Constant	67.453	1.948		34.634	.000		
PA Score	-.001	.064	.000	-.015	.988	.852	1.173
Sleep Score	-.423	.393	-.020	-1.077	.282	.355	2.816
DB Score	.000	.053	.000	-.005	.996	.888	1.127
Race/ Ethnicity	-4.449	.716	-.072	-6.216	.000	.955	1.047
Gender	.342	.657	.006	.521	.603	.969	1.032
ProductRE devSleep Score	.289	.490	.011	.590	.555	.359	2.782

a. Dependent Variable: Body Mass Index Percentile

This interaction was non-significant at $p < .05$.

Table 25.

ANOVA Table 4 of 4

Model		Sum of Squares	*df*	Mean Square	*F*	Sig.
1	Regression	40174.063	6	6695.677	8.261	.000[b]
	Residual	6282057.6	7751	810.483		
	Total	6322231.6	7757			

a. Dependent Variable: Body Mass Index Percentile

b. Predictors: (Constant), Gender, Race/Etnicity, Sleep Score, DB Score, PA Score, ProductREdevSleep Score

Table 26.

Model Summary 4 of 4

Model	R	R Square	Adjusted R Square	Std. Error of the Estmate	Durbin-Watson
1	.080[a]	.006	.006	28.469	1.972

a. Predictors: (Constant), Gender, Race/Ethniccity, Sleep Score, DB Score, PA Score, ProductREdevSleep Score

b. Dependent Variable: Body Mass Index Percentile

Since none of the three interactions, the physical activity score by race/ethnicity interaction, dietary behavior score by race/ethnicity interaction and the sleep score by race/ethnicity interaction, were significant as depicted in tables 18, 21 and 24, the impact of those variables on BMI percentiles did not differ significantly between White and Blacks. Therefore, this study lacks evidence to support the fourth hypothesis.

Summary

This chapter presented the results from the analysis of the dependent and independent variables as stated in the purpose of the study. It contains the tables, and graphs from the analyses, that were necessary in making sensible conclusions from the results of the analysis. Hypothesis 1, 2 and 3 were partially supported and hypothesis 4 was refuted.

Chapter 5: Discussions, Recommendations and Conclusions

This chapter presents discussions of the results of this research that was conducted primarily to examine the relationships between health risk behaviors and adolescent BMI percentiles that reflect weight status. This chapter also presents a summary of the recommendations and conclusions. Identification of key health-risk variables depending on their relation with BMI percentile was key to designing this study. This chapter also presents the discussions in relation to the most recent research as well as recommendations for further research, but also reveals several findings that ought to be addressed among adolescents in different genders and race or ethnicities. The three hypotheses regarding prediction of lower BMI percentiles by higher levels of physical activity, healthy dietary behaviors and more sleep were partially supported. Physical activity was a significant predictor of BMI Percentiles among high school students as determined by Spearman's rho bivariate correlation in this study. The results were, however, different across genders, with significant relationships in boys but not in girls.

Physical Activity

The results of this study indicate that physical activity had an inverse relationship with BMI percentile in boys, and not in girls, although with very weak correlations. For boys, as physical activity increased, BMI percentiles declined. However, not statistically significant, but negative correlations may imply a trend that an increase in physical activity would lower BMI percentiles in adolescent girls.

Some of the results of this study are similar to those of Levin et al. (2003) who also concluded that gender differences were evident among high school students surveyed in the 1999 national YRBS data collection. Levin and colleagues took a unique approach with YRBS data and physical activity by categorizing PA measures into five categories of dichotomous variables. They also examined the link with weight status using the different weight classification as suggested by CDC weight status categories. In the current study, higher BMI percentiles were evident in some girls who engaged in increased levels of physical activity including playing team sports, albeit a 2016 report by the World Health organization (WHO) suggested that in 2010, globally, 81 % of adolescent girls aged 11-17 years were less physically active than boys. In addition, the direct correlations between occasional active and BMI percentiles from boys in this study suggest that high school boys who engage in weekly moderate physical activity have higher BMI percentiles.

Dietary Behavior

The results of the bivariate correlations between dietary behaviors and BMI percentiles among boys and girls also yielded different results. There were gender differences in dietary behavior score that indicated non-significant associations between dietary behaviors and BMI percentiles in boys and girls. In addition, the categories of dietary behaviors in boys and girls yielded non-significant results. This study therefore suggests that healthier dietary behaviors are associated with lower BMI percentiles in boys and not in girls. Spearman's rho correlations between both frequent and moderate consumption and BMI percentiles were unique and different between boys and girls, yet significant for males.

This study found gender differences in dietary behaviors similar to those indicated in Patrick et al. (2004). In their study, 878 adolescents who were aged between 11 and 15 years were studied for diet, PA and sedentary behaviors as risk factors for overweight. There were noticeable differences between girls and boys in terms of percentage calories consumed from fat as well as total calories expended per day and fiber grams per day. These participants were also racially diverse. Though this revelation seems interesting in terms of comparisons, the studies did not use a similar approach to defining dietary behaviors and the two studies differ in design and setting. Also, the participants in the current study are older based on their grade levels. In Patrick et al. (2004), a randomized control approach was used, compared to the self- reported dietary behaviors that are common with the YRBS. In addition, the sample size was also very small compared to the national sample of YRBS.

Sleep

From the results of the current study, there were noticeable gender differences in correlation coefficients in sleep score computations. Firstly, Spearman's rho reported correlations between high school students sleep scores and BMI percentiles that depicted considerable shifts after gender categorization. Spearman's Rho reported significant inverse relationships between sleep score and BMI percentiles among boys ($r = -.047$, $p < .05$), and non-significant indirect relationships in their female counterparts.

The results from the bivariate association between sleep score and BMI percentiles are equivocal with an implication that further research on sleep duration within different weight status categories is needed. This vagueness may also originate from the fact that there is merely a single question on the YRBS on sleep. Other studies have found associations between children's weight status and sleep. These studies have also addressed other aspects of sleep, rather than just mere sleep duration. Snell et al. (2007) found correlations between sleeping less than 8 hours with higher BMI in adolescents regardless of gender. The current study revealed and affirmed that gaining the longer sleep in terms of duration in boys is associated with lower BMI percentiles unlike in girls. This result was similar to that of Reither et al. (2014).

Finally, the above systematic presentation of findings and discussions indicated gender differences in relationships between health risk behaviors of physical activity, dietary behavior and sleep with BMI percentiles when these relationships were examined using bivariate measures. Though the results from the correlation analysis especially in boys indicated statistical significance, the correlations were weak in nature. This is because of the existence of complex relationships might reflect a number of factors that are not addressed by the survey. Furthermore, the impact of all the health-risk behaviors on BMI percentiles was not different between Whites/Caucasians and Blacks/African Americans when a multivariate analytical approach was attempted.

Recommendations

YRBS questions on physical activity are frequency and duration based, making it hard to determine whether the frequency of student participation in numerous activities meets the required intensity in the 60 minutes or more of *moderate to vigorous* physical activity. It is recommended that future YRBS questions on physical activity include follow up questions using a Likert scale of the participants ‘rate of perceived exertion’ in the types of activities reported. This would at least emphasize the intensity of the PA. This limitation in the nature of the questions in the YRBS, however, should not limit similar approaches in studying these variables since the physical activity guidelines for children include a duration component (SHAPE America, 2016) and an increase in the duration of physical activity is also necessary to avoid the sedentary disease syndrome. Further studies targeting physical activity, dietary behaviors, sleep and their relationship to BMI percentiles are necessary but should be conducted with a different approach to defining the variables, perhaps with different quantifications and scales compared to the ones this study employed. Another way that future studies could approach YRBS questions in the physical activity category might include combining two responses. For example, the following questions from Table 1, could be combined to represent one category of physical activity.

Category 1: Qn. "how many days in last 7 days physically active over 60 minutes per day?"

Qn. "how many days go to PE classes?"

Category 2: Qn. "how many hours watch TV?"

Qn. "how many hours play video games or computer?"

Among the many changes in dietary practices and behaviors that should continue to be emphasized is checking the nutrition labels of food purchased in addition to consuming healthier meals as reflected in the Myplate program [Available at http://www.choosemyplate.gov/]. The USDA recently released the 2015-2020 dietary guidelines for America that also address school nutrition, in addition to the specific nutrition requirements from the Healthy, Hunger Free Kids Act (HHFKA). Though these recommendations continue to receive enormous challenges from some communities and schools, a greater number of schools are cooperating and increasing the chance of reducing sodium and fat in NSLP and SBP. However, more emphasis needs to be placed on other federal nutrition programs, such as summer food programs that might be easier to manipulate due to their nature. Not-for-profit organizations that offer snacks and extra meals at schools should be required to follow set standards in addition to controlling the inflow of foods that are mainly consumed in schools.

This study tended to find relationships in boys but not girls. One explanation for this finding might be that boys generally are more active than girls and the response categories used masked this fact. There could be several other reason surrounding the nature and strength of the relationship. The existence of more variability among boys in terms of physical activity participation, gives boys a better chance of showing this significant relationship. Also, BMI in girls might confound the relationship, and probably implying that body fat percentages would be a more reflective and better measure of body composition for them. On the other hand, health educators should continue encouraging their schools and communities to join health initiative and movements aimed at encouraging physical activity, health and wellness skills. The Let’s Move campaign and 50 Million Strong are examples of initiative that all schools should embrace. In many schools, these movements are already underway. Further research on addressing the impact of using *frequent* versus *moderate* consumption especially in children and adolescents is necessary. Moderate versus frequent consumption of the items listed in the YRBS might have different dietary and caloric implications to BMI percentiles.

The guidelines for recommended sleep duration for adolescent and other individuals across the lifespan differ between the National Sleep Foundation and the National Heart Lung and Blood Institute, which is grounds for misconceptions. An expert panel from these two organizations is required to curb the confusion. In addition, CDC needs to reconsider designing the question on sleep to include other aspects of sleep that are attracting more attention in the literature rather than limiting the sleep item to duration only. Questions that address both sleep quality and quantity are necessary in future YRBS.

Finally, I would recommend the replication of this study with the 2015 YRBS data from the CDC. Particularly, studying the concurrence of sleep and racial ethnicity in both girls and boys in the two higher weight status categories of overweight and obesity, would provide more insight. The combination of studies might then provide more clarity on the trends of the health risk behaviors studied, as well as the trend in the relationship between those behaviors and BMI percentiles between 2013 and 2015. Other studies would also examine impact of the health risk behaviors on BMI percentiles in individuals in overweight and obese weight status categories. In addition, I would suggest that a future study using an experimental design would capture very-well defined and specific measures of physical activity involvement, such as using accelerometers and more genuine measures of dietary behaviors as well as actual sleep duration rather than self-reports.

Conclusions

From the bivariate correlations, it was evident that there were associations between different health risk behaviors and BMI percentiles among the 2013 YRBS participants nationally. Since this sample was nationally representative, this study supports the need for adolescents to maintain higher levels of moderate to vigorous physical activity among adolescents irrespective of gender. This could also be based on the actual responses rather than relationships. Stricter guidelines in addressing dietary problems, not only in schools but also as a community wide effort are still warranted. Although these guidelines seem to exist, they are weak and easily circumvented. Health and physical educators should strengthen their lessons and include more behavioral outcomes on sleep duration, quality and disorders. The results from the bivariate association between sleep duration and BMI percentiles are equivocal with an implication that more needs to be addressed with sleep duration within different weights status categories. Adolescent dietary behaviors still largely remain a contentious topic, especially when both adolescents and their parents/guardians are unwilling to adopt the recommended guidelines. Therefore, further research and examination of newer data would be necessary to identify trends.

The insights gained by this examination emphasize that sleep might have strong influence on adolescent BMI percentiles. This study was able to establish and emphasize previous findings from similar research studies that have been highly contentious in terms of establishing links to weight status. The insights gained from this particular study, might provide the needed guidance in understanding the role of *more* versus *less* number of sleep hours on BMI percentiles particularly in adolescents. In addition, parents might be further informed of the role they need to play in adolescent sleep and general wellbeing, as well as motivating more health educators to emphasize the need for youths to gain recommended sleep hours daily regardless of race or ethnicity.

Finally, and if meaningful physical activity, healthier dietary behaviors and longer sleep durations are associated with healthier BMI percentiles, then more attention to physical activity diet and sleep behavior is still warranted. It is therefore necessary to further examine the factors such as the concurrence of sleep, dietary behavior, physical activity and racial ethnicity across gender and weight status categories.

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