The effects of individual attributes, health behaviors, and religion on adolescent obesity: a study of African American and Caucasian adolescents

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The effects of individual attributes, health behaviors, and religion on adolescent obesity: A study of African American and Caucasian adolescents

by

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A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Family and Consumer Sciences Education

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2008

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DEDICATION

This work is dedicated in loving memory of my father, Leonard Besah Nutakor, and my mother, Sabina Atsemuyo Evortepe Nutakor, for instilling in me the fear of GOD and the value of hard work by example. Your unconditional love and words of wisdom have kept me even after you went to be with the LORD. Thank you father and mother, for the sacrifices you made to educate me against the wide belief at the time, that educating a woman was a waste of resources. Thank you very much for believing in me that I could be anything that I want, and granting me the opportunity to become the first woman in our community to attend college. Each page I write today was laid very carefully by you. I wish you were alive to celebrate this major accomplishment with me, but I know you would have been very proud.
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The purpose of this study was to explore the influence of individual attributes (family socioeconomic status, gender, and race) and health behavior factors (vigorous physical activity, sedentary activity, dietary intake, and sleeping pattern) as well as religion (religious affiliations and religious commitment) on African American and Caucasian adolescents’ body weight. The sample for this study consisted of African American and Caucasian adolescents ($N = 3,596$) aged 14-18 years at Wave II of the National Longitudinal Study of Adolescent Health (Add Health). Stratification of the percentage of adolescents based on CDC growth charts indicates greater prevalence of overweight and obesity among African American than Caucasian adolescents. Structural equation modeling was used to analyze the relationships of these attributes and health behaviors with adolescent’s adiposity. Based on this model, multigroup comparisons between African American and Caucasian models were performed to determine the varied relationships of these variables with body weight. In both models, vigorous physical activity protected against overweight and obesity. The model for African Americans seems to fit the data better than does the model for Caucasians; however, the model for Caucasians had more significant pathways than the model for African Americans. In addition, the multiple group comparison regarding religiously committed African American and Caucasian adolescents, without controlling for religious affiliations, indicates that the influence of religiosity on youth adiposity is moderated by race.
CHAPTER 1. GENERAL INTRODUCTION

Introduction

The prevalence of overweight and obesity is rising worldwide. Over the past two decades, obesity has reached epidemic proportions, affecting all ages, racial and ethnic groups, both genders, and all levels of economic status of the population in almost all countries (Centers for Disease Control [CDC], 2005; Flegal, Carroll, Kuczmarski, & Johnson, 1998; Merten, 2005). Globally, more than one billion adults are overweight with at least 300 million clinically obese, along with 22 million overweight children under the age of five (World Health Organization [WHO], 2003). In the United States, the incidence of overweight and obesity is increasing at an alarming rate and affecting millions of people. The Surgeon General of the United States described the obesity crisis as potentially affecting every state, every city, every community, and every school across the nation and nearly two out of three Americans (Carmona, 2003). Currently, an estimated 66% of U.S. adults are overweight or obese, along with 17% of children and adolescents (CDC, 2005).

Overweight and obesity are associated with numerous and varied health consequences, ranging from premature death to several chronic conditions that adversely impact the overall quality of life (WHO, 2003). Overweight and obesity raise the risk of non-communicable diseases, including type 2 diabetes, cardiovascular diseases (heart disease, stroke, and hypertension), respiratory dysfunction, certain types of cancer, and physical disabilities, particularly when they occurred early in life (Crosnoe & Muller, 2004; U.S. Department of Agriculture [USDA], 2005; U.S. Department of Health & Human Services [USDHHS], 2006). The obesity epidemic accounted for 300,000 premature deaths annually in the U.S., second behind tobacco-related causes of preventable death in the
country (Allison, Fontaine, Manson, Stevens, & VanItallie, 1999; West Virginia Department of Health & Human Resources, 2006).

The incidence of overweight among children and adolescents in the U.S. escalated by more than 100% over the past two decades, based on 2001-2002 and 2003-2004 studies (Field et al., 2003), and the trend appears to be continuing. Recent epidemiological studies using National Health and Nutrition Examination Survey (NHANES) data suggest that the obesity crisis will continue into the next generation, as obesity and overweight rates among children and adolescents would indicate. Among children (aged 6 to 11 years) over nine million (19%) are overweight or obese (Carmona, 2003), and among adolescents (12 to 19 years) more than 17% are obese and more than 30% are overweight (National Center for Health Statistics, 2004b).

Obesity and overweight among children and adolescents are of great concern for public health, as the wide-ranging adverse health impacts that may arise during childhood and adolescence may increase or persist into adulthood (Carmona, 2003; Field, Cook, & Gillman, 2005), and have detrimental consequences for the long-term health of an adolescent (Merten, 2005). A study predicting obesity in adulthood from childhood suggests that approximately 80% of children and adolescents who were overweight became obese adults, and that the earlier it starts the more severe is the obese condition during adulthood (Freedman, Khan, Dietz, Srinivasa, & Berenson, 2001).

**Need for the Study**

The obesity epidemic in the U.S. is threatening the health of millions of adolescents. Obese and overweight adolescents are at high risk for long-term health consequences through the accumulation of various health risk factors over a lifetime (Wickrama, Wickrama, &
A growing body of research identified proximal and distal factors as contributing to the prevalence of obesity, which seemed to be higher among minorities (African Americans in particular) than among Whites (Merten, 2005; National Heart, Lung, and Blood Institute Growth and Heart Study Research, 1992; Sherwood, Story, & Obarzanek, 2004; Wickrama et al.). An individual’s propensity to poorer health is affected primarily by health behavior factors including physical activity, healthy food choices, and sleep (Carmona, 2003; Chaput, Brunet, & Tremblay, 2006). Additional studies showed that race/ethnicity mediates these health behaviors (Merten; Wickrama et al.). This might also be true for adolescent adiposity. It is of growing importance that studies employ these health behavior factors and race/ethnicity in their focus on a wide range of potential factors fundamental to our understanding of adolescent adiposity. However, there is a paucity of research regarding individual health behaviors and racial disparities in the prevalence of overweight among adolescents. In addition, there is no known study that incorporated vigorous physical activities, sedentary activities, fruits and vegetables intake, and sleeping patterns into one comprehensive model to examine the influence of all these variables together and of each separately on adolescent body weight.

Research indicates that religion plays a salient role in health; people with stronger sense of religious identify are more likely to have healthier lifestyles (Cline & Ferraro, 2006). Moreover, many religious/faith teachings not only discourage overeating and gluttony, but also provide moral and practical guidance beneficial to health (Cline & Ferraro). Although numerous research efforts have examined religion’s relationship with health (de la Mora, 2004; Levin, 2001), research to date on the impact of religion on body weight has received little attention. In particular, religion’s association with adolescent body weight has not been
established or explored in depth. This study extends the current literature by analyzing a nationally representative sample of U.S. adolescents to explore racial disparities in the prevalence of overweight and obesity among African American and Caucasian adolescents. This study explores the associations between being overweight and (a) health behaviors (including vigorous physical activities, sedentary activities, dietary intake, and sleeping patterns) and (b) religious affiliations and religiosity.

**Significance of the Study**

A study of adolescents’ health behaviors, religious commitment, and their varied relationships with adolescent body weight is important in today’s society, where the prevalence of obesity is alarming. First, understanding this relationship can help reveal the variables that affect the overweight and obesity epidemic. This information expands on the extant body of knowledge of the relationship among health behavior factors, religious commitment, and body weight among adolescents. Second, this work can serve as informative for targeting prevention, intervention, and treatment efforts, particularly for African Americans (because less information is available regarding their overweight and obesity development).

Third, if health behaviors play a salient role in maintaining body weight among adolescents, this study will help and encourage health educators, especially family and consumer sciences professionals, to promote as well as teach school children the importance of making healthy choices. The behaviors children and adolescents learn now will last a lifetime (Healthy People 2010, 2001). Fourth, if religion influences adolescents’ adiposity, the study will help public health professionals, family health educators, policymakers, and counselors to comprehend and take seriously the effectiveness of religion on body weight.
Undoubtedly, the results of this study will inform as well as encourage various religious groups, especially those with youth programs, to promote through their religious theology or teachings the benefits of protective factors (better health behaviors) against excess body weight. More importantly, this information may uncover significant racial/ethnic disparities regarding the relationship between religion and adolescent body weight. Finally, understanding the unique influence of health behaviors, race, and religion on adolescents’ body weight will help in developing innovative prevention and intervention strategies to address this major health problem.

**Dissertation Organization**

This dissertation is organized into five chapters. Chapter 1 includes a general introduction of the research topic. Chapter 2 provides a comprehensive review of literature. Chapter 3 comprises a manuscript to be submitted to the *Family and Consumer Sciences Research Journal* focusing on the extent to which health behaviors predict adolescent adiposity. Chapter 4 consists of a manuscript to be submitted to the *Journal of Youth and Adolescence* with focus on the influence of religious affiliations and religiosity on obesity during adolescence. The overall summary of the dissertation is presented in Chapter 5.
CHAPTER 2. REVIEW OF LITERATURE

Prevalence of Overweight and Obesity in the United States

The prevalence of overweight and obesity is rising worldwide. Over the past two decades, obesity has reached epidemic proportions, affecting all ages, racial and ethnic groups, both genders, and all levels of economic status of the population in almost all countries (CDC, 2005; Flegal et al., 1998; Merten, 2005). Globally, more than one billion adults are overweight (with at least 300 million clinically obese) and 22 million children under the age of five are overweight (WHO, 2003).

In the U.S., the incidence of overweight and obesity is increasing at an alarming rate and affects millions of people. The Surgeon General of the United States described the obesity crisis as potentially affecting every state, city, community, and school across the nation, and nearly two out of three Americans (Carmona, 2003). One study described the U.S. as the undisputed leader in obesity prevalence among developed nations (West Virginia Department of Health & Human Resources, 2006). Currently, an estimated 97 million adults are overweight or obese in this country alone. According to the CDC (2005), an estimated 66% of U.S. adults were overweight or obese, along with 17% of children and adolescents in 2003-2004.

The National Health and Nutrition Examination Survey (NHANES), designed to assess the health and nutritional status of adults and children in the U.S. through interviews and direct physical examinations, provide data on the prevalence of overweight and obesity in the U.S. Five NHANES rounds have been conducted since 1970, covering a national sample of approximately 30,000 individuals between 1 and 74 years of age. Unlike the previous NHANES surveys, which were conducted over a period of approximately four years
with a “break” of at least one year between survey periods, beginning in 1999–2000 the NHANES survey was conducted without breaks on a yearly basis. As a result of data derived from NHANES, researchers, health professionals, and makers of public policy have been able to chart the increasing prevalence of obesity in the U.S., as well as changes in obesity demographics (e.g., age, ethnicity, gender) (National Center for Health Statistics, 2004). Based on NHANES data, the prevalence of overweight and obesity among adults, adolescents, and children continues to increase since 1976.

Body mass index (BMI), defined as weight in kilograms divided by height in meters squared (kg/m$^2$), is the most appropriate and acceptable measure for assessing overweight and obesity in adults, adolescents, and children (CDC, 2005). For adults, weight status is based on absolute BMI level, whereas child and adolescent weight status is determined by comparing the individual’s BMI with age- and gender-specific percentile values (CDC, 2005).

From 1976-1980 to 2003-2004, the prevalence of overweight (BMI greater than or equal to 25.0) among U.S. adults age 20–74 years increased from 47% to 66%; and the prevalence of obesity (BMI greater than or equal to 30.0) increased from 15% to 33% (see Table 1) (CDC, 2005; Hill, Catenacci, & Wyatt, 2005; National Center for Health Statistics, 2004; Ogden et al., 2006).
Table 1. Prevalence of Overweight and Obesity among U.S. Adults, Age 20-74 Years

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<tr>
<td>Overweight or obese (BMI greater than or equal to 25.0)</td>
<td>47.0</td>
<td>55.9</td>
<td>64.5</td>
<td>65.7</td>
<td>66.2</td>
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<tr>
<td>Obese (BMI greater than or equal to 30.0)</td>
<td>15.0</td>
<td>23.2</td>
<td>30.9</td>
<td>31.3</td>
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Source: National Center for Health Statistics, 2004

**Overweight and Obesity in Children and Adolescents**

A more serious aspect that is of general concern is the prevalence of overweight among children and adolescents. The incidence of overweight among children and adolescents in the U.S. escalated by more than 100% over the past two decades, and the trend appears to be continuing (Field et al., 2003). In the 1960s, only 4% of 6- to 17-year-olds were overweight (The Center for Health Care in Schools, 2005), but recent epidemiological studies indicate that obesity rates have tripled for children and teens over the past 40 years, and over nine million children now are overweight or obese (Carmona, 2003). From 1976 to 1980, the prevalence of overweight doubled, from 7% to 15%, among children 6 to 11 years old and tripled, from 5% to 15%, among adolescents 12 to 19 years old (Sherwood et al., 2004). Data from the 2003-2004 NHANES provided further evidence of the continued increase of overweight and obesity among children and adolescents.

As shown in Table 2, overweight prevalence among U.S. children and adolescents was relatively stable from the 1960s to 1980. However, from NHANES II (1976-80) to NHANES III (1988-94), the prevalence of overweight nearly doubled among children and
adolescents. The NHANES 2003-04 overweight estimates suggest that since 1994 the incidence of overweight in youths has not leveled off or decreased, and is increasing to even higher levels (National Center for Health Statistics, 2004b). It is apparent with data from NHANES that between 1988-94 and 2003-04 the prevalence of overweight increased from 7.2% to 13.9% among 2- to 5-year-olds and from 11% to 19% among 6- to 11-year-olds. Among adolescents aged 12 to 19, overweight increased from 11% to 17% during the same period (Hedley et al., 2004; National Center for Health Statistics). The 2003-04 findings suggest the likelihood of another generation of overweight adults at risk for subsequent overweight- and obesity-related health conditions (National Center for Health Statistics).

Table 2. Prevalence of Overweight among Children and Adolescents Ages 2–19 Years

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<td>10.6</td>
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<td>6-11</td>
<td>4.2</td>
<td>4.0</td>
<td>6.5</td>
<td>11.3</td>
<td>15.1</td>
<td>16.3</td>
<td>18.8</td>
<td></td>
</tr>
<tr>
<td>12-19</td>
<td>4.6</td>
<td>6.1</td>
<td>5.0</td>
<td>10.5</td>
<td>14.8</td>
<td>16.7</td>
<td>17.4</td>
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Demographic Characteristics and Obesity

The U.S. obesity crisis is present across all demographic and social groups, yet certain subgroups of the population are at increased risk. In particular, African American adolescent girls show higher rates of overweight compared with their White counterparts (Sherwood et al., 2004). The NHANE survey in 1999-2000 showed that African American girls aged 6 to 11 years are twice as likely as same-aged White girls to be overweight (22.2%, vs. 11.6%), and the same pattern occurs for those 12 to 19 years old (26.6%, vs.
12.4%) (Ogden, Flegal, Carroll, & Johnson, 2002). Studies from the National Heart, Lung, and Blood Institute National Growth and Heart Study in 1987-97 indicated that 9- to-year-old African American girls have considerably higher body mass index than do same-aged White girls. Findings also show that more than one-half of the African American girls were overweight and more than one-third were obese by age 19 (National Heart, Lung, and Blood Institute Growth and Heart Study Research Group, 1992). Likewise, data from Coronary Artery Risk Development studies among African American and White young adults over a seven-year period in early adulthood showed that the prevalence of overweight increased from 32% to 50% among African American women and from 13% to 24% among White women (Lewis et al., 1997). Also, CDC (2005) reported a higher rate of obesity among African American women (50%) than among White women (31%).

The prevalence of overweight among children and adolescents increased significantly by gender from 1999 to 2004. Among female children and adolescents, the prevalence of overweight increased from 13.8% in 1999 to 16.0% in 2004, and among male children and adolescents, from 14.0% to 18.2% (Ogden et al., 2006). The prevalence of obesity among men also increased substantially, from 27.5% to 31.1% from 1999 to 2004, but there was no change in obesity among women (33.4% vs. 33.2%) (National Center for Health Statistics, 2004). Also, there were significant differences in obesity by age. Adolescents were more likely to be overweight than younger children, and older adults were more likely to be obese than younger adults. The only exception was among adults 80 years and over who were no different than adults 20 to 39 years of age (National Center for Health Statistics, 2004).

A more serious aspect of the increasing prevalence of overweight children, and of great concern for public health, is the risk of an overweight child becoming an obese adult.
Nearly three out of every four overweight adolescents may become overweight or obese adults (Carmona, 2003). According to Field et al. (2005), an obese child is twice as likely to become an obese adult and an overweight adolescent is 18 times more likely than their normal weight peers to become obese in early adulthood. Another study indicated that 25% of obese adults were overweight as children, and, if becoming overweight starts before 8 years of age, obesity seemed to be more severe during adulthood (Freedman et al., 2001). It is apparent from these findings that excessive weight during childhood and adolescence tends to increase or persist into adulthood.

**Consequences of Overweight and Obesity**

Overweight and obesity are associated with numerous and varied health consequences, ranging from premature death to several chronic conditions that adversely impact the overall quality of life (WHO, 2003). Overweight and obesity raise the risk of non-communicable diseases, including type 2 diabetes, cardiovascular diseases (heart disease, stroke, and hypertension), respiratory dysfunction, certain types of cancer, and physical disabilities, particularly when occurring early in life (Crosnoe & Muller, 2004; USDHHS, 2006), and for the first time children now are being diagnosed with high blood pressure (Carmona, 2003).

Furthermore, obesity is associated with pregnancy complications, menstrual irregularities, infertility, high blood cholesterol, increased surgical risks, and social discrimination (which has a strong negative relationship with quality of life) (West Virginia Department of Health and Human Resources, 2006). Obesity can affect quality of life through limited mobility and decreased physical endurance as well as through social, academic, and job discrimination (USDHHS, 2006). A longitudinal study of 1,500 White,
Black, and Hispanic children from age 10 to age 14 found that lower self-esteem was significantly more likely to be observed among obese than non-obese children by age 14 regardless of race/ethnicity (Frankenfield, n.d.). Two studies suggested that obese students were not accepted at prestigious colleges as often as their normal-weight counterparts, even with similar scholastic achievements (Belluscio, n. d.). According to Belluscio, heavier women earn lower incomes than normal-weight women, and about 20% of employers say they would not employ overweight and obese people.

Moreover, the Bogalusa Heart Study indicated that overweight adolescents were 8.5 times more susceptible than their leaner peers to hypertension as young adults (Srinivasa, Bao, Wattigney, & Berenson, 1996). In a sample of 5- to 17-year-olds, nearly 60% of overweight children had at least one cardiovascular disease risk factor, while 25% of overweight children had two or more cardiovascular disease risk factors (Freedman, Dietz, Srinivasa, & Berenson, 1999). Type 2 diabetes increasingly is diagnosed among overweight and obese children and adolescents, and the onset of diabetes in children as young as 5 years of age can result in advanced health complications such as cardiovascular diseases and kidney failure (Must & Anderson, 2003).

Today, obesity is the fastest-growing cause of death in the U.S. (Carmona, 2003). According to the National Institutes of Health [NIH], the obesity epidemic accounts for 300,000 premature deaths annually in the U.S., second behind tobacco-related causes of preventable death in the country (Allison, Fontaine, et al., 1999; West Virginia Department of Health and Human Resources, 2006). The Cancer Prevention Study II of mortality from cancer among U.S. adults, reported that the risk of mortality increased with increasing BMI at all ages for all categories of death (Bordeaux, Bolen, & Brotman, 2006; Calle, Rodriguez,
Walker-Thurmond, & Thun, 2003). Overweight and obesity accounted for 20% of all cancer deaths among women and 14% among men in the U.S., in a total of 900,000 cancer deaths annually in the U.S. (Bordeaux et al.; Calle et al.). Furthermore, 309,000 to 582,000 U.S. deaths in 1990 were associated with unhealthy diet and exercise (Allison, Fontaine, et al., 1999). In general, individuals who are obese (BMI > 30) have 50% to 100% increased risk of premature death from all causes, compared to their peers with healthy weight.

Although the primary concern of overweight and obesity is one of health, there are psychosocial disorders and social ramifications as well. Obese children and adolescents suffer more social difficulties than do their normal-weight peers (Merten, 2005; Swartz & Puhl, 2003). They are shunned, teased, or bullied and left out of many activities. These consequences are very damaging emotionally and may contribute to low self-esteem (which in turn adversely impacts their academic performance and peer relationships), depression, and an increased chance of developing substance abuse problems and eating disorders including anorexia and bulimia. The most immediate psychosocial consequences of obesity perceived by the children and adolescents themselves are social isolation and discrimination (Merten, 2005; USDHHS, 2006).

Overweight and obesity and their associated health problems have a significant economic impact on the U.S. health care system (USDHHS, 2006). Medical costs associated with overweight and obesity involve both direct and indirect costs (Wolf, 1998; Wolf & Colditz, 1998). Direct medical costs may include preventive, diagnostic, and treatment services related to obesity. Indirect costs relate to morbidity and mortality costs. Morbidity costs are defined as the value of income lost from decreased productivity, restricted activity,
absenteeism, and bed days. Mortality costs are the value of future income lost by premature death.

The national costs attributed to both overweight (BMI = 25–29.9) and obesity (BMI ≥ 30) accounted for 9.1% of the total U.S. medical expenditures in 1998 and may have reached as high as $78.5 billion ($92.6 billion in 2002 dollars) (Finkelstein, Fiebelkorn, & Wang, 2003). The NIH estimated the total cost of overweight and obesity to the U.S. economy in 1995 at $99.2 billion, including approximately $51.6 billion in direct health costs and $47.6 billion in indirect costs (West Virginia Department of Health and Human Resources, 2006). Data from the National Health Interview Survey suggest that 39.3 million workdays are lost to obesity-related causes annually in the U.S. The economic cost (medical cost and productivity lost) alone of obesity in the U.S. was estimated to be about $117 billion in 2000 (CDC, 2005). In 2002, the obesity epidemic, linked to diabetes, heart disease, and other conditions in the U.S., accounted for an estimated annual medical expenditure of $93 billion. The estimated economic cost of obesity to business, including health, life, and disability insurance and paid sick leave by private sectors, was $15.4 billion (Williams, Hartough, Miles, & Braun, 2005).

Causes of Overweight and Obesity

Obesity is a complex condition, with many variables contributing to its development. Recent studies suggest that genetic, metabolic, behavioral, and environmental factors influence overweight and obesity (Flegal et al., 1998; Taheri, 2004).

Genetic Factors

A number of studies indicate that certain genetic characteristics may increase an individual’s susceptibility to overweight (Farooqi & O’Rahilly, 2000; National Center for
Health Statistics, 2004). However, this genetic susceptibility may need to exist in juxtaposition with contributing environmental and behavioral factors (such as a high-calorie food supply and minimal physical activity) to have a significant relationship with weight (Farooqi & O’Rahilly). Genetic factors alone can play a role in specific cases of overweight. For example, overweight is a biological and a clinical feature for rare genetic disorders.

Although genetic composition undoubtedly contributes to an individual’s susceptibility to weight gain, genetics alone cannot explain the overall increase and the widening differences in the rate of weight gain by age in recent years (Carmona, 2003; Savaiano & Welsh, 2006). Genetic characteristics have not changed over the past two decades, but the prevalence of overweight and obesity among children, adolescents, and adults has approximately doubled (Center for Health Care in Schools, 2005; Ogden et al., 2002; 2006).

**Behavioral Factors**

The factors that contribute to childhood overweight interact with each other; therefore, it is not possible to specify one behavior as the “cause” of overweight (National Center for Health Statistics, 2004). However, certain behaviors have been identified as potentially contributing to an energy imbalance and, consequently, to overweight. According to Baur (2002) and Carmona (2003), the fundamental reason for the increased prevalence of adolescent obesity is significant changes in lifestyle. Some researchers have noted that a chronic state of energy imbalance must exist for weight gain to arise, suggesting that excessive caloric intake accompanied by a relative decrease in physical activity or energy expenditure may be the major contributor (Carmona, 2003; Fox, Pardini, & Welsh, 2006; WHO, 2003).
At the individual level, childhood overweight is the result of an imbalance between the calories a child consumes as food and beverages and the calories a child uses to support normal growth and development, metabolism, and physical activity. In other words, overweight results when a child consumes more calories than the child uses. The imbalance between calories consumed and calories used can result from the influences and interactions of a number of factors, including genetic, behavioral, and environmental factors (WHO, 2003). It is the interactions among these factors—rather than any single factor—that are thought to cause overweight. Furthermore, many underlying factors have been linked to the increase in obesity, such as increasing portion sizes; eating out more often; increased consumption of sugar-sweetened drinks; increasing television, computer, and electronic gaming time; changing labor markets; and fear of crime, which prevents outdoor exercise.

A number of research findings suggested an association between obesity and health behavior factors, including: (a) dietary intake, (b) physical activity, (c) sedentary activity, and (d) sleeping pattern.

**Dietary intake**

Good nutrition is essential for good health, normal growth, and development of children and adolescents (USDA, 2005). Dietary factors play a key role in the development and maintenance of overweight and obesity (Sherwood et al., 2004). Poor diet contributes to major causes of morbidity and mortality in the U.S. Overweight and obesity are linked to poor diet (USDA, 2005). More calories consumed than expended are the major contributing factors to the prevalence of overweight and obesity in this country. A growing body of evidence demonstrated that following a diet that complies with Dietary Guidelines may reduce the risk of chronic diseases including overweight and obesity (Kant, Graubard, &
Schatzkin, 2004). The *Dietary Guidelines for Americans* has been published jointly every 5 years since 1980 by the U.S. Department of Health and Human Services (USDHHS) and the U.S. Department of Agriculture (USDA) (Dietary Guidelines, 2000). The Guidelines provide authoritative advice for people 2 years and older about how good dietary habits can promote health and reduce risk for major chronic diseases, and serve as the basis for federal food and nutrition education programs (USDHHS, 2006). A healthy eating plan emphasizes fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products. It also includes lean meats, poultry, fish, beans, eggs, and nuts as well as low saturated fats, trans fats, cholesterol, salt (sodium), and added sugars. However, adherence to the dietary guidance is low among the majority of the U.S. population (Kant et al.).

According to USDHHS (2006), eating a healthy diet rich in fruits and vegetables can lower an individual’s risk for chronic diseases such as certain cancers and cardiovascular diseases. Because fruits and vegetables have low energy density, eating them is beneficial for weight management (Blanck et al., 2007). Data from the 2005 Behavioral Risk Factor Surveillance System (BRFSS) indicate that adults in the 50 states and the District of Columbia have not achieved the national objectives for fruits and vegetables consumption. In 2005, 32.6% of U.S. adults ate fruits two or more times per day, and 27% consumed vegetables three or more times per day.

By gender, 28.7% women and 36.4% of men consumed fruits two or more times per day; 32.2% of women consumed vegetables three or more times per day, compared to 22.1% among men. In addition, adults aged 65 years and older consumed more fruits two or more times per day (45.9%) compared to adults age 35-44 years (27.9%). Among racial groups, 28.6% of Whites consumed vegetables three or more times per day, compared to 23.7% of
African Americans (Blanck et al., 2007). In addition, adults who were not overweight or obese ate fruits two or more times per day (36.0%) and vegetables three or more times per day (28.9%), as compared to obese adults (28.1% and 26.0%, respectively) (Blanck et al.). These findings indicate that eating diets high in fruits and vegetables may influence being overweight or obese.

National data from the Youth Risk Behavior Survey (YRBS) of U.S. high school students showed that 76.1% of all students eat less than the recommended 5 or more servings of fruits and vegetables. Among children 2 years and older the average intake of fruits and vegetables declined from 3.4 to 3.2 servings from 1994-96 to 1999-2002 (Blanck et al., 2007). However the dietary intake of fruits and vegetables did not vary significantly among racial and gender subgroups (Lowry, Wechsler, Galuska, Fulton, & Kann, 2002).

Eating habits formed during adolescence continue into adulthood; as a result, poor dietary habits among adolescents have detrimental relationships with health in adulthood (Merten, 2005). Large portion sizes of food and beverages, eating meals away from home, frequent snacking on energy-dense foods, and consuming beverages with added sugar are contributing to excess energy intake of children and teens (WHO, 2003). In the area of sugar-sweetened drinks consumption, evidence is growing to suggest an association with increased overweight in children and adolescents (Malik, Schulze, & Hu, 2006).

In addition, a Missouri study indicated that other sweet drinks, for example, fruit drinks and fruit juice, increased the likelihood of becoming overweight and obese when consumed by those at risk of being overweight (Welsh et al., 2005). Therefore, reducing easy access to and consumption of such drinks by children and teenagers may help to limit their chances of being overweight.
**Physical activity**

Physically active children are more likely to remain physically active throughout adolescence and adulthood. Evidence provided by cross-sectional and longitudinal studies suggests that adolescents of both sexes who are involved in relatively high levels of physical activity have less adiposity than less active adolescents (Strong et al., 2005). About 45-60 minutes of moderate vigorous physical activity is needed on most days or every day to prevent unhealthy weight gain (WHO, n.d.).

In addition, studies of overweight boys and girls involved in systematic physical activity intervention provided evidence about the positive influence of physical activity on their body weight. Likewise, the Diabetes Prevention Program (DPP) approach to providing nutrition education, encouraging physical activity, and practicing behavioral modification among adults at high risk of developing diabetes demonstrated that healthful eating and physical activity can achieve modest weight loss (Savaiano & Welsh, 2006).

In spite of the documented evidence of the health benefits of physical activity, 74% of U.S. adults do not participate in moderate levels of physical activity that meet the public health recommendations and about one in four U.S. adults remain utterly inactive during leisure (Merten, 2005). Furthermore, children are spending less time in physical activity during school. Daily participation in school physical education (PE) among adolescents declined significantly over the last 13 years, from 42% in 1991 to 28% in 2003 (Lowry et al, 2004). During the same year period, the prevalence of being physically active during PE class dropped substantially from 42% to 34% among Black high school students. In 2003, more than one-third of high school students did not participate in the minimum recommended level of moderate or vigorous physical activity, 45-60 minutes (Lowry et al.).
**Sedentary activity**

Large shifts from physically active demanding work to sedentary work have been observed worldwide (Merten, 2005). According to the WHO (n.d.), the fundamental reason for the increased sedentary activity is because of the increasing use of technology in the home and more passive leisure pursuits. Findings indicate that children spend a considerable amount of time per day watching TV, videos, DVDs, and movies (Roberts, Foehr, & Rideout, 2005). Children 8 to 18 years old spend on the average nearly 6½ hours per day using media, during which time they use 2 or more media simultaneously, a phenomenon called media multitasking (Roberts et al.).

Several research studies reported a positive association between the times spent viewing television and increased prevalence of overweight in children (Crespo et al., 2001; Lowry et al., 2002; Sherwood et al., 2004). Sedentary activities, specifically television viewing, displaced time children spend in physical activities. Television viewing contributed to increased energy consumption through excessive snacking and eating meals in front of the TV, influenced children to make unhealthy food choices through exposure to poor nutritional quality food advertisements, and lowered children's metabolic rate (Eisenmann, Bartee, & Wang, 2002; Lowry et al., 2002). According to Lowry et al., television viewing represents the single greatest source of physical inactivity among U.S. children and adolescents. The YRBS indicates that watching television for more than 2 hours a day correlates with being overweight and eating inadequate fruits and vegetables (Lowry et al.).

In addition, the NHANES III data showed that the prevalence of obesity among U.S. children increased as hours of television watching increased and the prevalence of obesity was lowest among children with 1 hour or less of television viewing per day (Crespo et al.,
2001). Similarly, Dowda, Ainsworth, Addy, Saunders, and Riner (2001) found that girls who watched more than 4 hours of television per day were more likely to be overweight than those who watched less than 4 hours per day. According to Eisenmann et al. (2002), the prevalence of obesity in 12- to 18-year olds increased 2% for every additional hour of television viewing per day.

Further, racial differences were reported to influence the positive relationship between television viewing and adiposity, particularly for African American girls, because they spend more time viewing than their White counterparts (Sherwood et al., 2004). Results from NHANES III (1988 to 1994) demonstrated that 43% of African American girls, compared with 16% of White girls, watched more than 4 hours of television per day (Crespo et al., 2001). Likewise, YRBS results indicated that 54% of African Americans girls, compared with 13% of White girls, watched more than 4 hours of television per day (Eisenmann et al., 2002). Furthermore, the rate of television viewing increased with age. These findings showed that African American girls spending more time on watching television partially explained their obesity status in comparison with White girls.

**Sleeping pattern**

Sleep is essential to the human body, just as are food and water (Better Health, 2004). Insufficient sleep or lack of sleep has been identified as one important factor contributing to hunger, food selection, and energy expenditure (Taheri, 2004). Sleep deprivation has serious consequences for health and mortality including road accidents and work injuries. Failing to get enough sleep at night due to the Internet, computer games, late-night cable, school, family, work, and other distractions of modern life, exacerbates the risk for major illnesses such as cancer, heart disease, diabetes, and obesity (Stein, 2005). Children as young as 2
years of age might be in danger of becoming obese if they lose a lot of sleep (Taheri). These studies show that the epidemic of obesity is influenced by sleep loss fueled by technology advances.

A growing body of new studies provides evidence suggesting that the obesity epidemic is driven in part by a corresponding decrease in the average number of hours that people are sleeping; possibly by disrupting the hormones ghrelin and leptin that regulate sleep (Stein, 2005). Short sleep duration disturbs normal metabolism, which may contribute to obesity, insulin resistance, diabetes, and cardiovascular disease. It is also a problem for teenagers, for whom the need to sleep is greatest during this critical period of development (Taheri, 2004). According to Taheri, poor sleep sets up a vicious cycle. “It leads to fatigue, which leads to reduced levels of physical activity … which leads to lower energy expenditure … which leads to obesity, which leads to poor sleep” (p. 4). Short sleep duration is linked to increased risk of obesity both in adults and children as young as 5 years of age. Cappuccio (2006) noted that short sleep duration may lead to obesity through an increase of appetite via hormonal changes caused by the sleep deprivation. Lack of sleep produces ghrelin which, among other effects, stimulates appetite and creates less leptin which, among other effects, suppresses appetite.

Recent research in over 28,000 children and 15,000 adults reported that short sleep duration in both groups is associated with an almost two-fold increased risk of being obese (Cappuccio, 2006). People who sleep less have a greater increase in BMI and waist circumference over time and a greater chance of being obese (Cappuccio). Similarly, the analysis of a nationally representative sample of 10,000 adults indicated that those between the ages of 32 and 49 who sleep less than 7 hours a night are more likely to gain weight and
become obese (Stein, 2005). NHANES data, with more than 8,000 adults, demonstrated a clear link between the risk of being obese and the number of hours of sleep each night. The study found that people between the ages of 32 and 59 getting 4 or fewer hours of sleep a night were 73% more likely to become obese than those getting 7 to 9 hours of sleep nightly. People who slept for only 5 hours had a 50% higher risk than those who were getting a full night’s rest and those who got 6 hours of sleep were just 23% more likely to be substantially overweight (The Obesity Society, 2004).

Data across all age groups, even including children as young as 5 years of age, indicated that lack of sleep has tremendous impact on body weight (Taheri, 2004). For example, in a French study of 1,031 children age 5 years and sleeping fewer than 11 hours a night were more obese than those sleeping 11 hours or more. Likewise, in a Japanese study of 8,274 children, aged 6 to 7 years, the likelihood of obesity was 3 times greater for children sleeping fewer than 8 hours a night compared with those sleeping 10 hours. In addition, a study of 1,772 Spanish adolescents aged 15 years or older reported a correlation between short sleep duration and obesity (Taheri).

Sleep data of 1.1 million adults from the American Cancer Society also showed a link between short sleep duration and obesity as well as mortality. Again, a 13-year study of 496 Swiss adults reported an increase in BMI from 21.8 (age 27 years) to 23.3 (age 40 years), with concurrent decrease in sleep duration from 7.1 to 6.9 hours a night in men, and from 7.7 to 7.3 hours in women. However, this study noted that the correlation between short sleep duration and obesity diminished with aging. Therefore, the association between short sleep duration and obesity may be most important during the early years in life, when it might have the greatest impact on setting future eating habits (Taheri, 2004).
Another study at the Howard Hughes Medical Institute at Stanford University, in collaboration with the Wisconsin Sleep Cohort study of over 1,000 adults, indicated that short sleep duration is associated with increased body weight. Most importantly, the study provided the reason behind the association that less sleep lowers leptin and increases ghrelin. Therefore, promoting healthy behaviors—eating more vegetables and fruits as well as engaging in vigorous to moderate physical activity and getting enough sleep—will ensure weight loss and avoid further weight gain among children and adolescents (Chaput, Brunet, & Tremblay, 2006; WHO, 2003).

Further, the patterns of the progression of obesity become more common among people (especially women) in lower socioeconomic status groups. This relationship may even be bi-directional, setting up a vicious cycle (i.e., lower socioeconomic status promotes obesity, and obese people are more likely to end up in groups with low socioeconomic status) (WHO, 2003). The following paragraphs discuss the findings of the relationship between SES and predisposition to obesity.

**Family Socioeconomic Status and Obesity**

Many health disparities in the U.S. have been associated with inequalities in income and education (Drewnowski & Specter, 2004). The increasing prevalence of overweight and obesity is common among population groups with the highest poverty rate (Drewnowski & Specter). The rates of obesity and type 2 diabetes (often attributed to obesity) in the U.S. are strongly, consistently, and inversely associated with family socioeconomic status, such that the burden of disease falls disproportionately on population groups with limited resources, racial minorities, and the poor (Cristol, 2003; Drewnowski & Specter; Wickrama et al., 2006). This is because adolescents from economically disadvantaged families do not have
access to health services, healthy foods, and recreation facilities. Among both African American and Caucasian women, higher obesity rates tend to be associated with low income and low educational levels (Drewnowski & Specter; Wickrama et al., 2006).

Research findings based on nationally representative data (NHANES) indicated that family socioeconomic status such as poverty and single parenthood contribute to the increasing prevalence of overweight and obesity in the United States. Overweight and obesity are particularly common among minority groups and those with low socioeconomic status (Merten, 2005). Women of lower socioeconomic status (income ≤ 130% of poverty threshold) are 50% more likely to be obese than those with higher socioeconomic status (income > 130% of poverty threshold). However, the association of overweight and obesity with low socioeconomic status has been less consistent among men (Drewnowski & Specter, 2004; Healthy People 2010, 2001). Among children, the relationship between socioeconomic status and overweight is greater for non-Hispanic White adolescents from lower income families than those from higher income families (Healthy People 2010).

In addition, adolescents from socio-economically disadvantaged families lack balanced meals and healthy dietary practices. According to Drewnowski and Specter (2004), unaffordable prices and low income affect food choices, dietary habits, and diet quality. Wealthier families tend to purchase higher-quality meats, more fish and seafood, and more fruits and vegetables than do low-income families. Similarly, findings based on BRFSS data in 2007 among U.S. adults indicate that families who earned more than $50,000 per year eat more fruits and vegetables in comparison with those earning less (Blanck et al., 2007). Therefore, family socioeconomic status may influence adolescent eating behavior and the nutritional quality of the food consumed (Merten, 2005).
Furthermore, research showed that religious commitment, particularly when supported by religious affiliation, is an essential determinant of lifestyle and people with stronger sense of religious identity are more likely to have healthier lifestyles (Cline & Ferraro, 2006). Moreover, many religious/faith teachings not only discourage overeating and gluttony, but also provide moral and practical guidance beneficial to health (Cline & Ferraro). Thus, religion may protect against obesity.

**Religion and Religiosity**

Religion plays a fundamental role in the lives of Americans. According to Gallup poll results (2002), 95% of U.S. adults believe in God, 92% are affiliated with a church or synagogue, and 90% pray (75% pray daily), with 59% indicating the importance of religion in their lives and 44% attending church on a regular basis. In addition, research on religiosity found that 63% of U.S. teens aged 13 to 15 years and 52% of 16- to 17-year olds thought religion was very important in their lives; 54% and 51% reported attending church or synagogue in the past seven days, respectively; and 69% of 13- to 15-year olds and 59% of 16- to 17-year olds were affiliated with a church or synagogue (Gallup, Jr., 2001). Review of many rigorous social and epidemiological studies over the last decade showed significant positive linkage between religious involvement and physical health outcomes (Cline & Ferraro, 2006; de la Mora, 2004; Ellison & Levin, 1998). The relationship between religion and health has gained broader acceptance to the extent that even the most incredulous scientists are taking seriously the numerous literature sources identifying a positive connection of religion to better health (Kim, Sobal, & Wethington, 2003).

Religious affiliation and preference (Catholic, Lutheran, Baptist, etc.), each with their own beliefs and practices, may be associated with better health. Many faith teachings may
offer moral and practical guidance on how to attain, maintain, or recover physical and emotional health (Levin, 2001). Studies suggest that religious involvement is an important determinant of individual lifestyle and moral actions (e.g., Cline & Ferraro, 2006) beneficial to health. Many religiously committed individuals adhere to strict proscription by their religious denominations. For example, The Church of Jesus Christ of Latter-day Saints promotes good health by prohibiting smoking, the use of alcohol, and drugs (Kim et al., 2003).

In addition, religious involvement has a positive relationship with various indicators of health and well-being, such as mortality, cardiovascular disease, cancer, depression, loneliness, life satisfaction and happiness, and self-esteem (de la Mora, 2004). The National Health Interview Survey (NHIS) Multiple Cause of Death longitudinal study (1987-95) suggests that religiosity (religious attendance) was associated with mortality. People who never went to church were 1.87 times more likely to die prematurely than those who attend church on a weekly basis (Hummer, Rogers, Nam, & Ellison, 1999). Similarly, individuals who attend church weekly have been reported to have lower blood pressure than those individuals who do not attend religious services regularly (Walsh, 1998).

The protective benefits of religious involvement and affiliation may be influenced by gender, ethnicity, and age. A study shows that religious commitment and its beneficial relationship with health are greater for women than men with comparable levels of commitment (de la Mora, 2004). Also, the importance of religion in an individual’s life is greater among African Americans (85%) compared to Hispanics (75%) and Whites (58%). By age, religion is more salient to older individuals than to younger ones (Gallup Jr. & Lindsay, 1999). However, de la Mora noted that college students and adolescents who
indicate they have a personal relationship with God and a purpose in life were less likely to be depressed than those who indicated religion was not important in their lives.

With numerous substantial positive associations of religion on physical health outcomes, religion may help protect against excess body weight. “Gluttony is the object of disdain in many faiths (e.g. Proverbs 23:20-21), and obesity has long been considered a form of deviance or nonconformity” (Cline & Ferraro, 2006, p. 269). Some religious denominations discourage overweight and obesity. For example, Catholics believe depriving the body of food is related to purity; for Jews, the body is said to be made in the image of God; and among conservative Protestants, the body is described to be the ‘temple of the Holy Spirit’ (Bynum, 1987; Coakly, 1997; Kim et al., 2003; Synnot, 1992). Therefore, viewing one’s body as made of and the home of a deity may promote good health and ideal body weight. In addition, the importance of good health through seeing the body as sacred, the religious, especially those who practice their religion frequently, may be more active physically (Kim et al.), choose healthier diets (measured by green vegetables & fruits intake), and rest more adequately (as measured by hours of sleep) (Dodor, Hausafus, & Shelley, 2008) than their less religious counterparts. Furthermore, certain religious affiliations, for instance Seventh Day Adventists, espouse a vegetarian diet, which has been linked to lower body weight.

In addition, the social support provided by religion may contribute to lower body weight. Studies indicate that social support lowers children’s risk of being obese in Denmark and the U.S. (Gerald, Anderson, Johnson, Hoff, & Trim, 1994). Parham (1993) underscored the importance of social support needed for weight loss and maintenance as well as in promoting decreased body weight. Nevertheless, social organizations of many U.S. religions
use food (Sunday school donuts and church pot-luck dinners high in fat) as a celebratory good which may lead to higher rate of obesity. Thus “religions’ impact on body weight is an important health issue for modern societies, in which the rate of obesity is increasing” (Cline & Ferraro, 2006 p. 269).
CHAPTER 3. THE EFFECT OF ADOLESCENTS’ ATTRIBUTES AND HEALTH BEHAVIORS ON THEIR BODY WEIGHT: A STUDY OF AFRICAN AMERICAN AND CAUCASIAN ADOLESCENTS

A paper to be submitted to Family and Consumer Sciences Research Journal

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Abstract

This study explores the influence of health behaviors and individual attributes on adolescent overweight and obesity using data from Wave II (Add Health). Results of a structural equation model using maximum likelihood estimation reveal the causal paths (adolescents’ attributes and health behaviors) for overweight and obesity were different for African American and Caucasian adolescents. Generally, African Americans (34.2%) were more susceptible to overweight and obesity than Caucasians (25.7%). Although increasing levels of vigorous physical activities lowers the risk for obesity among African American and Caucasian adolescents alike, low family SES and being sedentary were associated with overweight and obesity among Caucasians. No significant associations were found among African Americans. Increased hours of sleep at night relate causally to obesity among African Americans. These findings suggest the consideration of race in the development of effective intervention and prevention approaches in curbing the obesity epidemic among U.S. adolescents.

Introduction

Over the last two decades the prevalence of overweight and obesity has reached epidemic proportions worldwide, affecting both genders, and all ages, racial and ethnic
groups, and levels of economic status of the population (Centers for Disease Control [CDC], 2005; Flegal, Carroll, Kuczmarski, & Johnson, 1998). The World Health Organization [WHO], (2003) estimated that approximately one billion adults are overweight, with at least 300 million clinically obese, and 22 million children under the age of 5 are overweight. In the United States, the obesity crisis potentially affects every state, city, community, and school across the nation, and nearly 2 out of 3 Americans (Carmona, 2003). Among U.S. adolescents, more than 30% are overweight and more than 11% of these are obese (CDC, 2005). Additional studies suggest that the obesity crisis will persist into the next generation. Recently published trend data from the National Health and Nutrition Examination Study (NHANES) indicate that the percentage of overweight and obese adolescents aged 12 to 19 years increased from 30% in 1999-2000 to 34% in 2003-04 (Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006), and this trend is continuing.

Overweight and obesity are associated with numerous and varied deleterious health problems, ranging from premature death to several chronic conditions that adversely impact the overall quality of life (World Health Organization, 2003). Overweight adolescents are 8.5 times more susceptible than their leaner peers to hypertension, diabetes, and heart disease as young adults (Srinivasa, Bao, Wattigney, & Berenson, 1996). In addition, overweight adolescents are 18 times more likely than their normal-weight peers to become obese in early adulthood (Field, Cook, & Gillman, 2005), and nearly 3 out of every 4 overweight adolescents may become obese adults (Carmona, 2003). Additional studies predicting obesity in young adulthood from childhood obesity reported that approximately 80% of children who were overweight at age 10 to 15 years were obese adults at age 25 years (Whitaker, Wright,
Pepe, Seidel, & Dietz, 1997). Thus, excessive weight during childhood and adolescence tends to persist into adulthood.

Although genetic compositions undoubtedly contribute to an individual’s susceptibility to weight gain, they cannot explain the increased prevalence in the rate of weight gain by age in recent years (Carmona, 2003; Savaiano & Welsh, 2006). Genetic characteristics have not changed over the past two decades, but the prevalence of overweight and obesity among children, adolescents, and adults has approximately doubled (The Center for Health Care in Schools, 2005). According to Baur (2002) and Carmona (2003), the fundamental reason for increasing prevalence of adolescent obesity is significant changes in lifestyle. Some researchers noted that a chronic state of energy imbalance must exist for weight gain to arise, suggesting that excessive calorie intake accompanied by a relative decrease in physical activity or energy expenditure may be the major contributor (Carmona, 2003; Fox, Pardini, & Welsh, 2006; World Health Organization, 2003). Playing video games and watching television, the greatest source of sedentary activity among U.S. adolescents, may promote overweight and obesity (a) by displacing involvement in vigorous physical activity that would burn up more energy, and (b) by increasing unhealthy dietary practices during television food advertisements (Lowry, Wechsler, Galuska, Fulton, & Kann, 2002). Television commercials accentuate foods of poor nutritional quality, rather than healthful foods such as fruits and vegetables (Story & Faulkner, 1990).

The consequential adverse relationships of overweight and obesity with quality of life have spurred the concern for educators and health professionals to understand body weight and seek its correlates. Previous studies used indicators such as prevalence (Flegal et al., 1998), economic cost (Allison, Zannolli, & Narayan, 1999), association with risk factors,
diseases, and annual death rates (Allison, Fontaine, Manson, Stevens, & VanItallie, 1999) to communicate the burden of obesity. Others examined the relationship between parental eating style and childhood overweight (Whitaker, Deeks, Baughcum, & Specker, 2000), the relationship of community variables, socioeconomic variables, and parental physical health with obesity (Merten, 2005). Also, the bulk of epidemiological studies documented the consequences of obesity on morbidity and mortality.

However, little research has been conducted regarding how disparities in adolescents’ attributes and health behaviors are interrelated in the prevalence of overweight among African American and Caucasian adolescents. In addition, no known study has incorporated these health behaviors—physical activities, sedentary activities, fruits and vegetables intake, and sleeping patterns—into one comprehensive model to evaluate the influence of each on adolescent adiposity. This study extends current literature by: (1) examining the influence of vigorous physical activity, sedentary activity, fruits and vegetables intake, and sleeping patterns of African American and Caucasian adolescents on obesity; (2) exploring whether individual attributes and family socioeconomic status (SES) determine adolescent adiposity; and (3) investigating whether race/ethnicity predicts overweight and obesity among African American and Caucasian adolescents.

**Hypothesized Relationships**

The hypothesized structural model in Figure 1 has pathways from each exogenous variable to adolescent adiposity. The model suggests that family SES, race, gender, and age correlate directly with adolescent obesity or indirectly through vigorous physical activity, sedentary activity, dietary intake of fruits and vegetables, and sleeping pattern. In addition, adolescent vigorous physical activity and sedentary activity will influence the likelihood of
overweight and obesity among adolescents. Also, this model examines the relationship between dietary behaviors and sleeping pattern on adolescent body weight. Each of these hypothesized paths is discussed in the next paragraphs.

**Family SES and Obesity**

Lower family SES, measured by such variables as poverty, lower levels of parental education, and single parenthood, contribute to adolescent health problems (Merten, 2005; Wang & Zhang, 2006). Disparities in the prevalence of overweight and obesity in the U.S. follow a SES gradient. Lower SES groups are more likely than higher SES groups to be obese (Wang & Zhang). For all racial and ethnic groups, women of lower SES (income ≤ 130% of poverty threshold) are 50% more likely to be obese than are those with higher SES (income > 130% of poverty threshold). However, men have equal propensity to be obese whether they belong to lower or higher SES groups (U.S. Department of Health & Human Services [USDHHS], 2006). Among adolescents, the relationship between SES and overweight is greater for non-Hispanic Whites from lower-income families than are those from higher-income families. Nevertheless, family SES does not consistently predict obesity prevalence among African American and Mexican American adolescents (Healthy People 2010, 2001; USDHHS).

Adolescents from socioeconomically disadvantaged families lack balanced meals and healthy dietary practices. According to Drewnowski and Specter (2004), unaffordable prices and low income affect food choices, dietary habits, and diet quality. Wealthier families tend to purchase higher-quality meats, more fish and seafood, and more fruits and vegetables than do low-income families.
Race/Ethnicity, Gender, and Age

The obesity crisis is present across all demographic and social groups, yet certain subgroups of the U.S. population are at increased risk (Sherwood, Story, & Obarzanek, 2004). In particular, the prevalence of obesity is soaring among African Americans and Hispanics more than any other ethnic group. According to NHANES 2003-2004, about 45% of African American adults were obese, compared to 37% of Mexican Americans and 30% of White adults (Ogden, et al., 2006). The prevalence of obesity was higher among adolescent females within particular ethnic groups. The NHANES in 1999-2000 showed that African American adolescent girls were twice as likely to be overweight as their White counterparts (27%, vs. 12%) (Ogden et al.; Sherwood et al.).

Trends in the prevalence of overweight and obesity also may be explained by gender and age. Based on NHANES data, prevalence increased considerably among female children and adolescents, from 14% in 1999 to 16% in 2003-04, and from 14% to 18% among male children and adolescents (Ogden et al., 2006). Similar trends were observed among children and adolescents by age. About 26% of children aged 2 to 5 years were overweight in 2003-04, compared to 37% of children aged 6 to 11 years and 34% of adolescents aged 12 to 19 years (Ogden et al.). These estimates suggest that increases in body weight are correlated with race/ethnicity, gender, and age.

Vigorous physical activity

Participation in habitual moderate to vigorous physical activity has been reported as a vital correlate of overweight and obesity. Obesity results from the energy imbalance created by increased calorie consumption and reduction in calories expended through vigorous physical activity (Lowry et al., 2002; Strong et al., 2005). Evidence provided by cross-
sectional and longitudinal studies suggests that adolescents of both sexes who are involved in relatively high levels of physical activity have less adiposity than less active adolescents (Strong et al.). Despite the health benefits of physical activity, more than one-third of high school students do not participate in the minimum recommended level of moderate or vigorous physical activity. Daily participation in school physical education (PE) among adolescents declined significantly, from 42% in 1991 to 28% in 2003 (Lowry, et al., 2004). During the same period, the prevalence of being physically active during PE class dropped substantially, from 42% to 34%, among Black high school students (Lowry et al.).

**Sedentary activity**

Large shifts from physically active demanding work to sedentary work have been observed worldwide (World Health Organization, 2005). Sedentary activities, specifically television viewing, displace time spent in physical activities, contribute to increased energy consumption through excessive snacking and eating meals in front of the TV, influence unhealthy food choices through exposure to poor nutritional quality food advertisements, and reduce the metabolic rate (Lowry et al., 2002). According to Lowry et al. television viewing represents the single greatest source of physical inactivity among U.S. children and adolescents. Several research studies have found a positive association between the time spent viewing television and increased prevalence of overweight in children (Crespo et al., 2001). The national school-based Youth Risk Behavior Survey (YRBS) indicates that watching television for more than two hours a day correlates with being overweight and inadequate eating of fruits and vegetables (Lowry et al., 2002). The NHANES III data on television watching, energy intake, and obesity in U.S. children shows that the prevalence of obesity increased as hours of television watching increased and the prevalence of obesity was
lowest among children with 1 hour or less of daily television viewing (Crespo et al., 2001). According to Eisenmann, Bartee, and Wang (2002), the prevalence of obesity in 12 to 18-year olds increased 2% for every additional hour of television watched per day.

Further, racial differences were reported to influence the positive relationship between television viewing and adiposity, particularly for African American girls because they spend more time viewing than their White counterparts (Sherwood et al., 2004). Results from NHANES III (1988 to 1994) demonstrated that 43% of African American girls, compared with 16% of White girls, watched more than 4 hours of television per day (Crespo et al., 2001). Likewise, YRBS results indicated that 54% of African American girls, compared with 13% of White girls, watched more than 4 hours of television per day (Eisenmann et al., 2002). Thus, reducing TV viewing can avoid further weight gain among children and adolescents.

**Fruits and vegetables intake**

Dietary factors play a key role in the development and maintenance of overweight and obesity (Sherwood et al., 2004). Eating a healthy diet rich in fruits and vegetables can lower an individual’s risk for chronic diseases such as certain cancers and cardiovascular diseases (USDHHS, 2006). Fruits and vegetables have low energy density; therefore, eating them is beneficial for weight management (Blanck et al., 2007). Studies demonstrated that adults who were not overweight or obese ate fruits 2 or more times per day (36.0%) and vegetables 3 or more times per day (28.9%), compared to obese adults (Blanck et al.). In spite of the benefits of good nutrition for good health, normal growth, and development of children and adolescents, approximately 80% of high school students do not eat the recommended 5 or more servings of fruits and vegetables a day (Dietary guidelines, 2000;
Studies demonstrated that following a diet in compliance with dietary guidelines may reduce the risk of chronic disease including overweight and obesity (Kant et al.).

**Sleeping pattern**

Insufficient sleep or lack of sleep has been identified as an important factor contributing to hunger, food selection, and energy expenditure (Taheri, 2004). Failing to get enough sleep at night exacerbates the risk for major illnesses such as cancer, heart disease, diabetes, and obesity (Stein, 2005). Children as young as 2 years of age might be in danger of becoming obese if they lose a lot of sleep (Taheri). Recent studies suggest that the obesity epidemic is driven in part by a corresponding decrease in the average number of hours that people are sleeping, possibly by disrupting the hormones ghrelin and leptin that regulate sleep (Stein). Short sleep duration disturbs normal metabolism, which may contribute to obesity, insulin resistance, diabetes, and cardiovascular disease. It is also a problem for teenagers, for whom the need to sleep is greatest during this critical period of development (Cappuccio, 2006; Taheri). Hormonal changes caused by lack of sleep leading to increased appetite could increase the risks of being overweight or obese.

Data across all age groups, even including children as young as 5 years of age, indicated that lack of sleep has tremendous impact on body weight (Taheri, 2004). For example, in a French study, 1,031 children aged 5 years sleeping fewer than 11 hours a night were more obese than those sleeping 11 hours or more. Likewise, in a Japanese study of 8,274 children aged 6 to 7 years, the likelihood of obesity was 3 times greater for children sleeping fewer than 8 hours a night compared with those sleeping at least 10 hours. In addition, a study of 1,772 Spanish adolescents aged 15 years or older reported a correlation
between short sleep duration and obesity (Taheri). Therefore, getting enough sleep could protect against obesity among children and adolescents.

**Review**

In summary, the current study hypothesized that adolescents’ attributes, including race and SES, may influence disparities in the prevalence of overweight and obesity among adolescents. Vigorous physical activity and sedentary activity will correlate with adolescents’ overweight and obesity. Further, eating fruits and vegetables may be associated with adolescent overweight and obesity. Also, hours of sleep may influence adolescents’ adiposity.

**Research Hypotheses**

Based on the review of literature presented, the following hypotheses were formulated to guide the current study.

1. Family SES is associated with overweight among adolescents.
2. Risk of overweight and obesity differs between male and female adolescents.
3. Vigorous physical activity is correlated with obesity among adolescents.
4. Sedentary activity is correlated with obesity among adolescents.
5. Dietary intake of fruits and vegetables is associated with overweight and obesity among adolescents.
6. The number of hours of sleep at night is correlated with overweight and obesity status.
7. African American and Caucasian adolescents have different rates of overweight and obesity.
Method

Sample

This study used the second-wave data from the National Longitudinal Study of Adolescent Health (Add Health). Add Health is a longitudinal study collected in three waves on adolescents’ lifestyles and health-related behaviors in the U.S. All high schools in the U.S. with an 11th grade enrolling a minimum of 30 students and a feeder school qualified for the study. High schools were stratified into 80 clusters by region, urbanicity, school size and type, ethnicity, and curriculum. The final sample for the study consisted of 134 schools, with school size ranging from 125 to more than 2,000 students. Minority adolescents were oversampled. However, only African American adolescents with college educated parents were sampled. The first wave, collected in 1995, consisted of 20,745 adolescent in-home interviews and 17,700 parent questionnaires.

The second-wave data used in this study were collected in 1996 with the same Wave I in-home interview sample. During Wave II, 14,738 adolescents completed in-home interviews. Telephone interviews were also conducted with 128 school administrators to update school information. This study utilized in-home interview data of only Caucasian and African American adolescents at Wave II. The second-wave data were selected because adolescence (ages 14–18 years) has been identified as a critical period for the development of overweight and obesity. In addition, Wave II provides detailed information on adolescent nutrition, one of the main independent variables (not available in Wave I or Wave III) for the assessment of adolescents’ dietary intake of fruits and vegetables.
Measures

Adolescent Obesity

Body mass index (BMI) is the most appropriate and acceptable measure for assessing overweight and obesity in children and adolescents (CDC, 2005). BMI is defined as weight in kilograms divided by height in meters squared (kg/m²). One of the advantages of BMI is that it is highly reliable and easy to compute, and an individual’s BMI status depends on gender and age, the same variables that must be considered when evaluating youth adiposity (Goodman, Hinden, & Khandelwal, 2000). In addition, BMI is more accurate at approximating body fat than is measuring body weight alone (USDA, 2005).

In the present study, BMI, with age- and gender-specific percentile values published by the CDC in 2000, were used to categorize adolescents as overweight and obese (CDC, 2005). Adolescents with BMI between the 85th and 95th percentiles for their age and gender were considered overweight, and those with BMI higher than the 95th percentile for age and gender were categorized as being obese. Self-reported weight and height were used to compute BMI.

Demographic Variables

Demographics of gender, race, and age were assessed. Dichotomous variables (coded 0 and 1) were used to identify race/ethnicity of Caucasians and African Americans, as well as gender. Age was self-reported in the questionnaire, but only Caucasians and African Americans aged 14 to 18 years were selected for the study.

Socioeconomic Status

Adolescents’ SES was assessed by three hardship items reported by the parent at Wave I and linked directly to each adolescent in the Wave II data set by identification
numbers. These SES variables were selected based on exploratory factor analysis. The items loaded on one common factor. Also, previous research used similar items to measure family economic hardship (Drewnowski & Specter, 2004; Wickrama & Bryant, 2003). The three items used to measure SES include: (1) “Are you receiving public assistance, such as welfare?” (2) “Are you receiving Aid to Families with Dependent Children?” (3) “Are you receiving food stamps?” A single score was computed by summing these three items. The scores ranged from 0 to 3, with the highest scores signifying low SES (greatest economic adversity). The Cronbach’s alpha standardized reliability coefficient for this measure was .85.

**Vigorous Physical Activity**

Adolescent vigorous physical activity was measured using three items selected based on previous studies that used similar items to assess vigorous physical activity among adolescents (Gordon-Larsen, Adair, & Popkin, 2002; Gordon-Larsen, McMurray, & Popkin, 2000). (1) “During the past week, how many times did you go roller-blading, roller-skating, skate-boarding, or bicycling?” (2) “During the past week, how many times did you play an active sport, such as baseball, softball, basketball, soccer, swimming, or football?” (3) “During the past week, how many times did you exercise, such as jogging, walking, doing karate, jumping rope, doing gymnastics, or dancing?” Responses of the above items ranged from 0 (not at all) to 3 (5 or more times). To generate a total average vigorous activity score for each adolescent, the 3 items were summed and then divided by 3, with scores ranging from 0 (low) to 3 (high). The mean score of vigorous activity was 1.2.
Sedentary Activity

Sedentary activity patterns of adolescents were measured based on extant literature. Previous studies used similar items including watching television and playing video or computer games to measure sedentary lifestyles in adolescents (Lowry et al., 2002; Merten, 2005). Three items were selected to measure sedentary activities among adolescents: (1) “How many hours a week do you watch television?” (2) How many hours a week do you watch videos?” (3) “How many hours a week do you play video or computer games?” The sum of these three items was computed to generate a total score of sedentary activity for each adolescent, with a higher score representing a high level of adolescent sedentary lifestyle. In addition, the total score was categorized into three groups: low (0-10 hours/week), moderate (11-24 hours/week), and high (25 or more hours/week) (Gordon-Larsen et al., 2000; Merten). On average, adolescents spend approximately 21 hours per week on sedentary activities.

Adolescent’s intake of fruits and vegetables

Given the previous research that shows consuming diets rich in vegetables, legumes, fruits, and whole grains daily will sustain a total fat intake without the risk of unhealthy weight gain (WHO, 2003), adolescent dietary intake focused on consumption of fruits and powerhouse vegetables. The classification of foods into the fruits and powerhouse vegetables group was based on their nutrient content and examples of foods in the food pyramid (USDA, 2005). A total score was generated based on whether adolescents ate a particular fruit and powerhouse vegetable the day before, as a regular meal or a snack, coded 0 (does not eat the fruit or vegetable) or 1 (consumes the food item). Examples of the items considered include: (1) “Yesterday, did you eat apples, apple sauce, pears, or pineapple?” (2) “Yesterday, did you eat oranges, grapefruit, tangerines or kiwi?” (3) “Yesterday, did you eat
bananas, plantains, grapes, berries, or cherries?” (4) “Yesterday, did you eat broccoli?” (5) “Yesterday, did you eat cabbage or bok choy?” (6) “Yesterday, did you eat spinach?” (7) “Yesterday, did you eat string beans, green beans, peas, or snow peas?” Previous studies have used similar items to assess children’s and adolescents’ consumption of healthy foods (Maina, 1999). Higher scores signify dietary intake rich in fruits and powerhouse vegetables. The Cronbach’s alpha standardized coefficient of reliability for these items was .67.

**Sleeping Pattern**

Although different age groups need different amounts of sleep, and sleep needs are individual, research has shown that inadequate sleep can lead to serious health consequences, such as increased BMI, increased risk of diabetes, and heart problems (National Sleep Foundation, n.d). The hours of sleep adolescents normally get was assessed by a single item: “How many hours of sleep do you usually get?” Responses ranged from 2 to 16 hours. Given the recommended number of hours of sleep children and adolescents need each night by age to maintain good health (National Sleep Foundation, n. d), and based on previous studies (Chaput, Brunet, & Tremblay, 2006), two categories were created: short sleep duration (2 to 7 hours of sleep) and long sleep duration (8 or more hours of sleep). The average hours of sleep adolescents reported they usually get is 7.6.

**Analytical Approach**

To examine the influence of adolescents’ attributes and health behaviors on the outcome variable—adolescent body weight—SPSS 15.0 and the structural equation model (SEM) capability in LISREL 8.7 (Jöreskog & Sörbom, 2004) were utilized. SEM is noted to be advantageous for taking a confirmatory, model-based approach to data analysis that could be used for complex inferential purposes. Further, the structural relations, modeled pictorially
for a clearer conceptualization of the theory under study, provide explicit estimates of parameters (measurement error) and the procedure can include both unobserved and observed variables (Byrne, 1998).

**Results**

The BMI categories defined by CDC (2005), with age- and gender-specific percentile values for children and adolescents aged 2 to 20 years, are presented in Table 1. The prevalence of both overweight and obesity is higher among African American adolescents (20.6% and 13.6%, respectively), compared with Caucasian adolescents (14.5% and 11.2%, respectively). More Caucasian adolescents have normal weight (72.1%), compared with African American adolescents (63.8%).

<table>
<thead>
<tr>
<th>Race</th>
<th>Underweight (%)</th>
<th>Normal (%)</th>
<th>Overweight (%)</th>
<th>Obese (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White (n = 2,696)</td>
<td>2.2</td>
<td>72.1</td>
<td>14.5</td>
<td>11.2</td>
</tr>
<tr>
<td>African American (n = 899)</td>
<td>2.0</td>
<td>63.8</td>
<td>20.6</td>
<td>13.6</td>
</tr>
<tr>
<td>Total (N = 3,596)</td>
<td>2.1</td>
<td>70.1</td>
<td>16.0</td>
<td>11.8</td>
</tr>
</tbody>
</table>

Data are from Wave II of National Longitudinal Study of Adolescent Health. Gender differences of overweight and obesity between racial/ethnic groups also appear in Table 2. The prevalence of overweight and obesity among African American female adolescents (52.2%) was greater than among Caucasian female adolescents (51.0%). However, Caucasian male adolescents were more susceptible to overweight and obesity compared with male adolescents of African American origin (49.0% and 47.8%, respectively). In general, female adolescents (51.3%) were more likely than male adolescents (48.7%) to be obese.
Table 2. Gender Differences on BMI Measures used in the Present Study by Race

<table>
<thead>
<tr>
<th>Ethnicity/Race</th>
<th>Gender</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Caucasian</td>
<td>1,323</td>
<td>49.0</td>
<td>1,379</td>
</tr>
<tr>
<td>African American</td>
<td>430</td>
<td>47.8</td>
<td>469</td>
</tr>
<tr>
<td>Total</td>
<td>1,753</td>
<td>48.7</td>
<td>1,843</td>
</tr>
</tbody>
</table>

\( N = 3,596 \). Data are from Wave II of National Longitudinal Study of Adolescent Health

Bivariate correlations among the study variables, together with descriptive statistics, are presented in Table 3. Family SES and sedentary activity are positively correlated \((p < .01)\) with adolescent overweight and obesity. Family SES adversity and increased sedentary activity level increase the risk for overweight and obesity among both African American and Caucasian adolescents. Vigorous physical activity and sleeping pattern are negatively associated \((p < .01)\) with adolescents’ adiposity. Also, fruit and vegetable intake is negatively correlated with adolescent obesity, an indication that insufficient consumption of fruits and vegetables is a risk factor for overweight among adolescents. African American race is significantly associated \((p < .01)\) with adolescent obesity.
Table 3. Bivariate Correlation and Descriptive Statistics among Study Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Family SES</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Vigorous activity</td>
<td>-.03</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Sedentary activity</td>
<td>.13**</td>
<td>.02</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Sleeping pattern</td>
<td>.01</td>
<td>.08**</td>
<td>.10**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Fruit intake</td>
<td>-.03</td>
<td>.24**</td>
<td>-.05**</td>
<td>.08**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Vegetable intake</td>
<td>-.05**</td>
<td>.13**</td>
<td>-.02</td>
<td>.03*</td>
<td>.37**</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. African American</td>
<td>.20**</td>
<td>-.08**</td>
<td>.24**</td>
<td>-.07**</td>
<td>-.03</td>
<td>-.03</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>8. Adolescent BMI</td>
<td>.05**</td>
<td>-.08**</td>
<td>.05**</td>
<td>-.05**</td>
<td>-.007</td>
<td>-.02</td>
<td>.09**</td>
<td>--</td>
</tr>
<tr>
<td>Mean</td>
<td>.28</td>
<td>1.20</td>
<td>21.33</td>
<td>7.62</td>
<td>1.23</td>
<td>1.45</td>
<td>--</td>
<td>22.87</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>.76</td>
<td>.68</td>
<td>2.87</td>
<td>1.39</td>
<td>1.28</td>
<td>1.40</td>
<td>--</td>
<td>4.58</td>
</tr>
</tbody>
</table>

* p < .05; ** p < .01

Structural equation modeling

SEM, using maximum likelihood estimation in LISREL 8.7 (Jöreskog & Sörbom, 2004), was utilized to evaluate the hypothesized model shown in Figure 1 and to conduct a multiple group comparison to determine if race acts as a moderator of adolescents’ adiposity. To evaluate the hypothesized model depicted in Figure 1, indices and their cutoff points recommended by Hu and Bentler (1995, 1999) and Jöreskog and Sörbom (1989) were used to assess goodness of fit for the model: root mean square error (RMSEA; value less than .05), comparative fit index (CFI; value greater than .95), standardized root mean square residual (SRMR; values of .05 or less), and adjusted goodness of fit index (AGFI; value greater than .95). An initial test of the saturated model resulted, by design, in a perfect fit to the data. The squared multiple correlations for the endogenous variables in the perfect-fit model were:
vigorous physical activity (.23), sedentary activity (.04), dietary intake (fruits and vegetable intake) (.06), sleep (.01), and BMI (.20).

Some of the structural parameter estimates were nonsignificant. To ensure model parsimony (Byrne, 1998), the following structural paths were trimmed from the model: from family SES and race to diet; from gender to sedentary activity and diet; and from age to sedentary activity and body weight. An estimation of the trimmed model provided a very good fit to the data, $\chi^2 (10, N = 3,596) = 74.34, p < 0.01, CFI > 0.999, RMSEA < 0.001, AGFI = 0.98, SRMR = 0.022$. Therefore, trimming the hypothesized model yielded a new parsimonious structural model that fits the data better.
The standardized path coefficients from the trimmed model are presented in Figure 2. All health behavior paths were significant, as hypothesized, except the path from sleeping pattern to adolescent body weight ($\beta = -.04; p > .05$). Therefore, all of the endogenous manifest variables appeared to have been measured satisfactorily by their respective indicators. Among the exogenous variables, only gender was found to have a significant direct relationship with adolescent adiposity.

![Figure 2. The effects of adolescents’ health behaviors on their body weight](image)

### Figure 2. The effects of adolescents’ health behaviors on their body weight

*** $p < .001$, ** $p < .01$, * $p < .05$

Summaries of the direct paths from the exogenous predictor variables to the first endogenous variables (health behaviors) are presented in Table 4. There are statistically
significant \( (p < .001) \) standardized direct effects from SES to vigorous physical activity \( (\beta = .25) \) and sedentary activity \( (\beta = -.19) \), and race is related to vigorous physical activity \( (\beta = .35) \). Also, there are significant \( (p < .01) \) standardized effects from SES to sleep \( (\beta = .05) \), from race to sedentary activity \( (\beta = .07) \) and to sleep \( (\beta = .07) \), and from gender \( (\beta = -.04) \) and age \( (\beta = -.13) \) to vigorous physical activity. In addition, the direct standardized effects from gender and age to adolescents’ health behavior (dietary intake) are only marginally significant \( (p < .05) \). These results suggest that adolescents’ family SES and race have significant positive influence on their vigorous physical activity, and may influence their adiposity.

Table 5 summarizes the direct paths from the first endogenous variable—adolescents’ health behaviors—to the second endogenous variable—adolescents’ body weight. There are statistically significant standardized direct effects from sedentary activity and dietary intake \( (p < .001) \) and vigorous physical activity \( (p < .01) \) to adolescents’ body weight. However, the standardized direct effect from sleep to adolescents’ body weight was insignificant. Thus, being vigorously active and eating sufficient fruits and vegetables are inversely associated with adolescents’ adiposity, while sedentary lifestyle is positively associated with adolescents’ adiposity.
Table 4. Path Estimates of Direct Effects from Exogenous Predictor Variables to Adolescents’ Health Behaviors

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Health Behavior</th>
<th>Standardized Direct Effect</th>
<th>Standard Error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socioeconomic status</td>
<td>Vigorous</td>
<td>.25</td>
<td>&lt; .01</td>
<td>12.86***</td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td>Sedentary</td>
<td>-.19</td>
<td>&lt; .01</td>
<td>-10.96***</td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td>Sleep</td>
<td>.05</td>
<td>&lt; .01</td>
<td>2.62**</td>
</tr>
<tr>
<td>Race</td>
<td>Vigorous</td>
<td>.35</td>
<td>.01</td>
<td>11.29***</td>
</tr>
<tr>
<td>Race</td>
<td>Sedentary</td>
<td>.07</td>
<td>.01</td>
<td>2.76**</td>
</tr>
<tr>
<td>Race</td>
<td>Sleep</td>
<td>.07</td>
<td>.01</td>
<td>2.42**</td>
</tr>
<tr>
<td>Gender</td>
<td>Vigorous</td>
<td>-.04</td>
<td>.01</td>
<td>-2.39**</td>
</tr>
<tr>
<td>Gender</td>
<td>Diet</td>
<td>-.07</td>
<td>.02</td>
<td>-2.13*</td>
</tr>
<tr>
<td>Age</td>
<td>Vigorous</td>
<td>-.13</td>
<td>.02</td>
<td>-2.57**</td>
</tr>
<tr>
<td>Age</td>
<td>Diet</td>
<td>-.22</td>
<td>.06</td>
<td>-2.07*</td>
</tr>
</tbody>
</table>

*** p < .001, ** p < .01, * p < .05

Table 5. Path Estimates of Direct Effects of Endogenous Predictor Variables on Adolescents’ Obesity (BMI)

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Dependent variable</th>
<th>Standardized Direct Effect</th>
<th>Standard Error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vigorous activity</td>
<td>Adolescent obesity</td>
<td>-.10</td>
<td>.06</td>
<td>-2.68**</td>
</tr>
<tr>
<td>Sedentary activity</td>
<td>Adolescent obesity</td>
<td>.26</td>
<td>.06</td>
<td>6.68***</td>
</tr>
<tr>
<td>Diet</td>
<td>Adolescent obesity</td>
<td>-.27</td>
<td>.07</td>
<td>-4.03***</td>
</tr>
<tr>
<td>Sleep</td>
<td>Adolescent obesity</td>
<td>-.04</td>
<td>.30</td>
<td>-1.04</td>
</tr>
</tbody>
</table>

*** p < .001, ** p < .01

Testing for race differences in adolescent obesity

To explore whether race influences adolescent overweight and obesity, two models were analyzed simultaneously to determine if the estimated causal paths for overweight and obesity varied between African American and Caucasian adolescents. The originally hypothesized model yielded a perfect fit, as is true by definition for a saturated model. Paths statistically irrelevant to the multigroup model were trimmed, to obtain a new parsimonious structural model that still fits the data well. A trimmed multigroup model was estimated to determine whether the confirmatory factor structures were different between African Americans and Caucasians. In the first estimation, the factor items were allowed to load
freely on the model for African Americans and Caucasians. The multigroup model yielded the $\chi^2$ value of 53.35 with 14 degrees of freedom (CFI > 0.99, GFI = 0.98). Both CFI and GFI values suggest that the multigroup model provided adequate fit to the data (Byrne, 1998).

The models showed distinctive loadings on a number of variables for the African American and Caucasian models. The model for Caucasians yielded a worse fit ($\chi^2 (7) = 41.00, p < .01$) than the model for African Americans ($\chi^2 (7) = 12.36, p < .08$), suggesting that the structural paths are different between African Americans and Caucasians. The estimated structural models with their respective significant pathways are presented in Figures 4 and 5 (Appendix A).

In the model for Caucasians (Figure 4), significant pathways existed from family SES to adolescents’ body weight, $\beta = .17, p < .01$, from vigorous physical activity to body weight, $\beta = -.21, p < .001$, from sedentary activity to body weight, $\beta = .11, p < .01$, and from gender to sleeping pattern, $\beta = .23, p < .001$ and sedentary activity, $\beta = -.08, p < .05$. For the African American model, there were also significant pathways from vigorous physical activity to adolescents’ body weight, $\beta = -.14, p < .01$, from gender to sleeping pattern, $\beta = .18, p < .01$, and from sleeping pattern to body weight, $\beta = .09, p < .01$. The difference between the structural models lays in the significant pathways between exogenous and endogenous variables. In the model for Caucasian adolescents, two additional significant pathways were noted from family SES and sedentary activity to adolescents’ body weight, as compared to the model for African Americans. In addition, a significant pathway from sleeping pattern to adolescents’ body weight was noted in the African American model, compared to the Caucasian model. Overall, the Caucasian model seems to have more significant pathways as
compared with the African American model, and therefore appears to explain better the influences of the exogenous and endogenous manifest variables on adolescents’ body weight. Nonetheless, it should be noted that sleeping pattern seems to influence body weight in the African American model but not in the Caucasian model.

For a meaningful comparison to be possible, the factor structures between groups need to be invariant (Byrne, 1998). Thus, another model with the structural paths allowed to be invariant was estimated for African Americans and Caucasians. The fit of this model yielded $\chi^2(18) = 62.60, p < .01$, and was a significant improvement from the freely estimated structural model, $\chi^2(14) = 53.35$. Comparing these two models yielded a statistically significant difference, $\Delta \chi^2(4) = 9.25, p < .05$, indicating that the causal paths were different for African Americans and Caucasians.

A final comparison between the models was undertaken with two indices—Akaike’s Information Criterion (AIC) and the consistent version of Akaike’s Information Criterion (CAIC)—that share the same conceptual framework (Hu & Bentler, 1995). The AIC and CAIC are helpful indices to use when comparing two or more models (Hu & Bentler). Upon examination of the AIC and CAIC indices of both models, the model for African Americans had a better fit (AIC = 70.31, CAIC = 238.54) than the model for Caucasians (AIC = 98.71, CAIC = 298.81). Therefore, the two models not only differed in terms of their respective significant pathways, but also in goodness of fit statistics.

In summary, multi group comparisons between the models for African Americans and Caucasians yielded distinctive pathways. The model for African Americans seems to fit the data better than does the model for Caucasians; however, the model for Caucasians had more significant pathways than does the model for African Americans. In light of the above
substantiations, it can be concluded that disparities in the prevalence of overweight and obesity between African American and Caucasian adolescents depend on a number of factors because both adolescents’ attributes and health behaviors have varied relationships with adiposity.

**Discussion**

The present study has three purposes. First, the study examined the influence of health behaviors (i.e., vigorous physical activities, sedentary activities, fruits and vegetables intake, and sleeping patterns) on African American and Caucasian adolescents’ overweight and obesity. Second, this research explored the role individual attributes (i.e., race, gender, age) and family SES play in the prevalence of African American and Caucasian adolescents’ adiposity. The relationships of these attributes with health behaviors were also examined. Third, the study investigated the unique influence of race/ethnicity in explaining body weight. SEM was utilized to explain the relationships of these attributes and health behaviors with adolescents’ adiposity.

**Adolescents’ family SES and obesity**

The first hypothesis stated that family SES is associated with overweight and obesity among adolescents. The findings in this study (bivariate correlation) support the proposed hypothesis of family SES contributing to the increased propensity of overweight and obesity among African American and Caucasian adolescents, and are consistent with previous research (Wang & Zhang, 2006). Of note is the racial disparity of family SES on adolescents’ adiposity. In the multigroup comparison, family SES had a statistically significant positive influence on Caucasian adolescents’ obesity, compared to African Americans. Consistent with Healthy People 2010 (2001), the correlation between SES and overweight is greater for
Caucasian adolescents from lower-income families than are those from minority groups (in this case, African Americans). This may be explained by the higher buoyancy that minority adolescents need to survive under adverse conditions, and therefore that they may be less sensitive to the impact of family poverty compared to Caucasians who may not be as contented under such conditions (Merten, 2005). Thus, we need to focus our intervention measures at the family level, as this lifestyle may persist into several generations because many families are incapable of breaking the (family) poverty cycle.

**Gender differences and obesity**

The second hypothesis concerned gender differences in the prevalence of adolescent overweight and obesity among African Americans and Caucasians. Specifically, gender was predicted to influence adolescents’ adiposity. This study provides strong support that gender is an important predictor of obesity among both African American and Caucasian adolescents. Specifically, the risk of overweight and obesity is higher for adolescent females than for males regardless of ethnicity/race. In addition, African American adolescent girls show higher rates of overweight and obesity in comparison to their Caucasian counterparts. This finding is consistent with previous work suggesting that African American adolescent girls show higher rates of overweight than do Caucasian girls (Sherwood et al., 2004). This association may be explained by cultural differences in the acceptance of large body size in some ethnic/racial groups. In particular, girls and women of African and African American progeny encounter less social pressure about adiposity (Sherwood et al.) and therefore tend to be more satisfied with their body weight in comparison with other racial groups. Future research should explore possible cultural and ethnic/racial perceptions of body weight in explaining the prevalence of overweight among African American adolescents.
Adolescents’ health behaviors and obesity

Regarding the health behavior variables, several significant pathways existed. It was hypothesized that adolescents’ vigorous physical activity would correlate with obesity. It was also predicted that sedentary lifestyle and hours of sleep at night would correlate with adolescents’ overweight and obesity. Moreover, it was envisaged that the extent to which adolescents eat diets rich in fruits and vegetables would be associated with overweight and obesity. These predictions were supported by the findings. Higher levels of vigorous physical activity and daily consumption of sufficient fruits and vegetables significantly decrease the risk for overweight and obesity. Also, being sedentary contributes to overweight status. Literature supports these findings of the relationship of vigorous physical activity and dietary intake of fruits and vegetables with reduced obesity, and sedentary lifestyle as a likely contributor to obesity status (Blanck et al., 2007; Eisenmann, Bartee, & Wang, 2002; Lowry et al., 2002; Strong et al., 2005). However, no significant association was found between nightly hours of sleep and overweight. This finding would seem rather peculiar, considering the evidence that exists for correlation between insufficient night sleep and obesity across all age groups (Cappuccio, 2006; Taheri, 2004) and challenges Taheri’s findings of positive correlation of short sleep duration and obesity in adolescents.

Race differences

In the present study, it was predicted that African Americans and Caucasians would have different rates of overweight and obesity. Findings indicating higher rates of overweight and obesity among African Americans than their Caucasian counterparts supported this prediction. Data from NHANES 2003-2004 showed a similar pattern. African Americans tended to have a higher prevalence of overweight and obesity compared to Caucasians.
(Odgen et al., 2006). In an attempt to assess the extent to which race is associated with obesity, stacked model comparisons were conducted. In the comparison group, it was intriguing to find that structural pathways for African Americans and Caucasians were statistically significantly different from each other.

It is important to note that apart from vigorous physical activity significantly predicting obesity for African Americans and Caucasians alike, other endogenous and exogenous variables influencing adolescent obesity were different for each group. Regarding exogenous variables in the model (family SES, gender, and age), a significant relationship was found between family SES and obesity for Caucasians. As previously mentioned, studies found that family SES has a considerable relationship with Caucasians’ adiposity in comparison with minority groups, in particular African Americans (Healthy People 2010, 2001; USDHHS, 2006). Moreover, a significant direct path existed between sedentary activity and obesity for Caucasian adolescents. As previously indicated, the literature supports the conclusion that increased participation in sedentary activity augmented the risk for obesity (Crespo et al., 2001; Lowry et al., 2002). Conversely, the finding in the present study challenges the Sherwood et al. (2004) conclusion that racial differences in obesity, particularly for African Americans, depended on them spending more time than their White counterparts watching television. This finding is surprising, and any conclusions would need to be drawn with caution. Perhaps sedentary activity is not statistically significant in predicting obesity in African American adolescents in this study because of the relatively small sample size.

The prediction that sleeping fewer hours at night would correlate with overweight and obesity was not supported by the results of the stacked model. Nonetheless, one fundamental
issue with this comparison suggests that Caucasian adolescents may have greater vulnerability to the influence of insufficient sleep at night than do African Americans, who demonstrated a positive association between sufficient sleep at night and obesity. Future research needs to validate the possible variations in the impact of hours of sleep at night on African American and Caucasian adolescents’ adiposity.

The current study provides invaluable information in our quest to understand the correlates of overweight and obesity, and implications for targeting prevention and intervention endeavors. In general, the current findings are consistent with previous studies of nationally representative samples (Strong et al., 2005), that found significant associations between high levels of vigorous physical activity and less adiposity in adolescence. In addition, findings of race differences in adolescents’ health behaviors (such as sedentary lifestyle and lack of sleep at night), and its associations with overweight and obesity, propose the presence of cultural beliefs and practices that must be considered in developing intervention and prevention programs for youth. The results also underscore racial differences in the link between family SES and obesity for youth; and the need for joint effort at the national, state, and community levels in addressing lower levels of SES, particularly among Caucasians, who demonstrated significant associations between family SES, eating insufficient fruits and vegetables, and being overweight.

The data utilized for this study were drawn from a nationally representative sample of adolescents. While the findings support the predictions and lend empirical support to previous research findings, a number of limitations of the present study must be acknowledged. First, the estimation of adolescents’ BMI was based on self-reports of weight and height. Personal measurement of weight is subject to error. However, adolescents’ self-
report of height and weight has been found to be sufficiently accurate in comparison with measured height and weight \((r = .92)\) (Goodman, Hinden, & Khandelwal, 2000). Second, estimates of family SES were computed based on parents’ reports, which might be biased. Third, measurement of exogenous and endogenous variables in the study may not be accurate and could obscure associations between variables. Finally, the data are cross-sectional; therefore, proposed causality cannot be determined definitively.

Despite these limitations, this study unveils important new information about the associations of adolescents’ attributes and health behaviors on obesity among African American and Caucasian youth. The study also provides convincing evidence to support the impact of vigorous physical activity on obesity. Understanding distinctive impacts of race/ethnicity on adolescents’ obesity is crucial for creating maximum effective intervention, and prevention strategies and policies must be culturally appropriate to curb the obesity pandemic among adolescents in this country. Parents should encourage adolescents to play active sports and exercise 3 to 4 times a week (the moderate level of physical activity). Schools, because they can reach nearly all youth from different racial and social backgrounds, must offer educational curricula (such as family and consumer sciences programs) that provide ample opportunities for students to practice skills that prepare them for living a healthy life throughout their life span. Additionally, communities need to promote vigorous physical activities by creating recreation centers with sports facilities and walking and bicycle trails safe enough for youth.
REFERENCES


APPENDIX

Figure 4. Structural Model of Adolescents’ Obesity for Caucasians
Figure 5. Structural Model of Adolescents’ Obesity for African Americans
CHAPTER 4. ADOLESCENT OBESITY: CAN RELIGIOSITY AND RELIGIOUS AFFILIATIONS AFFECT THIS EPIDEMIC?

A paper to be submitted to the Journal of Youth and Adolescence

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Abstract

Religion has been associated with good physical health and may represent a protective factor against overweight and obesity. This study explored religious affiliations, religiosity, SES, race, and gender-specific associations with body weight among African American and Caucasian youth in the United States. Data from the National Longitudinal Study of Adolescent Health were analyzed for 3,596 adolescents aged 14-18. Structural equation modeling revealed that high levels of religiosity reduced the risk of obesity in youth affiliated with Baptist denomination, but increased the vulnerability for overweight among fundamentalist Protestants. Among African American adolescents, religiosity was associated with increased risk of overweight; but reduced the risk of overweight for Caucasian youth, suggesting the presence of cultural practices to consider in designing interventions that are culturally appropriate for religious youth.

Introduction

The prevalence of overweight and obesity has reached epidemic proportions worldwide, affecting both genders, all ages, racial and ethnic groups, and levels of economic status of the population over the last two decades (Centers for Disease Control [CDC], 2005; Flegal, Carroll, Kuczmarski, & Johnson, 1998). The World Health Organization [WHO], (2003) estimated that worldwide approximately one billion adults are overweight, with at
least 300 million clinically obese, and 22 million children under the age of 5 are overweight. In the United States, the obesity crisis affects every state, city, community, and school across the nation, and nearly 2 out of 3 American adults (Carmona, 2003). Among adolescents, more than 30% are overweight and more than 11% of these are obese (CDC, 2005). Recently published trend data from the National Health and Nutrition Examination Study (NHANES) indicate that the percentage of overweight and obese adolescents aged 12 to 19 years increased from 30% in 1999-2000 to 34% in 2003-2004 (Ogden et al., 2006), and this trend is continuing.

Such increases of overweight and obesity, particularly among adolescents, is of great concern for public health. Overweight and obesity are associated with numerous and varied deleterious health problems, ranging from premature death to several chronic conditions that adversely impact the overall quality of life (WHO, 2003). Overweight and obesity raise the risk of non-communicable diseases, including type 2 diabetes, cardiovascular diseases (heart disease, stroke, and hypertension), respiratory dysfunction, certain types of cancer, and physical disabilities, particularly when occurring early in life (Crosnoe & Muller, 2004; U.S. Department of Agriculture [USDA], 2005; U.S. Department of Health and Human Services [USDAHHS], 2006). Overweight adolescents are 8.5 times more susceptible than their leaner peers to hypertension, diabetes, and heart disease as young adults (Srinivasa, Bao, Wattigney, & Berenson, 1996). In addition, overweight adolescents are 18 times more likely than their normal-weight peers to become obese in early adulthood (Field, Cook, & Gillman, 2005), and nearly 3 out of every 4 overweight adolescents may become obese adults (Carmona, 2003). Additional studies predicting obesity in young adulthood from childhood obesity reported that approximately 80% of children who were overweight at age 10 to 15 years were
obese adults at age 25 years (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Thus, excessive weight during childhood and adolescence tends to persist into adulthood.

Although genetic compositions undoubtedly contribute to individuals’ susceptibility to gain weight, this cannot explain the increased prevalence in the rate of weight gain by age in recent years (Carmona, 2003; Savaiano & Welsh, 2006). Genetic characteristics have not changed over the past two decades, but the prevalence of overweight and obesity among children, adolescents, and adults has approximately doubled (The Center for Health Care in Schools, 2005). According to Baur (2002) and Carmona (2003), the fundamental reason for increasing prevalence of adolescent obesity is significant changes in lifestyle.

Over the past decade, numerous social and epidemiological studies demonstrate that religion plays a salient role in determining personal lifestyles particularly beneficial to health (protection against illness and mortality). For many people, their faith or religious teachings provide practical guidance, direction, inspiration, and strength to achieve and maintain good physical and emotional health (de la Mora, 2004). For example, many biblically-based faiths (Proverbs 23: 20-21) consider overeating and gluttony objects of condescension and obesity a form of eccentricity or deviance (Cline & Ferraro, 2006). In addition, components of some religious denominations’ theology discourage overweight and obesity. For example, for Catholics, depriving the body of food was related to purity; for Jews, the body is believed to be made in the image of God; and, among conservative Protestants, the body is taught to be the “temple of the Holy Spirit.” Seventh Day Adventists espouse a vegetarian diet, which has been linked to lower body weight (Kim, Sobal, & Wethington, 2003; Seventh-Day Adventist Church, South Pacific, n. d.). Therefore, viewing one’s body as made of—and as the home of—a deity may promote good health and ideal body weight (Kim et al.).
In addition, religion may protect against excess body weight by providing social support needed for initial weight loss and maintenance of that loss—for example, attending religious services and participating in related activities such as group meetings and religion classes. Studies suggest that social support decreased body weight in children at risk for obesity in Denmark and the U.S. (Gerald, Anderson, Johnson, Hoff, & Trim, 1994; Lissau & Sorense, 1994) and promoted successful long-term weight loss (Foreyt & Goodrick, 1995). Although empirical evidence has demonstrated a positive impact of religious commitment on better health and well-being to the extent that even the most skeptical scientists are taking religion’s correlation with improved health more seriously (Kim et al., 2003), very little research to date has examined the association between religion and body weight. In particular, religion’s association with body weight among adolescents has not been established or explored in depth. The consequential effects of overweight and obesity adversely impacting the quality of life have spurred the concern among parents, clergy, educators, health professionals, and policy makers to understand body weight and seek its correlates.

Given the amassed evidence that religious commitment is linked to better health (de la Mora, 2004; Ellison & Levin, 1998; Levin, 2001) and that religion plays a central role in the lives of American teenagers (63% of teens aged 13 to 15 and 52% of those 16- to 17-years-old thought religion was “very important” in their lives; 54% and 51% reported having attended church or synagogue in the past seven days, respectively; and 69% of 13- to 15-year-olds and 59% of 16- to 17-year-olds were affiliated with a church or synagogue) (Gallup Jr., 2002), it is important to investigate the effects of religion on body weight. The present investigation extends current literature by (1) exploring the relationship between religiosity
and body weight among African American and Caucasian adolescents, and (2) examining whether overweight and obesity differ among religious affiliations.

**Hypothesized Relationships**

The hypothesized model shown in Figure 1 has pathways in common for the religious affiliations in the study. The model proposes that demographic antecedents (family socioeconomic status (SES), race, and gender) directly or indirectly influence adolescents’ overweight and obesity. Moreover, association of adolescents’ religiosity with body weight is examined in the model. Each of these paths is discussed in the subsequent paragraphs.

![Figure 1. Hypothesized Model](image)

**Family SES, religion, and obesity**

Lower family SES, measured by such variables as poverty-level income, low levels of parental education, and single parenthood, contribute to adolescent health problems (Merten, 2005; Wang & Zhang, 2006). Disparities in the prevalence of overweight and obesity in the U.S. follow a SES gradient. Lower-SES groups are more likely than higher-SES groups to be
obese (Wang & Zhang). For all racial and ethnic groups, women of lower SES (income ≤ 130% of poverty threshold) are 50% more likely to be obese than are those with higher SES (income > 130% of poverty threshold). However, men have equal propensity to be obese whether they belong to lower or higher SES groups (USDHHS, 2006). Among adolescents, the relationship between SES and overweight is greater for non-Hispanic Whites from lower-income families than for those from higher-income families. Nevertheless, family SES does not consistently predict obesity prevalence among African American and Mexican American adolescents (Healthy People 2010, 2001; USDHHS, 2006).

In addition, adolescents from SES-disadvantaged families lack balanced meals and healthy dietary practices. According to Drewnowski and Specter (2004), unaffordable prices and low income affect food choices, dietary habits, and diet quality. Wealthier families tend to purchase higher-quality meats, more fish and seafood, and more fruits and vegetables than do low-income families. Similarly, findings based on Behavioral Risk Factor Surveillance System data in 2007 among U.S. adults indicate that families who earned more than $50,000 per year eat 32.4% more fruits and 30.3% more vegetables in comparison with those earning less (Blanck et al., 2007).

Religious involvements appear to be highest among individuals with lower SES and less education. Such individuals are more likely to utilize religious coping strategies and believe in God’s power to provide their needs than do others with higher education and SES. Religious individuals are more satisfied with their lives than are those who are less religious (Martin & Bayne, 2000).
Race, Gender, and Religion

The obesity crisis is present across all demographic and social groups, yet certain subgroups of the U.S. population are at increased risk (Sherwood, Story, & Obarzanek, 2004). In particular, the prevalence of obesity is soaring among African Americans and Hispanics more than for any other ethnic groups. According to NHANES 2003-2004, about 45% of African American adults were obese, compared to 37% of Mexican Americans and 30% of White adults (Ogden, Flegal, Carroll, & Johnson, 2002). The prevalence of obesity was higher among adolescent females within particular ethnic groups. NHANES 1999-2000 data show that African American adolescent girls are twice as likely to be overweight as are their White counterparts (27% vs. 12%) (Sherwood et al.).

Trends in the prevalence of overweight and obesity also may be explained by gender and religion. Based on NHANES data, prevalence increased among female children and adolescents, from 14% in 1999 to 16% in 2003-2004, and from 14% to 18% among male children and adolescents (Ogden et al., 2002). Pertaining to religion, disparities exist in the prevalence of obesity among men and women. Data for adults from Americans’ Changing Lives (ACL) showed that women who actively participate in electronic religion tended to have greater risk of obesity than men. At the same time, women with higher rates of religious attendance and men who report higher religious consolation were less susceptible to obesity (Cline & Ferraro, 2006). These estimates suggest that increases in body weight are correlated with race, gender, and religiosity.

Religious Affiliations and Obesity

Religious affiliation or membership has been associated with better health and well-being through a variety of mechanisms that religious groups offer their members. These
include social support and good health practices prescribed by some religious affiliations that have been linked to lower body weight. For example, members of The Church of Jesus Christ of Latter-day Saints and members of the Seventh-Day Adventists accentuate health protective behaviors and have lower body weight (Kim et al., 2003). Also, teachings of The Church of Jesus Christ of Latter-day Saints, Seventh-Day Adventists, and Amish prohibit the use of drugs and alcohol, which are believed to be detrimental to health (Strawbridge, Shema, Cohen, & Kaplan, 2001). Likewise, Seventh Day Adventists espouse a vegetarian diet, which has been linked to lower body weight (Seventh-Day Adventist Church, South Pacific, n.d.). In addition, religious affiliations provide opportunity for high levels of social networking and social support for their members that buffer the effects of stress on health.

On the other hand, Cline and Ferraro’s (2006) analysis of a national sample of adults professing religious affiliation found that Baptist and fundamentalist Protestant denominations were more susceptible to overweight and obesity than were other religious affiliations. This suggests that research about the potential link between religion and obesity needs to consider the variations across religious affiliations.

**Religiosity and Obesity**

Research has shown that religiosity (religious involvement), as assessed by church (religious) attendance, religious importance, prayer, and participation in religious activities, confers positive effects on health and well-being. Documented evidence of a positive association between religiosity and health has been generally accepted, and the health benefits of religiosity are being taken more seriously among scientific researchers. People with religious attachments have been shown to have healthier lifestyles, lower rates of illness, a stronger sense of well-being, and greater longevity (Koenig, 1999). People who
attend church on a regular basis are reported to have lower rates of illness such as cardiovascular disease, cancer, mental health problems, and death (Levin, 2001). Recent studies have found that individuals who engaged in private religious activities (e.g., prayer, meditation, Bible study) had lower mortality rates than those who never prayed nor read the Bible (Helm, Hays, Flint, Koenig, & Blazer, 2000).

If religiosity helps to protect individuals against illness and mortality and obesity is associated with ill-health, then we can construe that religiosity may be linked to lower incidence of overweight and obesity among adolescents. Yet, research in support of such conclusion is limited. In fact, Kim et al. (2003) reported that religiosity was related to higher body weight among adults. The present investigation sought to explore whether religion provides protective benefits against body weight among adolescents.

**Research Hypotheses**

Based on the review of literature presented, the following research hypotheses were formulated to guide the current study.

1. Adolescents with lower family SES have different mean level of religiosity than do adolescents with higher SES

2. Level of religiosity is correlated with the risk for overweight and obesity among adolescents.

3. Self-identification with different religious affiliations is correlated with prevalence rates of overweight and obesity among adolescents.

4. Female and male adolescents have different mean levels of religiosity.

5. The relationship of religiosity with adolescents’ body weight is different for African American than for White adolescents.
Method

Sample

This study used the second-wave data from the National Longitudinal Study of Adolescent Health (Add Health). Add Health is a longitudinal study collected in 3 waves on adolescents’ lifestyles and health-related behaviors in the United States. All high schools in the United States with an 11th grade enrolling a minimum of 30 students and a feeder school qualified for the study. High schools were stratified into 80 clusters by region, urbanicity, school size and type, ethnicity, and curriculum. The final sample for the study consisted of 134 schools, with school size ranging from 125 to more than 2,000 students. Minority adolescents were oversampled. However, only African American adolescents with college educated parents were sampled. The first wave, collected in 1995, consisted of 20,745 adolescent in-home interviews and 17,700 parent questionnaires.

The second-wave data used in this study were with the same Wave I in-home interview sample. During Wave II, 14,738 adolescents completed in-home interviews. Telephone interviews were also conducted with 128 school administrators to update school information. This study utilized in-home interview data of only Caucasian and African American adolescents at Wave II. The second-wave data were selected because adolescence (ages 14–18 years) has been identified as a critical period for the development of overweight and obesity. In addition, Wave II provides detailed information on adolescent nutrition, one of the main independent variables (not available in Wave I or Wave III) for the assessment of adolescents’ dietary intake of fruits and vegetables.
Measures

**Adolescent Obesity**

Body mass index (BMI) is the most appropriate and acceptable measure for assessing overweight and obesity in children and adolescents (CDC, 2005; National Center for Health Statistics, 2004). BMI is defined as weight in kilograms divided by height in meters squared \((\text{kg/m}^2)\). For adults, weight status is based on the absolute BMI level, whereas child and adolescent weight status is determined by comparing the individual’s BMI with age- and gender-specific percentile values (CDC, 2005; USDA, 2005). One of the advantages of BMI is that it is highly reliable and easy to compute, and an individual’s BMI status depends on gender and age, the same variables that must be considered when evaluating youth adiposity (Goodman, Hinden, & Khandelwal, 2000; Merten, 2005). In addition, BMI is more accurate at approximating body fat than is measuring body weight alone (USDA, 2005).

In the present study, BMI, with age- and gender-specific percentile values published by CDC in 2000, was used to categorize adolescents as overweight and obese (CDC, 2005; USDA, 2005). Adolescents with BMI between the 85th and 95th percentiles for their age and gender were considered overweight, and those with BMI higher than the 95th percentile for age and sex were categorized as being obese. Self-reported weight and height were used to compute BMI.

**Demographic Variables**

Demographics of gender, race, and age were assessed. Dichotomous variables (coded 0 and 1) were used to identify race/ethnicity of Caucasians and African Americans, as well as gender. Age was self-reported in the questionnaire, but only Caucasians and African Americans aged 14–18 years were selected for the study.
Socioeconomic Status

Adolescents’ SES was assessed by three hardship items reported by the parent at Wave I and linked directly to each adolescent in the Wave II data set. These SES variables were selected based on exploratory factor analysis. Also, previous research used similar items to measure family economic hardship (Drewnowski & Specter, 2004; Wickrama & Bryant, 2003). The three items used to measure SES include: (1) “Are you receiving public assistance, such as welfare?” (2) “Are you receiving Aid to Families with Dependent Children?” (3) “Are you receiving food stamps?” A single score was computed by summing these 3 items. The scores ranged from 0 to 3, with the highest scores signifying low SES (greatest economic adversity). The value of Cronbach’s standardized alpha reliability coefficient for this measure was .85.

Adolescents’ Religiosity

Religion is a complex multidimensional construct, and reaching a consensus (standard) on its assessment has been a challenge for researchers (Kim et al., 2003). For this study, adolescent religiosity was assessed based on exploratory factor analysis. Previous studies have used similar items to measure religiosity among the U.S. adult population (Cline & Ferraro, 2006; Kim et al., 2003). These items asked about the adolescent’s religious attendance, religious salience, and religious practice. These questions include: (1) “In the past 12 months, how often did you attend religious service?” (2) “How important is religion to you?” (3) “How often do you pray?” (4) “How often did you attend youth religious activities?” The sum of these four items was computed to generate a total score of religiosity for each adolescent. Higher scores signify a higher level of religiosity. The value of Cronbach’s standardized alpha for these four items was .79.
Religious Affiliation

The appraisal of religious affiliation was based on previous research that collapsed religious denominations to facilitate meaningful interpretation, taking doctrinal similarities into consideration (Cline & Ferraro, 2006). Adolescent’s religious denomination was grouped into the following categories: fundamentalist Protestant (comprises Church of Christ, Pentecostal/Assembly of God, and Church of God), pietistic Protestant (includes Methodist, Christian Church, and African Methodist Episcopal), Reformation-era Protestant (includes Episcopalian, Lutheran, Presbyterian, and Congregationalist), Baptist (includes Southern Baptist, North American Baptist, and Fundamental Baptist), nontraditionalist (comprises Jehovah’s Witnesses, The Church of Jesus Christ of Latter-day Saints, Seventh Day Adventists, and Christian Scientist), Catholic, Jewish, other non-Christian (comprises Muslim, Hindu, and Buddhist), and none (no affiliation).

Analytical Approach

To examine the influence of adolescent’s religiosity on the outcome variable—adolescent body weight—SPSS 15.0 and the structural equation model (SEM) capability in LISREL 8.7 (Jörsekog & Sörbom, 2004) were utilized. SEM is noted to be advantageous for taking a confirmatory, model-based approach to data analysis that can be used for complex inferential purposes. Further, the structural relations, modeled pictorially for a clearer conceptualization of the theory under study, provide explicit estimates of parameters (measurement error), and the procedure can include both unobserved and observed variables (Byrne, 1998).
Results

Descriptive Statistics

Somewhat more female (51.3%) than male (48.7%) adolescents were in the sample (Table 1). Slightly more African American adolescents (20.6% and 13.6%, respectively) were overweight and obese compared with Caucasian adolescents (14.5% and 11.2%, respectively). In addition, the prevalence of overweight and obesity was greater in African American female adolescents (36.5%) than in Caucasian female adolescents (21.6%). Generally, male adolescents in the sample were more likely to be overweight and obese (30.3%) than female adolescents (25.4%). But among African American adolescents’, female showed higher percentage of overweight and obesity (36.5%) compared with male (31.6%). The mean BMI of the study participants was 22.87, and, on average, adolescents in the study live in more fortunate households.

The mean value of adolescents attending religious service was 3.01, which is once a month of attendance on the scale of 1 (not at all) to 4 (once a week or more). Also, the mean level of religious importance to adolescents was 3.32, implying that many of the adolescents consider religion fairly important in their life on a scale of 1 (not important at all) to 4 (very important). Adolescents in the study were praying on the average once a week. Additionally, the mean value for attending special youth religious activities was 2.25, less than once a month. As shown in the table, most of the adolescents were Baptists (25.7%), Catholics (19.5), and pietistic Protestants (17.9%).
Table 1. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total ( (N = 3,596) )</th>
<th>African American ( (n = 899) )</th>
<th>Caucasian ( (n = 2,696) )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>48.7%</td>
<td>47.8%</td>
<td>49.1%</td>
</tr>
<tr>
<td>Female</td>
<td>51.3%</td>
<td>52.2%</td>
<td>50.9%</td>
</tr>
<tr>
<td>SES</td>
<td>0.28 ± 0.76</td>
<td>0.55 ± 1.00</td>
<td>0.19 ± 0.65</td>
</tr>
<tr>
<td><strong>Religious affiliations</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Baptist</td>
<td>25.7%</td>
<td>46.4%</td>
<td>19.3</td>
</tr>
<tr>
<td>Catholic</td>
<td>19.5%</td>
<td>4.4%</td>
<td>24.8</td>
</tr>
<tr>
<td>Fundamentalist Protestant</td>
<td>3.7%</td>
<td>4.2%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Jewish</td>
<td>1.1%</td>
<td>0.0%</td>
<td>1.5%</td>
</tr>
<tr>
<td>None</td>
<td>12.6%</td>
<td>9.7%</td>
<td>13.8%</td>
</tr>
<tr>
<td>Non-traditionalist</td>
<td>2.7%</td>
<td>2.5%</td>
<td>2.8%</td>
</tr>
<tr>
<td>Other non-Christians</td>
<td>5.3%</td>
<td>3.8%</td>
<td>4.1%</td>
</tr>
<tr>
<td>Pietistic Protestant</td>
<td>17.9%</td>
<td>22.6%</td>
<td>16.6%</td>
</tr>
<tr>
<td>Reformation-era Protestant</td>
<td>11.6%</td>
<td>6.4%</td>
<td>13.5%</td>
</tr>
<tr>
<td><strong>Religiosity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prayer (1=never, 5= ≥ 1/wk)</td>
<td>3.90 ± 1.32</td>
<td>4.33 ± 1.03</td>
<td>3.75 ± 1.38</td>
</tr>
<tr>
<td>Religious importance (1= not, 4 = very)</td>
<td>3.32 ± 0.80</td>
<td>3.62 ± 0.57</td>
<td>3.21 ± 0.84</td>
</tr>
<tr>
<td>Religious service (1=never, 4= ≥ 1/wk)</td>
<td>3.01 ± 1.07</td>
<td>3.31 ± 0.93</td>
<td>2.90 ± 1.10</td>
</tr>
<tr>
<td>Youth activities (1=never, 4= ≥ 1/wk)</td>
<td>2.25 ± 1.24</td>
<td>2.56 ± 1.22</td>
<td>2.14 ± 1.23</td>
</tr>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>22.87 ± 4.58</td>
<td>23.59 ± 4.98</td>
<td>22.63 ± 4.41</td>
</tr>
<tr>
<td>Overweight</td>
<td>16.0%</td>
<td>20.6%</td>
<td>14.5%</td>
</tr>
<tr>
<td>Obese</td>
<td>11.8%</td>
<td>13.6%</td>
<td>11.2%</td>
</tr>
<tr>
<td>Overweight and Obese (Male)</td>
<td>30.3%</td>
<td>31.6%</td>
<td>29.9%</td>
</tr>
<tr>
<td>Overweight and Obese (Female)</td>
<td>25.4%</td>
<td>36.5%</td>
<td>21.6%</td>
</tr>
</tbody>
</table>

The analysis of overweight and obese adolescents for each religious affiliation is presented in Table 2. In general, Fundamentalist Protestants have the highest percentage of overweight and obese adolescents, followed by Baptists and Catholics. Adolescents with no religious affiliations also have a relatively high percentage of overweight and obese individuals. Jewish respondents have the lowest percentage of overweight adolescents.
Table 2. Adolescent BMI Percentiles by Religious Affiliations

<table>
<thead>
<tr>
<th>Religious Affiliation</th>
<th>Number of Cases (n)</th>
<th>Underweight %</th>
<th>Normal %</th>
<th>Overweight %</th>
<th>Obese %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baptist</td>
<td>925</td>
<td>1.7</td>
<td>67.4</td>
<td>17.7</td>
<td>13.2</td>
</tr>
<tr>
<td>Catholic</td>
<td>700</td>
<td>2.7</td>
<td>70.3</td>
<td>17.4</td>
<td>9.6</td>
</tr>
<tr>
<td>Fundamentalist Protestant</td>
<td>132</td>
<td>4.5</td>
<td>55.3</td>
<td>19.7</td>
<td>20.5</td>
</tr>
<tr>
<td>Jewish</td>
<td>40</td>
<td>0.0</td>
<td>95.0</td>
<td>5.0</td>
<td>0.0</td>
</tr>
<tr>
<td>None</td>
<td>453</td>
<td>2.4</td>
<td>70.0</td>
<td>13.9</td>
<td>13.7</td>
</tr>
<tr>
<td>Non-traditionalist</td>
<td>96</td>
<td>1.0</td>
<td>76.0</td>
<td>12.5</td>
<td>10.4</td>
</tr>
<tr>
<td>Other non-Christians</td>
<td>143</td>
<td>0.7</td>
<td>74.1</td>
<td>14.7</td>
<td>10.5</td>
</tr>
<tr>
<td>Pietistic Protestant</td>
<td>643</td>
<td>2.5</td>
<td>72.0</td>
<td>14.3</td>
<td>11.2</td>
</tr>
<tr>
<td>Reformation-era Protestant</td>
<td>417</td>
<td>1.7</td>
<td>71.9</td>
<td>15.8</td>
<td>10.6</td>
</tr>
</tbody>
</table>

Structural equation modeling

Structural equation modeling (SEM), using maximum likelihood estimation in LISREL 8.7 (Jöreskog & Sörbom, 2004), was utilized to estimate the hypothesized model presented in Figure 1 and to conduct a multiple group comparison to determine if religious affiliation acts as a moderator of adolescents’ adiposity. Goodness of fit for the hypothesized model presented in Figure 1 was assessed based on the indices and their cutoff points recommended by Hu and Bentler (1995, 1999), and Jöreskog and Sörbom (1989). These include root mean square error of approximation (RMSEA; value less than .05), comparative fit index (CFI; value greater than .95), standardized root mean square residual (SRMR; value of .05 or less), and adjusted goodness of fit index (AGFI; value greater than .95). An initial test of the saturated model resulted in a perfect fit to the data for all religious affiliations.

Some of the structural parameter estimates were nonsignificant; to ensure model parsimony (Byrne, 1998), these structural paths were trimmed from the models. This resulted in deletion of most affiliations that were originally included in the analysis because most of their structural pathways (although most have effects that are relatively large) were not
significant. These affiliations structural parameter estimates are provided in Appendix A. The two affiliations that were carried through to the final results were Baptist and pietistic Protestants. An estimation of the Baptist trimmed model (RMSEA < 0.007, CFI > 0.999, SRMR = 0.009, AGFI = 0.99) and pietistic Protestants trimmed model (RMSEA < 0.001, CFI > .999, SRMR = .006, AGFI = .98) yielded a new parsimonious structural model that fits the data well.

The standardized path coefficients for the Baptist and pietistic Protestants model (analyzed individually) are presented in Figures 2 and 3. In addition, summaries of the direct paths from the predictor variables to the outcome variables are presented in Table 3. There were statistically significant ($p < .01$) standardized effects from SES to religiosity ($\beta = -.25$) for Baptist; and from gender to adolescents’ body weight ($\beta = -.11$) for pietistic Protestants. For both affiliations, race directly affected religiosity, $\beta = .27$, $p< .01$ (Baptist) and $\beta = .35$, $p< .001$ (pietistic Protestants), and race was significantly related to adolescents’ body weight, $\beta = .15$, $p<.001$, for both affiliations. However, the direct effect from religiosity to adolescents’ body weight, although statistically insignificant in both denominations, has an inverse relationship with adiposity among Baptist adolescents and a positive association among pietistic Protestant adolescents. The squared multiple correlations for Baptist endogenous variables were .08 for religiosity and .02 for adolescents’ body weight, and for pietistic Protestants, .16 for religiosity and .03 for body weight.
Figure 2. Estimated Model for Baptist Adolescents and Their Body Weight

\[ n = 925, \; * p < .05, \; ** p < .01, \; *** p < .001 \]

Figure 3. Estimated Model for Pietistic Protestant Adolescents and Their Body Weight.

\[ n = 643 \; * p < .05, \; ** p < .01, \; *** p < .001 \]
Table 3. Path Estimates of Direct Effects of Exogenous and Endogenous Variables on Adolescents’ Body Weight, by Religious Affiliation

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Dependent Variable</th>
<th>Standardized Direct Effect</th>
<th>Standard Error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baptist</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>Religiosity</td>
<td>-.25</td>
<td>.11</td>
<td>-2.81**</td>
</tr>
<tr>
<td>SES</td>
<td>BMI</td>
<td>-.05</td>
<td>&lt; .01</td>
<td>-1.18</td>
</tr>
<tr>
<td>Race</td>
<td>Religiosity</td>
<td>.27</td>
<td>.35</td>
<td>2.84**</td>
</tr>
<tr>
<td>Race</td>
<td>BMI</td>
<td>.15</td>
<td>.01</td>
<td>3.18***</td>
</tr>
<tr>
<td>Gender</td>
<td>Religiosity</td>
<td>.09</td>
<td>.32</td>
<td>1.08</td>
</tr>
<tr>
<td>Religiosity</td>
<td>BMI</td>
<td>-.11</td>
<td>.01</td>
<td>-1.08</td>
</tr>
<tr>
<td>Pietistic Protestant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>Religiosity</td>
<td>-.09</td>
<td>.08</td>
<td>-0.64</td>
</tr>
<tr>
<td>Race</td>
<td>Religiosity</td>
<td>.35</td>
<td>.24</td>
<td>3.26***</td>
</tr>
<tr>
<td>Race</td>
<td>BMI</td>
<td>.15</td>
<td>.01</td>
<td>3.29***</td>
</tr>
<tr>
<td>Gender</td>
<td>Religiosity</td>
<td>.19</td>
<td>.22</td>
<td>1.94</td>
</tr>
<tr>
<td>Gender</td>
<td>BMI</td>
<td>-.11</td>
<td>.01</td>
<td>-2.74**</td>
</tr>
<tr>
<td>Religiosity</td>
<td>BMI</td>
<td>.02</td>
<td>.01</td>
<td>0.14</td>
</tr>
</tbody>
</table>

* p < .05, ** p < .01, *** p < .001

Multiple Group Analyses

Multiple group comparisons were conducted to determine whether religious affiliation, gender, and race act as moderators of religiosity effects on adolescents’ body weight. In exploring religious affiliation’s effect on adolescents’ adiposity, Baptist and pietistic Protestant models were analyzed simultaneously. In the initial estimation, the factor items were allowed to load freely on Baptist and pietistic Protestant models. The multigroup model yielded fit measures of $\chi^2(2 \text{ df}) = 1.66$, $p = .44$, with CFI > 0.99. Examination of the factor structures of the two models indicates distinctive loadings on various factors for the two models. A comparison between the models was also assessed with two indices—the Akaike Information Criterion (AIC) and the Consistent version of the Akaike Information Criterion (CAIC)—that share the same conceptual framework and are helpful in comparing two or more models (Hu & Bentler, 1995; Tabacknick & Fidell, 2001). The Baptist model
yielded a worse fit (AIC = 29.30, CAIC = 250.55) than the model fit for pietistic Protestants (AIC = 28.37, CAIC = 222.20). Therefore, the models not only differ in distinctive loadings but also in goodness of fit indices. These results imply that there were some differences between the model for Baptist and the model for pietistic Protestants.

An additional comparison of the Baptist and pietistic Protestant models was conducted with estimated structure paths allowed to be invariant, for a more meaningful comparison (Byrne, 1998). The fit of this model yielded $\chi^2(2 \text{ df}) = 1.30, p = .44$. The $\chi^2$ difference between the two models was not statistically significant, $\Delta \chi^2 = 0.36, p = .54$. Therefore, the structural paths are not different between Baptist and pietistic Protestant religious affiliations.

With regard to gender, a stacked model was analyzed with the factor items allowed to load freely in the model for males and the model for females, to ascertain whether the structural paths were different between males and females. The estimated multiple group analysis yielded a model with a good fit, $\chi^2(1 \text{ df}) = 6.45, p = .04, \text{CFI} = .99, \text{and RMSEA} = .034$. The structural path estimates of the direct effects of the exogenous variables on the endogenous variables in the model for males and the model for females are presented in Table 4. The major distinction between the models was in the number of significant direct effects between the exogenous and endogenous variables. In the model for men, there are 4 significant standardized effects, compared to 3 significant paths in the model for females. In the model for males, significant paths were evident from SES to religiosity, $\beta = .40, p < .001$, from SES to adolescents’ body weight, $\beta = -.06, p < .05$, from race to religiosity, $\beta = -.35, p < .001$, and from religiosity to adolescents’ body weight, $\beta = .07, p < .01$. The squared multiple correlations for the endogenous variables in the model for males were .28 for religiosity and
.01 for adolescents’ body weight. For the model for females, there were significant standardized effects from SES to religiosity, $\beta = .42, p < .001$, from race to religiosity, $\beta = -.30, p < .001$, and from religiosity to adolescents’ body weight, $\beta = .25, p < .001$. The squared multiple correlations for the model for females were .25 for religiosity and .06 for adolescents’ body weight.

Moreover, for a meaningful comparison of models, the factor structures between groups (male and female) were allowed to be invariant (Byrne, 1998). The fit of this model yielded $\chi^2(2 \text{ df}) = 11.76, p = .002$, and RMSEA = .03. Comparison of this model with the initial freely estimated structural model resulted in a significant difference, $\Delta \chi^2(1 \text{ df}) = 5.32, p = .02$. This suggests that there was a statistically significant difference in the causal paths for the models for males and females.

### Table 4. Path Estimates of Direct Effects of Exogenous and Endogenous Variables on Adolescents’ Body Weight, by Gender

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Dependent Variable</th>
<th>Standardized Direct Effect</th>
<th>Standard Error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>Religiosity</td>
<td>.40</td>
<td>.01</td>
<td>12.69***</td>
</tr>
<tr>
<td>SES</td>
<td>BMI</td>
<td>-.06</td>
<td>&lt;.01</td>
<td>-2.03*</td>
</tr>
<tr>
<td>Race</td>
<td>Religiosity</td>
<td>-.35</td>
<td>.01</td>
<td>-10.06***</td>
</tr>
<tr>
<td>Race</td>
<td>BMI</td>
<td>-.01</td>
<td>&lt;.01</td>
<td>-1.61</td>
</tr>
<tr>
<td>Religiosity</td>
<td>BMI</td>
<td>.07</td>
<td>.01</td>
<td>2.60**</td>
</tr>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>Religiosity</td>
<td>.42</td>
<td>.01</td>
<td>9.98***</td>
</tr>
<tr>
<td>SES</td>
<td>BMI</td>
<td>.15</td>
<td>&lt;.01</td>
<td>1.50</td>
</tr>
<tr>
<td>Race</td>
<td>Religiosity</td>
<td>-.30</td>
<td>.01</td>
<td>11.32***</td>
</tr>
<tr>
<td>Race</td>
<td>BMI</td>
<td>.05</td>
<td>&lt;.01</td>
<td>1.94</td>
</tr>
<tr>
<td>Religiosity</td>
<td>BMI</td>
<td>.25</td>
<td>.01</td>
<td>8.30***</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01, ***p < .001

Additional analysis was conducted to determine whether the factor structures were different between African Americans and Caucasians, without controlling for religious
denomination. An examination of both sets of structural paths provided insight into the significant paths in both models (Table 5). In the model for African Americans, there are two significant paths (from gender to religiosity, $\beta = -.12, p < .05$, and from religiosity to adolescents’ body weight, $\beta = .09, p < .01$), in comparison with three significant pathways (from gender to both religiosity, $\beta = -.17, p < .001$ and body weight, $\beta = .02, p < .001$, and from religiosity to body weight, $\beta = -.12, p < .001$) in the model for Caucasians. In addition, the stacked model had a good fit, $\chi^2(2 \, df) = 6.49, p = .03$, RMSEA < .01, and CFI < .99, and, because the significant paths identified were supported by the hypothesis and the stacked model provided adequate fit, no further analysis was conducted. In light of the evidence provided, religiosity was positively associated with adolescents’ adiposity among African Americans; but, among Caucasians, religiosity was inversely related to adolescents’ body weight.

Table 5. Path Estimates of Direct Effects of Exogenous and Endogenous Variables on Adolescents’ Body Weight by Race

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Dependent Variable</th>
<th>Standardized Direct Effect</th>
<th>Standard Error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>African American</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>Religiosity</td>
<td>.05</td>
<td>.02</td>
<td>1.17</td>
</tr>
<tr>
<td>SES</td>
<td>BMI</td>
<td>.01</td>
<td>&lt; .01</td>
<td>0.29</td>
</tr>
<tr>
<td>Gender</td>
<td>Religiosity</td>
<td>-.12</td>
<td>.01</td>
<td>-2.22*</td>
</tr>
<tr>
<td>Gender</td>
<td>BMI</td>
<td>.03</td>
<td>.01</td>
<td>1.52</td>
</tr>
<tr>
<td>Religiosity</td>
<td>BMI</td>
<td>.09</td>
<td>.01</td>
<td>2.60**</td>
</tr>
<tr>
<td><strong>Caucasian</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>Religiosity</td>
<td>.04</td>
<td>.01</td>
<td>0.99</td>
</tr>
<tr>
<td>SES</td>
<td>BMI</td>
<td>.05</td>
<td>&lt; .01</td>
<td>1.15</td>
</tr>
<tr>
<td>Gender</td>
<td>Religiosity</td>
<td>-.17</td>
<td>.01</td>
<td>4.72***</td>
</tr>
<tr>
<td>Gender</td>
<td>BMI</td>
<td>.02</td>
<td>&lt; .01</td>
<td>3.61***</td>
</tr>
<tr>
<td>Religiosity</td>
<td>BMI</td>
<td>-.12</td>
<td>.01</td>
<td>-6.21***</td>
</tr>
</tbody>
</table>

* $p < .05$, ** $p < .01$, *** $p < .001$
Discussion

The purpose of this study was to examine the relationship between religion (i.e., religiosity and religious affiliations) and body weight among African American and Caucasian adolescents. In addition, the effects of individual attributes (i.e., race, gender) and family SES on religiosity and body weight were explored. SEM was utilized to estimate the relationship of these attributes and religion with adolescent’s adiposity.

With regard to religious affiliations, fundamentalist Protestants displayed higher levels of obesity than did those of other affiliations. African American youth affiliated with fundamentalist religious groups are more vulnerable to overweight and obesity, but Jewish youth are less likely to be obese. Even though a stacked model analysis did not reveal statistically significant differences between religiosity and adolescents’ body weight by religious affiliations, probably due to small sample size, evidence does exist that some religious denominations—for example, Seventh Day Adventists—encourage a vegetarian diet, which had been associated with healthy body weight (Cline & Ferraro, 2006; Kim, et al., 2003). Because this study used cross-sectional data, longitudinal research with large religious group sample size is needed to uncover more fully the relationship between religious affiliation and body weight.

In addition, it is important to take into consideration the link between religiosity and family SES while interpreting these findings, as recent studies of African American and Caucasian youth have found a statistically significant association between lower SES and being overweight (Dodor, Hausafus, & Shelley, 2008). In this study, youth affiliated with the Baptist religious group showed an inverse relationship of SES with religiosity and body weight. This finding, which suggests that lower SES among Baptists is related to lower levels
of religiosity, is inconsistent with previous literature that reported SES was unrelated to religious practice (Ferraro, 1998).

Gender-stacked model analyses revealed that a higher level of religiosity was positively associated with higher body weight in both male and female adolescents, but the standardized direct effect was greater for female (.25, \( p < .001 \)) than for male adolescents (.07 \( p < .01 \)). It appears that one-fourth of religiously-inclined young females in the current sample are at a greater risk of overweight and obesity. Previous research among adults demonstrated a similar pattern of highly religious women more likely to become obese than men (Cline & Ferraro, 2006). At the same time, Cline and Ferraro had shown that women with higher rates of church attendance were less susceptible to obesity. Future research should distinguish the dimensions of religiosity and its link with obesity.

What is interesting to note in the current investigation is the difference in body weight between religiously inclined African American and Caucasian adolescents. Multiple group analyses demonstrate that religiosity had a positive statistically significant association with body weight for African Americans, but had a significantly negative linkage with body weight for Caucasians. These results support the prediction that the relationship of religiosity with youth adiposity may be different for African American than for Caucasian adolescents. Consistent with this finding, previous research with a nationally representative sample (Cline & Ferraro, 2006) found race as being the underlying factor for explaining the relationship between religiosity and body weight among U.S. adults, and highly religious African Americans more vulnerable to obesity.

In the present study, a number of limitations existed that need to be considered when interpreting the results. The estimation of the measures (adolescents’ BMI, religiosity,
religious affiliations) were based on self-reports that may be inaccurate and thus possibly obscure the relationships between variables. Some religious affiliations samples are relatively small and were not incorporated in the analysis. Large sample sizes are needed for accurate assessment of the influence of religious groups on body weight. Also, the data are cross-sectional, which limits conclusions about the direction of causality.

The present study enhanced our understanding of the influence of religiosity on overweight and obesity among adolescents. Analysis had shown that some religious affiliations, in particular, fundamentalist Protestant, had increased susceptibility to overweight and obesity. Racial and gender differences may have also intermingled with religiosity resulting in different association between religiosity and adiposity among adolescents. Evidence indicates that highly religious African American youth and religious female adolescents were at a higher risk for obesity. This was very surprising, given extant literature demonstrating religion’s positive association with better health and being overweight related with poor health.

The present study has demonstrated some evidence of religiosity association with adolescents’ overweight and obesity with which religious denominations in particular, fundamentalist Protestant and African American denominations, need to advocate much more effectively than before for faith based practices that espouse healthy lifestyles beneficial to health and protection against obesity. There is clearly a need for religious groups and organizations to consider working together with education and public health professionals to develop youth and culturally appropriate intervention programs to reduce the prevalence of overweight and obesity among their adolescents’ parishioners. Prospective
research examining the link between religious groups and obesity may assess better how individual lifestyles are related to religiosity and body weight.
REFERENCES


### APPENDIX: Path estimates of standardized direct effects of exogenous and endogenous variables on adolescent’s body weight by religious affiliation

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Dependent Variable</th>
<th>Standardized Direct Effect</th>
<th>Standard Error</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Catholic</strong></td>
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<td>-0.93</td>
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<td>SES</td>
<td>BMI</td>
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<td>.00</td>
<td>1.63</td>
</tr>
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<td>Race</td>
<td>Religiosity</td>
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<td>BMI</td>
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<td>0.04</td>
</tr>
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<td>Gender</td>
<td>Religiosity</td>
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<td>1.28</td>
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<td>Gender</td>
<td>BMI</td>
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<td>2.58**</td>
</tr>
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</tr>
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<td></td>
</tr>
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<td>Religiosity</td>
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<td>0.82</td>
</tr>
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<td>Religiosity</td>
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<td>2.44*</td>
</tr>
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<td>.03</td>
<td>0.05</td>
</tr>
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<td>Religiosity</td>
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<td>1.12</td>
<td>1.62</td>
</tr>
<tr>
<td>Gender</td>
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<td>-.28</td>
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<td>-1.40</td>
</tr>
<tr>
<td>Religiosity</td>
<td>BMI</td>
<td>.13</td>
<td>.00</td>
<td>0.95</td>
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<td><strong>Nontraditional</strong></td>
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<td>Religiosity</td>
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<td>.06</td>
<td>-1.03</td>
</tr>
<tr>
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<td>BMI</td>
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<td>.00</td>
<td>0.93</td>
</tr>
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<tr>
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<td>.02</td>
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* *p < .05, ** p < .01, *** p < .001*
CHAPTER 5: SUMMARY

Overweight and obesity is a major public health problem in the U.S., potentially affecting every state, city, community, and school across the nation, and nearly two out of three Americans (Carmona, 2003). More than 30% of adolescents are overweight and more than 11% of them are obese (CDC, 2005), and the trend appears to be continuing. A critical aspect is the risk of an overweight adolescent becoming an obese adult. The consequences of overweight and obesity, including premature death and several chronic conditions adversely impacting the quality of life (World Health Organization, 2003), have spurred the concern for understanding body weight and seeking its predictors.

The purpose of the present study was to explore the influences of individual attributes (family SES, race, gender, and age), health behaviors (vigorous physical activity, sedentary activity, dietary intake, and sleeping patterns) as well as religious affiliations (Baptist, Catholic, fundamentalist Protestant, Jewish, nontraditionalist, other non-Christian, pietistic Protestant, and reformation-era Protestant) and religious commitment on adolescents’ body weight among African American and Caucasian adolescents. Demographic (race and gender-specific) and religious denomination variations in the association among these variables and body weight were examined to explain the prevalence of obesity in today’s society. Structural equation modeling (SEM) in LISREL 8.7 (Jöreskog & Sörbom, 2004) was used to explain the role of the study variables on adolescents’ adiposity.

The data for this study come from Wave II in-home interview data of the National Longitudinal Study of Adolescent Health (Add Health). Add Health is a longitudinal study collected in 3 waves on adolescents’ lifestyles and health-related behaviors in the U.S. All U.S. high schools with an 11th grade enrolling a minimum of 30 students and a feeder school
qualified for the study. High schools were stratified into 80 clusters by region, urbanicity, school size and type, ethnicity, and curriculum. The final sample for Add Health consisted of 134 schools, with school size ranging from 125 to more than 2,000 students. Minority adolescents were oversampled. However, only African American adolescents with college educated parents were sampled. The first wave, collected in 1995, consisted of 20,745 adolescent in-home interviews and 17,700 parent questionnaires.

The Wave II data used in this study were collected in 1996 with the same Wave I in-home interview sample. During Wave II, 14,738 adolescents completed in-home interviews. Telephone interviews were also conducted with 128 school administrators to update school information. This study utilized in-home interview data of only Caucasian \(n = 2,697\) and African American \(n = 899\) adolescents (ages 14–18 years) at Wave II. The Wave II data were selected because adolescence (ages 14–18 years) has been identified as a critical period for the development of overweight and obesity. In addition, Wave II provides detailed information on adolescent nutrition, one of the main independent variables (not available in Wave I or Wave III) for the assessment of adolescents’ dietary intake of fruits and vegetables.

Body Mass Index (BMI), with age- and gender-specific percentile values published by the CDC in 2000, were used to categorize adolescents as overweight and obese (CDC, 2005). Adolescents with BMI between the 85\textsuperscript{th} and 95\textsuperscript{th} percentiles for their age and gender were considered overweight, and those with BMI higher than the 95\textsuperscript{th} percentile for age and sex were categorized as being obese. Self-reported weight and height were used to compute BMI.
The hypotheses of this study in general were supported by the findings, which underscore the significance of family SES, vigorous physical activity, sufficient consumption of fruits and vegetables, and religious affiliations in predicting adolescents’ body weight. Family economic hardship increased the risk for adolescents’ overweight and obesity. Multigroup analyses of the association of family SES and health behaviors with being overweight found significant association between overweight and lower SES for Caucasian youth. In this study, the same factor (family SES) had strong association with Caucasians eating insufficient fruits and vegetables, which has been reported to increase susceptibility to overweight and obesity. This pattern may persist into adulthood and several generations as families are unable to break the poverty cycle. The possible end result is high prevalence of overweight and obesity with associated poor health status for Caucasian youth with a higher level of economic hardship. Therefore, preventive and intervention strategies need to focus at the family level to assist such families to improve their economic status.

Further, this study provides support that gender has a direct significant relationship with adolescents’ body weight. In particular, adolescent females portrayed greater vulnerability to overweight and obesity than males irrespective of race. The finding also suggests increasing prevalence of overweight and obesity for African American young females than their Caucasian counterparts. This variation may be explained by the presence of cultural factors in which females of Africa and African American descent are satisfied with their body weight because of less social pressure on adiposity and general acceptance of large body size in their community. Future research needs to validate the incidence of cultural and racial perceptions of body weight among African American females.
The results of health behavior variables—being vigorously active, being sedentary, eating sufficient fruits and vegetables, and sleeping fewer hours at night—showed varied relationships with youth adiposity. In this study, vigorous physical activity and its direct relationship with decreased risk of overweight and obesity did not vary significantly between African American and Caucasian youth. However, greater participation in sedentary activity among Caucasian adolescents’ increased the risk for overweight and obesity compared to African Americans. Also, the findings provided invaluable information regarding the role of race in the association between fewer hours of sleep and body weight. Stacked model analyses found an inverse relationship between sufficient hours of sleep at night and overweight for Caucasian adolescents; suggesting that Caucasian youth may have greater vulnerability to the influence of insufficient sleep at night than African Americans, who demonstrated a positive association between sufficient sleep at night and obesity. Future study needs to confirm the possible variations in the impact of hours of sleep at night on African American and Caucasian adolescents’ adiposity.

In general, efforts to reduce and reverse the overweight and obesity pandemic in this country need to focus on promoting vigorous physical activity among youth. Concerted efforts of parents, schools, and the community are critical for positive changes in physical activity to occur through creation of recreation centers with sports facilities for youth. Parents should encourage adolescents to play active sports and exercise 3 to 4 times a week (the moderate level of physical activity) (Healthy People 2010, 2001). Parents should also limit adolescents’ sedentary activities such as TV viewing (the greatest source of sedentary activity) to two or fewer hours a day as recent research indicates watching TV more than two hours a day was associated with overweight among U.S. high school students. Schools must
offer educational programs such as those in family and consumer sciences education committed to preparing youth for a healthy life throughout their life span as well as empowering individuals and families to improve their well being. Health and education professionals need to consider cultural beliefs and practices in developing intervention and prevention programs for youth obesity prevention.

In our quest of understanding the correlates of body weight, religion which represents one of the most influential and available institutions that influence individual lifestyle and may support healthy body weight was examined. The finding suggests fundamentalist Protestants may be more vulnerable to obesity than any other religious group regardless of race. African American youth affiliated with fundamentalist Protestant worship have greater susceptibility to overweight and obesity. Jewish membership (exclusively Caucasians) was less susceptible to overweight and obesity compared to other religious affiliations. Perhaps, the small number of Jewish respondents in the sample or the strict adherence to Judaism promotes ideal body weight. Additional studies of Caucasian youth who have accepted Jewish religious traditions are needed to clarify whether Jewish religious practice protects against obesity.

The findings of higher prevalence of obesity among religiously committed adolescents could be attributed to cultural or racial factors. In fact, African Americans demonstrated statistically significant association between religiosity and body weight suggesting that highly religious African Americans are more likely to be overweight and obese. In contrast, Caucasian youth with high levels of religiosity were less vulnerable to obesity. This result has important implication for further research on detailed measures of the
dimensions of religiosity (such as fasting) which were not considered in this study. Other studies found attendance of religious service to lower the risk for obesity.

Moreover, additional findings reveal significantly higher levels of religiosity to be directly associated with obesity among female adolescents than among males. It is probable that female adolescents in this study did not consider physical activity and good dietary intake as part of a healthy lifestyle. Future studies should focus on the influences of physical activity and dietary intake on religiosity because recent findings indicate a significant association between physical activity and dietary intake and its relationship on body weight (Dodor, Hausafus, & Shelley, 2008).
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ACKNOWLEDGEMENT

My greatest appreciation goes to my major professors; Cheryl Hausafus and Mack Shelley. I am grateful to Dr. Hausafus for the assistance, guidance, and insight she has provided me throughout my study at Iowa State; and from whom I learned to keep my chin up in spite of life challenges, and to pay attention to details. Thanks to Dr. Shelley, for his patience, time, and tremendous support to enable me finish my study. Leaving the university without the dissertation complete provide a number of challenges, but his willingness, statistical expertise, professionalism, and strong communication skills, made this otherwise difficult time manageable for me. It was a privilege to work with you all. It has truly helped me learn and set a high standard to strive for. Every student should be fortunate to have such a support in their academic and professional life.

I sincerely appreciate all my committee members Dr. Beverly Kruempel, Dr. Gary Phye, and Dr. Leah Keino for their support and invaluable suggestions to make this dream a reality. Thanks to Dr. Kruempel for her mentorship, support, and inspiration for my academic and professional growth. Special thanks to Dr. Phye for giving me the opportunity to work at Psychology in Education Lab (PERL) where I gained experiences in educational research. I would like to thank my peers at PERL especially, Arlene de la Mora, for her advice and invaluable suggestions, and Tsun-Yao Ku for his time and support which enabled me better understand structural equation modeling.

I am forever indebted to my brothers (Francis Nutakor, James Nutakor, Chris Nutakor, Kofi Nutakor, David Nutakor, and Raphael Kwame Nutakor) and sisters (Yayra Nutakor Kugbey, Veronica Tafa Nutakor, and Annie Nutakor) for their unconditional love, encouragement, and continuous support. I am truly blessed to have you as my siblings.
Special thanks to my brother Chris and his wife Jennifer for their financial support, and to my sister-in-law Esther, for been there when we needed you. I would like to express my gratitude to my cousins Jara and Worla Nutakor, for all their prayers and support.

To my friends, I say thank you with all my heart, for having faith in me and giving me continuous support and inspiration. Where would I have been without you? I have overcome the most challenging circumstances in my life because you were there to listen, to pray with me, to wipe my tears, and to hold my hands. These are the memories I will treasure in my heart forever. Special appreciation to Juliet Amoh, Esi Colecraft, Yemisi Kuku, Emily Musumhi, Ken Kinney, Eunice Ackah-Hayibor, Faith Muturia, Francis and Rita Tayie, Florence Atiegar, Christina Yeboah, Rachael Martins, Inya and Ifeoma Nlenanya, and all others who have been there when we needed you. It is truly a blessing to have known all of you.

I am thankful to my church family—First Assembly of God, Ames, IA and Southside Assembly of God, Jackson, MS— for their prayers and support. I would like to express my heartfelt thanks to Tammy Ades, Lisa Hayes, Pastor Gary and Carol Pilcher, Ruth Crouse, Liz Chapman, Al and Melita Biela, for their love, spiritual, and emotional support in many ways.

My final thank is reserved for very special individuals in my life, my husband Daniel and children Seyram, Elikem, and Delali. I could not have done any of these without you. Daily you have made sacrifices so that I could reach this goal in my educational journey. I am very grateful for all your love, support, understanding, and prayers.

Above all, to Jesus Christ be the Glory, my source of strength, my source of hope, for only by His grace I can say Ebenezer.