OBESITY AMONG AMERICAN ADOLESCENTS: EFFECTS OF RACIAL, SOCIOECONOMIC, NEIGHBORHOOD, AND IMMIGRATION STATUS

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Abstract

The main objectives of this dissertation were: to study relationships between neighborhood characteristics such as access to parks, playgrounds, recreational facilities, libraries, housing condition, walk ability, neighborhood hygiene and safety and obesity among adolescents aged from twelve to seventeen years; and to examine the physical and social impact of these factors on obesity among adolescents. One of the main objectives of the dissertation was to examine the neighborhood, physical and social activity effects on obesity problems among immigrant adolescents. Therefore, the main purpose of the study was to investigate whether immigration status, neighborhood conditions, and socioeconomic status affect obesity among adolescents.

The National Survey of Children's Health, 2007 was used for the study. This was a nationwide dataset that included information on multiple aspects of children's lives. Adolescents surveyed were between ages 12-17 and were comprised of 36,284 respondents; 52.27% of them were males. About 69.9% of the adolescents were Whites, followed by 10.3% Hispanics, 10.2% Blacks , 4.8% Multi-racial , and 4.4% Others. In addition, 9% of the mothers and 9.9% of fathers and 3.8% of the children were not born in the United States.

Most of neighborhood factors were significantly related to obesity among adolescents. There was a probability that 52% of adolescents who were obese lived in neighborhoods with rundown housing; 52% lived in neighborhoods with garbage on the street; 48% lived in neighborhoods with no parks or playgrounds; and 47% lived in neighborhoods with no libraries. In addition, there was a probability that 44% of obese adolescents lived in neighborhoods where

people did not help each other; 48% lived in neighborhoods where parents could not trust neighbors; and 45% lived in unsafe neighborhoods.

Moreover, 31% of adolescents who did earn money, 46.9% who watched TV and played videos more than four hours a week, 47% who did not get involved in community service, and 29% who did not exercise at least 20 minutes more than four days a week, and 28 % who were not on a sports team or taking sports lessons were obese or overweight. All racial and ethnic groups were positively related to higher BMI scores except Whites. U.S. born adolescents were more likely to be overweight or obese than immigrant adolescents. However, Hispanic and Black immigrants were more likely to be obese than other immigrant adolescents. The policy significance of these findings are described and discussed in detail.

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DEDICATION

I dedicate my dissertation to my loving family: My parents Jamsrangiin Davaasambuu and Lkhamsurengiin Dariimaa. My brothers Chinbat Davaasambuu and Chinzorig Davaasambuu who supported me each step of the way.

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LIST OF ABBREVIATIONS

ANCOVA- Analysis of Covariance

BMI- Body Mass Index

CATI- Computer Assisted Telephone Interview

CDC- The Center for Disease Control and Prevention

FDA- Food and Drug Administration

FPL- Federal Poverty Level

HHS- Department of Health and Human Services

GDP- Gross Domestic Product

NIH- National Institute of Health

NHANES- National Health and Nutrition Examination Surveys

NHLBI-The National Heart, Lung and Blood Institute

NORC- National Opinion Research Center

NRSA- Health Resources and Services Administration

NSCH- National Survey of Children's Health

MCHB- The US Department of Health and Human Services Administration Maternal and Child Health Bureau

RWJF- The Robert Wood Johnson Foundation

SPSS- Statistical Package for the Social Sciences

USDA- The United States Department of Agriculture

YMCA- Young Men's Christian Association

YWCA- Young Women's Christian Association

CHAPTER I.

WEIGHT PROBLEMS AMONG ADOLESCENTS

Introduction

The Center for Disease Control and Prevention recognizes obesity as one of the leading health problems and public health challenges in the U.S. (CDC, 2010). According to the National Heart, Lung and Blood Institute, obesity affects about 97 million Americans and it is second cause of preventable death in the U.S. (NHLBI, 2010). The Surgeon General states that about 300,000 deaths in the country are related to overweight or obesity every year (Surgeon General, 2010). Obesity is one of the main causes of heart disease, diabetes type II, stroke, certain type of cancer, premature death and mental disorders such as depression and anxiety (Mohdad, Ford, & Bowman, 2001). In addition, obesity has been increasing rapidly from 14.3% in 1961 to 40% in 2008 (Ogden & Carroll, 2010). According to Ogden and Carroll, 43.2% of U.S. adults who are age 20 or older are overweight, 33.8% of this population is obese and 5.7% of the adults who are over 20 are extremely obese (Odgen & Carroll, 2010). Based on CDC report from Behavioral Risk Factor Surveillance System 2009, the highest percentage of obesity reported among adults aged between 50 and 69 (31,1%), the Non-Hispanic Blacks (36.8%), Non-Hispanic Black females (41.9%), Hispanics (30.7%), residents in South (28.4%) and the Midwest (28.2%). Moreover, obesity rates also differ by state, the highest rate results found in Mississippi (34.4 %) followed by 9 other states whose obesity percentages were higher than 30.0% in 2009: Alabama, Arkansas, Kentucky, Louisiana, Missouri, Oklahoma, Tennessee and West Virginia (CDC, 2010).

The CDC and the Robert Wood Johnson Foundation projected that obesity will continue to increase among the U.S. population in upcoming years, and about 52% of the U.S. adult women and about 51% of the U.S. adult men will be obese by 2030 (Grady & Cappretta, 2012). Therefore, overweight and obesity among the U.S. population is a widespread public health issue that affects not only quality of life and health of the citizens but also the economy of the country. A study was conducted by CDC and the Agency for Healthcare Research and Quality on the medical care costs associated with the obesity epidemic and found that the costs related to obesity prevention, diagnosis and treatment were about $147 billion in 2008 (Finkelsten, Trodon, Cohen, & Diets, 2009). The study also found that outpatient care related to obesity was 9.1% (1.9 billion) higher than it would have been without obesity for Medicare patients (Finkelsten, Trodon, Cohen, & Diets, 2009). Medicaid spending associated with obesity has increased by 11.9% (22.5 billion) higher than it would have been without obesity (Finkelsten, Trodon, Cohen, & Diets, 2009). Private insurance increases have been even greater and the total increase was 12.9% (31.5 billion) higher due to obesity increase (Finkelsten, Trodon, Cohen, & Diets, 2009).

As emphasized in the Trust for America's Health 2011 document from Robert Wood Johnson Foundation (RWJF), two-thirds of adults and one-third of children are currently obese or overweight (RWJF, 2011). According to the CDC, obesity among children has tripled in the past 30 years and more than one third of children in the U.S. are obese or overweight in 2008 (CDC, 2011). Childhood obesity has adverse health effects in both short and long term. Obese children are more likely to have cardiovascular disease, high blood pressure, and higher risk to develop diabetes, bone and joint problems and other social, and mental problems (CDC, 2011). Obese children are more likely to become obese adults, and tend to have more health problems

including different types of cancers, diabetes type II and cardiovascular diseases in their adulthood (CDC, 2011). Therefore, overweight and obesity issues among children are very serious widespread public health problem that need to be addressed at decision making levels.

The CDC acknowledges that some minorities and residents in low socioeconomic neighborhoods have less access to markets, stores, restaurants, and other services places that provide citizens with affordable, healthier foods such as fruits and vegetables. According to studies that have examined healthier and affordable food availability, the limited access to healthier food choices and life styles was one of the significant contributors to obesity among residents of low socioeconomic neighborhoods. For example, Hispanic boys between age two and nineteen are more likely to be obese or overweight than non- Hispanic White boys at the same age range, and non- Hispanic Black girls are significantly more likely to be obese or overweight than non- Hispanic White girls (Pediatric Nutrition Surveillance System, 2009). In addition, many minorities and low socioeconomic neighborhoods built in ways hard to be physically active, and safe, and use recreational places and public transportation (CDC, 2010). For example, a study from The People to People Health Foundation found that children who live in disadvantaged neighborhood conditions such as unsafe surroundings, poorly kept housing, limited access to sidewalks, parks and recreational facilities have 20-60% higher obesity rates (Singh, Siahpush & Kogan, 2010).

Some urban neighborhoods may have more fast food places and convenience stores than grocery stores where residents can buy fresh and healthier foods. Researchers from the University of Utah found a strong relationship between neighborhood fast food place option and higher obesity rates (Zick, Smith, Fan, Brown, Yamada & Kowaleski-Jones, 2009). The study

emphasizes that living in low socioeconomic neighborhoods with one or more convenience stores or fast food restaurant is associated higher obesity rate (Zick et. al, 2009). In addition, medical centers may be closed in urban areas due to financial situation and more importantly due to lack of political supports (Perdue, Stone, & Gostin, 2003). Therefore, the built environment can affect health outcomes and health disparities in the U.S. and can be a significant factor leading to overweight and obesity among minority children living in low social economic neighborhoods.

Health disparities in the U.S. are well documented in different research and epidemiological studies. Low income and minority populations have a shorter life expectancy, higher rates of disease, lower quality of life than non- Hispanic Whites (CDC, 2004). Over the last two decades, scholars have discovered a strong association between health outcomes and the environment, particularly built neighborhood characteristics. These studies found that health outcomes are strongly related to segregation, suburbanization, urban sprawl, urban revitalization and where and what type of neighborhoods in which people live. Having affordable housing, access to health care, secure employment, accessible transportation, education, safe and secure neighborhoods, access to parks and green environment, healthy food, and drinking water are still difficult to achieve for some communities, neighborhoods and individuals. Neighborhoods and communities are not built equitably and some become dumping grounds for toxic elements that affect human health and well-being. Studies have found that people who live in poor and racial minority neighborhoods are more likely to be obese, tend to eat less healthy food due to lack of access and higher costs for healthier foods rather than lack of information. These studies also have emphasized that people in poor and racial minority neighborhoods have less access to

recreational facilities such as parks and gyms, have higher concentrations of fast food facilities, and tend to have more health issues.

According to research from the University of Carolina in Columbia, the most common six diseases that cause mortality among Americans in the 20th century were first heart disease, second cancer, third stroke, fourth chronic lower respiratory disease, fifth diabetes, and sixth Alzheimer disease. The authors of the study stated that these disease are related to obesity and being overweight. The study emphasizes that one of causes of the obesity epidemic in the U.S. is that there is no neighborhood and metropolitan infrastructure that supports physical activity and access to healthy foods for low income neighborhoods.

These are four purposes of this study: (1) to contribute to research on obesity problems among the U.S. adolescents, especially immigrant and minority groups; (2) to study physical and social environment of different neighborhoods that may associated to obesity among the U.S. adolescents; (3) to provide useful information to policy makers at all levels of government, advocacy groups, and interest groups, public health professionals and urban planners; and (4) to make policy recommendation to decrease obesity among the adolescents. The main objectives of this dissertation are: (1) to study relationships between built neighborhood characteristics such as parental perception about neighborhood safety, access to recreational facilities, libraries grocery stores and obesity and being overweight among adolescents age between twelve and seventeen years; (2) to discover built neighborhood environment elements such as housing condition, walkability, neighborhood hygiene in low socioeconomic and immigrant neighborhoods and their contribution to obesity among the adolescents; (3) to examine leisure time activities and obesity among the adolescent population; and (4) to study associations between length of stay in

the U.S. and obesity among first and second generation adolescents. In general, the main purpose of this study is to examine if there are any disparities among adolescents in terms of immigration status, neighborhood conditions, socioeconomic status that may affect obesity.

Definition of Obesity and Measurements

The World Health Organization defines obesity as excessive total body fat that presents a risk to health. Individuals are considered obese when their weight is 20% heavier than their ideal weight. Fat accumulates when people consume more calories than they burn (WHO, 2009). CDC defines obesity as a chronic disease that develops from social, behavioral, cultural, physical and environmental factors (CDC, 2010). A more medical definition was given in Stedman's Medical Dictionary (Stedman, 2006): obesity is "an excess of subcutaneous fat in proportion to lean body mass. Excess fat accumulation is associated with increase in the size (hypertrophy) as well as the number (hyperplasia) of adipose tissue cells" (Stedman, 2006).

However, all organizations and professionals agree that no single cause can explain all cases of obesity and it usually ends up as results from an imbalance between energy intake and energy burning. Eating a lot and consuming more calories than needed may be responsible for some cases but, many obese people neither consume more calories nor eat different proportions of foods than normal weight people consume. Some studies of obese twins suggest that the genetics of individuals influence their metabolic rate, their eating behavior, and changes in their energy expenditures. In addition, more and more research finds that environmental factors, socioeconomic status, race, region of residence, and urban living are also highly associated with obesity.

Eating habits and patterns of physical activity also play a significant role in the amount of weight a person gains. The most recent studies indicate that the amount of fat in one's diet may have a greater impact on weight than the number of calories it contains. Carbohydrates like cereals, breads, fruits, and vegetables and protein (fish, lean meat, turkey breast, skim milk) are converted to fuel almost as soon as they are consumed. Most fat calories are immediately stored in fat cells, which add to one's body weight. Moreover, a sedentary lifestyle can contribute to weight gain. Psychological factors, such as depression and low self-esteem may also play a role in weight gain. According to research, excessive calories are converted into new fat cells in childhood, while excessive calories consumed in adulthood expand existing fat cells. Finally, dieting and exercise can only reduce the size of fat cells, not eliminate them; individuals who were obese as children may have much difficulty losing weight, since they may have many fat cells that developed in childhood. Therefore, people who were overweight or obese in childhood are more likely to be overweight and obese in adulthood as well.

There are several different methods to measure obesity e, g., waist circumference, waist to hip ratio, underwater weighing, air-displacement plethysmography, dilution method, dual energy X-ray absorptiometry, CT and MRI scanning and body mass index. Waist circumference is one of the most common measurements used to define overweight and obesity. It measures abdominal obesity to measure fat around the waist section of the body. It's the circumference of the midsection, measured in between the lowest rib and the top of the hip bone through belly button or at the narrowest point of the belly section (Hu, 2008). This measurement is easy to use, not expensive, and portable. It is convenient and highly correlated with body fat in adults, and helps to predict disease and death for some cases. Limitations of the measurement is it is not

standardized, and is difficult to use in children and less accurate than other measurements such as BMI.

The waist to hip ratio is also used to measure abdominal obesity. It's calculated by measuring the waist at the narrowest point of the abdominal section and the hip at the widest point of the buttocks, and then dividing the waist measurement by the hip measurement (Hu, 2008). The strengths of this measurement are it is inexpensive, safe, portable, convenient, and more accurate than waist circumference measurement. It is also helps to predict disease development in adults. The limitations are it is difficult to measure hip than waist and it is not easy to interpret due to increased fat around waist or decreased in lean muscles around hip area. Therefore, two individuals with very different BMI can have the same waist to hip ratio measurement.

Another measurement used to gauge obesity is skinfold thickness. This measurement uses a “pinch” to define the thickness of skin and the fat and this measurement can be used in specific areas of the body: the trunk, the thighs, front and back of the upper arm, and under the shoulder blade (Hu, 2008). The body fat is defined from the equation of these measurements. The strengths of the measurement are it is safe, easy to use, convenient and portable. Some limitations are it is not as accurate as other methods if it is performed by inexperienced individuals.

Bioelectric Impedance is also one of the obesity measurement methods. This method sends small electrical currents through the body defining resistance. The electricity is more resistant when passing through fat than when it passes through lean muscles and water (Hu, 2008). Equations are used to measure body fat and fat free percentage. The strengths of the

Bioelectric Impedance are it is convenient, safe, inexpensive, portable, and easy to use. The limitations of the method are that it is hard to calculate and not as accurate as other methods because proportion of body fat and water may change due to dehydration and illness.

The underwater method weighs individuals both in air and water. A person is weighed in air first and then submerged in a tank (Hu, 2008). This procedure helps to determine body volume, body density and body fat percentage because fat is less dense than water. A person who has high body fat will have low body density and tend to float more than a person who has high body density and less body fat. The strength of the underwater weighing is more accurate than previous methods. The limitations of this method are that it requires a lot of time and effort, and it is not the best option for children, older adults and people with high BMI.

The next method is air displacement plethysmography which is the same procedure with underwater weighing, but it is performed in the air instead of water. Individuals in swimming dresses sit in a small chamber; air pressure in the small chamber with the individual is compared with air pressure in the same size but empty chamber (Hu, 2008). The machine estimates body volume based on differences in air pressure. Some strengths of the method are it is faster than water weighing, more comfortable, accurate, safe, and it is better choice for children, older adults and people with high BMI than water weighing. One of the limitations is it is expensive and would require equipment such as a machine to calculate body volume.

The dilution method is used to calculate total body water and body fat mass. Individuals drink isotope labeled water and the body fluid of the individuals are tested for isotope levels that can be used to measure total body water, lean muscle and body fat mass (Hu, 2008). The strengths of the dilution method are it is accurate, safe, and can be used for everybody including

children, pregnant women and people with high BMI. The limitation of the method is that it cannot measure changes in body water because of illness dehydration.

The dual energy X-ray absorptiometry uses X-ray beams through different body parts at different rates to determine muscle mass, fat mass and bone density (Hu, 2008). One of the strengths of this method is it is accurate. The limitations include its expense, portability, and radiation exposure. It is also not able to distinguish different types of fat such as fat under the skin or around internal organs. Computerized tomography and Magnetic resonance imaging is another method to determine obesity. These two methods measure tissue, organ and whole body fat mass, muscle mass and bone mass (Hu, 2008). The strengths of the methods are it is the most accurate measurement to determine overweight and obesity and is able to measure different types of fat. The limitations of the method are it is very expensive, not portable, high amounts of ionizing radiation exposure and it is difficult to use for individuals with high BMI (Hu, 2008).

Finally, the World Health Organization (WHO) promotes BMI as a measurement to classify overweight and obesity in adults. BMI is defined as the weight of an individual in kilograms divided by the square of his or her height in meters (kg/m^2) (WHO, 2009). The WHO definition states that if a person's BMI is greater than or equal to 25 then he or she is overweight and if a person's BMI is greater than or equal to 30 then he or she is considered obese (WHO, 2009). The WHO emphases that measuring BMI is the most useful tool to determine overweight and obesity and it can be used for both sexes and for all ages of adults. BMI is calculated from an individual's weight and height and indicates body fatness. For children, BMI ranges are different for boys and girls and different for age groups. For example, if a child has a BMI between 85th and the 95th percentage then the child is considered overweight and if the child's BMI percent is

greater than 95th percent it is considered obese. The percentage indicates the relative status of the child's BMI number among the children of the same sex and age. The strengths of the measurement are it is easy to use, not expensive, strongly correlated with body fat levels and helps to predict disease development and death. The limitations of the BMI method are the measurement does not distinguish body fat and lean body mass and it is not accurate as other methods such as Dual energy X-ray absorptiometry, Computerized tomography and Magnetic resonance imaging. Therefore, the WHO recommends using it as a very general guide to determine overweight and obesity in populations because it may not be an accurate measurement of fatness for different individuals. However, BMI is the most used measurement to determine overweight and obesity for both adults and children. The basic logic of the using BMI as the most useful measurement is most people are not athletes, and for most people, BMI is a very good guide of body fat. Some research has shown that BMI is strongly correlated with the body fat and it was very useful measurement. Therefore, BMI measurement will be used in this dissertation as the measurement to define overweight and obesity among adolescents. In addition, the data that are used for statistical analysis used BMI measurement to determine body fatness. In the following chapter, an overview of the circumstances leading to obesity as a major public policy issue will be discussed.

CHAPTER II

PUBLIC POLICY ISSUES

The Healthy People Initiatives

The Healthy People Initiative is a policy document produced by several different federal agencies. The document developed national health objectives designed to identify the most significant preventable threats to health and established national goals to reduce these threats (Healthy People Initiative, 2020). The initiatives do not serve as federal guidelines or established federal public health policies. Instead, these initiatives are national proposals that require participation of nongovernmental organizations, state health agencies, public health professionals, specialists, local stakeholders and individuals who participate in developing and implementing the policy process. Therefore, the Healthy People Initiatives are the documents that determine national objectives to improve health of American citizens for ten years. The initiatives became national objectives and are recognized as a leading public health policy document in late 1990s due to growing recognition of health disparities and inequalities. The Healthy People Initiatives has had many ups and downs since 1979 and each initiative had own specific characteristics. For example, the first initiatives (Healthy People 1980) were concentrated on educating the public on health issues and healthy life styles and they were successfully implemented and helped to improve public health between 1979 and 1980. However, the second initiatives (the Healthy People 1990) were substantially diminished due to President Reagan's policy to reduce government spending. The third initiatives (the Healthy People 2000) included social and racial determinants as a part of public health issues. The fourth

initiatives (the Healthy People 2010) acknowledged that living environments and communities are also important factors shaping public health. The fifth initiatives (the Healthy People 2020) defined the public health issues as complex problems that need to be addressed systematically. The history of the Healthy People Initiatives will be discussed in the next section.

History of the Healthy People Initiatives

The Healthy People Initiatives started with the release of The Surgeon General's Report, *Healthy People: Surgeon General's Report on Health Promotion and Disease Prevention* in 1979. There were five main goals in the Surgeon General's report that were identified as the most significant health threats at that time: (1) low birth weight, (2) birth defects for infants, (3) influenza, (4) functional independence, and (5) pneumonia for older adults (HHS, 2010). The initiative served as a main public health policy in the US from 1979 to 1990. According to the Department of Health and Human Services (HHS), infant mortality decreased by 35% during these ten year period and childhood vaccinations increased to its highest level in this time period (HHS, 2001). Therefore, the policy implementation and its results were considered very successful and its goals were met.

The Healthy People 1990: Promoting Health/ Preventing Disease: Objectives for the Nation was developed after the successful implementation of the first initiative The Surgeon General's Report on Health Promotion and Disease Prevention (HHS, 2010). The second initiative developed goals to increase preventive health services, health protection and health promotion and recognized these issues as the most important public health problems in 1990 (HHS, 2010). The initiative had 226 specific, measureable health objectives such as improving health status, risk reduction, public and professional awareness, health services and protective

measures and evaluation. The policy was successfully implemented in areas such as childhood infection disease, and injury prevention (CDC, 1989). For example, as mentioned earlier, child mortality rates decreased by 35% and child fatality due to motor vehicle accidents also decreased by 28% during this time (CDC, 2000). However, the initiative was slowed down significantly during the President Reagan's time due to emphasis on smaller government and more financial responsibility (Green & Allegrante, 2011). Therefore, implementation of the Healthy People 1990 objectives were limited because of federal budget cuts.

The Healthy People 2000: National Health Promotion and Disease Prevention Objectives promoted three broad goals: (1) increase the longevity of healthy life, (2) reduce health disparities, and (3) increase access to preventive health services (CDC, 2000). Therefore, all measurable objectives addressed special population groups at high risk of poor health, high rates of death, disease and disability (CDC, 2000). The Healthy People 2000 included social determinants as an important part of the National Health Promotion (Green & Allegrante, 2011). There were thirteen items increasing physical activity for adults and reducing overweight in the Healthy People 2000. For example, reducing overweight by 20% for adults aged 20 or older and by 15% for adolescents aged 12-19; increasing physical activity by 30% among people aged 6 and older from light to moderate at least 30 minutes daily (CDC, 2001). Reducing overweight among selected population was developed as a national objective in Healthy People 2000. The Healthy People 2000 initiative was also successfully implemented and met more than 60% of its objectives (CDC, 2001). Based on National Health Survey in 1998, physical activity among adults increased by 30% and these adults attended in light to moderate exercise five or more days a week (CDC, 2001). Therefore, this objective met its goal. However, some objectives moved

away from their goals e. g., the obesity rate increased by 17% among adults and 22% among children during this ten year period (CDC, 2001).

The Healthy People 2010: Objectives for Improving Health was released as a leading policy initiative to improve public health between 2000 and 2010 (HHS, 2010). According to the final review of Healthy People 2000, the last two decades the U.S. public and public health policy makers learned that individual health is closely related to community health and that community health is strongly affected by collective beliefs, attitudes, and behaviors of individuals in the community. Thus, the Healthy People 2010 initiative was based on developing healthy communities and its vision was "Healthy People in Healthy Communities." (HHS, 1999). In addition, one of the encouraging lessons that was learned from Healthy People 2000 was that public health can be improved in a relatively short time of period. For example, overall alcohol and tobacco consumption reduced significantly, death rates for heart disease and unintentional injuries decreased and significant improvements were made in diagnosis and treatments for different types of cancers (HHS, 2010). Therefore, one of the health objectives in the Healthy People 2010 was to reduce obesity that has increased 50% over the past decades that disproportionally affects women and people of color.

Policy Intention and Healthy People 2010

Healthy People 2010: Objective for Improving Health had two broad goals, which were to increase quality and healthy life expectancy and to decrease health disparities (HHS, 1999). Healthy People 2010 identified 467 specific health promotion and disease prevention objectives in twenty eight areas. The policy identified ten leading health indicators to serve for health improvement of the citizens. The ten leading health indicators are physical activity, overweight

and obesity, environmental quality, tobacco use, substance abuse, responsible sexual behavior, mental health, injury and violence, immunization and access to health care (HSS, 1999). The policy addressed these issues as the most dangerous threats to public health in the U.S and the main concept of the policy was again "healthy people in healthy communities" (CDC, 2011).

Physical activity, overweight and obesity and environmental quality were identified as the main threats to public health by leading health agencies in different government levels in 2000 because these issues posed serious threats for the health for past several decades. In addition, experiences in tobacco control and other public health policies have shown that public policy can be a powerful instrument to change population behaviors (McKinnon, 2009). Each of these leading health indicators had specific objectives that developed through multilayered process and specific criteria. For example, obesity indicators had objectives to increase the proportion of adults who are at a healthy weight to 60% (19-1), reduce the proportion of adults who are obese to 15% (19-2), increase proportion of adults who exercise 30 minutes per day 5 or more times per week to 10%(22-2), reduce childhood obesity proportion to 11% (19-3) by 2010 (HHS, 1999).

The multiple lead federal agencies developed the specific objectives to reduce obesity and overweight among the population based on scientific studies and calculations, public comments and state and non-governmental agencies activities. These organizations and agencies introduced the objectives to the federal agencies that used a set of selection criteria to choose final objectives for the policy (HHS, 1999). Criteria for objectives were prevention oriented, drive actions, measurable, supported by the best available scientific evidence, comparable, valid, reliable and address population disparities (HSS,1999). The Healthy People 2010 Initiatives

included 350 national organizations and 250 state public health, mental health, substance abuse and environmental agencies to achieve the objectives. These agencies conducted three national meetings and five regional meetings on the development of Healthy People 2010. In addition, the public was given chances to share its ideas on two occasions in 1997 and in 1998 and more than 11,000 comments were shared through mail and internet from the public (HHS, 1999). Therefore, public, state and non-governmental agencies' recommendations were gathered through a series of regional meetings, public meetings of the advisory committee, websites and public comments published in the federal register giving them opportunity to participate in the policy intention process.

The key players for the policy were the Department of Health and Human Services (HHS), Center for Disease Control and Prevention(CDC), Food and Drug Administration (FDA), Health Resources and Services Administration (HRSA) (federal interagency workgroup), National Institute for Health (NIH), Department of Education (DOE), U.S. Department of Agriculture (USDA) at the federal levels. State health agencies and environmental organizations are key players at the state level and public health professionals, environmental activists and citizens are part of the key players in other side. The U.S. Department of Health and Human Services (HHS) has the Secretary's Advisory Committee on Healthy People Initiatives to develop recommendations about the development and implementation of the policies. This committee has twelve members who are experts in public health and they produced a framework and guidelines for implementation. Most of the committee members were leading researchers in different public health issues (HHS, 1999).

The CDC oversees the National Center for Chronic Disease Prevention and Health promotion including funding programs for states and communities. The Division of Adult and Community Health, Division of Nutrition and Physical Activity and Obesity, and Division of Adolescent and School Health manage governmental programs related to obesity. The National Center for Environmental Health of CDC also studied the relationships between the built environment and obesity (CDC, 2010). The Food and Drug Administration (FDA) regulates food labeling requirements and calorie counts. The FDA also compelled restaurants to make nutritional information available to consumers and manages the approvals of weight loss drugs (RWJF, 2009). The NIH oversees research and educational programs related to obesity. The NIH conducts obesity and obesity related disease, public education campaigns and the National Institute of Environmental Health Science examines the built environment's effects upon obesity (RWJF, 2009). Moreover, Health Resources and Services Administration concentrated on expending health coverage for all Americans and managed programs such as the Maternal and Child Health Block Grant and the Futures Initiative that works to encourage healthy behaviors (RWJF, 2009). The USDA oversees food and nutrition programs that impact obesity, obesity education, distribution of food at schools, and protection of the agricultural and dairy product markets (RWJF, 2009). The USDA also manages special programs such as the Supplemental Nutrition Program for Women, Infants and Children, the National School Lunch and Breakfast programs and the Child and Adult Care Food program (RWJF, 2009).

Policy Implementation

The leading federal agencies such as the HHS, the CDC and the FDA also developed a framework for policy implementation. The initiative addresses most implementation procedures

that were supposed to follow a certain process: mobilize, assess, plan, implement and track (MAP-IT). This framework was used to plan and evaluate the public health interventions that Healthy People 2010 was to achieve at all levels (HHS, 2010).

The workgroup from the federal agencies recommended that all subjects interested in obesity issues start by organizing key individuals and organizations into a coalition, look for supporters who have interests in developing healthy communities and who will contribute to the organization's process. Then, they identified roles for all supporters and partners: (1) to facilitate communities through meetings, events; (2) to develop education programs about obesity problems, and (3) to lead fundraising and policy initiatives in this process (HHS, 2010). Next in the implementation process was to assess and lead workgroups to collect state and local data in order to get an overall picture (understanding) of the obesity epidemic among varies populations and identify built environment problems. Planning is next step of the implementation process that was recommended by policy makers (HHS, 2010). The policy makers emphasized that a good plan should include clear objectives and specific steps to meet the objectives. The plan needs to be about what exactly needs to be changed, when, what amount and how it will be implemented. The implementation process is the most important part of the Healthy People 2010 initiative. Detailed instructions that included specific action steps and assigning responsible subjects and setting timelines or deadlines were included in this process (HHS, 2010). The final stage of implementation is tracking that includes evaluation, follow up plans, limitations, and next goals. Therefore, key players at the implementation level were federal and private partnerships, state action planers, regional health agencies, community coalitions and activists (HHS, 2010).

Much legislation, research work, programs and projects have been carried out during the last decade to implement the policy and meet the objectives at all levels. All states and the District of Columbia (D.C.) have developed their own healthy people plans that are based on the national initiative. Most states have created specific plans both to meet national objectives and their own specific goals as well. For example, twenty states and D.C. have developed nutritional standards for school kitchens that are stricter than the current USDA standards. Most of these legislative statutes require that foods have no transfat and saturated fat must be less than 10% of total calories (RWJF, 2010).

Twenty eight states and D.C. have nutritional standards for foods sold in schools and vending machines at schools and five states require physical education requirements for schools. For example, Louisiana passed legislation that requires that certain beverages can be sold at schools such as bottle of water, no-calorie or low calorie beverages that contain ten or less calories per eight ounces, up to twelve ounce of 100% fruit juice with no sweeteners and low fat, slim and non-dairy milk (RWJF, 2010). Arizona State passed laws that require all students from preschool to K-5 have thirty minute of physical activities every day. Washington D.C. requires charter schools to provide minimum 150 minutes physical education per week for all students (RWJF, 2010). Twenty states now have requirements for body mass index screening for children and adolescents or legislation that require weight related assessments in schools and twenty three states and Washington D.C. passed laws related to connecting schools to local farms. Nevada passed the law that requires all schools conduct body screening among four, seven and ten grade students every year. Alaska mandated the Department Agriculture to establish a farm to school program to increase the use of local farm products. Twenty three states increased sales taxes on

soda and five states published requirements for labeling legislation. New Jersey became the fifth state that requires menu labeling in 2010 (RWJF, 2010). The law requires restaurant chains in more than twenty locations to display the number of calories for all foods. Twenty four states have passed laws about "complete streets" that encourage safe access to community's streets for pedestrians, bicyclists of all ages and abilities. Michigan passed a law that requires the Department of Transportation to develop and implement complete street policies (RWJF, 2010).

Moreover, leading federal organizations have developed and funded different programs and projects and provided recommendations such as obesity prevention and control intervention in community settings and work places; obesity prevention and control behavioral interventions to reduce screening time, worksite health promotion assessment, healthy snack, heart healthy foods, losing weight, screening for obesity in adults, screening for iron deficiency anemia; behavioral counseling in primary care on losing weight, having healthy diet at the community level. In addition, the federal agencies that develop and implement the policy funded many programs and projects that related to the implementation of the policy. For example, CDC awarded $373 million to large cities and towns to fund evidence based prevention and strategies and $230 out of $373 was given to obesity prevention in 2010. CDC also awarded an additional $120 million for obesity prevention and tobacco prevention in 2010 (CDC, 2010).

Furthermore, one of the objectives of the policy was to engage communities in the policy development and implementation, especially in non- traditional communities such as minority communities and partners. For example, non-traditional community partners such as small businesses, local governments, civic, professionals and religious organizations and environmental activists did a lot of work toward meeting the objectives such as printing

immunization reminders, setting up hotlines, changing restaurant menus, opening more fitness places and programs, assessing school health education programs, sponsoring health fairs, and engaging in different activities.

Summaries of the Healthy People 2010

According to the CDC final review, 170 (23%) of the objectives met the goals that were targeted in the initiative, 349 (48%) objectives moved toward the Healthy People 2010 initiative goals, 39 (5%) objectives had no changes at all for last decade and 175 (24%) objectives moved away from the Healthy People 2010 goals (CDC, 2011). Many focus areas such as Educational and community based programs, environmental health, health communications, mental health, tobacco use and occupational safety moved toward the Healthy People 2010 and more than 75% of the objectives in these areas have met or exceeded the targets of the policy (CDC, 2011). However, two focus areas: arthritis, osteoporosis and chronic back condition and nutrition and overweight and obesity moved away from the policy targeted goals (CDC, 2011).

There was no significant progress made in the nutrition and obesity area during the last decade. The portion of adults aged 20 and older who maintain healthy weight has declined in the last ten years from 42% to 31% indicating that this goal moved away from the Healthy People 2010 goal to increase the portion of healthy weight adults up to 60% (CDC, 2011). In addition, obesity among children has increased in last decade from 24% to 35% showing that this goal also moved away from the target of 11% in the Healthy People 2010 initiative (CDC, 2011). Therefore, obesity among the adult population in the U.S. did not meet its target and increased significantly among both populations: adults and children.

The goals to increase healthy eating patterns has not made much progress toward meeting the Healthy People 2010 initiative targets. Only one objective has moved toward the initiative target: calcium intake has increased from 31% to 42% but well lower than the goal of 74% in the initiative. Food security for households declined from 88% to 85% moving away from the target of 94% in the Healthy People 2010 initiative (CDC, 2010). There were significant disparities in food security among households. For example, non-Hispanic White (89%) households had the highest rate of the food security compared to non- Hispanic Black (74%), Hispanic or Latino (73%) and American Indian or Alaskan Native (77%) households (CDC, 2011).

Healthy People 2020: Objectives for Improving Health

Nutrition and obesity targets have been expanded in Healthy People 2020 supporting a broader range of policies and environmental factors that would encourage healthy eating habits and a maintain healthy weight. The name of the focus area has changed from Nutrition and Overweight in Healthy People 2010 to Nutrition and Weight status in Healthy People 2020 to emphasize weight related objectives. One of the leading health indicators in Healthy People 2020 was *Nutrition, Physical Activity and Obesity* that includes measurable objectives (HHS, 2011). Nutrition and weight objectives in Healthy People 2020 are more focused on individual behaviors, healthy diets and environment that supports healthy life styles and the biggest goal is to reduce obesity by 10% (HSS, 2012). For example, the focus areas for nutrition and weight status objectives have six sections: healthy food access, healthcare and worksite settings, weight status, food security, food nutrition consumption and iron deficiency (HSS, 2012). There are nineteen new objectives added in the new initiative related to nutrition and weight status among

the population. Some objectives are to increase the number of States with nutrition standards for school children from 24 to 34 States; to increase schools that provide nutritious foods and drinks outside of school meals from 9.3% to 21.3%; and increase the number of States that have policies on food outlets (HHS, 2012). Four new objectives related to access to health care such as primary care physician to assess BMI, physician office visits to reduce weight, nutrition and physical activity counseling, and education for all patients. (HSS, 2012). For example, increasing the proportion of primary care physicians who check body mass index of patients from 48.7% to 53.6%; increasing the proportion of physicians who provide nutrition and weight counseling and education from 20.8% to 22.9%; and to increasing worksites that offer weight management counseling classes (HHS, 2012). Six objectives were included in the new initiative such as healthy weight in adults, obesity among adults, obesity in children, iron deficiency in pregnant women, and food security. For example, increasing the proportion of healthy weight adults from 30.8% to 33.9%; reducing obese adults from 33.9% to 30.5%; and reducing the proportion of obese children by 10% (HHS, 2012). Five new objectives were developed to track healthy eating such as state nutrition standards for child care, school requirements for fruits and vegetables, school standards restricting sweetened beverage at schools, state policies for food retail, and access to healthier food (HHS, 2012). For example, eliminating food insecurity for children from 1.3% to .2%; reducing household food insecurity from 14.6% to 6%; increasing fruits in diet from .5 cup to .9 cup per 1000 calories; increasing consumption of vegetables from .8cup to 1 cup per 1000 calories; increasing whole grains in diet from .3 ounce to .6 ounce per 1000 calories; reducing fats and sugars from 18.9% to 16%; reducing consumption of sodium from 3,641milligrams to 2,300 milligrams; and increasing calcium consumption from 1,118

milligrams to 1,300 milligrams were also promoted (HHS, 2012). Finally, more objectives were developed to reduce iron deficiency e.g., reducing iron deficiency for children aged 1-2 from 15.9% to 14.3%; reducing the deficiency for children aged 3 to 4 years from 5.3% to 4.3%; reducing iron deficiency for females aged from 12 to 49 years from 10.4% to 9.4% and reducing iron among pregnant women from 16.1% to 14.5% (HHS, 2012). All of the Healthy People Initiatives have made a significant impact on obesity among children. The following chapter will examine in more detail what remains to be done about the obesity epidemic among young people.

CHAPTER III.

OBESITY AMONG ADOLESCENTS IN DIFFERENT NEIGHBORHOODS, RACIAL, AND IMMIGRANT GROUPS

This chapter will discuss previous research studies that examined associations between obesity among adolescents in the U.S. and different environmental and social factors such as built neighborhood environment, physical and social activity, immigration status, racial and ethic groups, socioeconomic status etc. All research studies reviewed in this chapter were conducted in the U.S. and investigated obesity among adolescents. For example, the first part of the chapter covered research literature that studied obesity among children and built neighborhood factors and cultural aspects in neighborhoods. The next part of the chapter reviewed studies that examined obesity among adolescents in the U.S. and their physical and social activity. The last part of the chapter concentrated on research studies that investigated obesity among immigrant children. This chapter attempted to review available literature related to the dissertation research topic and statistical analyses pertinent to that research.

In addition, many aspects of the neighborhood factors, physical and social activity and racial and ethnic groups were intertwined in most studies. For example, the studies that examined physical and social activities among adolescents also studied obesity among racial and ethnic groups. Many studies that examined obesity and neighborhood aspects also included racial and ethnic groups of adolescent. In addition, race and ethnicity were very strong predictors of obesity among adolescents throughout the literature review. Therefore, the literature that studied neighborhood and physical social activities and immigration status also studied race and

ethnicity as one of the factors. Research literature that examined obesity among different racial and ethnic groups were discussed in all sections of the literature review. For example, the research studies that investigated the built neighborhood environment and obesity among different racial and ethnic group adolescents were also included in the *Childhood Obesity and Neighborhood Factors* part of the literature review. There were also studies that examined physical activity among different racial and ethnic group adolescents and obesity that covered in the *Childhood Obesity and Physical and Social Activities* section. Many studies that researched obesity among immigrant adolescents also investigated obesity among different racial and ethnic groups that included in *Childhood Obesity and Socioeconomic, Racial and Immigrant Factors* section.

The purpose of this chapter is to discover previously conducted research studies that related to obesity among adolescents and their living environment, physical and social activity and racial ethnic differences and use the information to develop research questions, hypotheses and statistical analyses that will help to understand, reduce and prevent obesity among adolescents. In addition, this literature review has been conducted to introduce research studies that previously demonstrated, and identify gaps in the research on obesity among adolescents and justify and explain the dissertation research. The literature review is presented in several sections.

Obesity among Adolescents and Built Neighborhood Factors

Researchers from the Health Resources and Services Administration of Nebraska and the University of Nebraska recently reported the impact of neighborhood conditions on obesity and overweight prevalence among U.S children using the National Survey of Children's Health, 2007

(Singh, Siahpush, & Kogan, 2010). The researchers reported that neighborhood conditions represent a larger social contexts and they also help developing public policies to improve health. Health benefits of neighborhood improvements not only increase physical activities but also help to decrease infant mortality, low birth weight, smoking, mental health problems and other health related issues (Singh et al., 2010). The study included neighborhood socioeconomic factors such as perceived neighborhood safety, garbage or litter in the neighborhood, poor or dilapidated housing and vandalism, and built environment factors such as access to sidewalks, walking paths, parks, playgrounds, recreation centers and libraries. More than 44,100 children between ten and seventeen participated in the study. About 26.7% of parents reported that they lived in the neighborhoods where there was no access to sidewalk or walking paths; 19.2% had no access to parks and playgrounds; 35% had no access to recreational centers (Singh et al., 2010). More than 14% of children lived in unsafe neighborhoods; 17% lived in neighborhoods where there was garbage and litter on streets or sidewalks; 14.6% lived in neighborhoods with poor or dilapidated houses (Singh et al., 2010). The study emphasized that minority children are more likely to live in poor neighborhood conditions. For example, 26% of Black and 23% of Hispanic children live in unsafe neighborhoods compared with 8% of White children (Singh et al., 2010). About 50% of children who live in poor and unsafe neighborhoods were less likely to be physically active and 52% more likely to watch TV more than two hours a day. According to the study, more than 16% of the children ages from ten to seventeen were obese and 31.6% were overweight in 2007 (Singh et al., 2010). The study also indicated that more than 20% of children in the least favorable neighborhoods were obese and 37% were overweight compared to 14.7% and 29.8% of children who live in the most favorable neighborhoods. The researchers reported that children

who live in unsafe neighborhoods had 61% higher odds of being obese and 43% of being overweight than children who live in safe neighborhoods (Singh et al., 2010).

According to a study that was conducted in Georgia, higher rates of morbidity and mortality among residents found in disadvantaged minority neighborhoods such as African American, Hispanic, Native American and immigrant communities (Rubin, Nodvin, Geller, Teague, Holtzclaw & Felner, 2007). The study stresses that these communities have several common characteristics that affect their health and environmental disparities. For example, all of these communities have limited financial resources to make choices, limited educational and language skills and employment opportunities, limited social resources related to low tax rates, and limited political power and some of them may have fear for authority figures (Rubin et al., 2007). Other research findings indicate that the above communities are more likely to have fast food places, liquor stores, convenience stores and less supermarkets and restaurants (Hood, 2005). These communities are also more likely to suffer from violence that prevents residents from physical activities, playing and socializing outside and keeping them indoors and more likely watching television (Hood, 2005). The above mostly environmental factors impact on health of the residents in the neighborhoods. A study of public housing communities in Los Angeles found that African American and Latino residents were two to four times more likely to suffer from obesity, asthma, eye and dental problems, depression and attention deficit disorders than other population groups due to neighborhood environmental situations (Tonniges & Palfrey, 2004).

A meta-analysis literature review studied the environmental characteristics of neighborhoods and how they affect childhood obesity. The meta-analysis included fifteen studies

published in PubMed, PsychInfo, and Geobase after 2005. The meta-analysis found that all fifteen studies included a total sample size of 1000 children (Dunton, Kaplan, Wolch, Jerrett & Reynolds, 2009). According to the meta-analysis, the studies found lower BMI rates among children from lower socioeconomic status families in greater hazards neighborhoods (Dunton et al., 2009). However, most studies found that obesity among girls was negatively associated with the safety of the neighborhoods. The studies found high BMI among girls who live in unsafe neighborhoods. In addition, locked school yards were negatively related to BMI of children, indicating that children who go to schools with locked yards were less likely to have higher BMI than children who go to schools without protected yards (Dunton et al., 2009). The analysts stated that availability of physical activities and access to biking and walking paths significantly related to higher BMI in children (Dunton et al., 2009). Moreover, the meta-analysis reported that adolescents who live in rural, exurban and urban areas were more likely to be obese than those living in suburban areas. The analysis concluded that the built environment is significantly associated with obesity and being overweight among children and adolescents (Dunton et al., 2009).

Another meta-analysis examined twenty articles that studied associations between obesity and the built environment (Papas, Alberg, Ewing, Heilsouer, Gary & Kiassen, 2007). The review included articles that were published in Medline, Psychinfo and Web of Science between 1966 and 2007. The meta-analysis reported that seventeen out of twenty articles found statistically significant associations between built environment and BMI (Papas et al., 2007). Four studies found positive relationships between access to recreational facilities and distance from recreational facilities in the neighborhoods showed that people who have less access to the

recreational facilities were more likely to be obese (Papas et al., 2007). One study found statistically significant negative associations between the number of fitness facilities per 1,000 people in the neighborhoods and BMI, showing that people who have less access to recreational facilities were more likely to have higher BMI (Papas et al., 2007). Nine studies found significant associations between residential density, land use mix, street accessibility, sidewalks and connectivity and BMI (Papas et al., 2007). People who live in dense residential and urban areas were more likely to be overweight or obese; people who have access to streets and sidewalk were less likely to have weight related problems than their counterparts who live in less dense residential area and who have access to street and sidewalk (Papas et., 2007).

A study that examined the relationships between the built environment and obesity found that higher socioeconomic neighborhoods had significantly higher odds of having one or more recreational facilities than low socioeconomic and minority neighborhoods (Gordon-Larsen, Nelson, Page & Popkin, 2006). The study used National Longitudinal Study of Adolescent Health 1994-1995 and included total of 20745 U.S. adolescents in grades between seven and twelve from eighty high schools and fifty-two middle schools. The study also used GIS and buffered 8.05 km facilities around each residence using census block groups (Gordon-Larsen et al., 2006). Census blocks with colleges and universities had significantly more recreational facilities compared to blocks that did not have any college or university. In addition, the odds of having at least one recreational facility decreased as minority population increased (Gordon-Larsen et al., 2006). Moreover, the study found that 5% odds of overweight decreasing with increasing one recreational facility per block and 5% of odds increase of physical activity among residents with increasing at least one recreational facility (Gordon-Larsen et al., 2006).

Individuals who lived in a block where seven recreational facilities were 32% less likely to be overweight and 26% more likely to be active than individuals who lived in block groups where there were no recreational facilities (Gordon-Larsen, 2006). The study concluded that recreational facilities including public facilities such as YMCAs, youth organizations, parks, and school facilities are distributed inequitably among census block groups. Racial and ethnic minority groups are at higher risk for lack of recreational facilities (Gordon-Larsen, 2006).

Researchers from the University of Texas, the University of California and the Centers for Disease Control and Prevention studied the associations between physical and social environments and obesity and physical activity among fifth grade students (Franzini, Elliot, Cuccaro, Schuster, Gilliland, Grunbaum, Franklin & Tortolero, 2009). The study collected data from 650 students in fifth grade from public schools in Birmingham, Alabama; Houston, Texas; and Los Angeles, California. This research included 236 Non- Hispanic Blacks, 205 Hispanics, 157 Non- Hispanic Whites and 52 other racial and ethnic group children (Franzini et al., 2009). The average age of the participants was eleven years; 55% of girls and 41% of boys were overweight or obese. Most children in the study were Blacks (38%) and Hispanics (30%). About 16% of the students were overweight and 25% of them were obese (Franzini et al., 2009). The study found that Black ($t=-2.30$, $p<.05$) and Hispanic ($t=-3.57$, $p<.05$) students had lower physical activities than White students. Neighborhood social environment was significantly associated with physical activity, number of days that children exercise, and free time activities (Franzini et al., 2009). Safety of neighborhood was the strongest predictor of the physical activity. The researchers concluded that if children get their physical activity at school, then

neighborhood physical characteristics such as traffic, density and land use would have less effect in children's weight related problems (Franzini et al., 2009).

Moreover, some scholars examined whether neighborhood recreation environment was related to adolescent physical activity, sedentary time and obesity in San Diego County, California. The study included 871 adolescents with mean age of 12.8 and 53% of the adolescents were girls (Norman, Adams, Kerr, Ryan, Frank, Roesch, 2010). The race distribution of the sample was 58% White, 13% Hispanic, 6% Black, 3% Asian or Pacific Islander and 20% multiracial adolescents (Norman et al., 2010). Results show that girls are less likely to be engaged in physical activities (74 minutes) and have more sedentary time (7.4 hours per day) compared to boys (100.5 minutes) and sedentary time (7 hours) (Norman et al., 2010). About 27% of girls and 28% of boys were obese (BMI >95th percentile) (Norman et al., 2010). The study also emphasizes that children who live in high housing facility dense area are more likely to be obese than children who live in open space areas, and close to parks. Girls who live in urban residential neighborhoods were less likely to be physically active than girls live in open space (Norman et al., 2010). The study concluded that housing facilities in dense neighborhoods provide less outdoor spaces to play and to be physically active and encourage more opportunities for inactivity. Adolescents in higher residential density may also have less convenient access to recreational facilities (Norman et al., 2010).

The Boston Youth Survey, 2006 was used to determine the relationship between perceived neighborhood safety and obesity and overweight among public high school students in Boston, MA. The study included 1,140 high school students in nine to twelve grades from eighteen public schools. More than half (57.8%) of the participants were female students, non-

Hispanic Blacks (46.5%), mean age 16.3 years and one third of the all respondents were born outside of the U.S. (Duncan, Johnson, Molnar & Azrael, 2009). About 18% of the students were overweight or obese and there were no statistically significant differences in sex, age or nativity of the participants and weight problems. However, this research found significant differences between obesity and race/ethnicity. Almost half (49.6%) of Hispanic students were overweight or obese followed by 45.6% of Black students compared to 39.3% of White students. Ninth graders (50.2%) were more likely to be overweight or obese than tenth graders (44.7%) and 11th graders (39.1%) (Duncan et al., 2009). More than 40% of the students responded that they sometimes feel safe in their neighborhoods compared with 11.6% rarely feel safe and 8.9% never feel safe (Duncan et al., 2009). There were statistically significant differences in neighborhood safety perceptions and race and ethnicity. Black and immigrant students were more likely to feel unsafe in their neighborhoods compared with White students who do not feel safe in their neighborhoods (Duncan et al., 2009). The study also found that students who do not feel safe in their neighborhoods were 1.21 times more likely to be overweight or obese than those students who said they feel safe. The researchers stated that there is a strong relationship between perceptions of neighborhood safety and obesity (Duncan et al., 2009).

Obesity among Adolescents and Physical and Social Activity

A research study conducted by the University of Pittsburgh examined physical activity for White and Black adolescent girls in the U.S. The study included 1,213 Black and 1,166 White girls aged between nine and nineteen years from area of San Francisco, Cincinnati and Washington D.C. (Kimm, Glynn, Kriska, Barton, Kronsberg, Daniels, Crawford, Sabry & Lui, 2002). The study used the Habitual Activity Questionnaire that included sports or recreational

activities such as bicycling, basketball, walking and sport lessons such as swimming, dancing and gymnastics. The study found that physical activity declined as girls' age increases e. g., it declined by 100% for Black girls and by 64% for White girls from age nine to nineteen (Kimm et al., 2002). In general, activity level was lower for Black girls at any age than White girls and 56% of Black girls and 31% of White girls did not have any habitual physical activities at their age nine to ten years (Kimm et al., 2002). The study also found higher rate of pregnancy among Black adolescent females and higher rate of smoking among White adolescent females that significantly prevented from physical activity for Black girls (Kimm et al., 2002). Parental education also related to the physical activity significantly for White adolescent girls but not Black girls. White girls who had parents only with high school education had much higher decline in habitual physical activities than the girls who had parents with college degree. In addition, White girls who lived in single parent households had higher decline than their counterparts who lived in two parent households but this was not significant difference for Black girls (Kimm et al., 2002).

Scholars from the University of Southern California examined physical activity and obesity among Hispanic adolescents. The study included 4,704 Hispanic adolescents aged ten to seventeen from the National Survey of Children's Health (Liu, Probst, Harun, Bennett & Torres, 2009). First generation Hispanic American adolescents were 25.2% compared to 43.8% of second and 31.1% of third generation of Hispanic adolescents and only 42.8% of the Hispanic students spoke in English in home as a primary language (Lui et al., 2009). The study emphasized that first generation Hispanic adolescents (43.7%) were more likely to fail recommended physical activity (at least 20 minutes and 3 times a week) than second generation

(38.9%) and third generation (28.9%) (Lui et al., 2009). In addition, the study found that adolescents whose primary household language is Hispanic were more likely to fail physical activity requirements than those who speak in English at home (Lui et al., 2009). The study also reported that obesity was the highest among second generation (20.5%) Hispanic adolescents compared to 20.1% among first generation and 16.9% among third generation (Lui et al., 2009).

Another study questioned the impact of physical activity and weight status among adolescent girls. Researchers from Tufts University recruited 173 girls aged between eight and twelve years old from public high schools in Cambridge, MA and all girls were not obese based on a skin-fold thickness measure at the recruitment (Must, Bandini, Tybor, Phillips, Naumova & Dietz, 2007). In addition, all girls were physically healthy and the researchers took obesity measurement once every year for four years and the girls completed a questionnaire that asked to recall their five types of activities: sleeping or lying down, sitting, standing, walking and physical activities such as exercising, playing or being involved in sports last 24 hour period each time day came for checkup. About 75% of the girls were White, 14% Black and 11% were other race and ethnicity (Lui et al., 2009). The study found that the girls spent about 4.2 hours daily for physical activity at the baseline and 3.7 hours at the end of the study thus the physical activity index declined from 15.29 at baseline and 12.12 at the end (Lui et al., 2009). There were also statistically significant ($p<.01$) increase in weight of the girls between the baseline and end of the study (Lui et al., 2009). However the study did not find any significant relationships between BMI and physical activity and physical inactivity (Lui et al., 2009).

Another research study investigated longitudinal associations between television viewing behavior and changes in physical activities of adolescents. The study included 6,369 girls and

4,487 boys who were between ten and fifteen years old in 1,997 (Taveras, Field, Berkey, Rifas-Shiman, Frazier, Colditz, & Gillman, 2007). The study followed the adolescents for four years from 1997 to 2001 and sent seasonal questionnaires that included information about dietary intake, physical activity and sedentary behaviors of the adolescents (Taveras et al., 2007). The study found that television viewing was less in the younger adolescents than older adolescents. For example, adolescents aged between ten and twelve years were watching TV from 30 minutes to 6.7 hours compared to 84 minutes to 7.2 hours for age between thirteen and fifteen years (Taveras et al., 2007). The study also reported that physical activity increased by .03 hours per week for each one hour increase in television viewing for all age and gender (Taveras et al., 2007). The study concluded that changes in television viewing were not associated with physical activity in U.S. adolescents (Taveras et al., 2007).

Another study from the University of Michigan and the University of North Carolina examined if adolescents' behaviors such as family dinner, television viewing, playing sports and physical activities were related to weight, gender of adolescents and young adults. The study chose students who were studying in seven to twelve grades in 1994-1995 school year from the National Longitudinal Study of Adolescent Health (Robinson, Stevens, Kaufman & Gordon-Larsen, 2010). The sample included 1,503 Black and 4,452 White participants aged seventeen to twenty six years after six years of following at the final weigh-in (Robinson et al., 2010). The participants were interviewed and weighed three times during six years of the study. The study results show that Black females were more likely to be obese than Black males in both in adolescent and young adult years (Robinson et al., 2010). The study also emphasized that White males were more likely to be obese in both adolescence and young adulthood, but there was not

much difference between White females and males (Robinson et al., 2010). Males were more likely to be physically active than females and they were more likely to play sports. In addition, the study found that White males were watching more movies and TV than White females. However, there was no statistically significant difference was found between Black females and males (Robinson et al., 2010). The study reported no significant relationships between sports participation and obesity but the relationships were negative, indicating that sports participation lowered obesity among Black males (34.2% of not obese category participated in sports compared 24.9% of the obese category, $p<.09$) and among Black females (16% of non-obese category participated in sports versus 19.3% of obese category, $p<.07$) (Robinson et al., 2010). In addition, the study did not find significant gender and education differences in obesity among the adolescents. Therefore, the study concluded that the adolescent behaviors such as participating in sports, television viewing and having dinner with family members did not contributed significantly to obesity among adolescents (Robinson et al., 2010).

A research study that examined physical activity, socioeconomic status, ethnicity and weight issues among adolescents stated that watching television on weekends and spending time playing video games were significantly associated with obesity among adolescents (McMurray, Harrell, Deng, Bradley, Cox & Bangdiwala, 2000). The study included 2389 adolescents, ten to sixteen years old; 52% girls and 48% boys; 77% Whites, and 23% Blacks from North Carolina area (McMurray et al., 2000). The weight status of the participants was measured using the skinfold norms of Lohman measurement and about 29% of girls and 32% of boys were obese (McMurray et al., 2000). The study also found that adolescents from lower socioeconomic families (41%) had higher rates of being overweight or obese than middles class (35%) and

higher socioeconomic families (24%) (McMurray et al., 2000). In addition, White adolescents (32%) had lower rates of being overweight or obese than Black adolescents (43%) which was a statistically significant ($p<.0001$) difference between racial groups (McMurray et al., 2000). There were racial, gender and socioeconomic differences in television viewing among adolescents. About 75% of adolescents viewed TV more than two hours every day (McMurray et al., 2000). About 50% of girls played video games on weekends and 35% played on weekdays compared to 79% of boys played on weekends and 69% on weekdays (McMurray et al., 2000). White adolescents viewed less TV and played less video games than Black adolescents at statistically significant levels ($p<.0001$) (McMurray et al., 2000). The study found significant relationships between playing video games more than two hours on weekdays and high BMI among boys and TV viewing more than two hours on weekdays for girls and high BMI (McMurray et al., 2000). They emphasized that race and socioeconomic factors were more significant risk factors than TV viewing or video games for adolescents. Being White and having higher socioeconomic status reduced the risk of being overweight or obese by 53-66% (McMurray et al., 2000).

Researchers from the University of South Carolina studied physical activity among White and Black adolescent girls and weight status. The study included 1015 girls with mean age of 14.5 from twelve high schools in South Carolina (Ward, Dowda, Trost, Felton, Dishman, & Pate, 2006). The study found that more African American girls (26.3%) were overweight or obese than White girls (16%) (Ward et al., 2006). In addition, 41.2 % of girls did some type of physical activities for at least 30 minutes per day and 44% of girls who had normal weight were physically active compared to 34.4% of overweight girls (Ward et al., 2006). Girls, from both

racial groups who were physically active had significantly higher scores ($p<.0001$) in self efficacy, attitudes, perceived behavioral control and enjoyment of physical activity than girls who were not physically active (Ward et al., 2006). Activity status for Whites was significantly related to family support and participation on sports teams. Activity status for Black girls was significantly associated with home equipment, access to parks and gyms, and participation on sports teams (Ward et al., 2006). However, family support was not significantly associated with activity status of Black girls (Ward et al., 2006).

Another study examined sedentary behaviors such as talking on the phone and hanging with friends, the association with physical activities, dietary behaviors and weight problems among adolescent girls. The study included a total of 283 adolescent girls in nine through twelve grades from twelve different high schools in the U.S. (Bauer, Friend, Graham & Neumark-Sztainer, 2012). About 28% of the participants were African Americans, 28% Whites, 16% Hispanics, 18% Asians and 11% of them were other ethnic race groups (Bauer et., al 2012). In addition, more than 18% of the girls were overweight and 28% of them were obese (Bauer et al., 2012). The study emphasized that watching TV, hanging around, talking on the phone, and listening to music were the most common leisure time activities among adolescent girls (Bauer et., al 2012). More than 50% of the participants spent considerable time watching TV and hanging around on a daily basis (Bauer et., al 2012). The study also found that girls who spent the most time watching TV were more likely to be overweight or obese and revealed the lowest fruits and vegetable intakes (3.8 servings per day) than girls who did not report any TV watching time and reported higher fruits and vegetable intake (5.3 serving per day) (Bauer et., al 2012). Moreover, girls who reported they spent a lot of time hanging around and consumed fast food

one or more times a week than girls who did not spend any time hanging around with friends (Bauer et., al 2012). Reading was the only behavior that was associated with healthy dietary behaviors and girls who spent the most time reading were consuming lower soft drinks and fast food intake (Bauer et., al 2012). However, the study did not find any statistically significant associations between the sedentary activities, dietary behavior and overweight and obesity among adolescent girls (Bauer et., al 2012).

Researchers from the University of California and the University of Washington studied the relationships between childhood obesity and leisure time computer use and television watching in California. The research used data from California Health Survey, 2005 and included completed surveys of 4,029 adolescents (Babey, Hastert & Wolstein, 2012). Most adolescents were Whites 41% followed by Hispanics 34%, Asians 11%, Blacks 9% and others 5% with median age of 14.4 year and 49% of the adolescents were females (Babey et al., 2012). According to the study, the average time spending for watching TV was 26.4 hours a week and using computers for non-school activities was 10 hours a week (Babey et al., 2012). American Indian adolescents were spending 25.7 hours watching TV followed by Blacks 22.7, Hispanics 17.1, Asians 14.9 and Whites 14.5 hours per week (Babey et al., 2012). Asian adolescents were spending the most time for computer use 14.4 followed by Blacks 11.8 and Whites 10.1 hours per week (Babey et al., 2012). An additional study found that engaging in physical activity was also related to watching TV and using computers for non-school related activity. For example, adolescents who did not engage in physical activity at least sixty minutes on any given day were spending an additional 3.8 hours watching TV and 1.7 hours using computers for fun (Babey et

al., 2012). The study also emphasized that adolescents from lower income households were spending more time watching TV and less time using computers (Babey et al., 2012).

Obesity among Adolescents and Socioeconomic, Racial and Immigrant Factors

A study conducted by the U.S. Department of Health and Human Services examined relationships between childhood obesity and socioeconomic, demographic and behavioral characteristics among 46,707 children aged ten to seventeen years. The study used National Survey of Children's Health, 2003 and included several different socio demographic and behavioral indicators such as age, gender, race, household composition, residency, primary language, parental education, poverty status, school and neighborhood safety, neighborhood social support, amount of television time, computer use, physical activities and sport participations. The study found significant associations between obesity and all the indicators except computer use (Singh, Kogan, VanDyck, & Siahpush, 2008). About 15% of all participants were obese and boys were significantly more likely to be obese than girls (18.1% vs 11.5%) (Singh et al., 2008). Obesity rates were higher among American Indian and Alaska Natives (26%), followed by non-Hispanic Black children (23%), Hispanics (19%), Asians (16%) and non-Hispanic White children (12%) (Singh et al., 2008). Compared to Non-Hispanic White children, Non-Hispanic Black and Hispanic children had 1.8 and 2.3 times higher odds of being obese. Children who live with parents who have not finished high school had 2.2 times higher odds of being obese than children with college educated parents (Singh et al., 2008). In addition, children from families below the poverty threshold had 2.8 times higher odds of being obese (Singh et al., 2008). Children who live in non-metropolitan areas, from non- English speaking households with socioeconomically disadvantaged backgrounds had 28% higher odds of being

obese than children who live in metropolitan areas and from English speaking households (Singh et al., 2008). Children who live in less socially support neighborhoods had 58% higher odds of being obese than their counterparts who live in higher social supportive neighborhoods. Children who watched TV three or more hours per day had 64% higher odds than children who watched TV less than one hour per day (Singh et al., 2008). Moreover, the study found that children who did not exercise had a 62% higher odds of being obese than children who exercised five times or more per week (Singh et al., 2008). The study also emphasized that girls have higher odds of being obese than boys especially if they live with parents with less than high school education (91% higher odds), and from lower social support neighborhoods (82% higher odds) (Singh et al., 2008). Therefore, the study decided that there are racial and socioeconomic disparities in childhood obesity.

A meta-analysis review was conducted for research studies that examined obesity among different age, gender, socioeconomic and racial and ethnic groups. The meta-analysis included eighty articles that were published in PubMed between 1990 and 2006 (Wang & Beydoun, 2007). According to the review, there were significant racial and ethnic groups and gender differences in obesity. Most studies found much higher obesity rates for minorities especially Blacks and Mexican Americans and women. The studies that were published in 1999-2002 reported that obesity rates were 20% higher among non-Hispanic Black women than non-Hispanic White women (Wang & Beydoun, 2007). Articles that were published in 1992-1995 found that obesity rates were the lowest among Asian Americans e. g., obesity among Asian American males was only one percent while the USA average was fifteen percent (Wang & Beydoun, 2007). Studies published in 1999-2000 found higher obesity rates among less educated

individuals except Black females. Black females who earned less than a high school education had lower obesity rates than their higher educated counterparts (Wang & Beydoun, 2007).

A research study was conducted among 8616 children who received medical services in Western Washington State and who had a prepaid health care plan (Grow, Cook, Arterburn, Saelens, Drenowski, & Lozano, 2010). The sample included six to eighteen years old children with median age of 12.3 years, 51.9% were male, 3.0% had state sponsored health insurance and 5.4% had Medicaid. Children with state sponsored and Medicaid insurance were more obese compared to children who had commercial health insurances. Most participants (72.9%) were Whites and lived in the neighborhoods where median household income was $59,118 and more than 67% were home owners and 26.0% of the children were from single parent households (Grow et al., 2010). The study found that 13% of girls and 17% of boys were obese (Grow et al., 2010). There were increased odds of childhood obesity for each $10,000 decrease in median household income and 10% decrease in percent of home ownership and 10% increase in obesity percentage of females with high school education or less educated parents, single parent households and non-white race. Therefore, the examiners stated that childhood obesity is significantly associated with socioeconomic status.

Another study was conducted to examine neighborhood poverty, race/ethnicity and adolescent obesity. This study used the National Longitudinal Study of Adolescent Health and included 20,745 adolescents aged thirteen to nineteen years from 134 schools in the U.S. (Wickrama, Wickrama & Bryant, 2006). Neighborhood poverty, single parent household, family poverty and minority racial group are positively correlated with adolescent obesity. The Asian American group was negatively related to adolescent obesity (Wickrama et al., 2006). The study

indicated that about 75% of the sample population lived in non-poor neighborhoods. However, the research emphasized that neighborhood poverty indicated high segregation of minorities in poor neighborhoods. As cited in the study, more than 52% of African Americans, 31.5% of Hispanic Americans and 43.5% of Native Americans lived in poor neighborhoods compared to 12.6% of Whites and 13.4% of Asians lived in poor neighborhoods (Wickrama et al., 2006). In addition, more than 13% of African American, 13.3% Hispanic, and 23.7% of Native American adolescents were obese compared to 10.3% of White adolescents. Adolescents who lived in poor neighborhoods had a much higher prevalence of obesity, i e., Native American adolescents who lived in poor neighborhoods were the highest percentage of obesity 40%, followed by Whites (14.37%), African Americans 14.19%, Hispanic 13.7% and 5.88% of Asian adolescents (Wickrama et al., 2006). The study also reported that adolescents who lived in poor neighborhoods were more likely to be obese than their same race counterparts who lived in non-poor neighborhoods. For example, White adolescents who lived in poor neighborhoods are 48% more likely to be obese than their counterparts in non-poor neighborhoods (Wickrama et al., 2006). Finally, the study reported that these racial disparities in adolescent obesity may emerge as racial disparities in adult health and socioeconomic achievements (Wickrama et al., 2006).

Another study examined if racial discrimination is related to increased BMI and obesity among Asian Americans. As cited in the study, stresses caused by disadvantaged socioeconomic status can be associated with obesity among immigrant and minority populations (Gee, Ro, Gavin, & Takeuchi, 2007). The study states that previous research showed that social stressors such as racial discrimination supports the hypothalamicpituitary releasing cortisol and other glucocorticoids. The researchers noted that glucocorticoids may increase appetite and encourage

taking comfort foods (Gee et al., 2007). The study also reports that the racial discrimination may directly affect to weight gain by segregating residents into neighborhoods with unhealthy food options and unsafe places for physical activities (Gee et al., 2007). The sample size for the study included 600 Chinese, 508 Vietnamese, 502 Filipinos, 148 Asian Indians, 115 Japanese, 84 Koreans, 38 Pacific Islanders and 82 other Asians who were sampled from National Latino and Asian American Study (NLAAS), 2003 (Gee et al., 2007). About 65% of participants were underweight or normal, 27% overweight and 9% were obese (Gee et al., 2007). Even though most respondents were in normal weight, the average BMI was 24.2% just under the overweight line of 25%. Almost 42% of the respondents have experienced racial discrimination followed by income and education (6%), age (4%), gender (3%), weight (.8%), and height (.8) (Gee et al., 2007). Most of the respondents were foreign born (77%), married (75%), and employed (67%) (Gee et al., 2007). The study found significantly higher BMI among those who reported racial discrimination ($b=.97$, $p<.01$) and other type of discriminations ($b=.09$ $p<.05$) (Gee et al., 2007). However, racial and weight discriminations were the strongest predictors for high BMI. The study concluded that if the person did not report racial discrimination then probability of being obese was 4.6% compared with 9.3% probability for the person who reported racial discrimination. These findings suggested that racial discrimination is a stressor that affects obesity among immigrant population (Gee et al., 2007).

Other researchers studied socioeconomic status, economic development of the sending country and childhood obesity among immigrant children in the U.S. The data were collected from the Early Childhood Longitudinal Survey Kindergarden Class of 1998-1999. This is a longitudinal study conducted by the National Center for Education Statistics and included

children from kindergarden to the fifth grade. The sample size was 20,650 children who participated in the survey from all states and the District of Columbia (Hook & Balistreri, 2007). The interviewers collected information about children from their parents. Most of the children (78.4%) were U.S. born; 17.2% of the children were first generation immigrants, and 4.4% were second generation immigrant children (Hook & Balistreri, 2007). The researchers used GDP per capita of countries to determine economic development in the children's country of origin. GDP per capita ranged from $347 to $73,105; average GDP per capita for first generation children was $6494 and $10,643 for second generation children (Hook & Balistreri, 2007). Socioeconomic statuses of children were determined through parents' education, occupations and household income. The study did not find any relationships between high BMI and country of origin for first generation immigrant children. However, the researchers found significantly higher rates of BMI for second generation immigrant children from higher income countries but not from low income countries (Hook & Balistreri, 2007). According to the study, the socioeconomic status of children was not significantly associated with high BMI for low levels of GDP per capita. In addition, BMI for children from higher GDP per capita countries had similarly high BMI with native children (Hook & Balistreri, 2007). The study also found that generation in the U.S. was significantly positively related to greater BMI growth among lower socioeconomic children. The researchers concluded that this study did support a common perception that immigrants adopt American poor nutrition and sedentary behaviors because immigrant children from high income countries gain significantly more weight than children from low income countries and second generation immigrant children had higher BMI than first generation (Hook & Balistreri, 2007).

Some research was also conducted to determine overweight, obesity and high blood pressure among rural adolescents in the U.S. The study included 2,038 (1,046 males and 974 females) ethnically diverse adolescents from thirteen to seventeen years old from Merced Union High School District (Rodriguez, Morer, Romo, Aleman, Weffer, & Ortiz, 2010). The participants were predominately Hispanic (53%), followed by non-Hispanic Whites (35%), Asian (7%), African American (4%) and other (1%) (Rodriguez et al., 2010). The mean age of the respondents was fifteen years and almost 59% had normal weight. Hispanic females had significantly higher percentage of obesity than non- Hispanic White females (Rodriguez et al., 2010). Researchers also used waist circumference as a measurement of obesity among adolescents. The study found higher abdominal obesity among African Americans (24% for males and 18.0% for females) followed by Hispanics (22.0% for males and 16.9% for females) compared with non-Hispanic Whites (15.7% for males and 14.7% for females) (Rodriguez et al., 2010). The study stated that adolescent males were in high risk of being overweight or obese than females in small rural and disadvantaged groups (Rodriguez et al., 2010).

Another study examined obesity among U.S. children and adolescents and the study used the National Health and Nutrition Examination Surveys (NHANES) for its analysis. The research used data from the NHANES at five different time periods: 1976-1980, 1988-1994, 1999-2000, 2001-2002 and 2003-2004 (Skelton, Cook, Auinger, Klein & Barlow, 2009). The longitudinal survey measured height and weight using Toledo self-zeroing weight scales. Gender, age, race and poverty level was also obtained for the study. The sample size for the analysis was 12,384 children ages between twelve and nineteen years (Skelton et al., 2009). About 16% of children were obese in 1999-2004 data and Black Americans and Mexican Americans had higher

prevalence of obesity than White Americans for all time periods (Skelton et al., 2009). The study also found significant higher rates of obesity among boys and older children ages than girls and younger children (Skelton et al., 2009). When obesity rates for 1999-2004 among children in the U.S. compared with 1976-1980 data, the obesity had increased 300% from .8% to 3.8%. When obesity rates for 1999-2004 were compared with data from 1988-1994, the obesity rates among children had increased by 72% and obesity rates had increased significantly among Black Americans (.7%, 3% and 4.3% $p<.0001$) and Mexican Americans (1.1%, 1.9% and 4.3%, $p<.0001$) (Skelton et al., 2009). The research also concluded that obesity rates were higher among low socioeconomic inner city children.

The U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau conducted research on changes in obesity and overweight prevalence among U.S. adolescents ten to seventeen years old. The research concentrated on changes between 2003 and 2007 and used NSCH data gathered by Centers for Disease Control and Prevention. The study included 41,793 children from 2007 data and 45,190 children from 2003 data (Singh, Siapush & Kogan, 2010). The researchers found significant racial and ethnic and socioeconomic inequalities among obese or overweight children aged between ten and seventeen years in both 2003 and 2007 (Singh et al., 2010). According to the study, more than 16% of the children were obese and 31.6% were overweight in 2007 and obesity prevalence increased by 10.4% for the children of the above age since 2003. In addition, obesity and overweight prevalence among adolescents aged from fifteen to seventeen years in 2007 increased by 24.1% from 2003 (Singh et al., 2010). Obesity rates were the lowest for Asian children (8.7%) and the highest for Black children (23.9%) and overweight prevalence was the

lowest for Asian children (18.4%) and the highest was for Black and Hispanic children (41%) in 2007 (Singh et al., 2010). The researchers also emphasized that obesity for children from low education, and unemployed households increased by 23% to 33% from 2003 to 2007. Obesity among children with parents who have less than twelve years of education was 30.4% in 2007 and it was three times higher than obesity rate for children who have parents with at least a college education (Singh et al., 2010). Obesity rates among children from poor households (below poverty line) was 27.2% which is 2.7 times higher than the obesity rate for children from families' income exceeding 400% of the poverty line (Singh et al., 2010). Moreover, obesity prevalence among children in metropolitan areas increased from 14.2% to 16.2% between 2003 and 2007. Obesity rate for children from single mother households increased from 18.9% in 2003 to 21.9% in 2007 (Singh et al., 2010). The study concluded that there are socioeconomic and racial disparities in childhood obesity.

Another study examined adolescent obesity among the immigrant population in the U.S. using the National Longitudinal Study of Adolescent Health survey. The total sample size of the study was 12,105 adolescents in grades seven to twelve during the 1994-1995 school years. The adolescents were classified by their race and ethnic identification, generation of their birth in the U.S. Generation and immigrant children were classified by born in the U.S. or U.S. citizens abroad, and migrated to the U.S. as children (Popkin & Udry, 1997). The study stated that second generation is the children of immigrants or children who were born in the county but have at least one parent was born abroad. Third and higher generations are the children who were born in the U.S. to native born parents (Popkin & Udry, 1997). The study found a very high level of obesity among African American females and Hispanic males and about 31% of both groups

were obese. The obesity levels for Mexican Americans (32.1%) and Puerto Ricans (30.3%) were the highest among Hispanic immigrants. Asian Americans, females (15%) and children who were born abroad (11.6%) were less likely to be obese compared to Asian American males (25%) and second generation (27.2%) Asian American adolescents. Obesity rate was doubled between first and second generation Asian Americans (Popkin & Udry, 1997). Patterns of the obesity among Hispanic immigrants were similar to the Asian American immigrants. First generation Hispanic immigrants (24.5%) were less likely to be obese than second generation (32.1%) Hispanic immigrants (Popkin & Udry, 1997). According to the study, all race and ethnic groups had higher levels of obesity than non-Hispanic Whites except Chinese and Filipino Americans. Chinese and Filipino American adolescents had substantially low rates than non-Hispanic White adolescents (Popkin & Udry, 1997).

Another research study was administered in six community based health centers, two hospitals and six health centers in New York City. The study sample was 13,011 people who were recruited from all five parts of the city: Bronx, Brooklyn, Manhattan, Queens and Staten Island) (Park, Neckerman, Quinn, Weiss & Rundle, 2008). The research study collected information about birth place and duration of residence in the U.S. The participants' home addresses were geocoded in a half mile radial buffer around the home in this study to define the neighborhoods. Thirty three percent of the participants were foreign born; 14% of these participants were linguistically isolated and a larger proportion of them lived in poor neighborhoods where many households were below poverty levels (Park et al., 2008). Foreign born participants were significantly less likely to be obese than U.S. born participants except Asians. The study did not find significant differences among foreign born and U.S. born Asians

(Park et al., 2008). Black Caribbeans (beta=1.63, p<.05) had the highest level of obesity, however, Black Caribbeans who lived in the U.S. less than 5 years had much lower BMI (Park et al., 2008). Immigrant density and language isolation was not associated with obesity significantly except among Hispanics. Foreign born Hispanics lived in linguistically isolated neighborhoods had statistically significant lower BMI than U.S. born Hispanics (p<.02) who lived in less linguistically isolated places (Park et al., 2008). The study noted that place of birth and duration of residency in the U.S. was significantly associated with BMI among immigrant groups in New York City (Park et al., 2008).

Another study was conducted to examine physical inactivity and sedentary behavior among immigrant and U.S. born children. This study used the National Survey of Children's Health, 2003. The sample size was 68,288 children aged six to seventeen years old (Singh, Yu, Siahpush, & Kogan, 2008). Physical activity was defined as the percentage or likelihood of children no reporting physical activity, three and more days of physical activity in the past week and number of days of physical inactivity among children in the past month (Singh et al., 2008). The immigrant children were divided into four groups: foreign born children with both immigrant parents (first generation), U.S. born children with both immigrant parents (second generation), U.S. born children with one immigrant parent (third), and U.S. born children with both U.S. born parents (fourth generation) (Singh et al., 2008). Results show that 79.4% of children with at least one foreign born parent lived in traditional two parent households compared to 28.1% of U.S. born children with U.S. born parents lived in single parent households (Singh et al., 2008). However, more than 35% of children with two immigrant parents lived below the poverty line while 14.7% of children with U.S. born parents lived below

the poverty line. In addition, more than 27% of children with immigrant parents lived in unsafe neighborhoods compared to 14% of children with U.S. born parents were active (Singh et al., 2008). As the study reports that more than 22% of Hispanic children with both immigrant parents were not physically active while only 9.5% of children with both U.S. born parents (Singh et al., 2008). Immigrant Hispanic children were at least sixteen days physically inactive in the past month compared with only four days for White children with U.S. born parents were inactive. Almost 32% of Black children with both U.S. born parents watched TV more than three hours per day compared with 5.4% of Asian children having both U.S. born parents (Singh et al., 2008). The investigators concluded that immigrant children were significantly less likely to be physically active than children with U.S. born parents (Singh et al., 2008).

Investigators from the University of California studied relationships between physical, socioeconomic and cultural aspects of immigrant children and health disparities in chronic disease prevalence. The study recruited seventy-one Asian and seventy-three Mexican sixth grade girls from Sacramento school district (Schaefer, Salazar, Bruhn, Saviano, Boushey & Van Loan, 2009). The majority of respondents were second generation immigrants and the study did not find significant differences between first, second and third generations (Schaefer et al., 2009). The study found that about 70% of Asian and 84% of Mexican girls received some type of government nutritional supports. Among Asian immigrants, Southeast Asian girls (Hmong, Mien, Vietnamese and Laotian) had the highest percentage of receiving governmental nutrition support (Schaefer et al., 2009). Mexican American girls were significantly taller (150 cm vs 142 cm), with higher BMI (21.9 vs 19.4) and greater body fat (31.3 vs 24.2) than Asian American girls (Schaefer et al., 2009). However, body fat percentage was significantly negatively related with

generation in the U.S. among Asian American girls but not Mexican American girls. The study also found that 15% of the variance in body fat percentage was explained by racial ethnic groups, socioeconomic status, and language use at home (Schaefer et al., 2009). The researchers concluded that obesity, overweight, and high body fat observed among Mexican American girls and these weight problems may indicate higher risk of developing chronic disease such as diabetes and heart disease (Schaefer et al., 2009).

Other research was conducted to examine obesity among Chinese American children in New York City. The study included Chinese American children aged between six and nineteen years who received annual medical exams in 2004 at two health centers in China towns in lower Manhattan and Queens in New York City. Investigators reviewed a total of 4,695 charts of Chinese American children with average age of 12.3 years (Au, Kwong, Chou, Tso & Wong, 2009). A majority of the children (94%) were insured with Medicaid or the state Health insurance programs; 3.7% did not have any health insurance and 2.5% had private insurance (Au et al., 2009). More than 14% of the study subjects were overweight and 10.2% were obese (Au et al., 2009). Boys had higher overweight or obese odds (2.43 vs 2.11) than girls. In addition, younger children aged from six to eleven had higher odds of weight problems (1.53 vs 1.33) than children aged from twelve to nineteen years. The study also found significantly positive relations between born in the U.S. and having weight problems. The study found that 40% of boys aged five to eleven who born in the U.S. were overweight or obese (Au et al., 2009).

Research conducted to examine how acculturation may affect physical activity and obesity among Hispanic adolescents and used the National Survey of Children's Health, 2003 data. Hispanic adolescents aged between ten and seventeen (n=3,890) was drawn for the analysis

(Lui, Probst, Harun, Bennett, & Torres, 2009). Slightly over 25% of Hispanic children were first generation, 43.8% of children were second and 31.1% were third generation immigrants (Lui et al., 2009). About 43% of Hispanic children lived in homes where English was the primary language spoken (Lui et al., 2009). The results show that first generation Hispanic children were more likely to live with parents having less than twelve year of education (43.8%) and lived under 100% poverty level (49.7%) compared with second generation children who lived in households with less than twelve year of parental education (12.3%), and only 14.7% of the households lived under 100% federal poverty level (Lui et al., 2009). In addition, first generation adolescents were more likely to fail obtaining recommended physical activity (43.7%) followed by second generation adolescents (38.6%) and third generation (28.9%) (Lui et al., 2009). Obesity prevalence among Hispanic immigrant adolescents was not significantly different and it was 20.1% for first generation, 20.5% for second generation and 16.9% for third generation adolescents (Lui et al., 2009). However, researchers found significant differences between English speaking households (22.5%) and Spanish speaking households (16.1%) (Lui et al., 2009). The study determined that acculturation may affect how adolescents participate in physical activity, spend their leisure time and rates of obesity among adolescents. However, the study indicated that little is known about the impact of acculturation (Lui et al., 2009).

Discussion about the Literature Review

This chapter covered many research studies that examined the impacts of built neighborhood factors, physical and social activity, racial and ethnic groups and immigrant statuses on obesity among adolescents. All research work that has been discussed in this chapter found persistent outcomes about obesity among adolescents including the built neighborhood

environment, physical and social activity inequalities among different racial and immigrant groups. These studies found that obesity among U.S. adolescents has increased significantly last few decades especially among adolescents from low socioeconomic households and neighborhoods. The studies found also that minority adolescents especially non-Hispanic Black and Hispanic children were more likely to be overweight and obese than their non-Hispanic White counterparts. Adolescents who lived in minority neighborhoods were less likely to have supportive neighborhood factors for physical activity such as having recreational facilities, sidewalk, parks and access a safe environment. In addition, adolescents who were from poor households were more likely to be overweight or obese than adolescents from middle and higher socioeconomic households. According to the literature review, second and third generation immigrant adolescents were more likely to be obese or overweight compared to the first generation immigrant adolescents. Therefore, these scientific findings emphasized that not only the neighborhood environmental inequalities such as unsafe neighborhoods and limited access to parks, playgrounds, and recreational facilities but also social stressors such as poverty, socioeconomic status, unsafe neighborhoods, and low levels of education have negative impacts on obesity among adolescents in the U.S. This dissertation will study several sets of environmental and social factors that relate to the built neighborhood factors, neighborhood culture, physical and social activity, race and ethnicity and immigration status and their associations with obesity among adolescents.

Even though many studies have been conducted on obesity problems among adolescents, not many studies have been conducted on neighborhood cultural factors such as neighbor trust, help each other out or count on each other; social activities in the neighborhood such as

participating in community activities, volunteering at school, church and other places, and having meals with family members. Immigrant status of adolescents in different neighborhoods and how these factors affect obesity also need more study. Most of the research studies discussed in the literature review examined obesity among adolescents based upon either the built neighborhood factors and demographics of adolescents or physical activity and/or immigrant and racial backgrounds. Therefore, this study is intended to expand the understanding of social economic, neighborhood environment, neighborhood culture, immigrant status, and other important factors and how they affect obesity among adolescents. More importantly, research will determine which factors appear most influential. The dissertation is based on the previous research studies that were discussed in this chapter and constructed to examine many more important factors that have not been discussed in previous academic studies which would provide more scientific information about adolescent obesity and contribute in promoting reduction and prevention of obesity.

There are four statistical analyses presented in this dissertation and each analysis is structured to create new information about obesity among adolescents. The first statistical model investigates obesity among adolescents and its relationship with built neighborhood factors such as access to parks, playgrounds, recreational centers, boys and girls clubs, libraries, having garbage on the street, poorly kept housing and broken windows or graffiti and cultural aspects of neighborhood such as people help each other out, neighbors trust each other, parents feel safe for their children in neighborhood etc. As discussed earlier, there was one study that examined how these built neighborhood factors affect obesity among children aged between ten and seventeen years old. However, there was no study that examined cultural aspects of neighborhood and

obesity among adolescents. Therefore, the first statistical model was much more comprehensive than the previous research studies that are presented in this chapter and include the cultural aspects of neighborhoods such as whether people help each other out, watch out for each other's children, if people can count on each other, trust each other to help children in the neighborhood. These neighborhood cultural aspects were added to the model to create new knowledge about obesity among adolescents and understand neighborhood contributing factors to obesity epidemic better. Therefore, the first statistical analysis included both built neighborhood factors and cultural aspects of neighborhood.

The second statistical analysis is planned to examine relationships between social and physical activity and obesity among adolescents. As discussed in the literature review section, many studies investigated associations between physical activities, television watching and obesity. However, there were not many studies that examined associations between other leisure time activities such as whether adolescents participated in any clubs or organizations, community service, volunteer work, earned money, ate meals with all family members etc. These social activity variables were added to the model to extend previous knowledge about social activity of adolescents and obesity problems.

The third statistical analyses was focused on immigrant status and designed to study how obesity and neighborhood and physical and social activities among immigrant adolescents were different than their U.S. born counterparts. As discussed in the literature review, most of research studies were focused on socioeconomic status, family characteristics, racial disparities among adolescents and obesity issues. However, there were not many studies that investigated built neighborhood and neighborhood cultural aspects and social and physical activity among

immigrant adolescents and obesity. Therefore, the third statistical analysis is created to examine built neighborhood environments and neighborhood cultural aspects and obesity among immigrant adolescents; and social and physical activity among immigrant adolescents and obesity. This analysis would provide more structured and detailed information about living situations and obesity among adolescents and their immigration statuses.

The last statistical analysis created to examine what variables from all three statistical analyses were the most strong predictors of obesity problems. Therefore, the forth statistical analysis is intended to study the most strong aspects that explain obesity among adolescent. Therefore, this study includes many variables to study obesity among adolescents comprehensively. Each statistical analysis and their results will be discussed in the Chapter V. The exact methods used to examine the four models will also be explained.

CHAPTER IV.

METHODOLOGIES

Introduction and Statistical Analyses

Based on the literature review, there are many social, economic, and environmental factors that influence obesity among adolescents. As mentioned earlier, this dissertation is designed to expand existing understanding and provide new information on obesity among adolescents. The study is focused on not just the built neighborhood effects but also physical and social activity, community service participation and family dynamics and neighborhood culture. In addition, the dissertation is intended to explore not just racial classifications of adolescents but also their immigration status and how these factors influence obesity.

The Chapter IV presents discussions about the research question, hypotheses, dataset and four different statistical models that were designed for comprehensive study of obesity among adolescents by including a variety of social, physical activity and neighborhood environmental factors, immigration status, gender, race and other variables. Each statistical analysis is treated separately and each analysis has an independent impact on understanding obesity issues among adolescents. Additionally, a final model will attempt to isolate the independent impact of variables on obesity.

For example, the first statistical analysis is focused on the neighborhood environment and its affect on obesity among adolescents in the U.S. The second statistical analysis is concentrated on physical and social activity among adolescents and their impacts on obesity problems. The third statistical analysis is focused on immigration status of adolescents and their neighborhood

environment and social and physical activity. This statistical analysis was created to examine neighborhood environmental differences among immigrant and non immigrant adolescents and examine the obesity rates among them. In addition, this statistical analysis is targeted on immigration status, physical and social activity and obesity among adolescents. The third analysis is intended to generate new knowledge about obesity among immigrant adolescents. The fourth analysis is designed to analyze all factors that were included in the previous statistical analyses. All variables from the previous three statistical analyses are included in the fourth analysis to assess which factors are the most strong predictors of obesity among adolescents. Therefore, every statistical analysis is independent and separate from each other and interrelated with each other. All statistical analyses had a common category: racial and ethnic categories because race and ethnicity was one of the strong predictors in the studies that discussed in the previous chapter.

Statistical Analyses (Models):

As indicated previously, each statistical model is designed to produce new knowledge about obesity among adolescents by including a much wider variety of variables and perspectives that are based on the literature review. For example, the first statistical analysis (Model I) includes a dependent variable, two sets of independent variables and several different control variables.

Dependent variable:

The dependent variable in all models is the weight status of the adolescents. Weight status was measured using BMI for age classification. The original weight status variable had four categories: underweight (BMI<5th percentile), normal weight (5th<BMI<85th percentile),

overweight (85th<BMI<95th percentile) and obese (BMI>95th percentile). A dummy variable was created with two categories: obese (BMI>85th+) and not obese (BMI<85th) for logistic regression analyses (Model I and Model II). Three categories of the weight status (underweight; normal weight and overweight/obese) was used in the ANCOVA and Multiple Regression Analysis models (Model III and Model IV). In addition, race and ethnicity of a child (Hispanic any race, White non-Hispanic, Black non-Hispanic, Multiracial non-Hispanic, Other non-Hispanic), age of a child between twelve and seventeen, and gender was included in the all statistical models. Therefore, these variables will be not discussed in the future explanations of the models in this chapter.

Independent Variables:

Built neighborhood aspects were measured in several ways: Neighborhood has access to sidewalks or walking paths; Neighborhood has access to park or playground area; neighborhood has a recreation center, community center or boys or girls club; neighborhood has a library or bookmobile; neighborhood has a litter or garbage on the street or sidewalk; neighborhood has poorly kept or dilapidated/rundown housing; and neighborhood has vandalism such as broken windows or graffiti. All variables were dichotomous with two categories: (yes-1 or no-0).

Neighborhood cultural aspects were also measured in several ways: People in the neighborhood help each other out; Watch out for each other's children; there are people I can count on in the neighborhood; there are adults nearby who I trust to help my child; I feel my child is safe in your community or neighborhood; and I feel my child is safe at school. All variables were measured with four categories: (definitely agree, somewhat agree, somewhat disagree, definitely disagree). Dummy variables were created for these variables: agree category

from the definitely agree and somewhat agree (1); and disagree category from somewhat disagree and definitely disagree (0) to make interpretation easier to understand and avoid fewer observations in frequency tables.

Control variables:

Several variables were included to measure family socioeconomic and immigration status: Poverty level of child's household (FPL 99%, FPL 199%, FPL 399%, FPL 400+); Child's mother born in the U.S.; Child's father was born in the U.S.; and The child was born in the U.S. The last three variables were measured at two categories: (yes-1 or no-0). Therefore, the Model I consists of many variables that related to neighborhood environment of adolescents. The built neighborhood environment has been discussed in one article (Sing et., 2010) in the literature review but neighborhood cultural aspects have not been studied in any other research that examined obesity among adolescents. The second set of the independent variables is a new set of variables that produces new information on obesity among adolescents. The control variables were also chosen based on information from the literature review. Many studies discussed in Chapter III found high rates of obesity in different racial and ethnic groups and among poverty levels of households. Therefore, the variables for race and ethnicity and poverty levels were chosen as control variables.

The second statistical analysis (Model II) is designed to study how physical and social activity of adolescents affect obesity. Like model I, this model also has several independent and control variables.

Independent variables:

Physical Activity*:* The selected child was on a sports team or did he/she take sports lessons after school or weekends during the past 12 months; and the child earned money from any work, including regular jobs as well as babysitting, cutting grass, or other occasional work. These two variables were measured with two categories: (yes-1 or no-0). How many days the child exercised, played a sport, or participated in physical activity for at least 20 minutes that made him/her sweat and breathe hard during the past week. This variables had four category measurement: (0-day-1, 1-4 days-2, more than 4 days-3) and a dummy variable was not created because it was important to analyze how many days of exercise would significantly affect obesity. This decision applied for all independent variables in this model because it was important to investigate obesity at higher levels of measurement to show differences between levels of activity. For example, it was valuable to see that how many days of community and volunteer work or how many hours of television watching would significantly impact obesity.

Social Activity: How often the child has been involved in any type of community service or volunteer work at school, church or in the community; and the variables was measured with four categories: (once a week or more, a few times a month, a few times a year and never). Participated in any clubs or organizations after school or on weekends past 12 months and was measured with two categories: (yes-1, no-0). Additional variables measured how many days all the family members who live in the household eat a meal together during the last week and measured at (0-day-1, 1-3 days-2, 3-6 days-3, everyday-4). The last variables was how much time the child usually watches TV, videos and plays video games a week and it was measured at (less than 1 hour-1, 1-4 hours-2 and more than 4 hours-3). The dummy variables were not

created for the last two variables because it was important to measure differences between times and hours adolescents spent for these activities.

Control variables:

Several measures of socioeconomic situation of adolescents were included in the model: Type of family structure in household (two-parent biological or adopted, or step family, single parent, other family type); whether the child's family receives food stamps; whether a child in the household receives free or reduced cost breakfasts or lunch; and primary language in household was English. Above three variables were measured at the nominal level: (yes or no). Mother's and father's education was measured with several categories :(less than high school, 12 year/high school, more than high school).

There were several studies that examined physical activity, television viewing and playing video games time and obesity in the literature review. However, no study that researched social activity and community service engagement and obesity. Therefore, this model is developed to study a variety of social activities and community service engagement among adolescents and obesity. Family structure, getting free or reduced breakfast and lunch at school, parents education and primary language in household were added to the model because all these factors may significantly relate to obesity in the previous research studies that were discussed in the literature review. Thus, it was important to study how these demographic and socioeconomic variables affect obesity among adolescents with newly added independent variables.

The third statistical analysis (Model III) is focused on the built neighborhood and neighborhood cultural aspects; and social and physical activity and obesity among immigrant adolescents. Therefore, this model examines neighborhood differences, physical and social

activity of immigrant and non-immigrant adolescents and how these factors affect obesity. In other words, this model is designed to examine if the mean differences in the obesity between immigrant and non- immigrant groups were greater than expected by chance when neighborhood characteristics, physical and social activity are included in the model. Therefore, Factorial ANCOVA was chosen for statistical analysis to determine whether there were mean differences in the BMI between immigrant and non-immigrant and different racial and ethnic groups. The immigrant status of the adolescents was determined by whether the adolescents or their both parents or one parent was foreign born. Five new covariates were created from Model I and Model II independent variables. Results of this analysis produce new information about immigrant adolescents, their neighborhood environments and obesity because there was no study that investigated neighborhood environment, physical and social activity and obesity among immigrant adolescents found for the literature review.

Independent variables:

Immigrant status of the adolescents was measured as a dichotomous variable (non-immigrant-1; immigrant-0). A new variable was created for immigration status adding all foreign born parents and adolescents into one group. Therefore, immigration status was determined by if the child or his /her parent(s) was born outside of the U.S.

Covariates:

Several covariates were also included in this model: Supportive neighborhood variable was created from following neighborhood cultural characteristics: people help each other out, neighbors look out for each other's' children, parents feel they can count on neighbors and

parents trust neighbors to help if their children are hurt. All variables were dummy variables and measured as (yes-1, no-0);

Amenities variable was created from following built neighborhood characteristics variables: sidewalks or walking paths, park or playground, recreation or community center, library or bookmobile (yes-1, no-0);

Detracting elements variable was created from following built neighborhood characteristics: litter or garbage, poorly kept housing and vandalism. This variable was also measured at the nominal level (yes-1, no-0);

Physical activity variable was created from three predictors of the Model II such as the selected adolescent was on a sports team or took sports lessons after school or weekends; played a sport or participated in physical activity for at least twenty minutes; and earned money from work including regular jobs as well as babysitting, cutting grass or other work). This variable was also measured with two categories: (yes-1 or no-0);

Social activity variable was created from the selected adolescent participated in clubs or organizations after school or on weekends, involved in community service or volunteer work at school, church or in the community, watched TV, videos and played video games and had meals with all family members together variables. This variable was also dummy variable: (yes-1 or no-0).

The last statistical analysis (Model IV) is designed to test how all these factors affect obesity among adolescents and most importantly which factors were the strongest predictors. In other words, the model examines the linear combination of predictors that maximally correlated with obesity among adolescents. The model was created because some of the variables in the

previous models were examined just based on theoretical importance of the variables not based on past research studies. For example, variables that related to the cultural aspects of neighborhoods, community services, and volunteer work were new variables that were added in the statistical analyses based on theoretical importance. Multiple regression analysis with stepwise/backward method was chosen to examine the best predictors for obesity among adolescents. The stepwise/backward method constantly reassess to determine if any less influential variable can be deleted from the model. The backward method places all predictors in the model and then calculates the contribution of each variable at the significant level of the t-test for each predictor. If a predictor is not making a significant contribution to obesity among adolescents then it deletes that predictor and reassesses the contribution for the remaining predictors. The backward method was chosen over forward method because of suppressor effects. In other words, the forward method deletes a predictor that has a significant contribution only when another variable is held constant, indicating a higher risk of a Type II error by deleting a predictor that has a significant contribution to the model.

Research Questions and Hypotheses

Research questions: Is there any relationship between obesity among U.S. adolescents and built and cultural environments of neighborhoods; obesity among U.S. adolescents and their leisure time activities; obesity among U.S. immigrant adolescents and their built and cultural environments of neighborhoods; and obesity among U.S. immigrant adolescents and their leisure time activities? Are there any built and cultural environments of neighborhoods, social and physical activity that affect obesity among adolescents the most? Even though prior research studies found that there were differences in obesity among adolescents and the built

neighborhood environment, physical activity, immigration status and race and ethnicity groups, this dissertation includes much more comprehensive variables than any of the prior studies that was discussed in Chapter III. Therefore, the last statistical analysis was designed to examine the strongest predictors for obesity among adolescents in the U.S. as a benefit of conducting much more comprehensive study. In addition, some factors such as neighborhood cultural environment, social activity and community engagement of adolescents that was included in the dissertation have not been researched previously or were not available based on the literature review. The several hypotheses guided the research.

Hypothesis #1: Adolescents who live in neighborhoods where there is no access to sidewalks, walking paths, parks, playgrounds, recreational centers, community centers, boys and girls clubs, and library or bookmobile; and where there is litter, garbage on street, dilapidated/ rundown housing, broken windows or graffiti are more likely to be obese than adolescents who live in neighborhoods where there is more resources such as access to sidewalks, walking paths, parks, playgrounds, recreational centers, community centers, boys and girls clubs, and library or bookmobile; and where there is no litter, garbage on street, dilapidated/rundown housing, broken windows or graffiti.

There was only one study (Singh et al., 2010) that examined this hypothesis extensively. According to this study, children aged between ten and seventeen from neighborhoods where there is no access to sidewalks, walking paths, parks, playgrounds, recreational centers were more likely to be obese. In addition, this study also found that children who live in neighborhoods where litter, garbage on street, dilapidated/rundown housing were more likely to be obese. Some factors such as community centers, boys and girls club, broken windows or

graffiti in neighborhood were not included in this study. A few studies (Papas et al., 2007; Gordon-Larsen et al., 2006) found in the literature review that obesity among adolescents was related to having recreational centers in neighborhood. All these studies found that adolescents who had recreational centers closer to home were more likely to be physically active.

Hypothesis #2: Adolescents who live in neighborhoods where people do not help each other out, watch each other's children, cannot count on each other, and do not feel safe are more likely to be obese than their counterparts who live in neighborhoods where there are people who help each other out, watch each other's children, people can count on each other, and people feel safe.

As mentioned previously, there were no studies that examined neighborhood cultural aspects. The only factor from the hypothesis #2 that was examined in few studies (Duncan et al., 2009; Singh et al., 2010) was parents' perception on neighborhood safety. All studies that investigated parents' perceptions of neighborhood safety found negative relationships between obesity among adolescents and neighborhood safety. Adolescents who lived in unsafe neighborhoods were more likely to be obese or overweight.

Hypothesis #3: Adolescents who participate in sports activities, exercise at least twenty minutes, participate in clubs, organizations, community service, volunteer work, earning money, and having meals with all family members are less likely to be obese than adolescents do not participate in the above activities.

There were no studies that researched social activity such as participating in clubs, organizations, community service volunteer work, and having meals with all family members and obesity among adolescents. However, several studies (Kimm et al., 2002; Lui et al., 2009;

Robinson et al., 2010; McMurray et al., 2000; Ward et al., 2006; Bauer et al., 2012) investigated relationships between obesity among adolescents and physical activity. All studies found that adolescents who are not physically active were more likely to have overweight and obesity problems.

Hypothesis #4: Immigrant adolescents who live in neighborhoods where there is no access to sidewalks, walking paths, parks, playgrounds, recreational centers, community centers, boys and girls clubs, and library or bookmobile; and where there is litter, garbage on street, dilapidated/rundown housing, broken windows or graffiti are more likely to be obese than adolescents who live in neighborhoods where there is more resources such as access to sidewalks, walking paths, parks, playgrounds, recreational centers, community centers, boys and girls clubs, and library or bookmobile; and where there is no litter, garbage on street, dilapidated/ rundown housing, broken windows or graffiti.

There was no prior research that examined the built neighborhood environment, social aspects of the neighborhood, and physical and social activities and obesity among immigrant adolescents. Most of prior research studies (Gee et al., 2007; Hook & Balistreri, 2007; Rodrigues et al., 2010), concentrated on obesity disparities among racial and ethnic groups and immigration status of adolescents. Most studies found that minority adolescents were more likely to be overweight or obese than White adolescents. In addition, many studies (Sing et al., 2008; Wang et al., 2007; Wickrama et al., 2006; Skelton et al., 2009; an Au et al., 2009) examined socioeconomic situation, poverty and parents education and obesity among adolescents. All these studies found that adolescents from lower socioeconomic status, poor households and whose parents have lower levels of education were more likely to be obese or overweight. In addition,

two studies in the literature review section (Popkin & Udry, 1997; Singh et al., 2008) examined obesity among immigrant generations and both studies found that second generation immigrant adolescents were more likely to be obese when compared with first generation immigrant adolescents.

Hypothesis #5: Immigrant adolescents who live in neighborhoods where people do not help each other out, watch each other's children, cannot count on each other, and do not feel safe are more likely to be obese than their counterparts who live in neighborhoods where there are people who help each other out, watch each other's children, and where people count on each other, and feel safe.

Hypothesis #6: Immigrant adolescents who participate in sports activities, exercise at least twenty minutes, participate in clubs, organizations, community service, volunteer work, earning money, and have meals with all family members are less likely to be obese than adolescents who do not participate in the above activities.

Only three studies (Singh et al., 2008; Schaefer, 2009; and Lui et al., 2009) reviewed physical activity and sedentary behavior among immigrant children aged from six to seventeen years. The study found that immigrant children were less likely to be active than U.S. born children. Therefore, all hypotheses related to obesity among immigrant adolescents in this dissertation are new hypotheses that have not been studied previously.

Obesity among adolescents and built neighborhood factors (Model I) is the first statistical analysis that is constructed to examine how built neighborhood factors and cultural aspects in neighborhoods affect obesity among adolescents and test the hypothesis #1 and hypothesis #2. This model includes many variables that can express not only the built neighborhood

environment but also the cultural aspects of the neighborhoods. For example, the model has variables such as whether adolescents have access to sidewalks or walking paths; parks or playgrounds; recreational centers, community centers or boys and girls clubs; and whether there are any litter or garbage on the street; dilapidated/rundown housing, broken windows or graffiti etc. These variables are selected to describe built neighborhood aspects. In addition, there are several other variables in the model to investigate culture in the neighborhood such as whether people in the neighborhood help each other out, watch each other's children, can count on neighbors, have adults that neighbors can trust their children, and if people feel safe in their neighborhoods. These variables are selected to express cultural aspects of neighborhoods and how these factors influence obesity among adolescents. There was no previous research study that discussed the cultural aspects of neighborhoods except neighborhood safety and obesity among adolescents was found in the literature review. Therefore, these variables intend to provide more in depth understanding of neighborhood factors, especially cultural aspects that affect obesity among adolescents.

Obesity among adolescents and physical and social activity (Model II) is structured to study how activities such as adolescents being on sports teams, taking sports lessens; exercising at least twenty minutes; participating in clubs and organizations; getting involved in community services and volunteer work; earning money through work; watching TV, playing video games and having meals at home with family members influence obesity among adolescents. This model is constructed to test hypothesis #3. The variables were chosen to discover relationships between leisure time activity and obesity research among adolescents. These variables, except watching TV and playing video games variable, have not been studied in obesity among

adolescents research. Therefore, these variables also will contribute to understanding of obesity among adolescents and help to reduce and prevent obesity.

The third model in the statistical analyses is concentrated on immigrant adolescents and obesity. There are many studies that have been conducted on obesity among immigrant adolescents and obesity differences between immigrant generations. However, there was not many studies found in the literature review that tested how the built neighborhood factors and neighborhood culture affect obesity among immigrant adolescents. In addition, there were also not many research studies that examined how physical and social activities influence obesity among immigrant adolescents. Obesity among immigrant adolescents and neighborhood factors (Model III) is structured to examine built neighborhood, neighborhood culture and physical and social activity among immigrant adolescents and created to test the hypothesis #4, hypothesis #5 hypothesis #6. Therefore, the third model was constructed to understand obesity among immigrant adolescents and how different built neighborhood environment and neighborhood culture and physical and social activity affect obesity. This model is created because it is equally important to understand obesity problems among immigrant adolescents to reduce and prevent obesity rates among adolescents in the U.S.

The last statistical analysis is concentrated on the most influential factors for obesity among adolescents (Model IV) which is designed to include all predictors that were examined in the previous three statistical analyses.

The National Survey of Children's Health

The National Survey of Children's Health (NSCH), 2007 will be used as the dataset. This is a very large nationwide dataset that includes information on multiple aspects of children's life:

physical and mental health, access to health care, family, neighborhood, and social factors. The first NCHS was conducted in English and Spanish in 2003-2004. The second survey was performed in 2007-2008, which is used in the dissertation as the major data resource. The third survey was conducted in 2011 but it has not been released publicly.

The NSCH, 2007 is a telephone survey sponsored by the U.S. Department of Health and Human Services Administration Maternal and Child Health Bureau (MCHB). The survey was conducted by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention in every state and the District of Columbia in 2007-2008. The NSCH is included a total of 91,642 randomly selected children aged from 0 to 17 and between 1,725 and 1,932 non institutionalized respondents who were chosen from each state and the District of Columbia (Blumberg, Foster, Fraser, Satorius, Skalland, Nysse-Carris, Morrison, Chowdhury & O'Connor, 2009). The survey included eleven sections: child and family demographics, the children's physical and mental health status, health care needs, health insurance, type and adequacy of the insurance, access to health care and quality of health services, health activities, parents' health and mental health status, and neighborhood characteristics. Therefore, the detailed survey about children's life style, health status and everyday activity gives the opportunity to test the hypotheses that developed in the dissertation.

As NCHS emphasized, the main goals of the survey are to provide information on children's health; promote an environment that encourages the health of children; reduce health disparities; improve health infrastructure; provide quality care; cooperate with states and communities planning; improve social and neighborhood physical environments that support the health and well-being of children.

The survey was conducted using "State and Local area Integrated Telephone Survey" that was developed from the National Center for Health Statistics to collect information on health topics at the state and local levels. Telephone numbers were dialed randomly to identify households with children under age eighteen years old (Blumberg et al., 2009). If a household had more than one child, one was chosen randomly for the interview. In addition, the survey had a specific sample design that creates samples representatives of the population of children in each state. State samples were designed to include at least 1,700 completed interviews (Blumberg et al., 2009). The number of households needed to be interviewed in each specific area was calculated using the expected proportion of households with children under age eighteen years old. Moreover, the NCHS used a Computer Assisted Telephone Interview (CATI) system for NSCH (Blumberg et al., 2009). This software displays the questionnaire on the computer screen to each interviewer and guides them through the interview automatically routing the questions based on previous answers. The interviewers directly entered the data into the computer. After the programming, CATI system was pretested to ensure the system functions interviewing 640 households (Blumberg et al., 2009). The National Opinion Research Center (NORC) at University of Chicago and its subcontractors conducted the telephone interviews. All interviewers had two types of training: trainer led (cooperative skills and project knowledge) and dual trainee interviews (section by section lecture). After this training, interviewers completed certification mock interviews with an additional written exam on frequently asked questions about the project (Blumberg et al., 2009).

The data collection process started with advance letters to explain the value of the survey, study legitimacy, confidentiality, and the rights of respondents and to decrease nonresponse.

Once a telephone number with mailing address was selected, an advance letter was sent to particular households before the telephone interviews. The letters informed household members that they would be receiving a phone call for the interview within two weeks, and it also included pages of frequently asked questions related to the project and interview topics (Blumberg et al., 2009).

After the advance letters, interviewers telephoned to the households and requested to speak with a parent or legal guardian who knew about the health and health care of the selected child. When the respondent (knowledgeable adult) came to the phone, the interviewer informed the respondent about his/her rights as a survey participant, obtained verbal consent and documented it in the CATI system. The eligible respondents were paid $10 or $15 for their time. NSCH interviews were administered in English and also in Spanish, Mandarin, Cantonese, Vietnamese and Korean (Blumberg et al., 2009). Professional interpreters translated the interview questionnaire and trained a particular language speaking interviewer who conducted the interviews. If the household adults did not speak English, Spanish or one of these Asian languages, the case finalized because of language. There were a total of 688 households who stopped interview process due to language (Blumberg et al., 2009). According to the NCHS, interview completion rates ranged between 60.5% and 76.6% for each state (Blumberg et al., 2009).

Basic Information About The Sample Population

The total sample size for the data was 91,642 children with a mean age of 9.15 with standard deviation 5.3 and 51.9% of the selected children were males. Most selected children lived with at least either biological, step, foster or adoptive mother (73.5%) or biological, step,

foster or adoptive father (20.5%). Slightly over 7% of the children's primary household language was not English. Most of the selected children were non-Hispanic Whites (67%) followed by Hispanics (12.6%), non-Hispanic Blacks (9.7%), Multiracial (4.7%), and Others (4.4%) (Table 1). According to the U.S. Census 2010, non-Hispanic Whites were 63.7%, Hispanics were 16.3%, non-Hispanic Blacks were12.2%, two or more races were 2.9% and Others including non-Hispanic Asians, non-Hispanic Native Hawaiian and Pacific Islander, non-Hispanic American Indian and Alaska Native were 4.9% of the total the U.S. population (Census Bureau, 2010). Therefore, the sample population represents the total population of the country.

Race and Ethnicity

Table 1.

		Frequency	Percent
Valid	Hispanic, any race	11523	12.6
	White, non-Hispanic	61739	67.0
	Black, non-Hispanic	8907	9.7
	Multi-racial, non-Hispanic	4885	4.7
	Others	3994	4.4
Missing		1546	1.7
Total		91642	100.0

About 12.9% of mothers of the selected children were not born in the U.S., compared to 12.3% of fathers, and 2.9% of the selected children were not born in the U.S. Therefore, most selected children (97.1%) were born in the U.S. According to the Census 2010, foreign born citizens were 12.9% of the total population (Census Bureau, 2010). Therefore, the sample population represents the immigration status of the U.S. total population.

In addition, about 12% of the households lived at or below 99% of poverty level of the Federal Poverty Guidelines; 17% of the households lived at or below 199% of the poverty level;

33.6% of the households lived at or below 399%; and 37.4% of the households lived above 400% of the poverty level (Table 2.).

Poverty Level of the Household Based on Federal Poverty Guidelines

Table 2.

		Frequency	Valid Percent
Valid	At or below 99% of poverty	10971	12.0
	At or below 199% poverty level	15591	17.0
	At or below 399% poverty level	30792	33.6
	At or above 400% poverty level	34288	37.4
Total		91642	100.0

Moreover, 20% of the selected children in the households received food stamps during the past 12 months, and 39.4% of the selected children received free or reduced cost breakfasts or lunches at school (Table 3).

Children who received food stamps and/or free or reduced cost breakfasts or lunches

Table 3.

		Food Stamps		Free or Reduced cost breakfasts or lunches	
		Frequency	Valid Percent	Frequency	Valid Percent
Valid	No	36382	79.6	26074	60.1
	Yes	9152	20.0	17095	39.4
	Don't know	85	0.2	161	0.4
	Refused	98	0.2	74	0.2
	Total	45717	100.0	43404	100.0
Missing		45925		48238	
Total		91642		91642	

CHAPTER V.

ANALYSES OF THE STATISTICAL MODELS

Model-I: Obesity Among Adolescents And Neighborhood Factors

Missing Data for Model I.

The dependent variable of the first model is BMI for age classification from twelve to seventeen years old. There were 36,284 children aged between twelve and seventeen and 55,358 children aged from zero to eleven years. According to the frequency table almost 27% of adolescents aged between twelve and seventeen were either overweight or obese (Table 4).

BMI for age classification for sample child aged 12-17 years

Table 4.

		Frequency	Valid Percent
Valid	Underweight -- less than 5th percentile	1554	4.4
	Healthy weight -- 5th to 84th percentile	24246	69.0
	Overweight -- 85th to 94th percentile	5055	14.4
	Obese -- 95th percentile or above	4276	12.2
	Total	35131	100.0
Missing		56511	
Total	91642	100.0	

There were not many missing values for independent variables for Model I. For example, sidewalks or walking paths in neighborhoods, there were only 717 missing values which was only .8% of the total sample; park or playground area in neighborhoods, there were only 720 (. 8%) missing values; there were only 728 (.8%) missing values for recreation center, community center or boys/girls' club; and there were 732 missing values (.8%) for library or bookmobile. In addition, there were not significant missing values for the neighborhood social characteristics.

For example, there were 1,763 (1.9) missing values for the variable of people helping each other out; 1,964 (2.1%) for people watching each other's children; 1,636 (1.8%) for people I can count on; and 1,668 (1.8%) missing values for adults I can trust variable. There were 731 (.8%) missing values for litter or garbage on sidewalk and streets; 736 (.8%) missing values for poorly kept or dilapidated housing; 741 (.8%) of missing values for broken windows or graffiti in neighborhoods. Since the missing values were not significantly high, they were excluded (deleted) from the model for the above variables.

Adolescents aged between 12 and 17 years were 39.6% (36,284) of the total sample, little over half of the adolescents were males (52.27%) and there were no missing data on the selected child's age and gender (Table 5). In terms of race and ethnicity, 25,369 (69.9%) Whites, followed by Hispanics 3,770 (10.3%), Blacks 3,710 (10.2%), Multi-racial 4,329 (4.8%), Others 3,994 (4.4%) for the model. In addition, 3,688 (9%) of the mothers were not U.S. born compared to 2,783 (9.9%) of fathers and 1,385 (3.8%) of the children who were not U.S. born. There were not many missing values for these variables and all missing values were deleted for the model. These variables were the same for all statistical models.

Selected Child's Age and Gender statistics (12-17 years)

Table 5.

Age	**12**	**13**	**14**	**15**	**16**	**17**	**Total**
Male %	7.5	2.25	0.2	8.7	9.8	10	52.3
Female %	7.0	1.53	2.2	8.0	8.7	9.1	47.5
Total %	14.5	3.78	2.4	16.7	18.5	19.1	98.8

Variables Coding.

Dummy variables were created for most of the variables to keep interpretations of the statistical analyses simple. Coding of the all dummy variables was as follows: the category coded

1 is the “response” category (e.g., overweight or obese) and the category coded 0 is the “reference” category (not overweight or obese) to make interpretation of the odds ratio and the sign of the B coefficient easier to understand. Several dummy variables were created for race categories. For example, the dummy variable was created Hispanic (1) from the variable with categories of White, non-Hispanic (0), Black non-Hispanic (0), multiracial non-Hispanic (0) and other non-Hispanic (0). The same procedure was conducted for non-Hispanic Blacks (1), Multiracial (1) and non-Hispanic others (1) while all other categories were (0). non-Hispanic White category was the baseline category. The dummy coding of racial and ethnic variables were the same for all models.

The difficulties with race categories were the data did not classify race as Asian, Native American and Alaskan Native, Hawaiian and Pacific Islander and all these categories were included in one category of others. In addition, these categories were created as separate variables e. g., Asian codes as (Asian only for selected states); Native American coded as (Native American only for selected states). Therefore, using these data would put minority respondents to be used more than once in the data analysis e. g., respondents in Asian category for selected states are included in the category of others for all states.

Dummy variables are created for most variables due to categorical nature of the variables in the model and making interpretations easier. All built neighborhood variables are dichotomous variables and there is no need to create new variables. However, dummy variables are created for other variables such as age categories, federal poverty level categories, and variables that related to cultural factors of neighborhood to make interpretation more clear. For example, ages between 12 and 17 were coded as (1) and all other age categories codes as (0). Gender is coded as male

(1) and female (0). Dummy variables were created for household poverty. For example, Federal poverty level (FPL) is 0-99% was coded as (1), FPL is 100-199%, (0), FPL is 200-399% as (0), and FPL is 400% as (0) and the procedure followed for each category expect for FPL 400% or above making this category as baseline category. Several dummy variable are created as follows: people in this neighborhood help each other out: agree including definitely agree and somewhat agree (1) and disagree including definitely disagree and somewhat disagree (0); we watch out for each other's children in this neighborhood: agree (1) and disagree (0); there are people I can count on in this neighborhood: agree (1) and disagree (0) ; and if my child were outside playing and got hurt or scared, there are adults nearby who I trust to help my child: agree (1) and disagree (0).

Dummy variables were created also for child is safe in the community or neighborhood: yes (1) and no (0); child is safe at school: yes (1) and no (0). Another set of dummy variables were created for birth status: mother was born in the U.S.: yes (1) and no (0); father was born in the U.S.: yes (1) and no (0); and the child was born in the U.S.: yes (1) and no (0). Finally, the BMI variable was coded as overweight and obese (1) and not obese (0) from the variable with 4 categories: underweight-less than 5th percentile; healthy weight-5th to 84% percentile; and overweight 85th to 94th % and obese- over 85th percentile.

Some Practical Issues and Assumptions.

There are several practical issues with conducting logistic regression analysis: for example, ratio of cases to variables. When there are too few cases and many predictor variables, some problems can occur, e.g., very large parametric estimates and standard errors. Therefore, extremely large parametric estimates and standard errors are indications of the small case to

variable ratio in the logistic regression analysis. However, ratio of cases to variables is not a problem in this model because the total number of respondents in the model is 38,122 and the total number of variables is 19. In addition, the adequacy of expected frequencies and power can be a problem when expected values are too small. These small expected values will produce little power. However, according to Cohen's (1988) table for statistical power, the sample size of 2,390 is enough to detect a small effect size (r=.1) when two tailed α=.01. The sample of this study is from a secondary dataset, thus there are not many choices about sample sizes. In addition, the sample size is very large and able to avoid the power issues. A goodness of fit test is run to evaluate expected cell frequencies for all variables including the outcome variable. There are no expected values 5 or fewer e.g., the least expected cell frequencies for the pair of other race and ethnic groups and overweight or obese variables are 495 sidewalks; the pair of sidewalks and overweight or obese variables is 3,979; and for the pair of parks and overweight or obese variables is 2,878. All other expected values were more than 495 in the cell frequencies.

Linearity assumptions

Logistic regression analysis assumes a linear relationship between continuous predictor variables and the logit transform of the outcome variable. In addition, logistic regression analysis does not assume a linear relationship between predictors. However, all the variables in Model I are discrete variables. Therefore, there are no linearity assumptions made for the model and this assumption is irrelevant for the model.

Multicolinearity assumptions

Multicolinearity can be a problem for logistic regression analysis, thus predictors should not be highly correlated. Multicolinearity is a problem for the logistic regression analysis

because when the correlation between predictors is very high, it increases the standard error b coefficient. This increased standard error indicates that the b coefficient in the sample is less likely to represent the population. According to the correlation matrix, there are not too many highly correlated variables in the model. However, the correlation matrix sometimes can miss subtle forms of multicolinearity. Therefore, multicolinearity diagnosis was run for this model (Table. 6). Even though there are no hard rules and cut point about value of the VIF, Myers (1990) suggests that a value of 10 is the point at which concern is needed. The VIF values show that there are no multicolinearity issues in the model. However, Bowerman and O'Connell (1990) suggest that if the average VIF for the model is greater than 1, then there is a multicolinearity problem in the model. Average VIF for the model is VIF=1.27, indicating that there might be a multicolinearity problem in the model. Tolerance values (1/VIF) show that there is no multicolinearity issue because all values of tolerance are greater than 0.2 as suggested by Mernard (1995). However, Eigenvalue shows how evenly the variances of the correlation matrix are distributed and the largest eigenvalue for the model is 15.031 and the smallest value is 0.008 indicating that the variances of the correlation matrix are not evenly distributed.

This means that the uncentered cross-product matrix is ill conditioned and any small changes in the variables may affect the regression parameters greatly. In addition, the condition index is a measure of dependency of one variable on the others. A high condition index will produce a higher standard error of the parameter estimates for the variable. Belsely et al. (1980) suggest that a criterion for multicolinearity is greater than 30. The condition index for this model has reached 42.872, indicating multicolinearity problems in the model. Therefore, variance proportions have been checked for each variable and for each eigenvalue. The variance

proportions show the proportion of the variance of each regression coefficient for each predictor that is associated with each eigenvalue. As Belsey et al. (1980) suggest that a condition index larger than 30 and variance proportions greater than .50 for at least two different variables show multicolinearity problem.

The variance proportions were checked and several values were larger than the suggested criteria for the analysis. For example, variance proportion for sidewalks or walking paths in neighborhoods was .56 and for parks or playgrounds in neighborhoods was .70 for eigenvalue of 0.133; the variance proportion for vandalism such as broken windows or graffiti was .58 and poorly kept or dilapidated/rundown housing was .57 for the eigenvalue of .66; the variance proportion for watching out for each other's children in neighborhood was .57 and for people in the neighborhood helping each other out was .82 for eigenvalue of .033; the variance proportion for people trusting each other in the neighborhood was .53 and for people I can counting on in neighborhood was .56 for eigenvalue of .026; the variance proportion for FPL 300-399 was .71 and for FPL 400 or above was .51 for eigenvalue of .364; and the variance proportion for mother was born in the U.S. was .61 and father was born in the U.S. was .66 for eigenvalue of .039. Therefore, some variables that are highly correlated to others are deleted. For example, sidewalks and parks (r=.446) variables are strongly correlated, thus the sidewalks variable is deleted from the model. The same procedures were conducted for poor housing and vandalism (r=.346) and the variable for vandalism is deleted from the model. In addition, watching out for children in the neighborhood and helping out neighbors (r=.517) are highly correlated and watching out for children in the neighborhood variable is deleted form the model. Trusting their neighbors is

highly correlated to counting on neighbors (r=.505) and the counting on neighbors variable is deleted from the model.

There is also a high correlation between FPL 300-399 and FPL 400 or above (r=.550) and FPL 400 or above is deleted from the model. Finally, the mother was born in the U.S. variable is highly correlated to the father was born in the U.S. (r=.632) and the father was born in the U.S. variable is deleted from the model. Therefore, neighborhood has sidewalks or walking paths, vandalism such as broken windows in the neighborhood, watching out for children in the neighborhood, counting on neighbors, FPL 400 or above and father was born in the U.S. variables are no longer in the model to fix multicolinearity issues.

Multicolineairty Diagnosis for Model I

Table 6.

	Tolerance	VIF	Eigenvalue	Condition Index
Sidewalk	0.730	1.370	15.031	1
Park	0.708	1.412	1.479	3.188
Recreation	0.827	1.209	1.081	3.73
Library	0.813	1.231	1.021	3.837
garbage	0.871	1.149	1.007	3.864
poor housing	0.835	1.197	0.984	3.909
Vandalism	0.844	1.185	0.939	4
Mother born	0.584	1.711	0.756	4.46
Father born	0.607	1.647	0.66	4.771
Child born	0.813	1.230	0.619	4.928
Hispanic	0.761	1.314	0.492	5.53
Black	0.943	1.061	0.46	5.716
Multi	0.976	1.025	0.364	6.422
Other	0.883	1.133	0.272	7.439
FPL99	0.881	1.136	0.2	8.676
FPL199	0.853	1.172	0.133	10.65
FPL399	0.868	1.152	0.112	11.593
AgeDV	0.993	1.007	0.092	12.756
Help out	0.660	1.516	0.078	13.918
Watch out	0.655	1.527	0.048	17.752
Count on	0.618	1.618	0.039	19.591
Trust	0.711	1.407	0.037	20.033
Safe neighbor	0.828	1.208	0.033	21.211

Table 6. Continued

	Tolerance	VIF	Eigenvalue	Condition Index
Safe school	0.887	1.128	0.028	23.052
GenderDV	0.998	1.002	0.026	23.861
			0.008	42.872

Independence of errors

Logistic regression analysis assumes that responses of cases are independent from each other. In other words, cases of the data should not be related to each other, e.g., the same respondents cannot be measured at a different time or repeatedly. Violation of the assumption creates overdispersion, meaning that observed variance is greater than expected variance in the logistic regression model. This bigger observed variance restricts standard errors and results in small confidence intervals. When the standard error is too small then the test statistic is bigger than it should be, therefore it is more likely to find statistical significance (Type I error). The Durbin-Watson test is run to examine if there is any independence errors known as autocorrelation (Table 7.).The Durbin-Watson test value (2.002) shows that the residuals are not correlated and the value is very close to 2 which by general consensus means that the assumption has certainly been met. According to the rule of thumb, values less than 1 or greater than 3 are violation of independency. Therefore, the model does not violate the assumption of independence of errors.

Model Summary for Model I

Table 7.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.096(a)	0.009	0.009	0.44868	
2	.232(b)	0.054	0.054	0.43849	2.002

Outlier assumptions

An outlier is a case that is substantially different from the main trend of the data, causing biases in the model. After running for logistic regression analysis casewise list, the result shows that there are several outliers detected in the model and the Hosmer and Lemeshow (α=.35.676, df=8, p<.0001) test was statistically significant, indicating that the model is not good fit for the data.

Therefore, further investigation needed for these outliers and z-score statistics was run to get more information about the outliers. The result confirmed the logistic regression analysis casewise list result. As the valid percent column shows that 94.5% of the cases with an absolute value less than 1.96 instead of expected percentage of 95% and 5.5% of the cases with an absolute value greater than 1.96. In other words, 5.5% of the cases were above the normal distribution limit. This suggests that there can be many outliers in this data set (table 8.).

Outliers for Model I

Table 8.

		Frequency	Percent	Valid Percent
Valid	Absolute z score less than 1.96	28850	31.5	94.5
	Absolute z score greater than 1.96	1633	1.8	5.4
	Absolute z score greater than 2.58	34	0.0	0.1
	Total	30517	33.3	100.0
Missing		61125	66.7	
Total	91642	100.0		

Therefore, absolute z scores were obtained to clarify outliers in the model and the result shows that the highest z score for an outlier was 2.761 which less than 3.29. Once there are enough cases in the modes to represent the study population, then 12 outliers were deleted from the model (Appendix B.). After deleting the outliers, the Hosmer and Lemeshow goodness of fit

test was run to examine the model fit for the data. The result shows that the model was good fit for the data (Hosmer and Lemeshow: α=11.143, df=8, p<.194) and there were no more outliers detected for casewise diagnosis.

Results For Obesity Among Adolescents And Neighborhood Factors.

Correlation Analysis between variables

Correlation analysis was run for all variables in the model (Appendix A. Correlation Analysis for Model I). According to results of the correlation analysis, all variables correlated to higher BMI statistically significant at level of p<0001except selected child's immigration status and household poverty is FPL from 200-399%. For example, being Black (r=.097), Hispanic (r=. 062), Multiracial (r=.018), living in FPL 0-99% (r=107), and FPL 100-199% (r=.070) are positively correlated to higher BMI. Therefore, Hispanic, Black and multiracial adolescents who live below FPL 199% are more likely to be overweight or obese than other racial groups. For example, being White (r=-.113) is negatively related to high BMI meaning that White adolescents are less likely to be overweight or obese. Gender (r=.097) is positively correlated to higher BMI, meaning that adolescent boys are more likely to be overweight or obese than adolescent girls. Age is negatively correlated to high BMI meaning that younger adolescents are more likely to be overweight or obese than older ones. FPL 400% or above (r=-.124), mother (r=-.023) or father (r=-.040) was born in the U.S. was negatively correlated to high BMI, meaning that adolescents who lived in FPL 400% or above and who have not U.S. born parents are less likely to have weight issues. Therefore, adolescents with the U.S. born parents were more likely to have weight problems than those who have non U.S. born parents.

Built neighborhood aspects: Living in neighborhoods where there is poorly kept or dilapidated or rundown housing (r=038), and litter or garbage on the street or sidewalk (r=.034) is also positively correlated to high BMI among adolescents. These correlations show that adolescents who live in neighborhoods poorly kept, dilapidated, and rundown housing and litter or garbage on the street or sidewalk are more likely to be overweight or obese than adolescents living in different neighborhoods. Parks or playground area (r=-.031), recreational facilities, community centers or boys or girls clubs (r=-.024) and libraries or bookmobiles (r=-.035) in neighborhoods are negatively correlated to high BMI, meaning that adolescents who live in neighborhoods where there are no parks, playgrounds, recreational facilities, community centers or boys or girls clubs and libraries or bookmobiles are more likely to have weight problems.

Neighborhood cultural aspects: Neighborhoods where people help each other out (r=-.060), trust one another (r=-.043), safe neighborhoods (r=-.061) and schools (r=-.046) are also negatively correlated to high BMI. Therefore, adolescents who lived in neighborhoods where people did not trust neighbors, did not help each other out and who live in unsafe neighborhoods and participated in unsafe schools were more likely to be overweight or obese.

Sequential Logistic Regression Analysis

Sequential logistic regression analysis was carried out to predict the group membership for overweight or obese and not obese categories. Sequential logistic regression analysis with ENTER instruction was chosen because of the covariates. Therefore, predictors are entered in two sets: neighborhood characteristics and demographics. The major question is whether neighborhood characteristics variables significantly increase the prediction of obesity among adolescents in comparison to demographic variables. The categorical predictor variables are

coded as ways of *Indicator* (default in SPSS) coding, which is the standard dummy variable coding. In addition, First category was chosen as a baseline category for the contrast. Therefore, SPSS predicted all "response" category e. g., neighborhood has park or playground (1), neighborhood has recreational facilities or girls or boys clubs (1), has a library or bookmobile (1), Hispanic (1), Black (1) etc.

The final sample size for the logistic regression analysis was 38,110 and log likelihood of the baseline model was 45,475.25 representing the fit of the most basic model to the data. A contingency table for the baseline models shows that SPSS classified 71.6% of the participants correctly. Variables not in the equation table showed that the residual α=351.94, $p<.0001$, indicating that variables not in the model were significantly different from zero and one or all of these variables would affect the model predictive power significantly. The highest value of Roa's efficient score statistic in the variables not in the equation table is 147.08 which is statistically significant at the level of $p<.0001$ for neighborhood safety, followed by 144.89, $p<.0001$ for people in the neighborhood help each other out and the lowest score observed is 18.76, $p<.0001$ for recreation centers, community centers or boys or girls clubs exist in the neighborhood. This confirms that each variable would make a significant contribution to the model at the statistically significant level of $p<.0001$.

All neighborhood characteristic variables were added to the model in Block 1. Log-likelihood of the new model was 45110.08 which is less than log-likelihood of constant only model. This indicates that the model was predicting an outcome variable more accurately than constant only model (45475.25-45110.08=365.17) and chi-square distribution of the value of 365.17 is statistically significant at the level of $p<.0001$, meaning that the second model

predicted the outcome significantly more accurate than the first model. The Hosmer and Lemeshow test (α=10.67, df=5, p<.06) indicated that the model was a good fit for the data. Cox & Snell R^2 (r=.009) and Nagelkerke R^2 (r=.013) showed that the model only explains 0.9%-1.3% of the outcome variable. In other words, neighborhood characteristic variables can explain only between 0.9% and 1.3% of the obesity and overweight problems among adolescents.

Wald chi-square statistics showed the unique contribution of each predictor while holding the other predictors constant to prevent any overlap between predictors (Table 9.). The highest contribution was made by "people in this neighborhood help each other out" (Wald α=39.63, p<.0001) followed by "neighborhood safety" (Wald α=.36.13, p<.0001); and "school safety" (Wald α=21.33 p<.0001). Therefore, the most contributions were made by neighborhood cultural aspect variables. "Library in the neighborhood" (Wald α=15.59, p<.0001); "park or playground in the neighborhood" (Wald α=15.00, p<.0001) and "poorly kept or dilapidated/ rundown housing in the neighborhood" (Wald α=14.32, p<.0001) made also significant contribution to the explaining obesity and overweight among adolescents. "There is litter or garbage on the street or sidewalk" (Wald α=4.30, p<.035) predictor made much less contribution to the model but the contribution was still statistically significant at level of p<.05. "There are adults nearby who I can trust to help my child" (Wald α=5.72, p<.017) predictor also made less contribution to the model but the contribution was statistically significant at level p<.05. Therefore, most built neighborhood and neighborhood cultural factors explained obesity and overweight among adolescents statistically significant levels. However, only "Recreation center, community center or boys or girls club" (Wald α=0.81, p<.368) predictor made the least contribution which was not statistically significant in the first block of the analysis.

Built neighborhood factors: Odds ratio for poorly kept or dilapidated/rundown housing (odds ratio=1.14) and for litter and garbage on the street or sidewalk (odds ratio=1.07) were positively related to the outcome variable. The odds ratios indicate that one unit change in predictors increases the outcome variable by the odds ratios. In other words, living in a neighborhood where poorly kept or duplicated or rundown housing increases obesity by 1.14 times. If the odds ratio is converted to probabilities: $\hat{Y}$=ODDS/1+ODDS, odds for poorly kept or dilapidated or rundown housing was ODDS=$e^{\cdot}$ =1.186. Therefore, the probability for poorly kept housing is $\hat{Y}$=.54 meaning that 54% of adolescents who live in neighborhoods where poorly kept or dilapidated/rundown housing were obese or overweight. The similar outcome was observed for litter or garbage on the street or sidewalk variable. One unit increase in litter or garbage on the street or sidewalk variable increases obesity by 1.07 times among adolescents. The probability for the outcome is $\hat{Y}$=.52, showing that 52% of children who lived in neighborhoods where litter or garbage is on the street or sidewalk were obese or overweight.

Odds ratios for all other predictors were less than 1, meaning that one unit change decrease in the predictor will increase obesity by the odds ratio for the predictor. For example, children who lived in neighborhoods where there were no parks or playground areas were more likely to be obese or overweight by odds ratio=.90, showing that these adolescents were .90 times more likely to be obese than children who lived in neighborhoods where there were parks and playground areas. The probability of being obese or overweight for adolescents who lived in neighborhoods without parks or playground areas is $\hat{Y}$=.48%, indicating the there was a probability that 48%children who lived in neighborhoods where there were no parks and playgrounds are obese or overweight. Not having recreational centers, community centers or

boys or girls clubs were negatively related to obesity, but the result was not statistically significant. Not having a library or bookmobile in the neighborhood increased obesity and overweight among adolescents by odds ratio=.87, meaning that these adolescents were .87 times more likely to be obese or overweight than the adolescents who live in neighborhoods where there was a library or bookmobile. In terms of probability, $\hat{Y}$=.47 shows that there was the probability that 47% of adolescents who lived in the neighborhoods where there were no libraries or bookmobiles were obese or overweight.

Cultural factors of neighborhood: children who lived in neighborhoods where residents did not help each other out were odds ratio=.76 and these adolescents were .76 times more likely to be obese than children who lived in neighborhoods where neighbors helped each other out. The probability of $\hat{Y}$=.44 indicated that 44% of children could be obese or overweight in the neighborhoods where residents do not help each other out. Similar results were found for "there were no adults nearby who I could trust to help my child" variable. The odds ratio for this variable was .89 indicating that children who lived in neighborhoods where there are no adults who parents can trust are .89 times more likely to be obese than children who lived in neighborhoods where parents could trust other adults to help their children. The probability percentage shows that $\hat{Y}$=.48 (48%) of the children who lived in neighborhoods where there are no adults that parents trust to help their children were likely to be obese or overweight.

Children who lived in unsafe neighborhoods, at least in parents' perception, were more likely to be obese or overweight by an odds ratio of .78 meaning that these adolescents were .78 times more likely to be obese or overweight than children that lived in safe neighborhoods. There was the probability of $\hat{Y}$=.45 (45%) of children being obese or overweight in unsafe

neighborhoods. School safety also negatively related to the obesity or overweight issues among teenagers. For children who went to unsafe schools, at least in parents 'perception, the odds ratio was .82 indicating that these adolescents were .82 times more likely to be obese or overweight than the adolescents who went to safe schools. There was a probability of $\hat{Y}$=.46 showing that there was a probability of 46% of children who went to unsafe schools was obese or overweight.

All predictors, except recreation centers, community centers or boys or girls clubs predicted the outcome variable at statistically significant levels and confidence intervals for odds ratio were in 95% indicating that true value of odds ratio is obtained at 95% of confidence intervals. Most of the built neighborhood factors were significantly related to obesity and overweight problems among adolescents. For example, there is a probability that 52% of adolescents who live in neighborhoods where there are poorly kept or dilapidated/rundown housing; 52% who live in neighborhoods where garbage or litter on the street; 48% who live in neighborhoods where there are no parks or playgrounds; 47% who live in neighborhoods where there are no libraries or bookmobiles to be overweight or obese. These results were very similar to findings from previous studies that were discussed in the literature review.

All of the cultural aspect variables were related to obesity very strongly. For example, there is a probability that 44% of adolescents who live in neighborhoods where people do not help each other; 48% who live in neighborhoods where parents cannot trust their neighbors; 45% of adolescents who live in unsafe neighborhoods; and 46% of adolescents who go to unsafe schools were overweight or obese. These results show that the cultural aspects of neighborhoods are very important factors that need to be addressed and studied more to reduce and prevent obesity among adolescents.

Binary Logistic Regression Results for Model I (Block 1)

Table 9.

Predictors	B(S.E.)	Wald α^2	95% C.I. for Odds ratio		
			Lower	Odds ratio	Upper
Park	-0.11 (0.03)***	15.00	0.85	0.90	0.95
Recreation	-0.02 (0.03)	0.81	0.93	0.98	1.03
Library	-0.15 (0.04)***	15.59	0.81	0.87	0.93
Garbage	0.07 (0.03)*	4.30	1.00	1.07	1.15
Poor housing	0.13 (0.03)***	14.32	1.07	1.14	1.22
Help out	-0.27 (0.04)***	39.63	0.70	0.76	0.83
Trust	-0.12 (0.05)*	5.72	0.81	0.89	0.98
Safe neighbor	-0.25 (0.04)***	36.13	0.72	0.78	0.84
Safe school	-0.19 (0.04)***	21.33	0.76	0.82	0.89
Constant	0.04 (0.07)	0.29		1.04	

*p<.01, ***p<.0001

Block 2 shows data when demographic variables were added to the model. Model I summary shows that the -2log likelihood statistic for Block 2 is 43789.41 which is much less than Block I -2 log likelihood meaning that adding demographic variables into the model increased its predictability. Adding the demographic variables reduced -2 log likelihood statistic by 45110.08-43407.36=1702.72, p<.0001, showing that the model was predicting whether an adolescent was obese or not obese significantly better than it was with only the neighborhood characteristic variables. The value of Cox and Snell R^2 was r^2=.052 and the value for Nagelkerke R^2 was r^2=.075, thus the model explained 5.2%-7.5% of the outcome variable which was much better than previous block. In other words, from 5.2 to 7.5% of the obesity or overweight issues among adolescents in the U.S. can be explained by this model. The value of Hosmer and Lemeshow was α^2=11.143, df=8, p<.194, indicating that the model was a good fit for the data and chi-square, and statistical significant values were larger than Block 1. However, the classification table shows that the model classified 71.9% of the participants correctly which was not much improvement from the previous block (71.6%).

According to the Wald α^2, the age of adolescents made the most contribution to the model (Wald $\alpha^2 = 393.04$, $p<.0001$), indicating that the age of the adolescents made the most contribution while holding other predictors constant (Table 10.). The Federal Poverty Level 0-99% also made a very strong contribution to the model (Wald $\alpha^2=377.02$, $p<.0001$), showing that the household poverty level predicted obesity or overweight among adolescents very strongly while holding other predictors constant. All Federal Poverty Level categories made very strong (statistically significant) contributions to the model, while holding other predictors constant. The gender of the adolescents also made a very strong contribution to the model (Wald $\alpha^2=376.98$, $p<.0001$) while holding other predictors constant. The next significant contribution was made by the Black (Wald $\alpha^2=203.25$, $p<.0001$) racial category, followed by the Hispanic (Wald $\alpha^2=89.77$, $p<0001$) racial category while holding other predictors constant.

In addition, whether neighborhoods had park or playground (Wald $\alpha^2=26.48$, $p<.0001$); whether neighbors helped each other out (Wald $\alpha^2=8.65$, $p<.003$); whether a child born in the U.S. (Wald $\alpha^2=8.13$, $p<.004$); and child being multiracial (Wald $\alpha^2=19.82$, $p<.0001$) made statistically significant contributions to the model while holding other predictors constant. Some of the neighborhood predictors that made statistically significant contributions to the previous block became not significant in the final model. This could happen because of the strong demographic predictors added to the model, and the neighborhood characteristic variables could be suppressed by the added predictors. The Wald statistic was also very conservative (underestimated) especially when the standard error was inflated because of the large regression coefficient (B).

The odds ratio for poorly kept or dilapidated/rundown housing in the neighborhood, mother was born in the U.S., child was born in the U.S., Hispanic race, Black race, multiracial, other race and ethnic groups, Federal poverty levels, and gender positively related to obesity and overweight among adolescents and the odds ratios for these predictors were larger than 1.

Built neighborhood factors: Odds ratio for neighborhood has access to parks or playgrounds was odds ratio=.86 $p<.0001$, indicating that adolescents who live in neighborhoods where there are no access to parks or playgrounds are .86 times more likely to have weight related problems. Odds ratio for poorly kept or dilapidated/rundown housing in the neighborhood was odds ratio=1.06 $p<.05$, meaning that adolescents who lived in the poorly kept or dilapidated/ rundown housing in the neighborhoods were 1.06 times more likely to be obese or overweight than other children who lived in neighborhoods there were no poorly kept housing and the result was statistically significant at level of $p<.05$. These results were consistent with Block I results.

Neighborhood cultural factors: Odds ratio for people help each other out was .88 $p<.01$, showing that adolescents who live in neighborhoods where people do not help each other are .88 times more likely to be overweight or obese than adolescents who live in neighborhoods where people help each other out. Odds ratio for safe neighborhood variable was .93 $p<.05$, expressing that adolescents who live in unsafe neighborhoods are .93 times more likely to suffer from being overweight and obese than adolescents who live in safe neighborhoods. There results were also the same with Block I results.

Demographic factors: The child was born in the U.S. predictor was positively related to the outcome variable and odds ratio for the predictor was 1.24, indicating that the children who were born in the U.S. were 1.24 times more likely to be obese or overweight than children who

were born outside of the U.S. This variable predicted the outcome variable at a statistically significant level and in terms of probability Ŷ=.32.6, thus there was a probability that 32.6% of children who were born in the U.S. were obese or overweight.

Being Hispanic was also positively related to obesity and overweight. Odds ratio for Hispanic group was 1.50, meaning that Hispanic adolescents were 1.50 times more likely to be obese than White adolescents (baseline category). The probability of being obese or overweight for Hispanic adolescents was Ŷ=.37 indicating that there is the probability that 37% of Hispanic adolescents were obese or overweight. The Black category also was positively related to the outcome variable and odds ratio was 1.76, showing that Black adolescents were 1.76 times more likely to be obese or overweight than White adolescents. The probability for the Black category was Ŷ=.41,, thus there was the probability that 41% of Black adolescents were obese or overweight. Being Multiracial was also significantly related to being obese or overweight. The odds ratio for the Multiracial category was 1.29, thus multiracial adolescents were more 1.29 times more likely to be obese or overweight than White adolescents. The probability for this category was Ŷ=.34, indicating that there was the probability that 34% of the Multiracial adolescents were obese or overweight. The odds ratio for other racial and ethnic groups was 1.02 meaning that adolescents from other racial and ethnic groups are 1.02 times more likely to be obese or overweight than White adolescents, but this predictor was not statistically significant.

The odds ratio for the Federal poverty level 0-99% was 2.33 meaning that adolescents who lived in Federal poverty level 0-99% (poor household) were 2.33 times more likely to obese or overweight than adolescents who lived in the Federal poverty level 400 and higher (baseline category). The probability for this category was Ŷ=.48, showing that there was the probability

that 48% of the adolescents who lived in the Federal poverty level were obese or overweight. The odds ratio for the Federal poverty level 100-199% was 1.79, meaning that adolescents who lived in the Federal poverty level 100-199% were 1.79 times more likely to be obese than the adolescents who lived in Federal poverty level of 400 or higher. The probability for this category was $\hat{Y}$=.41 resulting that there is the probability that 41% of adolescents who lived in the Federal poverty level 100-199% were obese or overweight. The odds ratio for the Federal poverty level 200-399% was 1.43, indicating that adolescents who lived in the Federal poverty level 200-399% were 1.43 times more likely to be obese or overweight than adolescents who lived in the Federal poverty level 400 and higher. The probability for this category was $\hat{Y}$=.36, showing that there was the probability that 36% of adolescents who lived in Federal poverty level 200-399% were obese or overweight.

The odds ratio for age predictor was .58, indicating that younger adolescents were .58 times more likely to be obese. The probability for age predictor was $\hat{Y}$=.18 therefore, there was the probability that 18% of younger adolescents were obese. The odds ratio for the gender category was 1.58, showing that male adolescents were 1.58 times more likely to be obese or overweight than females. The probability for this predictor was $\hat{Y}$=.38, showing that there was the probability that 38% of males was obese or overweight.

All new predictors that were added to the model, except mother was born in the U.S. and other race and ethnic groups, were predicted outcome variables at statistically significant levels and confidence intervals for odds ratio were 95%, indicating that true value of the odds ratios were obtained at 95% of confidence intervals.

Binary Logistic Regression Results for Model I (Block 2)

Table 10.

Predictors	B (S.E.)	Wald α^2	Lower	95% C.I. for Odds ratio	
				Odds ratio	Upper
Park	-0.15 (.03)***	26.48	0.81	0.86	0.91
Recreation	-0.03 (.03)	1.08	0.92	0.97	1.03
Library	-0.06 (.04)	2.71	0.87	0.94	1.01
Garbage	-0.03 (.04)	0.63	0.91	0.97	1.04
Poor housing	0.06 (.04)*	2.93	0.99	1.06	1.14
Help out	-0.14 (.05)**	8.65	0.80	0.88	0.96
Trust	-0.07 (.05)	1.87	0.84	0.93	1.03
Safe neighbor	-0.07 (.04)*	2.89	0.85	0.93	1.01
Safe school	-0.06 (.04)	1.60	0.87	0.95	1.03
Mother born in U.S.	0.06 (.05)	1.51	0.97	1.06	1.16
Child born in U.S.	0.22 (.08)**	8.13	1.07	1.24	1.44
Hispanic	0.41 (.04)***	89.77	1.38	1.50	1.63
Black	0.56 (.04)***	203.25	1.63	1.76	1.90
Multi-racial	0.26 (.06)***	19.82	1.15	1.29	1.45
Others	0.02 (.06)	0.06	0.90	1.02	1.15
FPL99	0.85 (.04)***	377.02	2.14	2.33	2.54
FPL199	0.58 (.04)***	270.54	1.67	1.79	1.92
FPL399	0.35 (.03)***	163.00	1.35	1.43	1.51
Age	-0.55 (.03)***	393.04	0.55	0.58	0.61
Gender	0.46 (.02)***	376.98	1.51	1.58	1.66
Constant	-0.69 (.12)	74.87		0.39	

*p<.05, **p<.001, ***p<.0001

Final Discussions on Model I Results.

A sequential logistic regression analysis was performed on obesity and overweight among U.S. adolescents age between twelve and seventeen and neighborhood characteristic predictors: whether parks or playground areas exist in neighborhood, whether recreation centers, community centers or boys or girls club existed in neighborhood, whether a library or bookmobile existed in neighborhood, whether there was litter or garbage on the street or

sidewalk, whether there was poorly kept or dilapidated/rundown housing in neighborhood, whether neighbors helped each other out, whether neighbors trusted each other, whether people felt safe in their neighborhood and whether parents felt safe about their children in school. In addition, demographic and social characteristic control variables were also included in the model: race and ethnicity of a selected child, age and gender, the Federal poverty level of the selected child's household, whether the mother of the selected child was born in the U.S., and whether the selected child was born in the U.S.

After deletion of 12 outliers, there were 35,131 adolescents available for the analysis: Whites 25,369 (69.9%), followed by Hispanics 3,770 (10.3%), Blacks 3,710 (10.2%), Multi-racial 4,329 (4.8%), and Others 3,994 (4.4%) and slightly over half of the adolescents were males (52.27%) for the model. In addition, 3,688 (9%) of the mothers were not U.S. born compared to 2,783 (9.9%) of the fathers and 1,385 (3.8%) of the children not U.S. born. Moreover, almost one third (29%) of the adolescents were obese or overweight in this model.

Most of the neighborhood characteristics and demographic variables predicted obesity among adolescents at statistically significant levels. Table 8 is a more accurate statistical analysis for neighborhood characteristic predictors due to Wald statistic underestimation. Therefore, all neighborhood characteristics were very strong predictors of obesity among adolescents as discussed in the previous section.

A test of the full model with all neighborhood predictors and demographic control variables against neighborhood characteristic predictors were statistically significant, $\alpha^2 = 43407.36$, $p<.0001$, indicating that predictors and control variables, as a set, reliably distinguished between adolescents who were obese or overweight and adolescents who were not

obese or overweight. Table 9 shows regression coefficients, Wald statistics, odds ratios, and 95% confidence intervals for odds ratios for each predictor and the control variables. Therefore, directional hypothesis #1 and hypothesis #2 are confirmed. In other words, adolescents who live in neighborhoods where there is no access to sidewalks, walking paths, parks, playgrounds, recreational centers, community centers, boys and girls clubs, and library or bookmobile; and where there is litter, garbage on street, dilapidated/rundown housing, broken windows or graffiti are more likely to be obese than adolescents who live in neighborhoods where there is more resources such as access to sidewalks, walking paths, parks, playgrounds, recreational centers, community centers, boys and girls clubs, and library or bookmobile; and where there is no litter, garbage on street, dilapidated/rundown housing, broken windows or graffiti. Adolescents who live in neighborhoods where there are people who do not help each other out, watch each other's children, people cannot count on each other, and people who do not feel safe are more likely to be obese or overweight than their counterparts who live in neighborhoods where there are people help each other out, watch each other's children, people can count on each other, and where people feel safe. In addition, race and ethnicity category made a very strong independent impact e.g., being minority especially Hispanic and Black adolescents living in households below FPL 0-99% and FPL 100-199% were highly associated with obesity among adolescents. Minority adolescents were much more likely to be obese or overweight ($p<.0001$) when compared with White adolescents. However, this model was able to explain only 1.3% of obesity issues among American adolescents.

Model-II: Obesity Among Adolescents And Physical And Social Activity

Descriptive Statistics and Missing Values for Model II.

There were 40,673 (63.5%) children on a sports team or taking sports lessons after school or on weekends compared to 23,354 (36.4%) children not on a sports team or taking sports lessons after school or on weekends. There were only 49 missing cases in this variable. About 9% (5,767) of the children did not do any physical activity in the past week compared to 25.3% (16,053) of the children who did physical activity for 1-3 days, 37% (23,498) of the children exercised 4-6 days and 28.6%(18,116) of the children exercised every day. There were only 74 missing values. For the selected child participated in any clubs or organization after school or on weekends variable, 40,352 (63%) children participated in clubs or organizations compared to 23,649 (36.9%) children did not participate in clubs or organizations after school or on weekends. About 15% (5,412) of children have been involved in any type of community service or volunteer work at school, church or in the community compared to 24.5% (8,900) for a few times a month, 42.8% (15,510) a few times a year and 17.5% (6,341) of children have never been involved in community service or volunteer work at school, church, or in the neighborhood. There were 108 missing values including those who refused to answer.

About 59% (21,306) of the adolescents between the ages of twelve and seventeen years were not working compared to 25.5% (9,181) working up to 9 hours a week and 15.4% (5,557) were working more than ten hours a week. There were 233 missing values including people who refused to answer.

About 6.6 % of the selected children did not spend any time watching TV or playing video games on weekdays compared to 44.2% who played one hour or less, 39.1% who played

between 1 and 4 hours and 10.1% who played four hours or more. There were 396 missing values.

More than 77% of the selected children lived with two parent, including biological, adopted and step families compared to 16.2% of the selected children who lived in single parent households (mother or father) and 6.3% in other family types. Almost 4% (3,522) of households did not share any meal with all family members together in the past week compared to 19.5% (17,824) of the households who shared meals 1-3 times when all family members were there, 33.4% (30,532) who shared 4-6 days and 43.2% (39,514) of the households shared meals every day when all family members were there. There were 250 missing values and all missing values for every variable were deleted from the model.

Variables Coding.

All dummy variable codings were created with the intention to make interpretations easier even though logistic regression analysis does not require variables to be dummy coded. A dummy variable was created for hours spent watching TV or videos or playing video games on an average weekday. The children who spent one to four hours are coded as (2) and more than four hours were coded as (3) and the children who did not spend any time watching TV or videos or playing video games and the children who spent less than one hour were coded as (1); A new variable was created for number of days all household family members shared a meal in the past week and no days were coded as (1), 1-3 days were coded as (2), 4-6 days were coded as (3) and everyday was coded as (4).

Another dummy variable was created for the children who were living in working poor households (income below poverty level and someone employed all year), and the children who

were living in working poor households were coded as (1) and the children who were not living in the working poor households were coded as (0); A dummy variable was created for hours spent working for pay and the children who did not work for pay coded as (0), children who worked for pay coded as (1). A new variable was created for community service or volunteer work at school, church or in the community and the children who did not volunteer and did not participate in the community activities was coded as (4), a few times a year was coded as (3), a few times a month was coded as (2), and once a week or more was coded as (1).

A new variable was created for the children who participated in any clubs or organizations after school or on weekends and the children who did not participate in organized activities outside of school was coded as (0) and the children who participated in organized activities outside of school was coded as (1). A new variable was generated for the children who exercised, played a sport or participated in physical activity for at least 20 minutes that made him/her sweat and breathe hard and the children who did not exercise was coded as (1), 1-4 days as (2), and more than four days was coded as (4). A dummy variable was created for the selected child who was on a sports team or he/she took sports lessons after school or on weekends and the children who answered "yes" was coded as (1) and "no" was coded as (0). A new variable was created for family structure and two parent- biological or adopted family coded as (1), two parent-step family was coded as (2), single mother or father family was coded as (3), and other type of family was coded as (4). A dummy variable was created for households that received food stamps during the past twelve months and households received food stamps were coded as (1) and who did not receive them was coded as (0). Another dummy variable was created for the

selected child who received free or reduced cost breakfasts or lunches at school and the children answered “yes” was coded as (1) and “no” was coded as (0).

A dummy variable was created for primary language of the household and English was coded as (1) and not English was coded as (0). A new variable was generated for the mother’s education and less than high school was coded as (1), high school graduated was coded as (2) and more than high school was coded as (3). Another variable was also created for father’s education and less than high school was coded as (1), high school graduated was coded as (2) and more than high school was coded as (3).

Some Practical Issues and Assumptions.

As discussed in the previous model, practical issues with conducting logistic regression analysis are also relevant to this model. For example, the ratio of cases to variables is not a problem in this model because the total cases of the model totaled 13,969 and the total number of variables is eighteen. In addition, a goodness of fit test was run to evaluate expected cell frequencies for all variables including the outcome variable. There is no expected values five or fewer e.g., there were fewer expected cell frequencies (223) for families not having meals together any day in a week and adolescents who volunteer work at school, church or in the community; for volunteering at school, church or in the community and not speaking English at home (273); expected frequencies for working poor families and having meals with all family members together were 263; for working poor families and father’s education were 279; and for all other expected values were more than 309 in the expected cell frequencies. Therefore, there were no problems with expected cell frequencies. In addition, some assumptions, such as the linearity, have not been discussed in this section because they were the same as previous model.

Multicolinearity assumptions

Multicolinearity diagnoses, however, were run for the model (Table. 11). Average VIF for the model is VIF=1.24 indicating that there can be multicolinearity problem. Tolerance values (1/VIF) show that there are no multicolinearity issue because all values of tolerance are greater than 0.2. However, the largest eigenvalue for the model is 11.585 and the smallest value is .09 indicating that the variances of the correlation matrix are not evenly distributed. In addition, the condition index reached 35.542 indicating possible multicolinearity problems in the model. Therefore, variance proportions were checked for each variable and for each eigenvalue. The variance proportions show the proportion of the variance of each regression coefficient for each predictor that is associated with each eigenvalue. The variance proportions were checked and several values exceeded the suggested criteria found in the analysis. For example, the variance proportion for child's family received food stamp during the past twelve months was .53 and for working poor families was .59 for eigenvalue of .664; the variance proportion for mother's education was .81 and for father's education was .58 for the eigenvalue of .038. Therefore, some variables that were highly correlated with others were deleted. For example, the child's family received food stamp in the past twelve months and father's education variables were deleted from the model. Therefore, the model has only sexteen variables.

Multicolinearity Analysis for Model II

Table 11.

	Tolerance	VIF		Eigenvalue	Condition Index
Sport team	.699	1.430	1	11.585	1.000
Money pay	.954	1.048	2	1.488	2.790
TV video	.923	1.084	3	1.030	3.353
Volunteer work	.893	1.120	4	1.001	3.401
Organized activity	.668	1.497	5	.987	3.425
Physical activity	.882	1.134	6	.708	4.046

Table 11. Continued

	Tolerance	VIF		Eigenvalue	Condition Index
Gender	.955	1.047	7	.664	4.177
Language	.599	1.670	8	.488	4.873
Mom Education	.693	1.442	9	.455	5.046
Father Education	.697	1.435	10	.439	5.137
Family structure	.942	1.062	11	.376	5.554
Food stamp	.799	1.252	12	.205	7.519
Free lunch	.736	1.358	13	.150	8.775
Meals	.963	1.039	14	.118	9.897
Working poor	.870	1.149	15	.100	10.770
Hispanic	.611	1.635	16	.080	12.046
Black	.919	1.088	17	.049	15.370
Multi	.979	1.022	18	.038	17.540
Other	.942	1.061	19	.029	19.862
			20	.009	35.542

Independence of errors

The Durbin-Watson test was run to examine if there is any independence errors (Table 12.). The Durbin-Watson test value (2.024) shows that the residuals are not correlated and the value is very close to two which is a conservative rule that the assumption has certainly been met. Therefore, the model does not violate the assumption of independence of errors.

Model Summary for Model II

Table 12.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.153(a)	0.024	0.023	0.46040	
2	.219(b)	0.048	0.047	0.45472	2.024

Outlier assumptions

After running the logistic regression casewise list, the result shows that there are several outliers detected in the model (Appendix D). The result for the goodness of fit for the data was

Hosmer and Lemeshow: α=41.922.df=8, p<.0001). Therefore, further investigation is needed for these outliers and case summaries were conducted for the cases with standardized residual greater than 2. A new coding variable (1=include, 0=exclude) was created only for the eleven cases that need to be checked. Cook's influential statistics were run and centered Leverage value and standardized residual statistics were calculated (Table 13).

Case Summaries for Model II

Table 13.

Case Number	Analog of Cook's influence statistics	Leverage value	Normalized residual
7069	0.00336	0.00051	2.57525
24749	0.00352	0.00052	2.60429
40986	0.00385	0.00057	2.59313
49387	0.00385	0.00057	2.59313
61446	0.00336	0.00051	2.57525
63438	0.00336	0.00051	2.57525
71773	0.01154	0.00174	2.57021
72834	0.00352	0.00052	2.60429
87430	0.00923	0.00129	2.66976
90702	0.00336	0.00051	2.57525
91408	0.00352	0.00052	2.60429
N	11	11	11

Cook's influence statistics provide information about how a case influences the model as a whole and Cook and Weisberg (1982) recommend that values larger than one may be a concern for the model. As the results show, all of the Cook's distance values were much less than one indicating that there is no concern about strong influence cases. The greatest number is Cook's distance=.01154 for the case number 71,773 which is smaller than cut off number of one. A second measure for outlier cases was the Leverage value which measures the influence of the observed value of the outcome variable (BMI) over the predicted values. The Leverage values needed to be close to ((R+1)/n) and (R+1) was equivalent to the number of predictors added one

and (n) was equivalent to sample size of the model. Therefore, the Leverage values need to be close to (19+1)/13973=.00143. However, Hoaglin and Welch (1978) suggest that an outlier case value is twice as large as than the average Leverage value might be the concern for the model (2 (R+1)/n). Stevens suggested that if the value is three times greater than the average value it may be a concern (3(R+1)/n). Therefore, the Leverage value should be at least .00286 or greater to be considered as an outlier. According to the test result, there is no value that may indicate an outlier problem. The largest Leverage value was .00174 for the case number 71,773 but this value is much less than the cut-off point required to indicated a problem. In addition, the larger value does not mean that the case has a large influence on the regression coefficient because this value was measured on the outcome variable not for the predictors. Finally, standardized residuals were calculated for each influential case to identify cases that have a large potential influence on the regression model. The largest influence was made by the case number 87,430 and standardized residual=2.66976 and it was greater than the absolute value of two. However, other statistics such as Cook's distance and Leverage value did not indicate that this case as a threat to the regression model. Therefore, all cases were kept in the model and not considered serious threats to the regression model.

Results For Obesity Among Adolescents And Physical And Social Activity.

Bivariate Correlation Analysis

Bivariate correlation analysis was conducted to determine associations between variables. The results show that BMI is significantly related to all variables in the model (Appendix C. Correlation Analysis for Model II).

Physical activity: Being on a sports team or taking sports lessons after school or on weekends was also negatively associated with high BMI (r=-.098, p<.0001), indicating that the children who were on a sports team or took sports lessons after school or weekends were less likely to be obese or overweight. High BMI and physical activity for at least 20 minutes that made the child sweat and breathe hard (r=-061, p<.0001) was also negatively related. Thus, the children who exercise at least 20 minutes were less likely to be obese or overweight. In addition, there was also a significant negative correlation between BMI and the selected child earning money from any work including regular jobs as well as babysitting, cutting grass, or other occasional work (r=.-038, p<.0001), indicating that those children who work for pay were less likely to be obese or overweight than those who do not work.

Social activity: The BMI was negatively correlated with any type of community service or volunteer work at school, church or in the community (r=-.032, p<.0001), showing that the children who volunteer or do community service were less likely to be obese or overweight. Finally, watching TV, videos or playing video games was also positively related to high BMI (r=. 106, p<.0001).

Demographic variables: Mother's education (r=-.117, p<.0001) was negatively correlated to the BMI, indicating that adolescents who have mother with higher education were less likely to be obese or overweight than adolescents who have mothers with lower education. High BMI was also positively correlated to children who get free or reduced cost breakfasts or lunches at school (r=.123, p<.0001), indicating that the children who get reduced cost or free breakfasts or lunches were more likely to be obese or overweight. In addition, there was also a statistically significant positive relationship between high BMI among adolescents and working poor

families (r=.078, p<.0001), indicating that children from working poor families were more likely to be obese or overweight.

Sequential Logistic Regression Analysis

Sequential logistic regression was carried out to predict the group membership for overweight or obese and not obese categories. Sequential logistic regression with ENTER instruction was chosen because of covariate analysis. Therefore, predictors are entered in two sets: physical and social activity variables in one set and all demographics in the second set. The major question is whether physical and social activity variables significantly predict the outcome variable (childhood obesity) while demographic variables were controlled. SPSS compared each category to the first category e. g., the adolescents who were on a sports team or took sports lessons after school or on weekends were compared to the adolescents who were not on a sports team or did not take sports lessons after school or on weekends. The adolescents who participated in any clubs or organizations after school or on weekends were compared to the adolescents who did not participated in any clubs or organizations after school or weekends.

The total sample size of the model was 13,969 and all of the participants were between twelve and seventeen years old. The classification table shows that 68.2% of the all cases were classified correctly and 9,524 of the participants were classified in the not obese category and 4,445 participants were classified in the obese category. The variables not in the equation table showed that the residual chi-square statistic was 366.270 and was statistically significant at p<. 0001 level, meaning that the coefficients for the variables not in the model were significantly different from zero. The addition of one or more of these variables to the model will significantly affect the predictive power. The overall fit of the new model (Block1) was assessed with the log-

likelihood statistic which was 17475.46 at the Block 0 level and it became 17107.67 at Block 1 indicating that the new model was predicting the obesity and overweight status of adolescents more accurately than the previous model and the model prediction improved by 17475.46-17107.67=367.79. There were total of seven variables, all associated with physical and social activities of adolescents included in the Block 1.

The Hosmer and Lemeshow test (α=8.909, df=8, p<.350) indicated that the model was a good fit for the data. Cox & Snell R^2 (r=.026) and Nagelkerke R^2 (r=.036) showed that the model only explained 2.6%-3.6% of the outcome variable. In other words, the variables in the model can explain between 2.6% and 3.6% of the obesity and overweight problems among adolescents.

As shown in the result, Table 13 for Block 1, B coefficients express change in the logit of the outcome variable related with one unit change in the predictor variables (Table 13). Wald chi-square statistics showed the unique contribution of each predictor while holding the other predictors constant to prevent any overlap between predictors (Table 14).

Physical activity: A strong contribution was made by "getting involved in a sport team or taking sports lessons after school or weekends" (Wald α=32.52, p<.0001); "exercising, playing a sport or participating in physical activity for at least 20 minutes" (Wald α=31.59 p<.0001); and and "earning money from work" (Wald α=14.99, p<.0001). One unit increase in exercising, playing a sport, or participating in physical activity for at least 20 minutes for 1-4 days a week would increase obesity among adolescents by an odds ratio of 1.03, indicating that the adolescents who get involved in physical activity at least 20 minutes for 1-4 days were more likely to be obese than those who did not participate in any physical activity. However, this difference was not statistically significant p<.56, indicating that there was no difference between

the adolescents who exercised at least 20 minutes for 1-4 days and the adolescents who did not exercise. One unit increase in exercising, playing a sport, or participating in physical activity for at least twenty minutes more than four days a week would decrease obesity among adolescents by odds ratio=.83, meaning that these adolescents were .83 times less likely to be obese than the adolescents who did not participate in any physical activity. The probability for this category was $\hat{Y}$=.29, indicating that there was a probability that 29% of the adolescents who did not exercise were obese or overweight. In addition, the results provided new information about adolescents physical activity outcomes. As findings showed, there was no significant differences between working out 1-4 days a week for 20 minutes and not working out at all. The physical activity reduces obesity and overweight problems among adolescents if they exercise more than four times week.

Adolescents who were not on a sport team or did not take sports lessons after school or on weekends were more likely to be obese or overweight by an odds ratio=.78, indicating the adolescents were .78 times more likely to be obese than the adolescents who were on a sports team or took sports lessons after school or on weekends. The probability of being obese or overweight for adolescents who were not on a sports team or did not take sports lessons was $\hat{Y}$=. 48, showing the there was a probability that 28% of these adolescents who were not on a sports team or did not take sports lessons were obese or overweight. One unit decrease in earning money from any work, including regular jobs as well as babysitting, cutting grass, or other occasional work increased obesity and overweight by an odds ratio=.87, indicating that the adolescents who did not earn money from work were .87 times more likely to be obese or overweight. The probability of being obese or overweight for the adolescents who did not earn

money from work was $\hat{Y}$=.31, meaning that there was the probability of 31% of these adolescents who did not earn money from work were obese or overweight.

Social activity: The largest contribution was made by "watching TV, videos and playing video games" (Wald α=125.27, p<.0001) followed by "having meals all family members together" (Wald α=30.68, p<.0001); "getting involved in community service or volunteer work" (Wald α=17.63, p<.001) . The least contribution was made by "participating in clubs or organizations after school or on weekends" (Wald α=1.23, p<.27), which was not statistically significant.

The adolescents who were watching TV, video and playing video games at least 1-4 hours a week were (odds ratio=1.404) 1.40 times more likely to be obese or overweight than the adolescents who did spent less than one hour. When the odds ratio is converted to probabilities: odds for watching TV, videos and playing videos is $\hat{Y}$=.708. Therefore, the probability for watching TV, videos and playing video games is $\hat{Y}$=.41.5, meaning there is a probability that 41.5 % of adolescents who watch TV, videos and play video games at least 1-4 hours a week are obese or overweight. The similar outcome observed for adolescents who watch TV, videos and play video games more than four hours a week with an odds ratio=1.75, indicating that these adolescents are 1.75 times more likely to be obese or overweight than those who spend less than 1 hour for watching TV, videos and playing video games. The probability for this category is $\hat{Y}$=. 46.9, meaning that there is the probability that 46.9% of the adolescents who spend more than four hours watching TV, videos and playing videos are obese or overweight. These results were consistent with the previous research that was conducted in this category.

All other variables in this section intended to produce new results about associations between physical and social activities and obesity problems among adolescents. One unit increase in having meals all family members at least 1-3 days a week would increase obesity among adolescent by odds ratio=1.095, indicating that these adolescents were 1.095 times more likely to be obese or overweight than the adolescents who did not have meals with family members. However, this odds ratio was not statistically significant p<.29, showing that there was no statistically significant difference between the adolescent who had meals less than three times with all family members and the adolescents who did not. One unit change in having meals with all family members together 4-6 times a week increased obesity among adolescents by an odds ratio=1.05, meaning that the adolescents who lived in households where all family members had meals together were 1.05 times more likely to be obese or overweight than those adolescents who did not have meals together with all family members. However, this statistic was not significant p<.06, indicating that there was no statistically significant difference in obesity rates among adolescents who had meals with family members 4-6 times a week and who did not. One unit change in having meals with all family members together for every day a week decreases obesity among the adolescents by odds ratio=.77, showing that the adolescents who have meals with all family members everyday were .77 times less likely to be obese or overweight than those who do not have any meals with family members and it was statistically significant p<. 0001. These findings showed very interesting results that there was no significant difference between being obese or overweight and having meals with all family members six days or less a week and not having meals together at all. Adolescents who had meals with all family members were much less likely to be obese or overweight than those who had meals less than seven days a

week. The probability for the outcome is $\hat{Y}$=.28, showing that there is a probability that 28% of adolescents who did not have meals with all family members are obese or overweight.

A one unit decrease in getting involved in any type of community service or volunteer work at school, church or in the community would increase obesity among adolescents by an odds ratio=.83, showing that the adolescents who had not been involved in community service or volunteer work at all were .83 times more likely to be obese or overweight than those adolescents who had been involved in community service or volunteer work once a week or more at school, church or in the community. In terms of probability, $\hat{Y}$=.30 expressed that there was a probability that 47% of the adolescents who did not participate in any community service or volunteer work were obese or overweight. A one unit increase in getting involved in any type of community service or volunteer work a few times a month would decrease obesity or overweight among adolescents by odds ratio=.84, meaning that these adolescents who participated in the above activities even few times a month were .84 times less likely to be obese than the adolescents who did not get involved in community service or volunteer work at school, church or in the community. The probability for this category was $\hat{Y}$=.30, indicating that there was a probability that 30% of the adolescents who did not get involved in community service or volunteer work were obese or overweight. A one unit decrease in getting involved in any type of community service or volunteer work a few times a year would increase obesity by odds ratio=. 95, but this statistic was not statistically significant $p<.44$, indicating that there was no statistical difference between getting involved in community service or volunteer work few times a year and not getting involved at all.

A one unit decrease in participating in any clubs or organizations after school or on weekends would increase obesity or overweight among adolescents by an odds ratio=.94, however, this was not significant p<.26, meaning that there was no statistical difference for obesity or overweight among adolescents who participated in any clubs or organizations after school or on weekends and the adolescents who did not.

Therefore, all predictors such as being on a sport team or taking sports lessons after school or on weekends, earning money from work, watching TV, video and playing video games, having meals everyday with all family members, getting involved in community service or volunteer work at least for few times a month or more, and exercising at least 20 minutes more than 4 days a week were related to being obese or overweight among adolescents at statistically significant levels and confidence intervals for odds ratio were in 95%, indicating that true value of odds ratio was obtained at 95% of confidence intervals. Findings for watching TV and video and playing video games were very similar with the findings from previous studies. All other finding contribute new information about obesity and overweight among adolescents and their physical and social activity.

Binary Logistic Regression Results for Model II (Block 1)

Table 14.

Predictors	B (SE)	Wald α^2	Lower	95% C.I. for Odds ratio	
				Odds ratio	Upper
Sport team	-0.25 (0.04)***	32.52	0.71	0.78	0.85
Money earned	-0.15 (0.04)***	14.99	0.80	0.87	0.93
TV and video		125.27			
TV and video (1)	0.34 (0.04)***	70.73	1.30	1.40	1.52
TV and video (2)	0.56 (0.06)***	101.59	1.57	1.75	1.95
Meals together		30.07			
Meals together (1)	0.09 (0.09)	1.11	0.93	1.10	1.30
Meals together (2)	0.05 (0.09)	0.32	0.89	1.05	1.24
Meals together (3)	-0.27 (0.08)**	10.12	0.070	0.77	0.084

Table 14. Continued

Predictors	B (SE)	Wald α^2	Lower	95% C.I. for Odds ratio	
				Odds ratio	Upper
Volunteer work (1)	-0.19 (0.05)***	13.30	0.75	0.83	0.92
Volunteer work (2)	-0.17 (0.06)**	9.16	0.75	0.84	0.94
Volunteer work (3)	-0.05 (0.06)	0.59	0.84	0.95	1.08
Organized activity	-0.06 (0.06)	1.23	0.84	0.94	1.05
Physical activity		31.59			
Physical activity (1)	0.03 (0.05)	0.34	0.93	1.03	1.14
Physical activity (2)	-0.19 (0.05)***	13.52	0.75	0.83	0.91
Constant	-0.68 (0.10)	50.53		0.51	

*p<.01, **p<.001, ***p<.0001

Block 2 shows the binary logistic regression results when demographic variables were added to the model. The model summary shows that the -2log likelihood statistic for Block 2 is 16767.21 which is much less than-2 log likelihood of Block 1, meaning that adding demographic variables into the model increased its predictability. Adding the demographic variables reduced -2 log likelihood statistic by 17107.68-16767.21=340.47, p<.0001, showing that the model is predicting whether obesity among adolescents is significantly better than it was with only the physical activity and other community service and volunteer work variables. The value of Cox and Snell R^2 was r^2=.049 and the value for Nagelkerke R^2 was r^2=.069, thus the model explains 4.9%-6.9% of the outcome variable, which is much better than the previous block. In other words, from 4.9% to 6.9% of the obesity or overweight issues among adolescents in the U.S. can be explained by the model. However, the classification table shows that the model classified 67.9% of the participants correctly, which was a slight decrease from the previous block (68.2%).

The Binary Logistic Regression results show B coefficients for each predictor with standard deviations, Wald chi-square statistics, and significant level for each predictor, odds ratios and confidential intervals at 95% for odds ratio are shown in Table 15. As the Wald chi-

square statistics show, the most contribution was made by gender (Wald $\alpha^2(1)=100.61$ followed by watching TV, videos and playing videos (Wald $\alpha^2(3)=61.89$, exercising, playing sports or participating in physical activity for at least 20 minutes Wald $\alpha^2(3)=48.28$, mother's education Wald $\alpha^2(3)=37.11$, receiving free or reduced breakfast or lunch Wald $\alpha^2(1)=34.29$, and Black race Wald $\alpha^2(1)=38.42$. These results were the same with the previous Block results.

Physical activity: A one unit change in not being on a sports team or taking sports lessons after school or on weekends are associated with .272 (standard error .05) changes in higher BMI. A one unit change in exercising or playing sports more than four times for at least twenty minutes is negatively associated with .242 (standard error .05) changes in higher BMI.

The odds ratio for being on a sport team or taking sports lessons after school or on weekends has an odds ratio=.76, $p<.0001$, meaning that the adolescents who were on sports team or took lessons are .76 times less likely to be obese or overweight than those who were not on sports teams or took sports lessons. The result was also consistent with the previous block. There was a probability that 21.5% of the adolescents who were not on sports team or did not take sports lessons after school or on weekends were obese or overweight.

Exercising, playing sports or participating in physical activity for at least twenty minutes for more than four days a week was negatively associated with high BMI odds ratio=.91, $p<.0001$, suggesting that the adolescents who exercise, play sports or participate in physical activity for at least twenty minutes were .91 times less likely to be obese or overweight than those who did not exercise, play sports and participate in physical activity. The probability for this category is 25% ($\hat{Y}=.25$) of the adolescents who did not exercise, play sports or participate in physical activity at least twenty minutes more than four days a week were obese or overweight. The

adolescents who exercise, play sport games or participating in physical activity less than four days a week (odds ratio=1.04, p<.42) were positively associated with higher BMI however, the relationship was not statistically significant.

The odds ratio for earning money from work was .91, suggesting that the adolescents who earned money from work, babysitting, grass cutting or other work were .91 times less likely to be obese or overweight. The probability of being obese or overweight for the adolescents who did not earn money was $\hat{Y}$=.25, suggesting that 25% of these adolescents who did not earn money from work were obese or overweight.

Social activity: According to the B coefficients, one unit change in some predictors made greater changes in the logit of the BMI. For example, one unit change in watching TV, videos and playing video games more than four hours a week is associated with positive .387 (with standard error of .06) changes in the logit of higher BMI. A one unit change in watching TV, videos and playing video games 1-4 hours a week is associated with positive .263 (standard error .04) changes in higher BMI. A one unit change in having meals everyday with all family members is negatively associated with .262 (standard error .09) results in a higher BMI.

As results show, watching TV, videos and playing video games was positively correlated at each category and odds ratio=1.30, p<.0001 for 1-4 hours and odds ratio=1.47, p<.0001 for watching TV, video and playing video games, showing that the adolescents who spent 1-4 hours a week for watching TV and video and playing video games were 1.30 times and the adolescents who spent more than 4 hours a week 1.47 times more likely to be obese compared with adolescents who spent less than 1 hour a week for these activities. The probability for the 1-4 hours a week was $\hat{Y}$=.32 and for more than four hours a week was $\hat{Y}$=.35, suggesting that

32%-35% of the adolescents who watched TV, videos and played video games more than one hour a week were obese or overweight.

Having meals with all family members everyday of a week was negatively correlated with high BMI and odds ratio=.78 p<.001, indicating that the adolescents who had meals with family members everyday of a week were .78 times less likely to be obese or overweight compared with those who did not. The probability of being obese or overweight for the adolescents who do not have meals with family members is 22%. However, having meals with all family members less than seven days a week had an odds ratio=1.10, p<.28 for 1-3 days and odds ratio=1.11, p<.21 for 4-6 days which was positively associated with the higher BMI but was not statistically significant.

Demographic variables: Being a male adolescent is positively associated with .387 (standard error .04) changes in higher BMI. A one unit change in mother's education at more than high school level is negatively correlated with .312 (standard error .04) and produces a higher BMI. One unit change in receiving free or reduced breakfast or lunch is positively correlated with .249 (standard error .04) and results in a high BMI. A one unit change in living in a working poor household is positively correlated with .139 (standard error .06) produces a high BMI.

Gender was positively related to a higher BMI and the odds ratio for the variable was 1.47, p<.0001, indicating that male adolescents were 1.47 times more likely to be obese or overweight than females. A probability, there was probability of 35% indicated that adolescent boys were obese or overweight. The primary language in the household was negatively

correlated to the obese or overweight odds ratio=.95, p<.51, indicating that the primary language in household was not a significant predictor for obesity among adolescents.

Mothers who graduated high school were negatively correlated to the obese or overweight variable and the odds ratio for mothers who graduated from high school was .89, p<. 07, stating that mothers who finished high school were negatively related to obesity or overweight problems among adolescents compared to mothers who did not finish high school. The association, however, was not statistically significant. In other words, there was no differences between mothers who graduated from high school and who did not graduated from a high school in obesity among adolescents. Mothers who have more than high school education were also negatively related to the outcome variable and revealed an odds ratio=.73, p<.0001, meaning that adolescents who had mothers with more than high school education were .73 times less likely to be obese or overweight than those who had mothers with less than high school education. There was a probability that 21% ($\hat{Y}$=.21) of adolescents who had mothers with less than high school education are obese or overweight compared with those who has mothers with more than high school education.

The model had four categories of the family structure variable: two parent biological or adopted, two parent step family, single parent and other and two parent biological or adopted families is the baseline category. Only single parent family was positively related to the obese or overweight category at a statistically significant level. An odds ratio=1.16, p<.0001, suggesting that adolescents who lived in single parent households were 1.16 times more likely to be obese or overweight than adolescent who lived in two parent biological or adopted families. There was

a probability that 29.5% (Ŷ=.29.5) of adolescents living in single parent families were obese or overweight.

Receiving free or reduced cost breakfast or lunch was positively correlated with being obese or overweight and an odds ratio=1.29, p<.000, indicating that adolescents who received free or reduces cost breakfast or lunch were 1.29 times more likely to be obese or overweight than adolescents who did not receive any reduced cost breakfast or lunch. There was a probability that 32% (Ŷ=.32) of adolescents who received free or reduced cost breakfast or lunch were obese or overweight. In addition, adolescents who lived in working poor households were also positively related to being obese or overweight and an odds ratio=1.15, p<.01 suggests that adolescents who lived in working poor households were 1.15 times more likely to be obese or overweight than adolescents who lived non-working poor households. There was a probability that 29% (Ŷ=.29) of adolescents who lived in working poor families were obese or overweight.

Moreover, being Hispanic was positively related to being obese or overweight and an odds ratio=1.20, p<.001, suggested that Hispanic adolescents were 1.20 times more likely to be obese or overweight than White adolescents. There was a probability that 30% (Ŷ=.30) of Hispanic adolescents were obese or overweight. Being Black was also positively related to being obese or overweight and an odds ratio=1.42, p<.0001 means that Black adolescents were 1.42 times more likely to be obese or overweight than White adolescents. There was a probability that 34% (Ŷ=.34) of Black adolescents were obese or overweight. Being a multiracial adolescent was positively related to being obese or overweight was an odds ratio=1.17, p<.08. Being an other racial and ethnic group adolescent was negatively related to being obese or overweight and odds ratio=.97, p<.74. These categories were not statistically significant when compared with White

adolescents suggesting that there is no statistical significant difference in obesity issues for these categories.

Binary Logistic Regression Results for Model II (Block 2)

Table 15.

Predictors	B (SE)	Wald α^2	Lower	95% C.I. for Odds ratio	
				Odds ratio	Upper
Sport team	-0.27 (0.05)***	36.88	0.70	0.76	0.83
Money earned	-0.10 (0.04)**	6.28	0.84	0.91	0.98
TV and video		61.89			
TV and video (1)	0.26 (0.04)***	40.81	1.20	1.30	1.41
TV and video (2)	0.39 (0.06)***	45.75	1.32	1.47	1.65
Meals together		19.80			
Meals together (1)	0.09 (0.09)	1.16	0.93	1.10	1.30
Meals together (2)	0.11 (0.09)	1.56	0.94	1.11	1.32
Meals together (3)	-0.26 (0.09)**	9.34	0.70	0.78	0.84
Volunteer work		3.73			
Volunteer work (1)	-0.07 (0.05)	1.63	0.85	0.94	1.04
Volunteer work (2)	-0.06 (0.06)	0.96	0.84	0.94	1.06
Volunteer work (3)	0.03 (0.06)	0.16	0.91	1.03	1.16
Organized activity	0.06 (0.06)	1.02	0.95	1.06	1.19
Physical activity		48.28			
Physical activity (1)	0.04 (0.05)	0.65	0.94	1.04	1.16
Physical activity (2)	-0.24 (0.05)***	20.08	0.71	0.79	0.87
Gender	0.39 (0.04)***	100.61	1.37	1.47	1.59
Language	-0.06 (0.09)	0.43	0.80	0.95	1.12
Mother’s educ		37.11			
Mother’s educ 1	-0.11 (0.06)	3.29	0.79	0.89	1.09
Mother’s educ 2	-0.31 (0.06)***	26.71	0.65	0.73	0.82
Family Structure		12.21			
Family Structure1	0.04 (0.06)	0.57	0.93	1.05	1.17
Family Structure2	0.15 (0.05)**	10.60	1.06	1.16	1.27
Family Structure3	-0.22 (0.23)	0.93	0.51	0.80	1.26
Free Lunch	0.25 (0.04)***	34.29	1.18	1.28	1.40
Working Poor	0.14 (0.06)*	5.85	1.03	1.15	1.29
Hispanic	0.18 (0.06)**	6.93	1.05	1.20	1.36
Black	0.35 (0.06)***	38.42	1.27	1.42	1.59
Multi	0.16 (0.09)	3.08	0.98	1.17	1.40
Other	-0.03 (0.10)	0.11	0.80	0.97	1.17
Constant	-1.02 (0.14)	56.332		0.36	

*p<.01, **p<.001, ***p<.0001

Final Discussion on Model-II Results.

Sequential logistic regression analysis was conducted to predict obesity or overweight problems among the U.S. adolescents using leisure time activity and demographic variables. The results showed that adolescents who watched TV and videos and played video games were much more likely to be obese or overweight than those who watched TV and videos and played video games one hour or less a week. The findings were consistent with the results from studies that were discussed in the literature review. In addition, adolescents who are on a sports team, taking sports lessons, exercising at least twenty minutes, participate in clubs or organizations, are involved in community services and volunteer work and have meals with all family members were all related to obesity among adolescents at statistically significant levels. These findings reveal relatively new information about studying obesity issues among adolescents and need to be investigated further. Some findings were very interesting e.g., there was no statistical differences between adolescents who exercised twenty minutes for four or less days and adolescents who did not exercise at all in terms of obesity. There was a statistically significant difference if adolescents exercised more than four days a week at least twenty minutes. Moreover, there was a no difference between adolescents who had meals with all family members four to six days a week and adolescents who did not have meals with family members at all in terms of obesity problems. Having meals became significantly related with obesity among adolescents if they had meals with family members everyday.

All findings related to demographic variables were similar to the results found in previous research studies. Mothers who have more than a high school education, single parent household, adolescents who were getting free or reduces breakfast and lunch at school, working

poor families, Black and Hispanic adolescents were significantly related to obese and overweight problems among adolescents. Adolescents who had mothers with more than a high school education were less likely to be obese or overweight while adolescents who lived in single parents and working poor households were more likely to be obese or overweight. Adolescents who were getting free or reduced breakfast and lunch at school were more likely to be obese or overweight. Finally, Hispanic and Black adolescents were significantly more likely to be obese or overweight than White adolescents. This model was designed to test hypothesis #3 and data confirmed hypothesis. Adolescents who participated in sports activities, exercise at least twenty minutes, participated in clubs, organizations, community service, volunteer work, earned money, and had meals with all family members are less likely to be obese than adolescents did not participate in the above activities. This results were the same for all racial and ethnic group adolescents.

Model-III. Obesity Among Immigrant Adolescents

Descriptive Statistics for Model III.

Table 16 shows the results of the third model. The table shows that there was no cell that has fewer than five expected count or observed count and the fewest observed count was twelve for underweight category for non-Hispanic Black immigrant adolescents while expected value was 18.5 for this cell. Hispanic group of non-immigrant group has sixty-one observed count while the expected value was sixty-eight and Other racial and ethnic variable in the non-immigrant group had observed value sixty-seven when expected count was 81.5. Therefore, there was no cell with fewer than five expected and observed value (Table 16). The data show enough cases to examine the issues comprehensively. Some issues, however, need to addressed.

Cross Tabulation for Model III

Table 16.

Immigrant status			BMI			
			underweight	**normal**	**overweight**	**Total**
Immigrant	Hispanic	Count	88	1029	641	1758
		Expected Count	98.6	1170.0	489.4	1758.0
	White	Count	80	1142	304	1526
		Expected Count	85.6	1015.6	424.8	1526.0
	Black	Count	12	205	112	329
		Expected Count	18.5	219.0	91.6	329.0
	Other	Count	68	567	174	809
		Expected Count	45.4	538.4	225.2	809.0
	Total	Count	248	2943	1231	4422
		Expected	248.0	2943.0	1231.0	4422.0
Non-immigrant	Hispanic	Count	61	1031	527	1619
		Expected Count	68.0	1123.8	427.2	1619.0
	White	Count	1025	16734	5540	23299
		Expected Count	978.8	16173.1	6147.1	23299.0
	Black	Count	113	1879	1285	3277
		Expected Count	137.7	2274.7	864.6	3277.0
	Other	Count	67	1275	599	1941
		Expected Count	81.5	1347.4	512.1	1941.0
	Total	Count	1266	20919	7951	30136
		Expected	1266.0	20919.0	7951.0	30136.0

Some Practical Issues and Assumptions of ANCOVA.

Unequal Sample Sizes

Unequal samples sizes could be a problem in ANCOVA. The unequal sample size means that all independent variable levels or combinations of independent levels did not contain equal numbers of cases. For example, in this model, there were 30,136 non-immigrant adolescents and 4,422 immigrant adolescents in one independent variable. In addition, there was a different number of cases in each racial and ethnic group. Therefore, unequal sample size was a problem for this model. As Tabachnick and Fidell (2007) suggested, sum of square type II was chosen as ANCOVA method to affect adjusted means as well as significant tests of effects and to deal with unequal sample sizes for non-experimental research. This method affects a hierarchy of testing

effects where the main effects are adjusted for each other and covariates while interactions are adjusted for main effects for covariates and for same or lower level interactions. This adjustment assigns heavier weighting to cells with larger sample sizes when computing marginal means and lower order interactions.

Outliers

Univariate and multivariate outliers have been checked for each group and for the model. There was no univariate outlier and maximum z-score for the outcome variable was 1.43 which was much less than suggested value (3.29) by Tabachnick and Fidell (2007). Every dichotomous variable was checked independently for outliers and there was no extreme uneven split between categories like 90-10 splits suggested by Rummel (1970). Other methods were also used to inspect univariate outliers such as histograms, box plots and normal probability plots. There was no univariate outliers found in the model. Cook's distance, leverage value and Mahalanobis distances were checked by multivariate analysis. Cook's distance measures overall influence of a case in the model and Cook and Weisberg (1982) suggested that values greater than one may be a cause of concern. There was no Cook's distance value greater than one in the model and the largest value for the distance was .0021 in the model. Therefore, there was no multivariate outlier in the model for Cook's distance measurement. Leverage value was checked for each case in the model to measure outliers and the maximum value was .001 with the Critical $\chi 2=16.266$ at $\alpha=.001$ with 3 covariates (Tabachnick and Fidell, 2008). Therefore, the critical leverage values (Table 17) was calculated for each group to detect outliers using the following equation:

$$hii=\frac{Mahalanobis\ distance}{N\text{-}1}+\frac{1}{N}$$

There was no case that exceeded the leverage critical value in the model. Mahalanobis measure the distance of cases from the means of the predictor variables. The highest value for Mahalanobis distances was 40.5 for case number 88601 and 40.4 for case number of 23748 which are quite high values, indicating they are the outliers and these two variables were deleted from the model once the model had enough power. All other Mahalanobis distance measures were less than $\chi 2=16.266$.

Critical Leverage Values for Each Group

Table 17.

Immigrant Status	**Race and Ethnicity**			
	White	**Hispanic**	**Black**	**Other**
Immigrant	1581	2099	340	839
Critical Value	6.34	12.51	2.99	1.21
Non immigrant	23782	1665	3701	2821
Critical Value	11.04	15.77	7.09	9.31

Singularity and Multicolinearity Issues

Bivariate correlation analysis was conducted for singularity and multicolinearity among covariates to see whether they were highly correlated with each other. As Tabachnick and Fidell (2007) suggested, if correlation among covariates comes close to or exceeds r= .50, it should be eliminated from the model because multicolinearity creates complications for the test. However, there was no correlation more than r= .18, $p<.001$ (two tailed) among covariates. In addition, linear regression analysis was used to test multicolinearity among covariates and there were no issues with multicolinearity. When supportive covariation was treated as a dependent variable, VIF=1.0 and Tolerance=1.0 with both independent variables: Amenities and Detracting. When the amenities variable was a treated as dependent variable VIF=1.03 and Tolerance=.968 with both independent variables: Detracting and Supportive. Finally, when detracting variable was

treated as a dependent variable, VIF=1.03 and Tolerance=.999 with both independent variables: Supportive and Amenities. Therefore, there were no singularity and multicolinearity issues in the model.

Normality of Sampling Distribution

ANCOVA assumes that the sampling distributions of means are normal within each group. However, there is no way to test the sampling distribution of means. As central limit theorem suggests, if there are no outliers and the sample sizes in groups are relatively equal, the robustness is expected with twenty degrees of freedom for large sample sizes. Therefore, normality of the sampling distribution is assumed because of the large sample size and no outliers should be present.

Homogeneity of Variance

ANCOVA assumes that the variance of dependent variable scores within each cell is the same as the population variance. In other words, variance of the outcome variable should be the same in each group. Levene's test was used to diagnose the assumption of homogeneity. Levene's test examined the null hypothesis that the variances in the groups were equal. The test result for the models was $F(7, 33883)=112.77$, $p<.0001$, indicating that the homogeneity of variance assumption was violated. However, in large sample size, Levene's test could be significant even though group variances were not very different. There is a way to correct the violations of homogeneity by transforming the outcome variables scores but the results of the model would be limited to the transformed scores which was not the purpose of the study. Therefore, the confidence interval requirement has been changed from 95% to 99% and $\alpha=.05$ has been changed to $\alpha=.01$, once the assumption violated at statistical significant level of $p<$.

0001, to avoid Type I error due to the assumption violation. In other words, level of confidence of interval and statistical significance was measured at more conservative levels.

Linearity

ANCOVA also assumes linear relationships between each covariate and the outcome variable. When the linearity assumption is violated it reduces the power of the test. Once all covariates are dummy variables, it is assumed that the linearity assumption has been met for the model because dichotomous dummy variables can only have linear relationships with other variables.

Homogeneity of Regression Slopes

The homogeneity of regression slopes assumption assumes that the relationships between outcome variable and the covariate is the same in each group. Homogeneity of regression slopes was tested through interaction of the all independent variables and covariates and the value was $F(8, 33875)=2.630$, $p<.078$ which was greater than $p<.05$, indicating that the assumption has satisfied for this model.

Reliability of Covariates

This assumption requires that covariates are measured without any error and they are reliable. In non-experimental research, unreliable covariates may lead to either Type I or Type II error depending on group means. The degree of error depends on how unreliable the covariates are in the model. It is assumed that people are reasonably consistent when reporting the presence or absence of built neighborhood characteristics and their poverty levels because these were more objective questions in comparison to if a person had a library or working path in his or her

neighborhood. Thus, reliability is assumed and no adjustments were made for unreliability of covariates.

Results of the Factorial ANCOVA.

A 2X4 between-subject of covariance analysis was performed on BMI among adolescents. Independent variables were immigration status of the adolescents (immigrant and non-immigrant) and racial and ethnic groups (White, Hispanic, Black and Others). Covariates of the model consisted of neighborhood characteristics (supportive, amenities, detracting) and social and physical activity of adolescents. Analysis was performed by SPSS GLM, weighting cells by their sample sizes to adjust for unequal sample sizes between groups. Another adjustment (α=.01, $p<.0001$) was made due to violation of homogeneity of variance assumption to prevent Type I error. Results of evaluation of the assumption of normality of sampling distributions, linearity, and homogeneity of regression and reliability of covariates were satisfactory. Two subjects were excluded from the model due to higher Mahalanobis distance scores.

The total sample size of the model was N=33,891 and 4,222 of them were immigrant adolescents and 29,699 were non-immigrant. In the immigrant groups, there were 1,497 Whites, 1,652 Hispanic, 303 Blacks and 770 others. In non-immigrant group, there were 23,003 Whites, 1582 Hispanics, 3,179 Blacks and 1,905 others.

The analysis results showed that BMI varied significantly across immigrant status, race and ethnic groups and neighborhood characteristics and physical and social activity. The strength of the relationships between dependent variables, independent variables and covariates were very strong with a 99% confidence interval. All F values in the models were greater than critical F

distribution values at p<.0001 level, meaning that the F-ratios were large enough not to occur by chance. The adjusted marginal means with 99% confidence interval showed that race and ethnic group's variable had a strong relationship with BMI. As summarized in Table 18, race F(3, 33880)=123.43, p<.0001with partial η^2=0.11, indicating that different racial and ethnic groups were significantly related to BMI. Immigrant status of the adolescents also related to BMI at a statistically significant level F(1, 33880)=22.83, p<.0001. However, partial η^2=.03 showed that there was a weaker relationship between immigrant status of the adolescents and BMI than the relationship between racial and ethnic groups and BMI. Therefore, immigrant status was not a very strong predictor of being obese or overweight for adolescents in the U.S.

However, very strong relationships were observed between built neighborhood characteristics and weight problems among adolescents. All built neighborhood factors predicted the obesity at a statistically significant level of p<.0001, which was very strong even when the confidence interval was 99% with α=.01. For example, supportive characteristics of neighborhoods F (1, 33880)=33.84, p<.0001, when immigrant status and racial groups were controlled, indicated that supportive characteristics of neighborhoods strongly related to obesity among adolescents. In addition, statistics for amenities in neighborhoods were F(1, 33880) =27.74, p<.0001, showing that the amenities characteristics were also very strongly related to obesity among adolescents. Detracting characteristics of neighborhoods were also associated with being obese or overweight for adolescents and statistics were F(1, 33880)=15.24, p<.0001, showing that detracting elements in neighborhoods were one of the factors for weight problems among adolescents in the U.S. Therefore, all built neighborhood characteristics did matter in

obesity among adolescents. In other words, obesity among adolescents were significantly different depending on where and in what type of neighborhoods they live.

The amount of variation accounted for by the model was SS_R=144.54 units; however a large amount of variation units (8659.16) has been not explained by the model. This can be due to the fact that a very conservative approach has been taken for the model such as changing alpha from .05 to .01, confidence interval from 95% to 99% and choosing Bonferroni correction over Sidak correction as a post hoc test. In terms of mean differences among groups, group mean for race (31.54) was higher than immigrant status group (5.83), indicating that race variables explained more of the variances in BMI than immigrant status. As earlier mentioned, race was a stronger predictor of obesity among adolescents than immigration status.

Test of Between-Subjects Effects

Table 18.

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	144.54	10	14.45	56.55	0.000	0.06
Intercept	11718.35	1	11718.35	45849.41	0.000	0.58
Supportive	8.65	1	8.65	33.84	0.000	0.04
Amenities	7.09	1	7.09	27.74	0.000	0.03
Distractive	3.89	1	3.89	15.24	0.000	0.01
Immigrant status	5.83	1	5.83	22.82	0.000	0.03
Race	94.63	3	31.54	123.43	0.000	0.11
Error	8659.16	33880	0.25			
Total	176023	33891				
Corrected Total	8803.71	33890				

The parameter estimates table displayed results of the regression analysis for the model (Table 19). Neighborhood characteristics were still very strong predictors of obesity among adolescents even when immigration status and race was controlled. For example, a one unit decrease in supportive neighborhood characteristics such as having walking path, playgrounds,

recreational centers, library or book mobile would increase overweight or obesity among adolescents by b=.05, p<.0001 with a 99% confidence interval. Amenities showed very similar result; a one unit decrease in helping each other out, trusting neighbors and watching each other's children would increase overweight and obesity among adolescents by b=.04, p<.0001 with a 99% confidence interval. Detracting elements in the neighborhood, such as poorly kept housing, vandalism, litter or garbage on the street or sidewalk, was positively related to overweight and obesity among adolescents. A one unit increase in detracting elements would increase obesity among adolescents by b=.03, p<.0001. Thus, obesity among adolescents is very different depending on where adolescents reside. Consequently, it is important to discuss and take into account of neighborhood factors to reduce and prevent from adolescent obesity.

In addition, being an immigrant was negatively correlated with BMI, indicating that being an immigrant adolescent would decrease overweight and obesity among the adolescent by b=-.15, p<.0001 level. In terms of race and ethnic groups, only White adolescents were negatively correlated to the BMI, suggesting that being White would decrease overweight and obesity by b=-.07, p<.0001 compared to being an Other racial and ethnic groups. Being Hispanic or Black was associated with BMI positively but, the relationship for Hispanics was not statistically significant b=.01, p<.44 compared to other racial and ethnic groups. In addition, the table shows mean differences between combined racial and immigrant groups. Being a White immigrant was positively correlated with BMI by b=.10, p<.0001 compared to other racial and ethnic groups. Being a Hispanic immigrant also had a positive relationship with BMI and b=.17, p<.0001, showing that Hispanic immigrants had more overweight and obesity problems than other racial and ethnic groups. Being a Black immigrant was positively related to BMI and

statistics b=.11, p<.0001, showing that Black immigrants were more likely to overweight or obese than Other racial and ethnic groups.

Parameter Estimates

Table 19.

Parameter	B	Std. Error	t	99% Confidence Interval	
				Lower Bound	Upper Bound
Intercept	2.34*	0.02	150.06	2.30	2.38
Supportive	-0.05*	0.01	-5.82	-0.07	-0.03
Amenities	-0.04*	0.01	-5.27	-0.06	-0.02
Distractive	0.02*	0.01	3.91	0.01	0.04
[Immigrant status=.00]	-0.14*	0.02	-6.71	-0.2	-0.09
[Race=1.00]	-0.07*	0.01	-5.98	-0.10	-0.04
[Race=2.00]	0.01	0.02	0.78	-0.03	0.06
[Race=3.00]	0.08*	0.02	5.563	0.04	0.12
[Immigrant status=.00] * [Race=1.00]	0.10*	0.03	3.838	0.032	0.163
[Immigrant status=.00] * [Race=2.00]	0.17*	0.03	6.199	0.101	0.246
[Immigrant status=.00] * [Race=3.00]	0.11*	0.04	2.827	0.009	0.201

* p<.0001

Bonferroni corrected post hoc comparisons were conducted to compare group means and see where exactly the significant differences were in the model. The difference between immigrant and non- immigrant remains statistically significant μ=-.051 (std error=.01), p<.0001 for immigrant group. The result shows that immigrant group is negatively related to the dependent variable BMI when compared with non- immigrant group. As shown in Table 20, Bonferroni corrected post hoc comparisons were also conducted for racial and ethnic groups. There were statistically significant differences among White and Hispanic groups (μ=-.12, p<. 0001) and the relationship for White group was negative, meaning that Whites were negatively related with BMI when compared with Hispanics. The similar group differences and relationships were obtained between White and Black adolescents (μ=-.16, p<.0001) and White

adolescents were negatively related to the dependent variable, BMI, when compared with Black adolescents. There were no statistically significant differences between Hispanic and Black adolescent groups (μ=-.03, p<.31) and the relationships were negative, meaning that the Hispanic group was negatively related to BMI when compared with the Blacks group. However, this relationship was not statistically significant. Hispanics and Other racial and ethnic groups were significantly different in terms of group means (μ=.10, p<.0001) and the relationship was positive for Hispanics indicating that they were positively related to BMI when compared with others. There were statistically significant mean differences between Black and Other racial and ethnic groups (μ=.13, p<.0001) and Blacks were positively related to BMI when compared with others. Other racial and ethnic groups were negatively related to BMI when compared with Hispanics (μ=-.10, p<.0001), and group differences were statistically significant. There were also statistically significant mean differences between others and Blacks (μ=-13, p<.0001) and the relationship with BMI was negative for others group. Therefore, the post hoc test showed exactly where statistically significant differences were in the model. There were no mean differences between Whites and the Others groups, and between Hispanics and Blacks. All other comparisons had statistically significant mean differences. All racial and ethnic groups were positively related to BMI except Whites, indicating that adolescents in minority groups were more likely to be overweight or obese when neighborhood characteristics were controlled which is the same with results from the previous logistic regression models. Especially, Hispanic and Black adolescents were more likely to be overweight and obese than Whites and Other racial and ethnic groups. Non-immigrant (U.S. born) adolescents were more likely to be overweight or obese than immigrant adolescents who were not born in the U.S. or who were born in the U.S.

but one or both parents were foreign born. Overall, neighborhood characteristics were very strong predictors of obesity among adolescents in the U.S. and these characteristics were still significantly related to obesity among adolescents even after controlling demographic factors.

In addition, this model was designed to test differences among immigrant groups in terms of obesity issues and the model found statistically significant differences between immigrant adolescents. Therefore, hypothesis # 5 was confirmed for this model. In other words, immigrant adolescents who live in neighborhoods where there are people do not help each other out, watch each other's children, contain people who cannot count on each other, and have people who do not feel safe are more likely to be obese than their counterparts who live in neighborhoods where there are people who help each other out, watch each other's children, contain people who can count on each other, and where people feel safe.

Pairwise Comparisons

Table 20.

(I) Race	(J) Race	Mean Difference (I-J)	Std. Error	99% Confidence Interval for Difference(a)	
				Lower Bound	Upper Bound
White	Hispanic	-.12(*)	0.01	-0.159	-0.088
	Black	-.16(*)	0.02	-0.210	-0.105
	Others	-0.02	0.01	-0.064	0.017
Hispanic	White	.12(*)	0.01	0.088	0.159
	Black	-0.03	0.02	-0.090	0.021
	Others	.10(*)	0.01	0.056	0.144
Black	White	.16(*)	0.02	0.105	0.210
	Hispanic	0.03	0.02	-0.021	0.090
	Others	.13(*)	0.02	0.076	0.193
Others	White	0.02	0.01	-0.017	0.064
	Hispanic	-.10(*)	0.01	-0.144	-0.056
	Black	-.13(*)	0.02	-0.193	-0.076

* The mean difference is significant at the .01 level.

a Adjustment for multiple comparisons: Bonferroni.

Covariates of the model consisted of physical activities (the selected adolescents were on a sport team or took sports lessons after school or weekends, the selected adolescent exercised, played a sports or participated in physical activity for at least twenty minutes and the selected adolescents earned money from work including regular jobs, as well as baby sitting, cutting grass, or other occasional work) and social activities (the selected child participated in clubs or organizations after school or on weekends, the selected child has been involved in community service or volunteer work at school, church or in the community, the selected adolescent spent time watching TV, video and playing video games, and had meals with all family members).

Similar results were observed with the physical activities covariate F (1, 34512) =16.93, $p<.0001$ with partial $\eta^2=.03$, indicating medium relationship with BMI (Table.21). Therefore, physical activities were related to obesity at statistically significant levels even when racial and immigrant group variables were added to the model. However, the social activities covariate was not significantly related to BMI F (1, 34512)=.89, $p<.35$, showing that there was no statistically significant relations when immigrant status and racial and ethnic groups were included in the model as independent variables even though all social activities variables predicted BMI at statistically significant level in Model II. In terms of mean differences among groups, for racial and ethnic groups it was $\mu=36.27$ which is much higher than immigrant status group $\mu=7.30$, indicating that the race categories explained more variation in obesity among adolescents than immigrant status which was the same results reported in previous models.

Test of Between-Subjects Effects

Table 21.

Source	Type II Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	128.09	9	14.23	55.47	0.000	0.15
Intercept	41929.39	1	41929.39	163415.62	0.000	0.83
Social_activities	0.23	1	0.23	0.89	0.346	0.01
Physical_activities	4.34	1	4.34	16.93	0.000	0.03
Immigrant status	7.29	1	7.29	28.43	0.000	0.05
Race	108.81	3	36.27	141.36	0.000	0.12
Error	8855.13	34512	0.26			0.001
Total	179402	34522				
Corrected Total	8983.23	34521				

The parameter estimates table displayed results of the regression analysis for the model. For example, one unit increase in social activities such as getting involved in community service, volunteer work, participating in organized activities, clubs, having meals with all family members will decrease overweight or obesity among adolescents by b=.01, p<.346 with 99% of confidence interval. However, this was not a statistically significant relationship. A one unit increase in physical activities such as being on a sport team, taking lessons after school or weekends, participating in physical exercise at least twenty minutes more than four days would decrease overweight and obesity among adolescents by b=.03, p<.0001 with 99% confidence interval. Thus, physical activities among adolescents played much stronger role in being obese or overweight than social activities.

Therefore, hypothesis #6 was partially confirmed. In other words, immigrant adolescents who participated in sports activities, being on a sports team, exercised at least twenty minutes each day were less likely to be overweight and obese than immigrant adolescents who did not exercise and participate in physical activities. However, the study did not find statistically

significant relationships between being overweight or obese and participating in clubs, organizations, community service, volunteer work, earning money, and having meals with all family members. This part of the hypothesis # 6 was rejected.

There were several different comparisons made to gather more information about weight problems among adolescents and racial and ethnic groups (Table22.). Immigrant status was negatively correlated with being overweight or obese, indicating that being an immigrant adolescent would decrease overweight and obesity by b=-.15, p<.0001 level. In addition, the table shows relationships between BMI and combined racial and immigrant groups. For example, being a White immigrant was positively correlated with BMI by b=.10, p<.0001 compared to other racial and ethnic groups. When White was examined as a racial group, this relationship was negative but when it was examined as White immigrants the relationship became positive and statistically significant compared to the White non-immigrant population. Being a Hispanic immigrant also had positive relationship with BMI and b=.17, p<.0001, showing that Hispanic immigrants had more overweight and obesity problems than the Hispanic non-immigrant group. Being a Black immigrant was positively related to BMI and statistics b=.11, p<.0001 showed that Black immigrants were more likely to be overweight or obese than other racial and ethnic groups.

Parameter Estimates

Table 22.

	B	Std. Error	t	Sig.	99% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	2.28	0.01	181.99	0.000	2.25	2.31
Social activities	-0.01	0.01	0.94	0.346	-0.01	0.02
Physical activities	-0.02	0.01	-4.11	0.000	-0.04	-0.01
[Immigrant status=.00]	-0.15	0.02	-6.98	0.000	-0.20	-0.09

Table 22. Continued

	B	Std. Error	t	Sig.	99% Confidence Interval	
					Lower Bound	Upper Bound
[Race=1.00]	-0.08	0.01	-6.57	0.000	-0.11	-0.05
[Race=2.00]	0.02	0.02	0.79	0.433	-0.03	0.06
[RACE1=3.00]	0.08	0.02	5.72	0.000	0.05	0.12
[Immigrant status=.00] * [Race=1.00]	0.1	0.03	3.98	0.000	0.04	0.16
[Immigrant status=.00] * [Race=2.00]	0.17	0.03	6.26	0.000	0.10	0.24
[Immigrant status=.00] * [Race=3.00]	0.09	0.04	2.45	0.014	-0.05	0.18

Contrast analysis was performed to examine where the exact differences were in the model. As table 22 showed, immigrant groups were compared with the non-immigrant groups. The difference in adjusted mean was .058 $p<.0001$, showing that there were statistically significant differences between immigrant and non-immigrant groups at the confidence interval of 99%. In other words, the immigrant and non-immigrant groups were significantly different in being overweight and obese 99% of the times.

The estimated marginal means of the groups were $\mu=2.22$ for the immigrant group and $\mu=2.28$ for non-immigrants, which was statistically significant at level of $p<.0001$, showing that being overweight and obese was significantly higher in the non-immigrant groups. These conclusions were consistent with previous results as shown by the main ANCOVA and parameter estimates. Since the contrast results were statistically significant and the $F(1, 34512)=29.882$, $p<.0001$was much larger than the critical $F(1, \infty)=10.83$, $p<.0001$, the effect of size was calculated from the test result table (Table 23). The effect of size for these significant adjusted mean differences was $\eta^2=.12$, indicating medium relationships. According to Cohen's guideline,

if η^2=.01 (small), if η^2=.09 (medium) and if η^2=.25 (large) effects (Cohen, 1988). Therefore, 12% of the variance in the adjusted BMI was associated with immigration status, which was a medium effect. $ES = \frac{X'i - X'k}{\sqrt{MS'w}} = \frac{0.058}{\sqrt{0.257}} = \frac{0.058}{0.507} = 0.12$

Contrast Results (K Matrix)

Table 23.

Immigrant status Simple Contrast(a)		Dependent Variable BMI2	
Level 2 vs. Level 1	Contrast Estimate	0.058	
	Hypothesized Value	0	
	Difference (Estimate - Hypothesized)	0.058	
	Std. Error	0.011	
	Sig.	0.000	
	99% Confidence Interval for Difference	Lower Bound	0.031
		Upper Bound	0.085

Test Results

Table 24.

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	7.667	1	7.667	29.882	0.000
Error	8855.133	34512	0.257		

Estimated Marginal Means

Table 25.

Immigrant status	Mean	Std. Error	99% Confidence Interval	
			Lower Bound	Upper Bound
Immigrant	2.220(a)	0.009	2.195	2.244
Non immigrant	2.278(a)	0.005	2.265	2.290

Model-IV: Strong Predictors Of Obesity Among Adolescents

Descriptive Statistics and Missing Values for Model IV.

The purpose of the last statistical analysis is to determine which factors make the most influential contributions to obesity among adolescents. As previous statistical models showed, all factors: built neighborhood factors, cultural aspects of neighborhoods, physical and social activity of adolescents, racial factors, gender and other demographic factors were significant predictors of obesity among adolescents. Therefore, it is important to estimate which factors are the most crucial for reducing and preventing obesity among adolescents.

Multiple regression analysis was chosen to regress all the predictors that were included in the previous three models. There were a total of thirty-two variables that measured different categorical influences. The dependent variable was obesity among adolescents and is the same as that used in previous models and measured with three categories: underweight, normal weight and overweight/obese. All thirty two variables were included in the model and the backward method was used for determination of the strongest predictors of obesity among adolescents. As mentioned earlier, the backward method was chosen over stepwise and forward methods to avoid Type II error. In other words, the backward method was chosen to prevent deleting a predictor that has strong influence on obesity. Therefore, the selection of the variables was completely based on mathematical criteria and SPSS removed all variables that did not make significant contributions to obesity among adolescents.

The total sample size of the model was 12,928 adolescents and 52.3% of them were males. More than 63% of the adolescents were White, followed by 14.1% of Black, 13.5% of

Hispanic, 4.5% of Multiracial and 4.1% of other race and ethnic groups. There were no significant problems with missing values.

Some Practical Issues and Assumptions.

Many assumption of multiple regression analysis were checked and fixed in previous models. For example, outlier, multicolinearity and independence errors have been examined and fixed, thus, these assumptions have not been examined for this model. All predictor variables were quantitative or categorical and the outcome variable (BMI) considered as quantitative (measured at the interval level), continues and unbounded (BMI<5th, 5th<BMI>85th, and BMI>85th). It was also assumed that the residuals in the model are random and normally distributed, meaning that the differences between model and observed data were close to zero. In addition, it was assumed that all of the values of outcome (BMI) variable were independent, expressing that each value came from different individuals.

Results of Multiple Regression Analysis.

After conducting multiple regression analysis with the backward method, there were sixteen variables out of thirty-two variables, that predicted obesity among adolescents, the best left in the model. The variables left in the models were Federal Poverty Levels, spending time for watching television and playing video games, Hispanic, Black, White, gender, being in a sports team and getting sports lessons after school or on weekends, exercising at least twenty minutes, mother's education, getting reduced price or free breakfast and lunch at school, having meals with all family members, having access to park and playground, earning money from work, family structure mother was born in the U.S. and child was born in the U.S.

Model summary results showed that this model explained 6.4% (R^2=.064) of obesity epidemic among adolescents and this was much higher percentage than the previous models. Therefore, 93.6% of the obesity among adolescents has not been explained by this model. The adjusted R^2=.062, which was very close to R^2=.064 and differences between two measurements were only .002, expressing how well the model could be generalized. The difference between the adjusted R^2 and R^2 shows that if the models were derived from the population not from the sample there would be less than .2% difference in obesity prediction. It is important that the results from this model can be generalized to the entire population because then the model can accurately predict the same results from the same set of variables in a different group of adolescents. In other words, if the difference is close to zero then the results can be generalized for adolescent population in the U.S. Therefore, the cross-validation was conducted using Stein's formula for cross-validation: $Adjusted\ R^2=1-\left[\left(\frac{n-1}{n-r-1}\right)\left(\frac{n-2}{n-r-2}\right)\left(\frac{n+1}{n}\right)\right](1-R^2)$=.003 expressing that the difference between R^2 and adjusted R^2 was very small and the results can be generalized to the entire population.

ANOVA

Table 26.

	Model	Sum of Squares	df	Mean Square	F	Sig
1	Regression	151.257	29	5.216	25.352	0.000
	Residual	2653.570	12898	0.206		
	Total	2804.826	12927			
14	Regression	150.081	16	8.828	42.932	0.000
	Residual	2654.745	12910	0.206		
	Total	2804.826	12927			

The ANOVA table (Table 26.) displayed the results of the first and last models to discuss the improvement of the last model with sixteen variables from the first model with thirty-two variables. F(df 16)=42.932 p<.0001 was much higher than the first model F(29)=25.353 p<.

0001, indicating that the last model predicted obesity among adolescents much more accurate than the first model. In other words, the capability of predicting obesity among adolescents had been improved significantly with the most influential sixteen variables than with the all variables.

Results of Multiple Regression Analysis

Table 27.

	B	SE B	β
Constant	0.296	0.037	
Gender	0.081	0.008	.086***
Black	0.088	0.012	.066***
Watching TV/Video	0.042	0.006	.063***
Physical Activity	-0.033	0.006	-.054***
Sports team	-0.049	0.008	-.053***
White	-0.050	0.013	-.052***
Mother's education	-0.034	0.006	-.051***
Poverty	-0.026	0.007	-.043***
Hispanic	0.056	0.015	.041***
Free Lunch	0.039	0.010	.041***
Mother born U.S.	0.048	0.018	.034**
Having meals with family	0.017	0.004	.033**
Child born U.S.	0.066	0.023	.029**
Family Structure	0.012	0.005	.023*
Access to Park	-0.023	0.009	-.021*
Earning money	-0.018	0.008	-.019*

*p<.01, **p<.001, ***p<.0001

As the results showed, the most influential predictor was gender of adolescents and in this case β=.086, p<.0001, indicating that male adolescents were more likely to be overweight or obese. Being Black adolescent was also very strong predictor of obesity among adolescents and β=.066, p<.0001suggested that Black adolescents were more likely to be obese or overweight than other racial and ethnic adolescents. Watching TV and playing video games were also very strong prediction of obesity β=.063, p<.0001. This value indicated that watching TV and playing

video games increased by one standard deviation, obesity increased by .063 standard deviation. In other words, if the standard deviation of the watching TV and playing video games was .7 then standardized β could be multiplied by standard deviation of BMI (.063X.465) to see the weight gain of adolescents who spent more time watching TV and playing video games. Therefore, every .7 hours of watching TV or playing games would increase weight of adolescents by .03 percentile of the BMI measurement for children. This interpretation is true only if the effects of all other variables are held constant. Similar results were found for exercising, playing a sport or participating in physical activity for at least twenty minutes and β=-.054, p<.0001, predicting that one standard deviation of exercising, playing a sport or participating in physical activity for at least twenty minutes would decrease obesity by .02 percentile of the BMI measurement. However, this result is true if the effects of all other variables are held constant. The results for being in a sport team and taking sport lessons after school or weekends were very similar with the exercising, playing a sport or participating in physical activity at least 20 minutes.

Being White was negatively correlated with obesity with β=-.052, p<.0001. Therefore, White adolescents were less likely to be obese or overweight than other racial and ethnic adolescents. In addition, mother's education was also negatively associated with obesity β=-.051, p<.0001, demonstrating that one standard deviation decrease in mother's education would increase obesity among adolescents by .51 standard deviation. Poverty of households was negatively related with β=-.43, p<.0001, showing that children who lived in FPL399+ were less likely to be obese or overweight than adolescents who lived in households in lower than FPL 399

at statistically significant levels. In other words, adolescents who lived in poorer households were more likely to be obese or overweight.

Being Hispanic and getting free or reduced breakfast or lunch at school was also significantly (β=.041, $p<.0001$) predicted the obesity among adolescents. Hispanic adolescents were more likely to be obese or overweight than White, Multiracial and other racial and ethnic adolescents. However, the relationship between being Hispanic and obese was weaker than the relationships between being Black adolescents and obesity. Getting free or reduced priced breakfast or lunch would increase obesity by .02 percentile of BMI measurement.

Mother was born in the U.S., child was born in the U.S. and having meals with all family members were positively predicted obesity among adolescents at statistically significant levels of $p<.001$. Moreover, living in single parent households was also associated with obesity among adolescents positively at a statistically significant level of $p<.01$. However, having access to parks or playgrounds and earning money from any type of jobs were negatively correlated with obesity at statistically significant levels of $p<.01$. Therefore, having access to parks or playgrounds and earning money from any type of jobs would decrease obesity among adolescents significantly.

Final Discussion on Model IV Results

The multiple regression analysis was conducted to determine the strongest predictors from all previous statistical models. There were total of thirty-two variables including the outcome variable-obesity among adolescents and age which was held constant. All variables were entered into the model simultaneously and then the regression analysis deleted all variables that did not make significant contributions to the model based on a mathematical equation.

Sixteen variables were left in the model and each made statistically significant prediction for obesity among adolescents. The demographic variables (gender, Black, White and Hispanic), physical and social activity variables (watching TV/playing video, exercising and being on a sports team) and socioeconomic variables (poverty, getting free or reduced price food, and mother's education) were strong predictions for obesity. The results were similar to previous research studies that were discussed in the Chapter III. These results showed especially demographic and socioeconomic variables, were the significant predictors of obesity among adolescents throughout of this study and the studies previously conducted and discussed in the literature review. Therefore, these predictors should be studied and considered in public policies that related to reducing and preventing obesity among adolescents in the U.S.

However, there were thirteen variables deleted from the model because of their predictive capabilities were not statistically significant. Most of the removed variables were built and cultural neighborhood variables such as access to recreational facility and boys and girls clubs, having library or bookmobile, garbage or rundown houses in neighborhood and neighbors help each other, trust each other and help each other out etc. Therefore, the built and cultural aspects of the neighborhood were not strong predictors when demographic, socioeconomic and physical activity predictors were included simultaneously in the model. There was one study that examined built neighborhood factors such as access to parks or playgrounds and other aspects and the study found significant association between built neighborhood factors and obesity among adolescent. Model I results also showed that these factors were very strong predictors when they were examined separately with fewer demographic variables in the model.

The conclusions were that the demographic, socioeconomic variables and physical activity variables were stronger predictors of obesity among adolescent than built neighborhood and neighborhood cultural aspects, and social activity of adolescents. The only variable from the built neighborhood factors in model IV was having access to parks or playgrounds. However, the prediction (β=.021, $p<.01$) was not strong as other variables.

Hispanic and Black adolescents were more likely to be obese or overweight than other racial and ethnic adolescents. Only White adolescents were negatively related to obesity among adolescents. Therefore, minority adolescents were much more likely to be overweight or obese than their White counterparts. This result was the same throughout the statistical models in this study and in previous research studies conducted among adolescents. Male adolescents were more likely to be obese or overweight in the statistical models of this study. However, there were some studies in the literature review that found female adolescents were more likely to be obese or overweight.

Adolescents who got free or reduced breakfast or lunch and from poor families (especially lower than FPL 199%) were more likely to be obese or overweight. This result was true also throughout of the statistical models. There was no study that discussed getting free or reduced breakfast or lunch at school leads to obesity in the literature review. Therefore, this information is relatively new and will be discussed more in the policy recommendation part of the dissertation. Mother's education also played an important role in weight problems among adolescents which was consistent with the result of Model II, and one research study that concluded that adolescents with college educated parents were less likely to be obese or

overweight. Watching TV and playing video games was also strong predictor which had the same result as those predicted in Model II and in previously conducted research studies.

Exercising, playing a sport or participating in physical activity for at least twenty minutes that made adolescent sweat and breath hard and being on a sport team or taking sports lessons after school or weekends were also strong predictors of obesity among adolescents. The results were consistent with Model II. However, the Model II results showed that adolescents who exercised, played a sport or participated in physical activity for at least twenty minutes more than four days each week were negatively associated with obesity at statistically significant level. In addition, having meals with all family members was left in the model, indicating that the variable significantly predicted obesity among adolescent and was consistent with Model II predictions. However, the result from the Model II reported that it was significant if adolescents had meals with all family members at least six days each week.

If the mother was born in U.S. and the child was born in U.S., the results were the same as the results of Model I and some previous research studies. Some studies that were previously conducted on obesity among immigrants found that some immigrant groups were more obese or overweight in comparison with their American born counterparts. Immigrant adolescents were less likely to be obese or overweight than U.S. born adolescents in this study. Adolescents who lived in single parent families were more likely to be obese or overweight and result was also consistent with results of Model II. Earning money from any work, including regular jobs as well as babysitting, cutting grass or other work was also important predictors for obesity among adolescents. Adolescents who earned money from work were less likely to be obese or overweight and this was the same for result derived from Model II.

CHAPTER VI.

OBESITY AMONG AMERICAN ADOLESCENTS: RESULTS, CONCLUSIONS, AND POLICY RECOMMENDATIONS

Introduction

The latest analysis of obesity among the U.S. population was released on August 14, 2012 from Trust for America's Health and Robert Wood Johnson Foundation (RWJF, 2012). According to this analysis, obesity is still increasing among the population. For example, twelve states (mainly in Midwest and South) have adult obesity rates higher than 30% compared to just one state in 2008 (RWJF, 2012). According to the director of Trust for America's Health (Jeffrey Levi), obesity is the biggest health problem the country ever faced (as cited in RWJF, 2012).

There are many policies, rules and regulations based on the Healthy People Initiatives, related to reducing obesity among the population especially among children in the last decade. For example, a total 14,000 of school districts had some kind of policy to reduces obesity among school children by the end of 2011 (RWJF, 2011). Most school based policies focused on food service in school cafeterias, vending machines, school stores, physical health education and physical activity education. There were twenty states and Washington DC that established nutritional standards for school meals, thirty five states and Washington D.C. had nutritional standards for competitive foods, all fifty states and Washington D.C. had physical education requirements, and forty-eight states and Washington D.C. had health education requirements for school children (RWJF, 2011). In addition, twenty-six states and Washington D.C. had farm to school programs in 2011 (RWJF, 2011). Many of nutritional standard regulations were stricter

than USDA requirements and many schools installed new vending machines e, g., 500 vending machines with healthier choices were installed at schools in San Diego in 2010 (RWJF, 2011).

In terms of improving neighborhoods, several projects have been carried out over the last decade. For example, the *Living Cities* project was funded from RWJF providing $85 million to improve access to healthy foods and employment opportunities, increase walkability in communities in Baltimore MD, Cleveland, Detroit MI, Newark, and Minneapolis-St. Paul. In addition, The Active Living by Design project was conducted to improve parks, streets and houses in Louisville, KY and it was funded with $200 million from RWJF. Activate Omaha, NE project has implemented the "walking school bus" programs in two Omaha schools providing options for children to walk or bicycle to school safely. Walking school bus program is designed for groups of children to walk to school together under adult supervision. In addition, Omaha developed an east to west network of bicycle routes to connect with existing routes that run from north to south (RWJF, 2012).

The Playgrounds Program has rebuilt yards of elementary schools where children can play and be active in New York, NY. Each playground project was built through a participatory design process involving students, school staff and community members and many of these school yards were designed as classroom learning process and after school programs. The project has built 176 playgrounds throughout New York city since 1996 and about 380 thousand children were provided with some type of playground (Playground Project, 2012).

Some neighborhoods in the Seattle, WA area have developed Feet First program to help residents get involved in improving their neighborhoods and be more physically active. The Feet First program organized monthly walkings to see if streets are resource with potential for

physical activity, to identify barriers to physical activities, and to check traffic signal timing and signs for walking. After the inspections, participants discussed possible improvements and needed policy changes in their neighborhoods. The Feet First program assisted residents to collaborate with government officials (Feet First, 2012).

California was the first state in the U.S. to legislate a *Safe Routes to School* program and it is one of the biggest programs that attempted to reduce obesity among school children. The goal of *Safe Routes to School* is to reduce and prevent childhood obesity by increasing the number of children who walk or bicycle to school. In California, state and federal funds are provided through a competitive grants process to local projects. Projects help parents, schools, and professionals in transportation, engineering, health and law enforcement to reduce obstacles to walk or bicycle to school by improving safety through educational programs. More than $66 million funded 139 local community projects in 2011 and an additional 139 projects have been granted with $28 million in 2012 (Safe Routes to School, 2012).

Thirty eight *Complete Street* policies have been implemented in Michigan and more than two million residents have benefited from the program. The program concentrates on what needs to be done to help residents walk or exercise in their neighborhoods. The legislation was passed in 2010 and the Michigan Department of Transportation will consider all users of the roads from public transportation riders, motorists, bicyclists and pedestrians (Complete Street, 2012).

The *Healthy Page Avenue* project in St. Louis, MO was initiated between 2009 and 2010 to increase access to healthy foods, walkability, promote unity, provide high quality school district, economic stability, good housing and neighborhood management and reduce crimes (Healthy Page Project, 2010). The Page Avenue Project is the first health impact assessment in

the Midwest. According to Healthy Page Survey results, about 48% residents were engaged in some kind of physical activities such as walking and jogging on the neighborhood streets and recreational centers. Overall, the project was successful (Healthy Page Project, 2010).

Rio Grande Riverpark project is under development in El Paso County TX to design a multi-use trail and open space (parks) network around the Rio Grande River in the El Paso, TX area. The $30 million project will build a 32-mile linear park and trail network that will support neighborhood revitalization, cultural heritage and environmental education, and economic development. The project will be carried out through collaborative effort and actions of local residents, health care professionals, and city, county and federal government officials (Rio Grande Riverpark Trail System, 2012). In addition, every state has some type of project, such as *Brownfield and Land Reuse* programs, to develop and improve better built neighborhoods in their communities.

However, improving neighborhood built environments and making them friendly for physical activities are not comprehensive like projects at school settings. Fewer communities were able to get funding for redevelopment of the built environment. There are fifty-two million Americans living in poor neighborhoods (20% or more of residents are poor). The percentage of individuals living in poor neighborhoods are different throughout the country e, g., 2% of the population of New Hampshire compared to 42% in Louisiana, Mississippi and Washington, D.C. (U.S. Census Bureau, 2005). Minority racial and ethnic groups are most likely to live in poor neighborhoods and about 50% of Blacks live in poor neighborhoods, compared with only 10% of Whites (U.S. Census Bureau, 2005). These results show that there are several barriers exist that prevent successful interventions to build safer and better neighborhood environments that

support physical activity. In addition, even comprehensive food programs at schools are not reducing obesity among adolescents. The result of this study showed that adolescents who get free or reduced breakfast or lunch at school tend to be more obese or overweight.

Results

Built neighborhood factors: The first sequential logistic regression analysis results showed that there were significant relationships between being overweight or obese among U.S. adolescents and built neighborhood factors. For example, adolescents who lived in neighborhoods where there were poorly kept or duplicated or rundown housing were 1.14 times more likely to be obese or overweight. The probability for poorly kept housing was $\hat{Y}$=.54, meaning that 54% of adolescents who lived in neighborhoods where poorly kept or dilapidated/ rundown housing were obese or overweight. A similar outcome was observed for litter or garbage on the street or sidewalk variable. Adolescents who lived in neighborhoods where there was garbage on the street were 1.07 times more likely to be obese or overweight and there was a probability that 52% of adolescents who lived in neighborhoods where litter or garbage is on the street or sidewalk were obese or overweight. This suggests that the built neighborhood environment does play an important role in obesity epidemic among adolescents.

Adolescents who lived in neighborhoods where were no parks or playground areas were . 90 times more likely to be obese than children who lived in neighborhoods where there were parks and playground areas. There was a 48% probability of being obese or overweight for adolescents who lived in neighborhoods without parks or playground areas. Not having a library or bookmobile in the neighborhood increased obesity among adolescents by odds of .87 times, and the probability showed that 47% of adolescents who lived in neighborhoods where there

were no libraries or bookmobiles were likely to be obese or overweight. This result is the same as those found from the previous paragraph. Therefore, poor neighborhood conditions were important predictors of obesity among adolescents.

However, after conducting multivariate regression analysis, there was only one predictor from built neighborhood factors left in the model. Having access to parks or playgrounds in neighborhood negatively affected obesity at a statistically significant level. Therefore, adolescents who lived in neighborhoods with parks or playgrounds were less obese or overweight than those who did not have access to parks or playgrounds.

Cultural aspects of neighborhood: Adolescents who lived in neighborhoods where residents did not help each other out were .76 times more likely to be obese than children who lived in neighborhoods where neighbors helped each other out. The probability indicated that there was the probability that 44% of children could be obese or overweight in the neighborhoods where neighbors did not help each other out. Adolescents who lived in neighborhoods where there were no adults who parents can trust were .89 times more likely to be obese and there was probability that 48% of adolescents who lived in neighborhoods where there were no adults parents trust to help their children were likely to be obese or overweight.

Adolescents who lived in unsafe neighborhoods, at least in parents' perception, were .78 times more likely to be obese or overweight than children that lived in safe neighborhoods. There was the probability of 45% of adolescents being obese or overweight lived in unsafe neighborhoods. School safety also negatively related to the obesity or overweight issues among teenagers. These results showed that the neighborhood cultural environment was an important

factors for obesity problems among adolescents. Adolescents who lived in neighborhood where people do not trust, help out and count on neighbors were obese or overweight.

However, no predictors were left in the multiple regression analysis, indicating that these predictors had no strong influences on obesity among adolescents when compared with other factors, even though they were highly correlated with obesity.

Physical activity: Adolescents who were not on a sports team or took sports lessons after school or on weekends were .76 times more likely to be obese or overweight than those who were on sports teams or took sports lessons. There was a probability that 21.5% of the adolescents who were not on sports team or did not take sports lessons after school or on weekends were obese or overweight.

Exercising, playing sports or participating in physical activity for at least 20 minutes for more than four days a week were negatively associated with high BMI adolescents who exercised, played sports or participated in physical activity for at least 20 minutes were .91 times less likely to be obese or overweight than those who did not exercise, play sports and participate in physical activity. The probability for this category was 25% of the adolescents who did not exercise, play sports or participate in physical activity at least 20 minutes more than four days a week were obese or overweight.

Earning money from work was also another important factor for obesity among adolescents and adolescents who earned money from work, babysitting, grass cutting or other work were .91 times less likely to be obese or overweight. The probability for the adolescents who did not earn money for being obese or overweight was 25%.

After multiple regression analysis, being on a sports team or getting sports lessons after school or on weekends was one of the strong factors that predicted obesity in the model. In addition, adolescents who exercised for at least twenty minutes more than four days in a week, were less likely to be obese or overweight. Therefore, physical activity was very strong predictor of obesity among adolescents. However, there was no significant difference between adolescents who did not exercise at all and adolescents who exercised less than four days a week. Earning money from any type of work including babysitting, grass cutting etc. was also strongly related to obesity and those adolescents who earned money from jobs were less likely to be obese or overweight.

Social activity: Adolescents who watched TV, videos and playing video games 1-4 hours a week were 1.30 times and the adolescents who spent more than four hours a week 1.47 times more likely to be overweight or obese than adolescents who spent less than one hour a week for these activities. The probability suggested that 32%-35% of the adolescents who watched TV, videos and played video games more than one hour a week were likely to be obese or overweight.

Having meals with all family members every day of a week was negatively correlated with high BMI and adolescents who had meals with family members everyday of a week were . 78 times less likely to be obese or overweight compared with those who did not. The probability of being obese or overweight for the adolescents who did not have meals with family members was 22. Thus, being on a sports team, taking sports lessons, exercising at least four times a week, having meals everyday with all family members and watching and playing less TV and video games were very important to reduce and prevent obesity among adolescents. Getting involved

in community service and volunteer work in the community and school was negatively correlated with obesity among adolescent but results were not statistically significant.

In the final multivariate regression analysis, adolescents who watched TV, videos and playing video games more than one hour a week were also more likely to be obese or overweight than those who watched less than one hour. When adolescents who watched TV, videos and played video games one to four hours were compared with adolescents who watched TV, video and played video games more than four hours a week, the adolescents who watched less than four hours were less obese or overweight than those spent more than four hours a week in these activities. Therefore, watching TV, video and playing video games were directly related to obesity among adolescents.

Having meals with all family members everyday of a week was negatively correlated with obesity among adolescents. However, having meals at home less than six days a week was positively related to obesity indicating that adolescents who have meals at home with all family members everyday were less obese or overweight than those who did not.

Demographic factors: Demographic variables were very strong predictors for obesity among adolescents. Being an Hispanic adolescent was positively related to obese or overweight and odds ratio=1.20, $p<.001$, suggesting that Hispanic adolescents were 1.20 times more likely to be obese or overweight than White adolescents. There was a probability that 30% ($\hat{Y}=.30$) of Hispanic adolescents were obese or overweight. Being a Black adolescent was also positively related to obesity and *odds ratio*=1.42, $p<.0001$, meaning that Black adolescents were 1.42 times more likely to be obese or overweight than White adolescents. There was a probability that 34% ($\hat{Y}=.34$) of Black adolescents were obese or overweight. Being a multiracial adolescent was

positively related to obese or overweight and *odds ratio*=1.17, p<.08. These results were consistent with the previous model results and the literature review.

Moreover, single parent family was positively related to the obese or overweight category at a statistically significant level. Adolescents who lived in single parent households were 1.16 times more likely to be obese or overweight than adolescent who lived in two-parent biological or adopted families. There was a probability that 29.5% ($\hat{Y}$=.295) of adolescents who lived in single parent families were obese or overweight.

Receiving free or reduced cost breakfast or lunch was positively correlated with obesity or being overweight and odds ratio=1.29, p<.000, indicating that adolescents who received free or reduces cost breakfast or lunch were 1.29 times more likely to be obese or overweight than adolescents who did not receive any reduced cost breakfast or lunch. There was a probability that 32% ($\hat{Y}$=.32) of adolescents who received free or reduced cost breakfast or lunch were obese or overweight.

In addition, adolescents who lived in working poor households were also positively related to being obese or overweight and odds ratio=1.15, p<.01, meaning that adolescents who lived in working poor households were 1.15 times more likely to be obese or overweight than adolescents who lived non-working poor households. There was a probability that 29% ($\hat{Y}$=.29) of adolescents who lived in working poor families were obese or overweight. These results were also consistent with the literature review results.

The third statistical analysis examined obesity among immigrant adolescents. Immigrant status of the adolescents also related to BMI at statistically significant levels F(1, 33880)=22.83, p<.0001. However, partial η^2=.03 showed that there was a weaker relationship between

immigrant status of the adolescents and BMI. Strong relationships were observed between built neighborhood characteristics and weight problems among adolescents. All built neighborhood factors predicted obesity at a statistically significant level of $p<.0001$, which was strong even when the confidence interval was 99% with $\alpha=.01$. For example, a one unit decrease in supportive neighborhood characteristics such as having walking paths, playgrounds, recreational centers, libraries or book mobiles would increase overweight or obesity among adolescents by $b=.05$, $p<.0001$ with 99% of confidence interval. Amenities showed very similar results. One unit decrease in helping each other out, trusting neighbors and watching each other's children would increase overweight and obesity among adolescents by $b=.04$, $p<.0001$ with 99% confidence interval. Detracting elements in the neighborhoods such as poorly kept housing, vandalism, litter or garbage on the street or sidewalk were positively related to overweight and obesity problems among adolescents. A unit increase in detracting elements would increase obesity among adolescents by $b=.03$, $p<.0001$. Thus, obesity among adolescents was very different depending on where adolescents reside and it is very important to discuss and take into account neighborhood factors that reduce and prevent adolescent obesity. The results were the same as those found in Model I.

Finally, neighborhood aspects were also significantly different for immigrants, non-immigrants and different racial and ethnic groups. Black, Hispanic and immigrant adolescents were more likely to live in disadvantaged neighborhoods where poorly kept housing, no walkways and garbage on the street. In addition, Black, Hispanic and immigrant adolescents were also more likely to live in neighborhoods where parents believe that the neighborhoods were dangerous and neighbors do not help each other out compared with White adolescents.

According to the results, the physical activities covariate F (1, 34512) =16.93, p<.0001 with partial η^2=.03, indicated a medium relationship with BMI. Therefore, physical activities were related to obesity at statistically significant levels. However, the social activities covariate was not significantly related to the BMI F (1, 34512)=.89, p<.35, showing that there was no statistically significant relationship.

In terms of mean differences among groups, the mean for racial and ethnic groups was μ=36.27 which was much higher than immigrant status group μ=7.30, indicating that race categories explained more variance in obesity among adolescents than immigrant status, which was the same results as those found in the previous model. Being an Hispanic immigrant also had a positive relationship with BMI and b=.17, p<.0001, showing that Hispanic immigrants had more overweight and obesity problems than Hispanic non-immigrant group. Being a Black immigrant was positively related to BMI and statistics b=.11, p<.0001 showed that Black immigrants were more likely to be overweight or obese than other racial ethnic groups or immigrant category. Even being a White immigrant was positively correlated with BMI by b=. 10, p<.0001 compared to non-immigrant White adolescents.

In the final multivariate regression analysis, most of the demographic variables were still very strong predictors of obesity among adolescents. For example, only White adolescents were negatively associated with obesity at a statistically significant level. Hispanic and Black adolescents were much more likely to be obese or overweight than any other race/ethnic adolescents. Male adolescents were more likely to be obese or overweight than their female counterparts. Economic status of household predicted obesity strongly. Adolescents who get free or reduced breakfast or lunch at school were more obese or overweight than those who did not.

In addition, adolescents who lived in households below or at FPL 199% were also more obese or overweight. Adolescents who lived in households above or at FPL 499% were less likely to be obese or overweight at a statistically significant level. Therefore, the economic status of adolescents and their household were strong predictors of obesity among adolescents. Adolescents who lived in single parent households were also more obese or overweight than adolescents who lived in two parent households. Moreover, adolescents who were born in U.S. were more obese or overweight than those who were born outside of the country. Finally mother's education was also one of the stronger predictors. Adolescents who had mothers with more than a high school education were less likely to be obese or overweight than those whose mothers had high school or lower levels of education.

The final regression analysis showed that only 6.4% of obesity issues explained by the sixteen variables left in the model. Therefore, 93.6% of obesity problems are left unexplained and the results are restricted in a frame of the explanation power.

Conclusions

In summary, the dissertation discussed obesity among American adolescents and their neighborhood environments, physical and social activities, racial and ethnic groups and socioeconomic status. There were four different statistical models in the dissertation and each model attempted to study a particular environment that might be contributing to the obesity epidemic among adolescents. For example, the first model covered the built and cultural aspects of neighborhood extensively. The second model was designed to investigate physical and social activity of adolescents and their relationships with obesity. The third model examined differences between immigrant and non-immigrant groups in terms of obesity, controlling for their

neighborhood environments and their physical and social activities. Each model included the demographic and socioeconomic factors of adolescents and their household status. The last model tried to study which factor was the most influential in shaping obesity among adolescents.

The built and cultural aspects of the neighborhood were strong predictors of obesity among adolescents in the first model. Adolescents who lived in disadvantaged neighborhoods, without parks, playgrounds, recreational facilities, boys and girls clubs or libraries, were more likely to be obese or overweight. In addition, adolescent who lived in neighborhoods where there were rundown houses, garbage in the street and broken windows were more obese or overweight. Moreover, adolescents who lived in neighborhoods where people did not trust, help out, count on each other and that contained parents who did not feel that their children were safe were more obese and overweight. Most of the adolescents who lived in these disadvantaged neighborhoods were minority adolescents. Therefore, the built and cultural aspects of neighborhoods where adolescents live do affect their obesity and well-being. These factors became less important in the last model, because other variables, mostly demographic, were added into the model and were suppressed by the strong demographic factors.

Physical and social activities were also important factor to obesity among adolescents. Adolescents who were on a sports team or taking sports lessons were less obese or overweight than those who were not physically active. Adolescents who had a job and earned money were also less obese than those who did not work. In addition, Adolescents who volunteered in their communities and participated in different social activities were less obese and overweight. Spending time watching TV, videos, and playing video games were among the strong predictors of obesity. Adolescents who spent more time on these activities were more obese and

overweight. Again, minority adolescents were less likely to be physically and socially active than White adolescents. Many of these variables remained as strong predictors in the last model.

There were significant differences between immigrant and non-immigrant groups in terms of obesity. Immigrant adolescents were less obese or overweight than non-immigrant adolescents. However, immigration status was not as strong a predictor as was racial status among adolescents.

The last statistical model included all predictors from the previous models in an effort to examine the strongest factors that influenced obesity among adolescents. Several different factors influenced obesity among adolescents based on the results of the last analysis. These factors will be discussed in the last part of this section and their policy implications will be explored. The conclusions are based on results of the fourth statistical model and are as follows:

1. The results of the literature review and statistical analyses showed that having access to parks or playgrounds were significantly associated with obesity among adolescents.

2. Being on a sports team or getting sports lessons after school or weekends were also significantly related to obesity problems among adolescents. Exercising more than four days a week appears to decrease obesity among adolescents significantly.

3. Earning money from any type of jobs was also negatively related to obesity among adolescents strongly.

4. Watching TV, videos and playing video games predicted obesity among adolescents significantly.

5. Having meals with all family members at home appears to decrease obesity among adolescent at a statistically significant level.

6. Getting free or reduced meals at school appears to increase obesity among adolescents significantly.

7. Demographic factors were the strongest predictors of obesity among adolescents. The demographic factors were included in the each statistical analysis and they were the strongest predictors of obesity among adolescents in each analysis. Minority adolescents had much higher rates of obesity in comparison to White adolescents.

Policy Recommendations Derived From The Research

Recommendation one: The study results showed that adolescents who had access to parks or playgrounds were significantly less likely to be obese or overweight when compared with those who did not have any access to such in the built neighborhood environment. As discussed in the literature review, there was one study that examined access to parks and playgrounds and its relationship to childhood obesity (Singh et al., 2010). The study results were consistent with those reported in the dissertation. Children who did not have access to parks or playgrounds were more obese or overweight. Therefore, it is important to promote policies that encourage communities to build or provide children with access to parks or playgrounds and encourage the programs like *The Playgrounds Program* in New York, NY and *Rio Grande Riverpark* project now under development in El Paso County TX

Recommendation two: Also, it is important to promote policies that support adolescent involvement in a sports team and to exercise at least twenty minutes more than four days a week. Public schools can promote policies or rules that children exercise more than four days or week and stimulate them to get involved in sports teams. There are already many projects that have started in different states that can be implemented throughout the country. For example, the *Safe*

Routes to School program in California, the Feet First program in Seattle Washington, and the *Living Cities* projects in Baltimore MD, Cleveland, Detroit MI, Newark, and Minneapolis-St. Paul are good examples that need to be expanded.

Recommendation three: Earning money from any type of work is also a very important factor reducing obesity issues among adolescents. Minority adolescents were much less likely to earn money from work. Therefore, schools and other community based agencies such as the YMCA, YWCA, boys and girls clubs, Big brothers and sisters already have policies that encourage minority adolescents to participate and get employed in the agencies. These programs appear important and should be expanded.

Recommendation four: Watching TV, videos and playing video games was strongly related to obesity among adolescents. Public schools may develop rules or regulations that educate adolescents and their parents on the relationship between obesity and watching TV and playing video games. Several studies (Taveras et al., 2007; Robinson et al., 2010; McMurray et al., 2000; and Bauer et al., 2012) in the literature review also found a progressive relationship between obesity and time spent for watching TV and playing video games. Adolescents who watched more TV and played more videos tended to be more obese or overweight. Therefore, it is important to educate parents and adolescents about the negative affects of spending too much time on these activities.

Recommendation five: Having meals with all family members at home everyday appears to decrease obesity among adolescents significantly. Having meals together might help improve or strengthen family relationships because adolescents would have more opportunity to learn about family values, ethnic heritage, their community and most importantly healthy eating

habits. Therefore, it is important to educate adolescents and their parents about the importance of having meals at home and using family meals to educate youth about obesity.

Recommendation six: The study result indicated that adolescents who received free or reduced breakfast or lunch at school were more likely to be obese or overweight. The program that helps with foods for low income children might be a contributor of the obesity epidemic among low income adolescents. There were about 14,000 school districts that had some type of policy related to food service in school cafeterias, vending machines and school stores in 2011. Therefore, a policy that addresses free or reduced breakfast or lunch at schools and supports schools to provide healthy breakfasts or lunches for children from low-income families appears warranted from the research findings.

Recommendation seven: Finally, demographic factors were very strong predictor of obesity among adolescents. Minority adolescents were disproportionally obese or overweight. It is very important to have policies that specifically targeted minority adolescents and promote physical activity, opportunities to work and be active in their communities. In addition, the Healthy People Initiative 2020 and its implementation should focus on minority and low income individuals.

This dissertation studied the built and cultural aspects, physical and social activities and obesity among American adolescents exclusively. A total of 32 predictors examined in four different statistical analyses provided new information about reducing and preventing the obesity epidemic among adolescents, and discussed the public health ramifications in the U.S. However, the dissertation was able to explain only about 7% of the obesity issues among adolescents, 93% of the issue were left unexplained. According to the study, race and ethnicity and socioeconomic

status of adolescents had the strongest influence on obesity among adolescents. The results show that obesity is not just about people who eat a lot but also was an issue among those who do not want to be physically active. The causes of the obesity epidemic appear to be rooted in the racial and socioeconomic inequalities in this country. As discussed in documentary film “Unnatural Causes of Obesity” by Robert Sapolsky (2009), obesity is not just bad habits; it is about bank accounts and skin color.

APPENDIX A.

CORRELATION ANALYSIS FOR MODEL I.

	AGE1	Gender	White	Black	Hispanic	Other	Multi	Poverty	Child born	Father born	Mother born
BMI1	-.071 (**)	-.080 (**)	-.099 (**)	.054 (**)	.054(**)	-.056(**)	.018(**)	.135(**)	.009(*)	-.024(**)	-0.005
AGE1	1	-0.007	.040 (**)	-.040 (**)	-.040(**)	-.026(*)	-.017(**)	-.051(**)	-.018 (**)	.043(**)	.032(**)
Gender		1	-.007 (*)	-0.001	-0.001	0.01	.007(*)	0.002	-0.001	0.006	0.005
White			1	-.560 (**)	-.560(**)	-.356(**)	-.328(**)	-.285(**)	.161(**)	.424(**)	.392(**)
Black				1	1.000(**)	-.078(**)	-.086(**)	.231(**)	-.192 (**)	-.441(**)	-.435(**)
Hispanic					1	-.078(**)	-.086(**)	.231(**)	-.192 (**)	-.441(**)	-.435(**)
Other						1	-.087(**)	-.024(*)	-.135 (**)	-.355(**)	-.333(**)
Multi							1	.020(**)	.008(*)	.012(**)	-.020(**)
Poverty								1	-.094 (**)	-.181(**)	-.157(**)
Child born									1	.319(**)	.355(**)
Father born										1	.632(**)
Mother born											1

Continued

	BMI	Sidewalk	Park	Recreation	Library	garbage	poor housing	Vandalism	Help	Watch out	Count on	Trust
BMI	1	-.018(**)	-.032(**)	-.022(**)	-.037(**)	.034(**)	.035(**)	.021(**)	.074(**)	.042(**)	.071(**)	.051(**)
Sidewalk		1	.446(**)	.246(**)	.221(**)	.019(**)	-.034(**)	.065(**)	0.003	-.010(**)	.011(**)	-.030(**)
Park			1	.270(**)	.311(**)	0.006	-.012(**)	.044(**)	-.028(**)	-.031(**)	-.026(**)	-.046(**)
Recreation				1	.365(**)	.013(**)	-.036(**)	.031(**)	-.032(**)	-.029(**)	-.035(**)	-.045(**)
Library					1	-.015(**)	-.028(**)	-0.003	-.059(**)	-.047(**)	-.061(**)	-.060(**)
garbage						1	.311(**)	.293(**)	.180(**)	.165(**)	.155(**)	.156(**)
poor housing							1	.346(**)	.176(**)	.164(**)	.141(**)	.155(**)
Vandalism								1	.187(**)	.164(**)	.148(**)	.150(**)
Help									1	.631(**)	.615(**)	.499(**)
Watch out										1	.624(**)	.573(**)
Count on											1	.641(**)
Trust												1

*p<.01, ** p<.001, ***p<.0001

APPENDIX B.

CASEWISE LIST FOR MODEL I.

Case	Selected Status(a)	Observed BMIlog	Predicted	Predicted Group	Temporary Variable	
					Resid	ZResid
1754	S	1**	0.127	0	0.873	2.620
23611	S	1**	0.119	0	0.881	2.721
33336	S	1**	0.123	0	0.877	2.676
39906	S	1**	0.116	0	0.884	2.761
41739	S	1**	0.116	0	0.884	2.761
41863	S	1**	0.129	0	0.871	2.596
47390	S	1**	0.128	0	0.872	2.606
51117	S	1**	0.119	0	0.881	2.721
57474	S	1**	0.125	0	0.875	2.644
59987	S	1**	0.124	0	0.876	2.664
63518	S	1**	0.119	0	0.881	2.721
64727	S	1**	0.127	0	0.873	2.620
71992	S	1**	0.134	0	0.866	2.547

S = Selected, U = Unselected cases, and ** = Misclassified cases.
Cases with studentized residuals greater than 2.000 are listed.

APPENDIX C.

CORRELATION ANALYSIS FOR MODEL II.

	BMI	Age	Gender	Hispanic	White	Black	Multi	Other	Family structure	Mom education	Father education	Language
BMI	1	-.107 (**)	.097 (**)	.062 (**)	-.113 (**)	.097 (**)	.018 (**)	-.002	.096 (**)	-.117 (**)	-.136 (**)	.059 (**)
Age		1	.007(*)	-.052 (**)	.050 (**)	.014 (**)	-.025 (**)	-.025 (**)	.084 (**)	-.026 (**)	-.014 (**)	.065 (**)
Gender			1	.001	.007 (*)	.001	-.007 (*)	-.011 (**)	-.003	-.006	.001	-.007 (*)
Hispanic				1	-.560 (**)	-.127 (**)	-.086 (**)	-.082 (**)	.032 (**)	-.262 (**)	-.240 (**)	-.532 (**)
White					1	-.483 (**)	-.328 (**)	-.315 (**)	-.201 (**)	.214 (**)	.178 (**)	.363 (**)
Black						1	-.074 (**)	-.071 (**)	.248 (**)	-.059 (**)	-.036 (**)	.071 (**)
Multi							1	-.048 (**)	.043 (**)	.017 (**)	.013 (**)	.051 (**)
Other								1	.000	.009 (**)	.022 (**)	-.116 (**)
Family structure									1	-.145 (**)	-.080 (**)	.024 (**)
Mom education										1	.556 (**)	.309 (**)
Father education											1	.266 (**)
Language												1

Continued

	Food stamp	Free lunch	Meal1	TV video	Working poor	Work pay	Volunteer work	Organized activity	Physical activity	Sport team
BMI	.095(**)	.123(**)	.031(**)	.106(**)	.078(**)	-.038(**)	-.032(**)	-.083(**)	-.061(**)	-.098(**)
Age	-.086(**)	.009	-.208(**)	.042(**)	-.045(**)	.011	.009	.017(**)	-.185(**)	-.025(**)
Gender	-.004	.006	.011(**)	.065(**)	-.003	.005	-.096(**)	-.011(**)	.135(**)	.069(**)
Hispanic	.071(**)	.191(**)	.037(**)	.031(**)	.154(**)	-.071(**)	-.042(**)	-.144(**)	-.093(**)	-.098(**)
White	-.198(**)	-.276(**)	-.002	-.084(**)	-.187(**)	.117(**)	.009	.150(**)	.076(**)	.131(**)
Black	.180(**)	.170(**)	-.074(**)	.101(**)	.103(**)	-.061(**)	.025(**)	-.076(**)	-.034(**)	-.090(**)
Multi	.039(**)	.012(*)	.003	.008(*)	.007(*)	-.017(**)	-.011(*)	.008	.023(**)	-.002
Other	.001	.007	.048(**)	-.017(**)	.017(**)	-.048(**)	.016(**)	-.006	.003	-.006
Family structure	.242(**)	.241(**)	-.024(**)	.098(**)	.152(**)	-.050(**)	-.100(**)	-.145(**)	-.045(**)	-.150(**)
Mom education	-.217(**)	-.259(**)	-.013(**)	-.128(**)	-.261(**)	.041(**)	.115(**)	.276(**)	.095(**)	.215(**)
Father education	-.236(**)	-.296(**)	-.006	-.126(**)	-.249(**)	.016(**)	.106(**)	.257(**)	.067(**)	.202(**)
Language	-.041(**)	-.182(**)	-.049(**)	.002	-.180(**)	.101(**)	.029(**)	.169(**)	.132(**)	.109(**)
Food stamp	1	.379(**)	.044(**)	.078(**)	.312(**)	-.068(**)	-.083(**)	-.143(**)	-.005	-.137(**)
Free lunch		1	.015(**)	.096(**)	.259(**)	-.107(**)	-.068(**)	-.177(**)	-.042(**)	-.165(**)
Meal1			1	-.052(**)	.038(**)	-.084(**)	.070(**)	-.004	.119(**)	-.008(*)
TV video				1	.062(**)	-.012(*)	-.121(**)	-.104(**)	-.084(**)	-.106(**)
Working poor					1	-.051(**)	-.034(**)	-.161(**)	-.035(**)	-.134(**)
Work pay						1	.066(**)	.036(**)	.001	.006
Volunteer work							1	.228(**)	.099(**)	.124(**)
Organized activity								1	.138(**)	.534(**)
Physical activity									1	.202(**)
Sport team										1

* p<.01, ** p<.001, *** p<.0001

APPENDIX D.

CASEWISE LIST FOR MODEL II.

Case	Selected Status(a)	Observed BMI	Predicted	Predicted Group	Temporary Variable	
					Resid	ZResid
7069	S	1**	0.131	0	0.869	2.579
24749	S	1**	0.128	0	0.872	2.607
40986	S	1**	0.129	0	0.871	2.596
49387	S	1**	0.129	0	0.871	2.596
61446	S	1**	0.131	0	0.869	2.579
63438	S	1**	0.131	0	0.869	2.579
71773	S	1**	0.132	0	0.868	2.566
72834	S	1**	0.128	0	0.872	2.607
87430	S	1**	0.122	0	0.878	2.677
90702	S	1**	0.131	0	0.869	2.579
91408	S	1**	0.128	0	0.872	2.607

S = Selected, U = Unselected cases, and ** = Misclassified cases.
Cases with studentized residuals greater than 2.000 are listed.

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VITA AUCTORIS

Sarantsetseg Davaasambuu was born in Zavkhan aimig, Mongolia, to Davaasambuu Jamsran and Dariimaa Lkhamsuren. She has two younger brothers, Chinbat Davaasambuu and Chinzorig Davaasambuu.

Sarantsetseg Davaasambuu graduated from high school in Mongolia. After high school, she attended the Ural State University in Russian to study “Theory of Communism” for 3 years years. However, the school closed its program because the communist system collapsed and there was no more need to study "Theory of Communism". Therefore, Ms. Davaasambuu came back to Mongolia and graduated from the Department of Sociology at Mongolian National University. Ms. Davaasambuu joined the Mongolian Army as a Sociologist Officer and served for 7 years. During her service she has conducted more than 250 research surveys, published more than a dozen research articles, and translated 3 books from English into Mongolian. She has taught Statistics and Research Methodologies courses at the Defense University in Mongolia.

In 2006, Ms. Davaasambuu joined attended the George Warren Brown School of Social Work at Washington University in St. Louis to pursue Master’s degree. She has been awarded the James O. Billips Scholarship for two years at Washington University. After graduation, Ms. Davaasambuu has started a social worker job at Saint Mary’s Hospital, St. Louis, MO.

Ms. Davaasambuu started a Doctoral Program at the Department of Public Policy Studies at Saint Louis University in 2008. She has been awarded with the Global Supplementary for Doctoral Students from Open Society Institute and graduate research assistant from Saint Louis University.