RISK OF OBESITY IN YOUTHS WITH FUNCTIONAL LIMITATIONS AND THE POTENTIALLY MEDIATING EFFECT OF YOUTH LIFESTYLE, PARENTING EXPERIENCE, NEIGHBORHOOD SOCIAL CAPITAL AND SOCIAL PARTICIPATION

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ABSTRACT

Purpose: The purpose of this study was twofold, to determine (1) if obesity is more prevalent among youths with functional limitations than among youths without special needs; and (2) to determine if variables related to the domains of youth lifestyle, parenting experience, perceived social capital, and youth social participation mediate the relationship between youths with functional limitations and obesity.

Design: This study is a secondary analysis of cross-sectional data from the nationally representative dataset, the National Survey of Children's Health.

Exposure: Youths between the ages of 10 and 17 with functional limitations or no special healthcare needs.

Outcome: Sex-specific body mass index $\geq 95^{th}$ for age percentile values using 2000 Center of Disease Control growth charts.

Variables of interest: Potential mediators were examined in four domains: (1) youth lifestyle, defined as participation in after-school sports, physical activities, hours spent watching television, having a television set in the youth's bedroom, eating family meals together, and getting enough sleep; (2) parenting experience, defined as parental aggravation, coping, and emotional support; (3) perceived neighborhood social capital; and (4) youth social participation, defined as participation in after-school club activities.

Results: Gender was an effect modifier, with 27.7% of females with functional limitations being obese, as compared to 12.9% of females with no special needs. There was no statistically significant difference between the prevalence of obesity in male youths with functional limitations and in those with no special needs. The association between female youths with functional limitations and obesity was partly mediated by participation in after-school sports and participation in physical activities.

Conclusion/Implications: The findings from this study suggest that lack of female participation in after-school sports and physical activities is partly responsible for the increased prevalence of obesity in those with functional limitations compared to those with no special needs. Future interventions that reduce barriers to and increase facilitators of after-school sports and physical activities could reduce the difference in obesity prevalences between females with functional limitations and those with no special needs.

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DEDICATION

My dissertation is, of course, dedicated to the three most important people in my life, my wife, Nancy, and my two precious daughters Dana and Rebecca. The three of you are everything to me and I can not express the love I have for each of you. I owe you each many hours of time. For Rebecca that will be cards, playing SIMs and watching you do gymnastics. For Dana it will be, running at the gym, rock climbing and going to the Gunks. And last, but definitely not least, my wife. Your patience, support, and encouragement, have been more than any husband should expect. You never doubted my ability to finish this long process, even when I did. I never could have done this without you, and I love you very much.

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CHAPTER 1

INTRODUCTION

There has been a dramatic increase in the prevalence of obesity over the last thirty years (Flegal, Carroll, Ogden, & Johnson, 2002; Ogden, Yanovski, Carroll, & Flegal, 2007; Ogden et al., 2006). The problem has reached epidemic proportions, with two-thirds of adults and one-third of children being defined either as obese ($\geq 95^{th}$ Body Mass Index [BMI] percentile) or as overweight (85^{th}–94^{th} BMI percentile) (Ogden, Carroll, & Flegal, 2008; Ogden et al., 2006). Many studies have established that there are strong relationships between BMI and co-morbidities such as heart disease, cancer, stroke, and diabetes (Baik et al., 2000; Dorn, Schisterman, Winkelstein, Jr., & Trevisan, 1997; Bray & Bellanger, 2006; Colditz et al., 1990; Flegal, Graubard, Williamson, & Gail, 2007; Flegal, Graubard, Williamson, & Gail, 2006; Flegal, Graubard, Williamson, & Gail, 2005; Gregg et al., 2005; McGee, 2005; Kastarinen et al., 2000; Schienkiewitz, Schulze, Hoffmann, Kroke, & Boeing, 2006; Wilson, D'Agostino, Sullivan, Parise, & Kannel, 2002). Current estimates suggest that at least 80% of deaths attributed to obesity occur in adults with BMIs > 30 kg/m (Allison, Fontaine, Manson, Stevens, & VanItallie, 1999). The leading causes of mortality are attributed to the obesity-related risk behaviors of poor diet and physical inactivity, which account for 400,000 deaths annually (16.6% of the total deaths) (Mokdad, Marks, Stroup, & Gerberding, 2004). This is second only to tobacco, which accounts for 435,000 deaths annually (18% of the total deaths) (Mokdad et al., 2004). Obesity-related lifestyle activities account for more deaths than alcohol consumption, motor vehicle accidents, firearm incidents, and drug use. An estimated 8 years of life are lost (YLL) for white women between the ages of 20 and 30, and 13 years for white men if they have a BMI $\geq$ 45 kg/m^2 percentile. The greatest YLL is 20 years for Black men aged 20, which represents a 29% reduction in life expectancy.

An elevated BMI has been associated with a multitude of medical conditions (Schienkiewitz et al., 2006; Colditz et al., 1990). An estimated fivefold increase in hypertension (HTN) is associated with being overweight (Wolf et al., 1997). The risk of coronary events increased from 1.7 to 2.6 to 3.4 as BMI increased from < 29 kg/m^2 to < 33 kg/m^2 to $\geq$ 33 kg/m^2 (Wilson et al., 2002). More recently, a condition associated with increased adipose tissue known as metabolic syndrome has gained attention (Bray & Bellanger, 2006). Although the criteria is not universally accepted, the International Diabetes Federation established two criteria for diagnosing metabolic syndrome: (1) increased ethnically specific waist circumference and (2) abnormalities in two of four blood-related symptoms (elevated triglycerides, depressed high-density lipoproteins [HDL] cholesterol, fasting blood glucose between 100 and 126 mg/dl, and elevated blood pressure) (Bray & Bellanger, 2006). Metabolic syndrome is strongly associated with premature type II diabetes development, and is considered a precursor to cardiovascular disease (CVD) and diabetes (Haslam & James, 2005). Excess weight has been associated with numerous other medical conditions, including but not limited to non-alcoholic fatty liver disease, gallbladder disease, certain forms of cancer, sleep apnea, arthritis, reproductive abnormalities, and psychosocial dysfunctions (Barlow, 2007; Barlow & Dietz, 1998; Daniels, 2006; Ogden et al., 2007).

Although there is public recognition that an elevated BMI is associated with increased mortality and morbidity in adults, the prevalence of obesity in children is rising at an alarming rate. Using the 2000 Centers of Disease Center (CDC) published age/gender growth charts as a comparison the prevalence of obesity in children between the ages of 6 and 17 has tripled (Ogden et al., 2007; Ogden, Flegal, Carroll, & Johnson, 2002; Ogden et al., 1997). The 2007–2008 National Health and Nutrition Examination Survey (NHANES) indicates that 21.2% of boys between the ages of 6 and 11 were obese, compared to 18.0% of girls (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). For children between the ages of 12 and 19, there is a slight decrease in both genders, with 19.3% of the boys being obese, compared to 16.8% of the girls. When the data was stratified by ethnicity/race/gender, it showed a higher prevalence of obesity in Mexican American boys between the ages of 12 and 19 (28.3%), compared to non-Hispanic white boys (20.5%) and to non-Hispanic Black boys (17.7%). There was a higher prevalence of obesity in non-Hispanic Black girls (20.2%) compared to non-Hispanic white girls (14.5%). A more recent publication has suggested a more optimistic trend in pediatric obesity over the last ten years (Ogden, Carroll, McDowell, & Flegal, 2007; Ogden et al., 2008). Using NHANES data for the years 1999–2006, Ogden et al. (2007) found that the prevalence of obesity showed no significant increase regardless of age, gender, or ethnicity. Although a lack of increase is positive, it is imperative that the prevalence of obesity among children is reduced, since it is a clear predictor of adult obesity and chronic medical conditions (Berenson, 2005; Nader et al., 2006; Singh, Mulder, Twisk, van, & Chinapaw, 2008; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997).

As troubling as the increase in obesity in the general pediatric population is, there has been an even more troubling increase in obesity in the disabled pediatric population. Using the 1999-2002 NHANES, Bandini, Curtin, Hamad, Tybor, and Must (2005) found that children with physical limitations (29.7%) and learning disabilities (21.9%) were at a higher risk of obesity than age-matched controls (15.7%). Using multivariate logistic regression, controlling for age, sex and race-ethnicity, there was a 2.29 times increased risk of obesity in boys with learning disabilities, and a 1.7 times increased risk for girls. Rimmer, Rowland and Yamaki (2007) used the Youth Risk Behavior Survey (YRBS) to complete a secondary comparative analysis of obesity in children with self-reported mobility limitations against age-matched controls. Adolescents with self-reported mobility limitations were nearly twice as likely to be overweight as were the controls.

In another national survey, Chen, Kim, Houtrow, and Newacheck (2009) used the 2003 National Survey of Children's Health (NSCH) to estimate the prevalence of obesity across a variety of physical, developmental, and behavioral/emotional diagnoses. For all children, they found an obesity prevalence of 14.8 % (95% CI = 14.7, 15.0) after adjusting for age, gender, race/ethnicity, income, parental education, family structure, and region. Obesity prevalence was increased across all diagnoses examined, with the highest being for children with diabetes (26.4%), autism (23.4%), developmental disabilities/physical impairments (22.4%), and multiple ear infections (27.1%). In a second study using the same dataset, Barlow and Chang (2007) found that children with chronic conditions were 1.17 times more likely to be obese (> 95th percentile) than those without chronic condition, after controlling for race/ethnicity, parent education, socio-economic status, TV viewing and behavior problems.

Information Gaps

Many different factors are associated with the increasing likelihood of obesity among youths with no disability (Anderson & Butcher, 2006; Barlow, 2007; Flynn et al., 2006). It has been suggested that over the last thirty years children have adopted an unhealthy lifestyle, leading to a decrease in physical activities and a concurrent increase in poor eating habits and sedentary activities (Anderson & Butcher, 2006; Barlow, 2007; Barlow & Dietz, 1998; Flynn et al., 2006; Minihan, Fitch, & Must, 2007; Must & Strauss, 1999). Besides a child's lifestyle, there is evidence that social participation maybe associated with youth obesity (Strauss & Pollack, 2003).

In children with disabilities, it is generally believed that their physical or mental disability is associated with adoption of poor lifestyle activities (Maher, Williams, Olds, & Lane, 2007; Rimmer, Braddock, & Pitetti, 1996; Rimmer, Riley, Wang, Rauworth, & Jurkowski, 2004; Rimmer, Rowland, & Yamaki, 2007; Rimmer, Rubin, & Braddock, 2000; Whitt-Glover, O'Neill, & Stettler, 2006). For example, physical limitations requiring wheelchair use would prevent a child from participating in activities such as recreational and/or competitive sports, which in turn reduces socialization. Reduction in physical activities in the disabled population is believed to coincide with an increase in sedentary activities such as TV watching or playing of video games. To date, no studies have used nationally representative datasets to demonstrate that youths (ages 10–17) with disabilities have poorer lifestyle activities or less social participation. Further, no studies have examined whether the higher prevalence of obesity in youths with disabilities compared to non-disabled youths is accounted for by poor lifestyle activities and/or lack of social participation.

Although most of the literature has focused on a youth's actions, there is mounting evidence that parenting experience and parental perception of neighborhood social capital are associated with obesity in their youth. In the context of this study, parenting experience is defined as self-reported parental aggravation, emotional support, and coping with the daily demands of raising their youth. Published studies have demonstrated that parents of youths with medical conditions report increased parental aggravation and poor social support and coping (Raphael, Zhang, Liu, & Giardino, 2010; Schieve, Blumberg, Rice, Visser, & Boyle, 2007; Streisand, Mackey, & Herge, 2010). No studies have been published exploring the association of youth obesity with parenting experience, comparing youths with or without disabilities. Lastly, parental perception of neighbor social capital has been associated with obesity in youths (McKay, Bell-Ellison, Wallace, & Ferron, 2007; Singh, Kogan, & van Dyck, 2008; Singh, Kogan, van Dyck, & Siahpush, 2008). Social capital refers to the quality of relationships within a social network, whether they exhibit, for example, reciprocity or mutual trust (Kawachi & Berkman, 2000; Sampson, Raudenbush, & Earls, 1997). How parental perception of social capital changes in the presence of a disability has yet to be studied. For example, a parent with a youth in a wheelchair with a cardiac condition and behavior issues may have a different perspective on the statement "There are people I can count on in this neighborhood" than a parent whose youth does not have a disability. If parental social capital is associated both with obesity and is decreased in parents who have a youth with a disability, it possible that poor parental social capital would be partly responsible for increased obesity in youth with a disability.

Statement of the Problem

Approximately 12% of those under 18 years old in the general population currently require medical care (McPherson et al., 1998; Newacheck & Taylor, 1992; Newacheck et al., 1998). It has been suggested that the prevalence of obesity is 1.5–2.0 times greater in the disabled population than in the non-disabled population (Chen, Kim, Houtrow, & Newacheck, 2009; Rimmer et al., 2007). To date, no studies have examined the potential mediating effects of youth lifestyle activities, parenting experience, perceived neighborhood social capital, and social participation on the increase in the prevalence of obesity in youths with disabilities.

Purpose of the Study

The purpose of this study is to determine (1) if youths with functional limitations have a higher prevalence of obesity than youths without special needs, and (2) if variables related to the domains of youth lifestyle, parenting experience, perceived neighborhood social capital, and youth social participation mediate the relationship between youths with functional limitations and obesity. This study uses the National Survey of Children's Health (NSCH), a publicly available dataset, to explore the relationship between obesity and youths with functional limitations (Blumberg et al., 2009a). The strength of the NSCH is that it represents a sample of households in all 50 states, thus allowing for calculation of national prevalence estimates. The large sample size allows for testing of relationships that otherwise would not be possible.

This study will use the four steps outlined by Baron and Kenny (1986) to test for mediation. First, this study will determine if youths with functional limitations have a higher prevalence of obesity compared to youths with no special needs. Second, it will examine the strength of the relationships between obesity with youth lifestyle activities, social participation, parenting experience, and perceived neighborhood social capital. Third, it will examine the relationships between the presence of functional limitations with youth lifestyle activities, parenting experience, perceived neighborhood social capital, and social participation. Variables that are statistically associated with both obesity and the presence of functional limitations are considered potential mediators, as suggested by Baron and Kenny (1986). The potential mediators will be entered into a statistical model to determine which variables mediate the relationship between youths with functional limitations and obesity. The Sobel test will be used as a final assessment to determine if the mediation is statistically significant.

Significance of the Study to Public Health

Advances in medical care and social integration of disabled individuals have increased their life span substantially. The increase in life span has raised concerns that this population will suffer from chronic conditions brought about by obesity. It is vital that the health of children with disabilities be monitored, because they consume the majority of the youth healthcare costs (Fox, Wicks, & Newacheck, 1993; Neff & Anderson, 1995; Newacheck & Taylor, 1992; Newacheck et al., 1998). In the past, it was assumed that having a disability meant that an individual was by default unhealthy (World Health Organization, 2001). It is now understood that one can be both disabled and healthy. Therefore health promotion is as important in the disabled population as it is in the nondisabled population (U.S. Department of Health and Human Services, 2000).

The results of this study will benefit youths, parents, clinicians, and legislators. At this time, it is not clear if youths with disabilities are any more prone to being obese than are nondisabled youths. Using the nationally representative data from NSCH, this study will establish the extent of the problem at the national level. This will be invaluable as legislators establish policies that allocate resources to this potentially unrecognized and under-funded problem. In addition, this study will establish behaviors that parents and clinicians can use to identify youth at risk of becoming obese.

Research Questions

This study attempts to address the following research questions:

Research Question 1: Is there a higher prevalence of obesity in youths with functional limitations than in youths with no special needs?

Research Question 2: Is the association between youths with functional limitations and obesity mediated by youth lifestyle, the parenting experience, perceived social capital, and youth social participation (see Figure 1)?

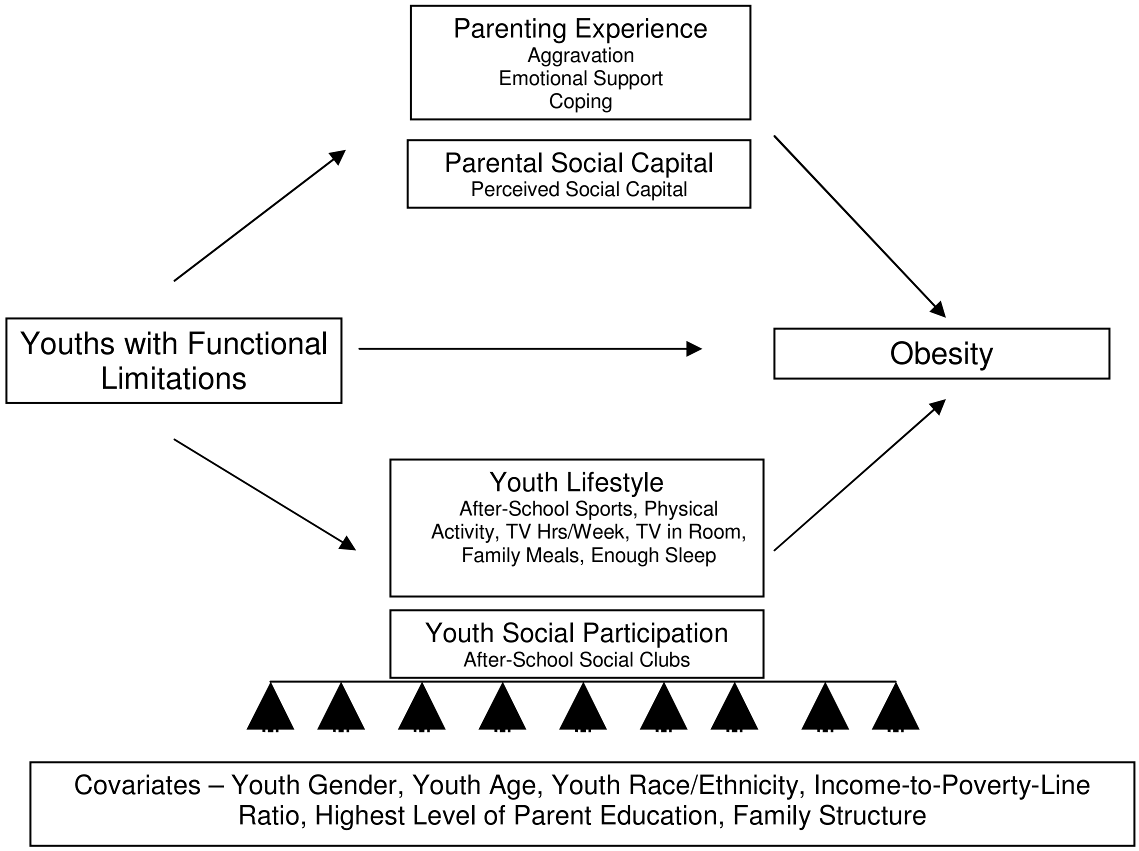


Figure 1. Conceptual Framework for Testing Mediation. Framework testing association between obesity and having functional limitations, as well as the potentially mediating effect of youth lifestyle activity, parenting experience, neighborhood social capital and youth social participation.

Definitions of Terms

Body Mass Index – Body Mass Index is calculated by dividing a child's weight by the square of their height. Using nationally representative samples that are gender- and age-specific, BMI curves are created to indirectly estimate excessive adipose tissue for an individual child (Ogden et al., 2010; Ogden et al., 2007; Kuczmarski et al., 2000).

Demographic variables – Demographic covariates that will be used include the child's age, gender, race/ethnicity, income-to-poverty-line ratio, highest level of parent education, and family structure.

Functional limitations – The term *functional limitations* is defined by the developers of the NSCH using the screen questionnaire. A youth is said to have a *functional limitations* if his or her parent states that they (1) had activity limitations, (2) that the limitations are chronic and has lasted or is anticipated to last a minimum of 12 months, and (3) the limitations is related to a medical, mental, or behavior problem. The question regarding functional limitations is one of four questions developed by the Maternal and Child Health Bureau (MCHB) to identify children with, or at risk of having special healthcare needs (Bethell et al., 2002a; Bethell et al., 2002b; Blumberg et al., 2009).

Metabolic Syndrome – The International Diabetes Federation established two criteria for a diagnosis of Metabolic Syndrome: (1) increased ethnically specific waist circumference, and (2) abnormalities in two of four other blood-related symptoms (elevated triglycerides, depressed high-density lipoproteins HDL cholesterol, fasting blood glucose between 100 and 126 mg/dl, and elevated blood pressure) (Bray & Bellanger, 2006).

Obese – For this study, children were considered obese if they were in the 95th percentile or above when compared to age- and gender-matched norms. Children were defined as non-obese if they were below the 95th percentile when compared to age- and gender-matched norms (Barlow, 2007; Ogden et al., 2007; Ogden et al., 2006).

Parenting experience – For this study, parenting experience is represented by the combination of five questions regarding parental aggravation, emotional support, and coping with the daily demands of raising a child. Three questions are derived from the parenting index scale and the aggravations scale (Abidin, 1997; Blumberg et al., 2009; Easterbrooks & Goldberg, 1984). These questions are combined to create a parent aggravation scale, and are considered an aspect of parenting stress (Blumberg et al., 2009). These questions relate to parents' difficulty of caring for a child, whether their child bothers them, and whether they felt anger toward their child. Emotional support is measured by a single question asking if a parent has someone around to provide day-to-day emotional support. Coping is measured by a single question that asks if the parent is coping with the day-to-day demands of parenting. Several published studies have used each of these constructs (Barlow & Chang, 2007; Raphael et al., 2010; Streisand et al., 2010).

Social capital – Social capital is a measure of relationships between social networks (Blumberg et al., 2009). The social capital scale in this study is taken from the Child Well-Being Topical Module of the Survey of Income and Program Participation (Blumberg et al., 2009; Fields & Smith, 1998; Sampson et al., 1997). The questions are derived from a questionnaire that Sampson et al. (1997) used to measure social capital at the neighborhood level. Questions include measures of mutual aid, mutual trust, and collective efficacy. Singh et al. (2008) preformed factor analysis to validate the grouping of questions in this study. Several published studies have used social capital as a construct (McKay et al., 2007; Singh et al., 2008).

Special needs – In this document, the term *special* needs uses the definition developed by the MCHB: "Children with special health-care needs are those who have or are at risk for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that acquired by children generally." Children are identified as having special needs using the Screeners Questionnaire (Bethell et al., 2002a; Bethell et al., 2002b; Blumberg et al., 2009).

Youth lifestyle – For this study, *youth lifestyle* denotes a group of six variables: a youth's participation in high-intensity physical activities, participation in after-school sports, hours of weekday television watching, having a television in the youth's bedroom, eating family meals together, and number of nights getting enough sleep. Each variable was developed using past literature and was agreed to on by a panel of experts (Blumberg et al., 2009). Several published studies have used each of these variables to examine associations with obesity and/or youths with special needs (Barlow & Chang, 2007; McKay et al., 2007; Singh et al., 2008).

Youth social participation – For this study, youth social participation is represented by a single question (Blumberg et al., 2009). The question asks about participation in after-school clubs/organizations.

Youth – For this study, youths are defined as between 10 and 17 years of age. For the purposes of this study, the single term child or adolescent was not sufficient to capture the pre-adolescent and adolescents ages included in this study.

CHAPTER 2

REVIEW OF THE LITERATURE

Associations with Childhood Obesity

Childhood obesity prevention has become a national priority (Barlow, 2007; Institute of Medicine Committee on Prevention of Obesity in Children and Youth, 2005). It is through epidemiological studies using national surveillance systems that obesity and its consequences have been identified as a public health risk (Ogden et al., 2002; Ogden et al., 2002). Having recognized the trends in childhood and adult obesity, there is now a growing focus on identifying the causes of obesity and creating effective prevention programs. It is generally accepted that weight gain is the product of barriers and facilitator of energy intake (calories eaten) and energy expenditure (calories used) (Anderson & Butcher, 2006; Barlow, 2007; Dehghan, Akhtar-Danesh, & Merchant, 2005). This literature review is limited to the research questions and hypothesis under investigation. The literature review will focus on the relationships between obesity and the domains of lifestyle, parenting experience, social capital, and social participation, which are measured in the NSCH.

Associations of Mediators with Obesity

Lifestyle. For the purpose of this proposal, *lifestyle* refers to variables representing a youth's daily activities measured in the NSCH. This construct builds on work recently published by Anderson and Whitaker (2010) that examines the relationship between the exposure to three "household routines" and their relationship to obesity. In this study, the household routines are regularly eating meals together (> 5 nights/week), attaining adequate sleep (> 10.5 hours/night), and limiting screen-viewing time (< 2 hours/day) (Anderson & Whitaker, 2010; Whitaker, 2003). Using data from Early Childhood Longitudinal Study Birth Cohort conducted by the National Center for Education Statistics, the authors examined exposure of each household routine separately and in combination. They found that prevalence of obesity in children exposed to all three routines was 14.3% (95% CI = 11.3%, 17.2%) compared to 24.5% (95% CI = 20.1%, 28.9%) children exposed to none of the household routines. Exposure one to household routine, any two, all three decreased the odds of being obese from 0.84 (95% CI = 0.63, 1.12), to 0.64 (95% CI = 0.47, 0.85), and to 0.63 (95% CI = 0.46, 0.87), respectively. The domain of lifestyle activities in this study uses Anderson & Whitaker (2010) concept of household routines by adding the measures of physical activities and participation in after-school sports.

Physical Activity and After-School Sports. As pointed out earlier, obesity is generally considered to be an imbalance between energy intake and energy expenditure (Epstein et al., 1995). The role of exercise and physical activity in the prevention of obesity is unclear (Must & Strauss, 1999; Parsons, Power, Logan, & Summerbell, 1999). Using data from the 2003 NSCH, Singh et al. (2008) found that after controlling for socioeconomic factors, children who exercise more than 5 days a week were protected against obesity compared to those who exercise 3–4 days a week (OR = 1.25; 95% CI = 1.12, 1.42); 1–2 days a week (OR = 1.34; 95% CI = 1.18, 1.56) and 0 days a week (OR = 1.62; 95% CI = 1.39, 1.89). Similarly, McMurray et al. (2000) analyzed questionnaires from 2,389 adolescents regarding physical activities, TV viewing, and video game playing. Their study found that if males have at least one high-intensity physical activity

3–5 days a week, the odds of being overweight are reduced (RR = 0.64; CI: 0.42, 0.98). Further illustrating the importance of high intensity physical activity, Ness et al. (2007) used accelerometers to measure total moderate and vigorous physical activities in 5,500 children. Using dual x-ray emission aborptiometry scans they found a strong direct correlation between physical activity and obesity. They conclude that total level of physical activity may not be as strong a predictor of adiposity as the intensity of the physical activity.

However, not all studies support the link between physical activity and obesity. In a review of ecological studies, Reichert, Menezes, Wells, Dumith, and Hallal (2009) concluded that national physical activity levels have either remained the same or increased over time, while the population prevalence of being overweight or obese has increased. Cross-sectional studies of the association between levels of physical activity and BMI (as an estimate of adiposity) have also yielded inconsistent results, with associations being either small or non-existent (Must & Tybor, 2005; Wareham, 2007). Even in interventional studies, increases in physical activity are not associated with dramatic reductions in BMI (Wareham, 2007).

The mixed relationship between physical activity and obesity may be a product of poor outcome measurement. Studies of physical activity often use self-report or parent proxy report for their child, which may be inaccurate and therefore misclassify the activity level of the child (Must & Strauss, 1999). For example, Adams et al. (2005), as well as Klesges et al. (2004), found that with self-report, females tend to over-report physical activity levels. They attribute the over-reporting to social desirability bias, i.e., the tendency to respond in a manner that reflects expected norms rather than actual levels. Further, a recent study suggests that the of amount physical activity is not as important as participating in a specific type of physical activity. Vogels, Westerterp, Posthumus, Rutters, and Westerterp-Plantenga (2007) compared physical activities in overweight and non-overweight children using self-report and physical activity monitors (accelerometers). There was no difference between the groups' self-reported physical activities. However, using the accelerometer data, structured activities (i.e., team activities) motion was significantly less in overweight children. This study suggests that the quality of physical activity is directly related to obesity. The study concluded that efforts to prevent obesity through physical activity should encourage "as many as possible structured and scheduled sports activities throughout the week." Although not specifically looking at structured versus unstructured sports, the previously described study by Singh, Kogan, Siahpush, and van Dyck (2008) also found a lack of sports team participation to be a predictor of obesity (OR = 1.28; 95% CI = 1.15, 1.42).

Television. It is commonly believed that obesity can be attributed to increases in sedentary activities (e.g., watching TV and playing computer/video games), with concurrent decreases in physical activity (Buchowski & Sun, 1996; DuRant, Baranowski, Johnson, & Thompson, 1994; Taras, Sallis, Patterson, Nader, & Nelson, 1989). Several theories have been presented to explain the relationship between screen time (TV/video/computer use) and obesity. For example, Borzekowski et al. (2001) found that food commercials commonly aired in cartoon programs affect the future food choices of preschoolers. In addition, exposure to commercials has been associated with unnecessary food intake while watching TV (Dixon, Scully, Wakefield, White, & Crawford, 2007;

Lobstein & Dibb, 2005; Taras et al., 1989; Coon & Tucker, 2002; Thomson, Spence, Raine, & Laing, 2008). As a consequence, calorie intake became habitual with TV watching (Temple et al., 2006; Temple, Giacomelli, Kent, Roemmich, & Epstein, 2007).

A complete review of all the studies comparing screen time and obesity are beyond the scope of this thesis. This section will review a select group of studies that support this relationship. The end of the section discusses additional intervention studies and their key findings.

In 1985, Dietz and Gortmaker (1985) published one of the earliest epidemiological studies that examined obesity and TV watching, using data from NHANES cycles II and III. They estimated that, in children between the ages of 12 and 17, there is a 2% increase in the prevalence of obesity for every additional hour of TV watched. Jago, Baranowski, Baranowski, Thompson, and Greaves (2005) prospectively studied the effects of TV watching on BMI on a cohort of 3- and 4-year-old children followed for three years. Using repeated measures analysis, they found that by age three, the increased amount of time spent watching TV was associated with elevated BMI, even with basic demographics held constant. Based on nationally representative data from the 2003 NSCH, it is estimated that watching more than three hours of TV a day compared to one hour increases the odds of obesity by 1.78 (95% CI; 1.26, 2.52), 1.88 (95% CI; 1.5-2.34) and 2.1 (95% CI; 1.90-3.32) in Hispanic, white, and Black children, respectively.

Besides associations between TV watching and obesity, links have been found to exist between availability of a TV in a child's bedroom and obesity. Dennison, Erb, and Jenkins (2002) found that the presence of a TV in a child's room increases obesity risk by 1.34 times (95% CI = 1.01, 1.69) for children between the ages of 2 and 5. The study also noted that 40% of children have TVs in their room. Similarly, Adachi-Mejia et al. (2007) found that the presence of a TV in a child's bedroom increases the odds of being obese by 32% (95% CI = 1.03, 1.70) for children between the ages of 9 and 12.

Meals together. Previous studies have found a link between eating together as a family and BMI in both children and young adolescents (Gillman et al., 2000; Larson, Neumark-Sztainer, Hannan, & Story, 2007; Neumark-Sztainer, Hannan, Story, Croll, & Perry, 2003; Veugelers & Fitzgerald, 2005; Veugelers, Fitzgerald, & Johnston, 2005; Videon & Manning, 2003). Studies have found an association with increased frequency of family meals together and children reducing their intake of soft drinks and fatty foods (Gillman et al., 2000; Larson et al., 2007; Veugelers & Fitzgerald, 2005). Gillman et al. (2000) found that children who eat with their families were more likely to eat more fruits and vegetables, less fried food and soda, less saturated and transfats, a lower glycemic load, and more fiber. For adolescents, family meals are associated with increased consumption of fruit and vegetables, grains, and calcium-rich foods, and reduced intake of soft drinks (Larson et al., 2007; Neumark-Sztainer et al., 2003).

Examining the protective effect of family meals, Anderson et al. (2010) correlated families with BMI in a cross-sectional sample of 8,550 children all around the age of 4. They found that frequent family meals (> 5 nights/wk) were protective against obesity (OR = 0.77; 95% CI = 0.65, 0.92) and that in combination with positive sleeping and reduced TV time, the protective effect was even greater. Using longitudinal data from Harvard's Youth\Adolescent Food Frequency Questionnaire, Veugelers and Fitzgerald (2005) studied the protective effect of family meals in 4,242 children. They found that having 3 to 4 family meals a week reduced obesity risk by 0.68 times (95% CI = 0.52, 0.88), after controlling for SES, age, maturational stage, race/ethnicity, physical activity, inactivity, and energy intake.

In another prospective study, Sen et al. (2006) examined the incidence of being overweight as a function of family meal frequency. In their study of 5,014 children between the ages of 12 and 15, there was an inverse relationship between family meals and being overweight in white adolescents. No associations were found for adolescents who were Black or Hispanic. The authors suggested that racial and ethnic differences might be responsible for caloric content of food and/or differences in portion of food typically consumed during mealtime. A third prospective study by Gable, Chang, and Krull (2007) also found that increased family meals together reduced obesity.

Lastly, Fulkerson, Neumark-Sztainer, Hannan & Story (2008) conducted a five–year longitudinal study with less definitive results. At baseline there was a protective effect of family meals against childhood obesity, however, at the fifth year the associations became non-significant. They stated that although there may be dietary and psychological benefits to family meals, the weight related long-term benefits might be more complex and require further examination (Fulkerson et al., 2008).

Sleep. The last decade has seen an increased interest in the relationship between sleep deprivation and obesity. Causal pathways are not understood completely but several have been suggested. For example, an indirect link suggests that chronic fatigue results in reduced physical activity and/or more exposure to sedentary activities like TV watching (Dinges et al., 1997; Patel & Hu, 2008; Sivak, 2006). An alternative hypothesis suggests that lack of sleep results in a neural hormonal imbalance that increases caloric intake (Spiegel, Tasali, Penev, & Van, 2004). This hypothesis suggests that reduced sleep duration increases appetite by stimulating the production of a peptide (ghrelin) which encourages food intake/fat storage, while decreasing a hormone (leptin) linked to hypothalamus regulation of energy balance (Taheri, Lin, Austin, Young, & Mignot, 2004).

A recent systematic review of the literature by Patel and Hu (2008) was inconclusive. They reviewed 36 articles published between 1966 and 2007 that related sleep and obesity. Of the studies meeting their inclusion criteria, 31 were cross-sectional and 5 were prospective. For adults, 17 of the 23 cross-sectional studies supported an association between sleep and increased weight. Three longitudinal studies also supported a similar relationship between sleep and weight, although the strength of the relationship waned with age. In the 13 cross-sectional and cohort studies of children, there was a very strong and consistent association between sleep and future obesity. The authors emphasize that the evidence may not be stronger due to poor measures of actual sleep (often self-reported), and unexplored relationships with possible confounders (Patel & Hu, 2008).

A more recent systematic review and meta-analysis was undertaken by Cappuccio et al. (2008), using publications relating short sleep duration to obesity in children. Their analysis included 13 studies of a total of 30,000 children between the ages of 2 and 20. Seven of the 11 studies reported a statistically significant association between sleep duration and obesity. The pooled data resulted in 1.89 (95% CI = 1.46, 2.43) odds of a child being obese in the presence of reduced sleeping hours. The authors recognize that the cross-sectional nature of the data prevents a causal relationship. A second systematic review and meta-analysis by Chen, Beydou, and Wang (2008) using a different database search, search words, and inclusion/exclusion criteria supported the findings of Cappuccio et al. (2008). Chen, Beydoun, and Wang (2008) found that in children sleep duration has a strong relationship with being overweight or obese, with shorter duration of sleep increasing the odds of obesity by 1.58 (95% CI = 1.26, 1.98). This relationship was dose-dependent, with children having the shortest sleep duration having an increased odds of being obese (OR = 1.92; 95% CI = 1.15, 3.20). Chen, Beydoun, and Wang (2008) reported that an additional hour of sleep reduces the risk of being overweight or obese by 9% (pooled OR = 0.91; 95% CI = 0.84, 1.00).

The literature does suggest that there is a gender-specific relationship between obesity and sleep (Cappuccio et al., 2008; Patel & Hu, 2008). For example, Knutson et al. (2005) used data from the National Longitudinal Study of Adolescents Health to explore the association between self-reported sleep and being overweight. In this study of 4,486 youths between the ages of 15 and 18, they found that for each additional hour sleep, there was a 10% reduction in the risk of being overweight for males, but not for females. They suggested that the gender difference could be related to puberty and hormonal changes, which occur earlier in females than males. They also pointed out that during puberty males have an increase in fat-reducing hormones such as testosterone, growth hormones, and insulin-like growth factors, whereas females experience an increase of fat mass associated with increased estradiol. A weakness of this study was its reliance on self-reported sleep rather than on a validated sleep questionnaire or sleep monitor. In a follow-up study, Klutson and Lauderdale (2007) used a nationally representative sample of adolescents that included a 24-hour diary taken during two random weekdays, as well as self-reported sleep hours. Their study found that obesity was associated with self-reported hours of sleep but not with the sleep diary. There was no interaction between self-reported sleep and gender, but the association was stronger for males than females. The difference in of the association between obesity and the type sleep instruments highlights the potential validity issues associated with measuring sleep.

Lastly, Gupta, Mueller, Chan, and Meininger (2002) explored the association between obesity and sleep using an actigraph, which is a validated sleep/wake monitor. They used data from the Heartfelt Study, which was designed to study the relationship between cardiovascular reactivity, blood pressure, and mood in adolescents. They found a relationship between sleep and obesity for both males and females, but the strength of the relationship was inversely related to age and strongest for males.

Parenting experience. In this study, the domain of *parenting experience* includes the three constructs of parental aggravation, emotional support, and coping. The first construct, parental aggravation, is derived from the Parenting Stress Index and has been cited as one indicator of parenting stress (Abidin, 1997). The other two constructs, emotional support and coping, have been described as attributes that are inversely related to parenting stress. This section will review a few studies that have associated different aspects of parenting stress with childhood obesity.

The last fifty years have seen a widespread increase in the number of families with two working parents and in the number of single women in the labor force. Between 1952 and 2004, the percentage of working women age 16 and older has grown from 34% to 59% (Bureau of Labor Statistics, 2007). It has been suggested that parenting stress is partly explained by maternal work hours (Anderson, Butcher, & Levine, 2003). Anderson et al. (2003) found that a mother's working ten hours a week increases her child's chance of being overweight by 1%. The relationship was strongest in families with higher socioeconomic status. The cross-sectional nature of the data precludes the establishment of any causal relationship. However, one implication is that increased work time results in reduced time for meal preparation, increased out-of-home eating, and delegation of child care to third parties, who may provide less nutritious meals (Anderson et al., 2003). It is also unclear whether an increase in maternal working hours is a true reflection of parental stress.

Using more direct measures of stress, Lohman, Stewart, Gundersen, Garasky, and Eisenmann (2009) explored the relationship between adolescent obesity, stressors (individual, paternal, family), and food insecurities. Maternal stress was measured by hours of work, lost work due to disability, the Rosenberg Self-Esteem Scale, the Brief Symptom Inventory, health status, and a social/support network scale. They found that maternal stress was associated with a child's increased BMI, particularly in food insecure homes. They suggested that time pressed parents may have "poor food choices, such as fast food meals that are not well balanced." In addition, they recognize that insecure homes tend to purchase cheaper, energy-dense foods and overeat when food is available (Lohman, Stewart, Gundersen, Garasky, & Eisenmann, 2009). Lastly, they also suggested that food-insecure families with stressed parents may rely on outside sources, such as friends, work, or school, where food choices may encourage obesity. In another study, Zeller et al. (2007) compared behaviors of parents of obese children to the parental behaviors of non-obese children. They reported that mothers of obese children had greater psychological distress, higher family conflict, and more mealtime challenges than mothers of non-obese children, even when controlling for parental obesity. The authors suggested that future interventions should target parent behavioral management strategies particularly during meal times.

Not all studies have found a relationship between variables in the parenting experience in child obesity. Ievers-Lanis and Redline (2007) examined the relationship between obesity and sleep, a child's psychological functioning, and parental stress. Stress was measured using the Parenting Stress Index. In this study of 819 children between the ages of 8 and 11, only sleep duration was associated with obesity. For every one-hour reduction in sleep, there was a 41% increase in the odds of a child being obese. Parents' stress and child's psychological functioning were associated with sleep duration, but not with obesity. Lastly, Barlow and Chang (2007) use the 2003 National Survey of Children's Health to look at parental aggravation and childhood obesity. Parental aggravation was defined by answers to three questions:

1. During the past month, how often have you felt [S.C.] is much harder to care for than most children [his/her] age?
2. During the past month, how often have you felt [he/she] does things that really bother you a lot?
3. During the past month, how often have you felt you are angry with [him/her]?

In this nationally representative dataset, they found that parent aggravation was associated with being obese, presence of behavior problems, TV watching, and the presence of a chronic medical condition. Using logistic regression, the relationship between parent aggravation, problem behavior was not associated with child obesity after controlling for TV watching and general demographics.

Social capital. Social capital represents embedded resources in social structures, which are accessed and/or mobilized in purposive active (Kawachi & Berkman, 2000). The definition and utility of social capital in health outcomes is relatively new and is a developing area of study (Kawachi, Kim, Coutts, & Subramanian, 2004; Szreter & Woolcock, 2004). Social capital can be measured at the individual or collective levels. Individual social capital includes aspects of social support and social networks, whereas collective social capital is the willingness of the community to work toward a common goal (Kawachi & Berkman, 2000).

The study of the association between social capital and obesity prevention is relatively new. One theory suggests that the mechanism of action is "diffusion of innovation," in that high social capital neighborhoods demonstrate high levels of exercise and healthy eating and will influences other in the community to do the same (Lindstrom, Moghaddassi, & Merlo, 2003). Components of social capital, also referred to as collective efficacy, can be described by constructs including but not limited to mutual trust and reciprocity. Recent studies have specifically explored the relationship between social capital and obesity using NSCH dataset (McKay et al., 2007; Singh et al., 2008).

Two studies have been published using the NSCH data that compare correlates of social capital (referred to as "social context" by the authors) with obesity in children (McKay et al., 2007; Singh et al., 2008). McCray et al. (2007) defined social context using the social capital dimensions of social trust and mutual aid. *Social trust* is defined as a parent's belief that "if my child were outside playing and got hurt or scared, there are children nearby I can trust to help my child" ; *mutual aid* is defined as a parent's belief that "people in this neighborhood help each other out" (McKay et al., 2007). After controlling for demographics using hierarchical generalized linear modeling for BMI, individual-level mutual aid and social trust was protective against elevated BMI (respectively, OR = 0.90; 95% CI = 0.86, 0.94 and 0.93; 95% CI = 0.89, 0.98). In their conclusion, they recognize that health behaviors require a collective look at individual decision-making as well as social actions, such as social capital, that influence decision-making.

Expanding on McKray et al.'s (2007) definition of social capital, and also using the NSCH database, Singh et al. (2008) created an index of four variables capturing social cohesion, trust, and reciprocity. Their social capital index was tested with factor analysis, which confirmed the existence of a single scale. The scale was a composite of the following statements: (1) "People in this neighborhood help each other out"; (2) "We watch out for each other's children in this neighborhood"; (3) "There are people I can count on in this neighborhood"; (4) "If my child was playing outside and got hurt or scared, there are adults nearby who I trust to help my child." Regardless of gender, those with the lowest social capital index scores were at higher risk of obesity (males 1.35; 95% CI = 1.05, 1.75 and females OR = 1.63; 95% CI = 1. 19, 2.24).

Social participation. Very little research has focused on social participation leading to obesity in children. In general, it is difficult to determine the direction of causation when looking at the obesity/social participation relationship. For social participation, the assumption is that increased obesity leads to social isolation. As an example, children as young as 6 years old use derogatory words to describe other children who are overweight (Caskey & Felker, 1971; Kilpatrick & Sanders, 1978). In another study, when children were given a choice of playmates with different characteristics, overweight children were ranked as least desirable (Richardson, Hastorf, Goodman, & Dornbusch, 1961).

An alternative hypothesis is that social isolation, or lack of social participation, could contribute to the risk of obesity. Strauss and Pollack (2003) explored this relationship using the nationally representative data from the National Longitudinal Study of Adolescent Health. A sample of 90,118 adolescents between the ages of 13 and 18 completed a detailed home assessment that included height/weight measurements. Compared to normal weight adolescents, overweight adolescents were more socially isolated and outside of social networks. Normal weight adolescents were engaged in more sports activities, school clubs, and had more frequent friendship nominations from friends ($p < 0.05$). Using a Kamado-Kawai free-energy drawing of social network mapping, Strauss and Pollack graphically illustrated the reduction of social networks in obese children (Figure 2).

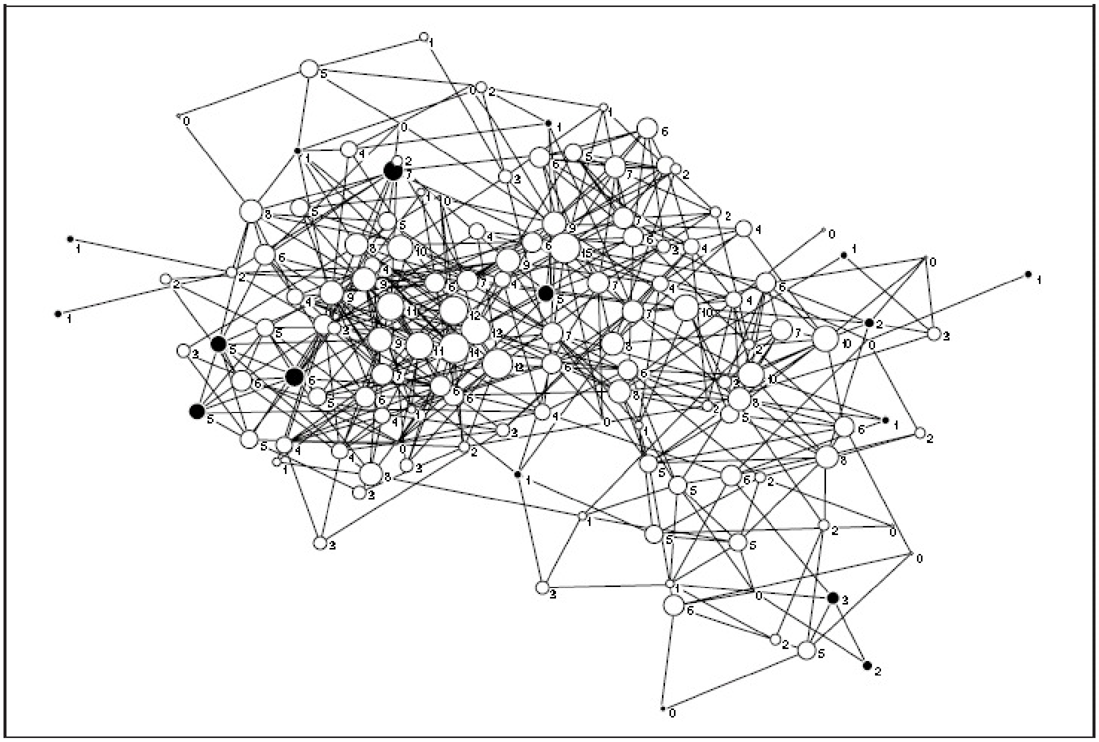


Figure 2. Kamado-Kawal Drawing of Social Network Mapping. Each dot in the figure represents a national longitudinal study of adolescent health respondents. The size of the dots and the number next to each dot represent the number of friendship nominations by others. The black dots represent overweight adolescents. As demonstrated in the figure, overweight adolescents received less on-chip nominations and were less centrally located in the social network than normal weight adolescents. (Strauss & Pollack, 2003)

The potentially protective effect of social participation against obesity is also found in the adult literature. Using telephone survey data, Veenstra et al. (2005) found that social involvement was associated with lower overweight status, even after controlling for individual and neighborhood characteristics. Using more direct measures of obesity, Moore, Daniel, Paquet, Dube, and Gauvin (2009) further explored the relationship between social networks. Using waist circumference as a measure of excess adipose tissue, they looked at responses of self-reported social networks (based on occupation), trust in others, and social participation. Responses were controlled for using basic demographics and behavioral variables, including physical activity, fruit and vegetable consumption, alcohol consumption, and smoking. The study found that social networks, but not social participation, were protective against obesity. At first glance, this study would not support a link between social participation and obesity in children. A social network for their study was operationalized by the participant's work environment. For children, school activities and school-related after-school activities become their "occupation." The results of their study suggested that future explorations of children should consider school as their occupation when considering social participation.

Clearly, there is no definitive causal link between social participation and obesity. Increased social participation may facilitate positive adult role models and connectivity to their peers (Koehly & Loscalzo, 2009). Indirectly, social interactions may provide a sense of community and reduce loneliness or depression, which is associated with increased obesity. Lastly, social participation in activities such as after-school club activities may exercise social control over negative behaviors such as smoking and illegal drug use (Lisha & Sussman, 2010).

Defining Children with Special Needs

Federal and state agencies are charged with providing and developing systems to help children with disabilities. According to Title V of the Social Security Act, the Maternal and Child Health Bureau (MCHB) Children with Special Needs Program of each state is responsible for planning systems that serve children with special needs. In particular, under Title V of the MCHB in Children with Special Needs Program, states are responsible for planning systems to serve children with special needs (McPherson et al., 1998). To promote consistency and coverage across conditions, it was recognized that a common definition of 'children with special needs' was required (Perrin et al., 1993). Formulating a common definition was necessary to allow State Title V program funds to be used for planning programs that would cater to the special needs population. This new definition was policy-driven with the goal of accessing State Title V programs funds for program planning in the special needs population (McPherson et al., 1998). To create this definition, a working group consisting of federal and state Children with Special Healthcare Needs (CSHCN) program directors, parents, healthcare professionals, epidemiologists, and policy analysts met three times in 1994 and 1995 (McPherson et al., 1998).

This group established that the new definition needed to

1. be simple and easy to understand;
2. have utility for major policy and program directions for the federal Title V programs for children with special needs;
3. have utility for state Title V systems development mission, specifically the development of comprehensive community systems of family-centered services for children with special health-care needs;
4. recognize linkage among primary health services, specialty health services, and related services;
5. be specific and measurable; and
6. reflect current scientific knowledge. (McPherson et al., 1998)

The consensus was that the definition of 'special needs' would be based on services a child requires. The working group also recognized that since the goal was to develop policies for future populations, the definition should include children at risk for needing elevated services in the future. The final definition as articulated by the working group was:

> Children with special health-care needs are those who have or are at risk for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that acquired by children generally. (McManus, Fox, Newacheck, McPherson, & Dunbar, 1997)

There are several notable features of this definition (Bethell et al., 2002a; Bethell et al., 2002b; Stein & Jessop, 1982). First, it incorporates not only children currently requiring services, but also those who may need services in the future. Second, it recognizes the important services not only for physical disabilities but also for behavioral and emotional conditions. Lastly, it recognizes that regardless of diagnosis or condition, there is often a shared set of consequences in terms of services used (Bethell et al., 2002a; Bethell et al., 2002b). Also noted was that it implied a non-categorical approach to grouping children; suggesting that use of health care services (i.e. medical care services, preventative services and rehabilitation services) are central to policy activities as opposed to a specific medical diagnosis and the consequences of a specific condition (Stein, Bauman, Westbrook, Coupey, & Ireys, 1993; Stein & Jessop, 1982; Stein & Jessop, 1989).

In keeping with the spirit of the MCHB definition, a nationwide collaboration was conducted to develop a short screener questionnaire to identify special needs children (Bethell et al., 2002a; Bethell et al., 2002b: McPherson et al., 1998). The screener questionnaire consisted of 5 consequence-based questions that asked parents to say whether their child:

(a) Is [S.C.] limited or prevented in any way in [his/her] ability to do the things most children of the same age can do?
(b) Is [his/her] need for prescription medicine because of ANY medical, behavioral, or other health condition?
(c) Does [S.C.] need or get special therapy, such as physical, occupational, or speech therapy?
(d) Does [S.C.] need or use more medical care, mental health, or educational services than is usual for most children of the same age?; and
(e) Does [S.C.] have any kind of emotional, developmental, or behavioral problem for which [he/she] needs treatment or counseling?

Two follow-up questions were asked: (1) Is the condition expected to last 12 months? and (2) Is the condition a consequence of medical, behavioral, or other health conditions?

The Children with Special Healthcare Needs (CSHCN) Screener Questionnaire is intentionally broad and exclusively measures the consequences of health conditions (McPherson et al., 1998). This allows an epidemiological approach to analyzing associations in children with special needs. Using a disease-specific approach would be relatively impossible in national surveys due to the low prevalence of many childhood conditions (Stein & Jessop, 1982; Stein & Jessop, 1989; Stein et al., 1993). The utility of the screener's questionnaire was tested in a national sample of children under 18 and a random sample of children under 14 in a managed healthcare plan (Bethell et al., 2002a; Bethell et al., 2002b). The purpose is to determine if shorter self-administered five-question screener questionnaire could adequately identify children with special-needs than using longer but validated Questionnaire for Identifying Children with Chronic Conditions-Revised (QuICCC-R). They found that the CSHCN screener questionnaire had 90% agreement with the longer QuiCCC-R questionnaire and did not systematically leave out or miss children with any specific types of medical, behavioral, or health conditions. More importantly, it did not fail to identify any children with serious diagnoses or medical conditions requiring extensive use of health services. The reliability of the CSHCN has not been tested. Currently, the CSHCN screener has been incorporated into the National Medical Expenditures Panel Survey, the National Survey for Children's Health (NSCH), and CAHPS (Bethell et al., 2002a).

In the past, authors have used the responses on the CSHCN screener questionnaire to group children into a variety of categories (Kogan, Newacheck, Honberg, & Strickland, 2005). Using previous literature, Bramlett, Read, Bethell, & Blumberg (2009) grouped responses into theoretical categories that would represent different health statuses and degrees of complexity of healthcare needs (Bethell et al., 2002b; Westbrook, Silver, and Stein, 1998).

1. CSHCN by current need for more use of prescription medication to manage an ongoing medical, behavioral, or other chronic condition criteria, and qualifying on no other needs (Rx meds group only)

2. CSHCN who qualified on one or more of three elevated service needs or use screening criteria: elevated need or use of medical, dental health, or educational services; need or use specialized therapies; and/or need for treatment or counseling for a chronic emotional, behavioral, or developmental condition; but who do not qualify on prescription medications or functional limitations (the "elevated services only" group)
3. CSHCN qualifying time of prescription medication screening criteria and one or more of the three elevated service use criteria listed above, but not on functional limitations (the "Rx meds and elevated services" group)
4. CSHC and qualifying on functional limitations criteria (limitation in the ability to do things most other children of same age can do due to the presence of an ongoing medical, behavioral or health condition), alone or in combination with any other screening criteria (the "functional limitations" group).

The authors examined distribution of health status, complexity of needs, family impact, health-related costs, and types of health problems using data collected from the NSCHS. They found that the categories successfully grouped children by varying needs of resources. For example, the prevalence of emergency room visits by children in the following categories - medication only, services only and medication, services, and functional limitations, was 8%, 11%, 15%, and 23%, respectively. The low prevalence of children in the Rx only group with emergency room visits suggested minimal impact on a child's health status or complexity of their illness (as would be the case with a child diagnosed with attention deficit disorder or asthma). These conditions could be medically managed well by medication and are less likely to have any functional limitations or need for physical, occupational therapy medical or behavioral interventions. From a policy perspective, this is valuable information since they will less likely need to be included when planning, implementing, or evaluating a community-based program (Bramlett et al., 2009; Bumbalo, Ustinich, Ramcharran, & Schwalberg, 2005; Mulvihill et al., 2005). Unlike the Rx group, children with functional limitations had the greatest negative impact on family, medical expenditures, and required the most services. Bramlett et al. (2009) concluded that the subgroups identified by "qualitative grouping show that the classification scheme is associated with the health status, complexity of a healthcare needs, and health problems of the child."

Associations of Mediators and Youths with Disabilities

Physical activity and after-school sports in children with disabilities.

Achieving sufficient physical activity levels in children with disabilities is a common concern for parents and clinicians. Athletics in the school system are not designed for children with disabilities (Rimmer et al., 2004). Within the community, there are inadequate resources and the small density of children with similar disabilities impedes them to organize either competitive or intramural adaptive sports teams. For children with assistive devices or wheelchairs, neighborhood barriers such as hills, lack of sidewalks, and/or distances between homes prevent participation in general physical activities (Rimmer et al., 1996; Rimmer et al., 2007). As an example, Figoni et al. (1998) surveyed 34 fitness centers in the Kansas City metropolitan area to look for environmental barriers that could be obstacles for people with disabilities. In their study, physical environments were evaluated by counting the number of facilities that were in compliance with the American Disability Act (Figoni et al., 1998). A low percentage of facilities were compliant in the following areas: access to customer service desk (19%), availability of adaptive equipment (15%), presence of drinking fountains (15%), presence of ramps (30%), and parking (24%). This study also indicated that social environment was a barrier, finding that staff tended not to interact with the person with the disability but rather with their personal attendant.

For obesity prevention in youths with disabilities, barriers to physical activities are particularly disconcerting since most mobility-restricted children have reduced energy expenditure. As a result, children with mobility restriction should reduce their calorie intake and/or increase the intensity of their exercise. Unfortunately, the literature suggests that disabled children are not participating in adequate amounts of physical activity, as compared to their peers. Comparing 100 disabled children to a national sample, Steele et al. (1996) found dramatic differences in frequency and type of physical activity. For example, the prevalence of biking 30 minutes every day was 7% for disabled children, compared to 23% in the national sample. Of the national sample, 15% reported playing on a sports team, compared to 7% of disabled children. Seventy percent of children with disabilities seldom or never jogged or exercises for 10 minutes per day, compared to 30% reported by the national sample.

Maher et al. (2007) compared participation in physical activities in children with cerebral palsy to nondisabled children. Their cross-sectional postal survey included responses from 118 children. The study used the Physical Activity Questionnaire for adolescents to rate levels of physical activity. They found a trend of less structured and lower intensity participation in physical activities by children with cerebral palsy. For example, in the school setting, 35% of children with cerebral palsy reported not participating in physical activities compared to 20% of nondisabled children. For after-school activities, 55% of children with cerebral palsy did not participate in any physical activities, compared to 16% of nondisabled children. Similarly, 50% of children with cerebral palsy did not participate in any physical activities on weekends, compared to 12% of nondisabled children. The results from these studies reflect the reduction in physical activities that has been reported in adults with disabilities (Nosek et al., 2006; Rimmer et al., 2000; Rimmer, 2005; Rimmer et al., 2004).

In children with disabilities, there is a clear reduction in structured team-oriented physical activities, but there is also a concurrent increase in unstructured solitary activities (Law et al., 2006; Maher et al., 2007; Poulsen, Ziviani, Cuskelly, & Smith, 2007; Poulsen, Ziviani, Johnson, & Cuskelly, 2008). For example, Hogan et al. (2000) used cross-sectional data to describe health patterns in children with and without disabilities. Their study highlighted the isolation often felt by children with disabilities. Children with a disability were reported as feeling lonelier (OR = 1.74; 95% CI = 1.24, 2.40), more isolated (OR = 1.59; 95% CI = 1.20, 2.12), less likely to feel accepted (OR = 0.52; 95% CI = 0.61, 0.98), or having a sense that they do not belong (OR = 0.57; 95% CI = 0.42, 0.78). Similar results were reported by Steele et al. (1996). They reported that 7% of children with disabilities played a team sport, compared to 50% of non-disabled children. Looking at social activities, nearly 60% of disabled children seldom or never played with friends, compared to 29% of their counterparts. Furthermore, 6% played every day with a friend, compared to 15% of nondisabled children.

In children with developmental coordination disorders, Poulsen et al. (2008) explored physical activities categorized as structured (e.g., team sports) or unstructured (e.g., informal outdoor play). In their study of boys between the ages of 10 and 13, they found that children with developmental coordination disorders were less likely to participate in team sports, structured social activities, and structured physical activities. Conversely, they were more likely to participate in unstructured nonphysical activities and structured social non-physical activities. Interestingly, they found that boys with developmental coordination disorders had higher loneliness scores that were mediated by participation in team sports.

Lastly, a study by Whitt-Glover, O'Neill & Stettler (2006) compared levels of physical activities in children with Down's syndrome and compared them to their unaffected siblings. In their study of 58 participates, they found that children with Down's syndrome were heavier than their siblings. Using accelerometers they also found that children with Down's Syndrome participated in less total vigorous physical activities for short bouts. Their study does not establish a causal relationship between obesity and having a disability, but their findings do suggest that the relationship warrants further investigation.

Television and youth with disabilities. Only a handful of studies compared screen time activities in children with a disability to children without a disability. The first study compared patterns of physical and sedentary activities in nondisabled children, using the World Health Organization Behavior in School Children Questionnaire (Hogan, McLellan, & Bauman, 2000). This study of 3,918 students in New South Wales, Australia, included 5.8% of children who self-reported having a disability. The authors found that there was a 42% higher use of video games, and 57% use of computers in disabled children, compared to nondisabled children ($p < 0.05$). Also exploring the relationship between TV viewing and disability, Steel et al. (1996) compared hours of TV watching per day in 100 children with disabilities to the hours reported in a national sample of non-disabled children. They reported that nearly 40% of children with disabilities watched four or more hours of TV a day, compared to 12% of the national sample watching four or mores hours of TV a day (Steele, Kalnins, Jutai, Bortolussi, & Biggar, 1996).

In contrast, Mahr et al. (2007) compared screen time in 112 children with cerebral palsy to normative age and gender-matched datasets. To evaluate sedentary activities this study group created a scale indexing "screen time" watching TV, videos, video games, or playing on computers or the internet. Sedentary activities, like TV watching and computer use, were similar among the children with cerebral palsy and the nondisabled comparison group. Using data from the Centers for Disease Control and Prevention's 2005 Youth Risk Behavior Survey, Jones and Lollar (2008) compared responses to health risk behaviors questions of children with self-reported children disabilities to those without. They found that additional 3 hours of watching TV was not statistically different from those with a disability to those without (OR 1.10; 95% CI = 0.9, 1.3). They did find that children with a disability were 1.60 (95% CI = 1.30, 2.0) times more likely to use computers for 3 or more hours a day.

Family meals and youth with disabilities. Currently there is a scarcity of research that examines family meal times in children with special needs/disability. There is some evidence that having a child with a disability impacts both how food is prepared and the time available for meals. For example, behavioral problems that result from a child's disability could make family meals prohibitive. Collins et al. (2003) studied eating patterns in children with Down syndrome, autism spectrum disorder and Cri Du Chat. They found in all age groups, children with spectrum disorder were less likely to eat the usual family diet and reported more eating problems, in particular obsessive eating patterns. Due to the social complexity of autism, they hypothesize that there is an increased focus on food and less interest in the social aspect associated with meals. The authors further noted that parents of disabled children reported problems with behaviors such as eating too fast or too slow; using their fingers to play with their food; and taking food off someone else's plate (Collins et al., 2003). In a second cross-sectional study of 36 children with Down syndrome and their siblings, O'Neill, Shults, Stallings, and Stettler (2005) used the Child Feeding Questionnaire to explore parental control in feeding. They found that parents used different feeding strategies for each sibling. They were more likely to use restrictive feeding with the Down syndrome child and feel more concern regarding their child's weight status.

Parents may have to alter their feeding practices to accommodate their child's disability. In a survey of 101 Canadian adolescents with self-reported disabilities, 8% reported eating vegetables more than once a day. In contrast, a national Canadian sample of children of the same age, 20% of adolescents reported eating raw vegetables once a day. The disabled children stated that the less nutritious foods were easier to handle physically, and the report suggested that raw vegetables might be more difficult to chew and swallow. In the same study, it was found that 33% of youths with disabilities eat French fries at least once a day, compared to 11% of the Canadian national sample. The study is supported by a similar work on cerebral palsy that found a relationship between severity of physical impairment and increased difficulty in eating (Fauconnier et al., 2009; Varni et al., 2006).

Lastly, food and eating may assume a different role in parent-child relationship in the presence of a disability. Minihen et al. (2007) report on a study with parent focus groups that "indicated that they sometimes felt guilty about the many things their children were unable to do, or that they needed to 'pick their battles; with respect to household rules, with the result that healthy eating might be de-emphasized while tooth brushing or a new behavior modification program was emphasized." In addition, parents reported that they would purchase heavily advertised foods due to the desire to have their child 'fit in' with their peers. Lastly, junk food was reportedly used as rewards for behavioral control in children with special needs (Minihan et al., 2007). None of the studies described directly looked at family meals together and its association with having a child with a disability, but the studies suggest that the dynamics of meal times could be altered in families with a disability.

Sleep and youth with disabilities. There is substantial evidence that sleep disorders are a secondary complication of a variety of pediatric disorders. For example, Duchene's muscular dystrophy is a genetic condition that results in the deterioration of muscle fibers and their replacement with adipose and connective tissue. In Duchene's muscular dystrophy, the pulmonary system becomes severely compromised, and respiratory failure accounts for 80% of deaths (Nagai, 1989). Poor respiratory function often initially manifests itself during sleep (Smith, Calverley, & Edwards, 1988). In a study of 21 non-ambulatory patients with Duchene's muscular dystrophy, the prevalence of obstructive sleep disorder was 60% (Khan & Heckmatt, 1994). In a second study, a retrospective review of 34 patients referred for respiratory assessment, 64% reported sleep-related symptoms, 91% of patients were diagnosed with obstructive sleep apnea and 32% had hypoventilation at night (Suresh, Wales, Dakin, Harris, & Cooper, 2005). Similar to Duchene's muscular dystrophy, muscle paralysis from a spinal cord injury is also associated with sleep disorders. Tran, Hukins, Geraghty, Eckert, and Fraser (2010) found that 73% of patients with a spinal cord injury had evidence of sleep obstruction with a third of the sleep obstruction being moderate to severe. Although obesity has not been studied in patients with a spinal cord injury, several neuropsychological variables, including verbal attention, concentration, and memory, have been associated with sleep hypoxia (Sajkov et al., 1998).

Sleep dysfunction has been documented in adolescents with mental retardation. In a survey of 200 parents, 50% reported that their children had trouble falling asleep, 67% were restless at night, and one-third reported that their child got insufficient sleep (Quine, 2001). Sleep dysfunction remained even after three years. In another study by Poindexter and Bihm (1994), it was reported that 40% of cognitively delayed adults slept less than five hours per night, qualifying them as chronically partial sleep-deprived. In a more recent study, Nosek et al. (2006) examined a variety of secondary conditions in 443 women with physical disabilities over a one-year time period. Their study found that

80% of women reported having sleep problems. Although the relationship between sleep and obesity was not explored in this study, 50% of the sample population was classified as overweight.

Parenting experience in families with disabled youths. The presence of a disability significantly alters family dynamics. Providing regular childcare can be both physically and psychologically demanding (Hauser-Cram et al., 2001; Tong et al., 2002; Tong et al., 2003). Clearly, the demands of caring for a child with a disability increases parental stress and test a parent’s ability to cope with daily demands (Hauser-Cram et al., 2001). Several studies have demonstrated that chronic conditions exacerbate parental stress (Hung, Wu, & Yeh, 2004; Warfield, 1999). Using data from the CSHCN, Bumbalo et al. (2005) reported that 40% of families had accrued additional costs due to their child's disability. Using a subset of the CSHCN representing New Hampshire, 31% of parents reported having inadequate insurance, 21% reported having financial problems, 27% reported having to reduce work hours, and 14% reported needing professional care coordination. It has been reported that children with special care needs have twice as many physician contacts and five times as many hospital stays as nondisabled children (Newacheck et al., 1998).

Although numerous studies have examined parental stress and coping in children with special needs, only a handful of publications use data from the NSCH. Schieve et al. (2007) used data from the 2003 NSCH to look at associations between parenting children with autism, developmental disabilities or child with no disability with different stress indicators. The survey included an aggravation scale composed of four questions assessing how often a parent in the last month felt (1) the child was much harder to care for than most same age children, (2) bothered a lot by things the child did, (3) they were giving up more than their life than they expected to meet the child's needs, and (4) angry with their child. In addition to the aggravation scale, Schieve et al. (2007) assess the parental perception of closeness and ability to share or talk about things that matter to the child. Lastly, a single question was asked regarding parents' ability to cope with the daily demands of parenting. With respect to daily coping, only 38.6% of parents of children with developmental problems were coping very well, compared to 50% of parents of children with autism or 57.3% of parents of children without a special healthcare needs. Thirteen percent of parents of children with developmental problems usually or always felt angry with their child compared to 4% of parents of children with autistic children or 2.3% of parents of children without special needs. When reporting if their child was harder to care for than most children of their age, 54% of parents with autistic children stated "Usually" or "Always," compared to 29% of parents of children with developmental problems, and 4% of parents without special healthcare needs. Only 72% of parents with children having developmental problems felt very close to their children compared to 87% of parents with autistic children and 86% of parents having children with no special healthcare needs. Lastly, parents having children with autism or developmental problems were more likely to come from single-parent families, fall below 200% of the federal poverty line, have less education, and receive special services.

Several studies that did not use the NSCH dataset also found associations between having a child with a disability and negative parenting experiences. Holmbeck et al. (1997) compared parents of children with spina bifida to parents of children with no disabilities using the subdomain of social isolation of the Parenting Stress Index and the Parenting Satisfaction Scale. Compared to controls, parents of children with spina bifida reported less parenting satisfaction, higher total stress, and higher levels of social isolation. Further, mothers of children with spina bifida were less likely to utilize social support as a coping mechanism than mothers of children with no disability. Glenn, Cunningham, Poole, Reeves, and Weindling (2009) also used the Parenting Stress Index to compare parents raising children with cerebral palsy to norms published during the development of the Parenting Stress Index. They found that parents of children with cerebral palsy report greater social isolation than published norms.

Social capital in disabled population. This study intends to examine the relationship between parent-perceived neighborhood social capital in families of children with and without special needs. Unfortunately, a literature search found no articles specifically looking at social capital, as defined by the NSCH dataset, in families with and without special needs. One paper was found that examined the relationship between developmental disabilities and social capital. In this study, Oelofsen and Richardson (2006) compared families with preschool children having developmental disabilities to families with typically developing children. The study measured social support using the Family Supports Scale, and also measured a type of social capital using the Sense of Coherence Scale, as measured by the Orientation to Life Scale. The study found that parents of children with developmental delays scored lower on both the Family Supports Scale and Sense of Coherence Scale. Within families, mothers consistently scored lower on the same scales than fathers. A similar pattern was not seen in families without disabled children. The authors suggest that the implications are that low Orientation to Life Scale scores may indicate a reduced ability to cope in parents of children with a disability.

Currently, there is no literature that looks at the relationship between perceived neighborhood social capital and its relationship to children with disabilities.

Social participation of youth with disabilities. The World Health Organization defines *participation* as involvement in life situations (World Health Organization, 2001). For some children with a chronic medical condition, a successful outcome is not a change in their medical condition but rather the ability to participate in life situations on an equal basis with their peers. Unfortunately, children with disabilities lag substantially behind their peers in terms of participation in social activities. In a study of 199 children with cerebral palsy, Parkes, McCullough, and Madden (2010) compared responses on the Frequency of Participation Questionnaire to norm referred peers. They found that compared to non-disabled children, children with cerebral palsy were less likely to participate in community groups, outdoor activities, non-sporting games, craft activities or cultural events.

Several very large studies have been conducted demonstrating that, as the severity of a child's disability increases, their participation in social activities decreases. In a prospective cross-sectional study of 500 children with cerebral palsy, Palisano et al. (2009) compared responses on the Children's Assessment of Participation and Enjoyment to the child's assigned level on the Gross Motor Functional Classification Scale (GMFCS). The GMFCS is a five-level ordinal scale, with Level I representing a fully ambulatory child with little upright mobility impairment and Level V representing a wheelchair dependent child. They found that the odds ratio of a child not participating in any social activities increased from 4.6 (95% CI = 1.4, 15.8) for GMFCS levels II/III, to 8.2 (95% CI = 2.4, 27.7) for GMFCS levels IV/V, when compared to GMFCS Level I. For GMFC level I, 35.8% of the activities were done with friends and others compared to 28.5% for GMFCS level II/II, and 27.3% for GMFCS level IV/V. In an even larger study, Faucommier et al. (2009) used the Life-H questionnaire to evaluate participation of children with cerebral palsy in a variety of functional and social activities. They found that 95% of the children could participate in activities at school, but 31% of them did so only with difficulty. Thirty-five percent of children with cerebral palsy were able to take part in activities in local recreational facilities, but 15% reported doing so only with difficulty, and 25% could not participate because it was too difficult. Similar to Palisano's et al. (2009) study, Faucommier et al. (2009) found that participation in the domains of school and recreation activities decreased with increased levels on the GMFCs.

Conclusion

The literature reviewed in this chapter suggests that obesity is more prevalent in youths with a disability than it is in youths without a disability. None of the studies reviewed attempted to identify constructs that explain the differences in prevalence of obesity between youths with a disability and youths without a disability. The literature reviewed supports the association between obesity in youths and the domains of youth lifestyle activities, parental stress, perceived social capital and social participation. The literature also suggests that youths with special needs/disabilities have lower levels of healthy lifestyle activities and less social participation. There is evidence that parents having a child with a disability are more likely to have a negative parenting experience and lower social capital. The present study is a significant contribution to the literature since it is the only study to determine if youth lifestyle activities, the parenting experience, perceived neighborhood social capital, and youth social participation can mediate the relationship between youths with functional limitations and obesity.

CHAPTER 3

METHODS

Design and Purpose of the Study

This study is a secondary analysis of cross-sectional data collected for the 2007 National Survey of Children's Health (NSCH). The purpose of this study is twofold:

1. to establish that youths with functional limitations are more likely to be obese than are youths without special needs, and
2. to determine whether variables related to youth lifestyle, parenting experience, perceived neighborhood social capital and youth social participation mediate the relationship between youths with functional limitations and obesity in youth.

This chapter will describe (a) the purpose of NSCH, (b) the method of data collection, (c) ethical considerations, (d) variables used for analysis, and (e) the statistical analysis plan.

National Survey of Children's Health

The Maternal and Child Health Bureau (MCHB) of the Health Research and Service Administration in the U.S. Department of Health and Human Services (DHHS) is charged with promoting and improving the health, safety, and well-being of American women, infants, children, adolescents, and their families. The vision statement of the MCHB is "for a society where children are wanted and born with optimal health, receive quality care, and are nurtured lovingly and sensitively as they mature into healthy, productive adults" (Blumberg et al., 2009). Further, the MCHB strives to secure "equal access for all to quality healthcare in supportive, culturally competent, family and community settings" (Blumberg et al., 2009). To meet this goal, the MCHB sponsored the development and implementation of the NSCH. The first NSCH was conducted in 2003, the second in 2007. Unlike previous national surveys, the NSCH was designed to collect data on children's health and well-being that could be compared across states, and to provide national estimates of the prevalence of health conditions, health-related risks, and protective factors.

As described by the Design and Operation of the National Survey of Children's Health 2007 manual (Blumberg et al., 2009):

> The NSCH content is intentionally broad, and addresses a variety of physical, emotional, and behavioral health indicators and measures of children's health experiences with the healthcare system. The survey includes an extensive battery of questions about the family, such as parental health, stress, coping, and family activates. The NSCH also asks respondents for their perceptions of children's neighborhood. No other survey provides the breadth and depth of information about children, families, and neighborhoods with sample size sufficient for state-level analysis in every state, collected in a manner that allows comparison among states. (p. 9)

The initial 2003 NSCH framework contained 8 domains. It was developed by a panel of state and federal maternal and child health program directors, representatives of family organizations, and experts in child health-services research and survey design. The 2007 NSCH questionnaire was expanded from 8 to 11 domains: (1) demographic characteristics, (2) health and functional status, (3) health insurance coverage, (4) healthcare access and utilization, (5) medical home, (6) early childhood (ages 0–5), (7) middle childhood and adolescence (ages 6–17), (8) family functioning, (9) parental health, (10) neighborhood characteristics, and (11) additional demographic characteristics. This study was based on data collected for the domains of demographic characteristics, health and functional status, middle childhood and adolescence, family functioning, and neighborhood characteristics.

Data Collection of the NSCH

Data collection for the NSCH used the State and Local Area Integrated Telephone Survey (SLAITS) Program conducted by the National Center for Health Statistics (NCHS) at the Centers for Disease Control and Prevention (CDC). SLAITS is a broad-based surveillance system available at state and local levels to track and monitor the health and well-being of children and adults. The SLAITS program is a large-scale random-digit-dialed telephone survey that contacts over 1 million households a year. Other surveys that use the SLAITS program include the National Immunization Survey, the National Survey of Adoptive Parents, the Influenza Vaccination Module, the Survey of Adult Transition and Health, the National Asthma Survey, the National Survey of Early Childhood Health, and the National Survey for Children with Special Needs. The NSCH was completed in conjunction with the National Immunization Survey.

Once a household had been contacted and identified as having a child under the age of 18, it was given the opportunity to participate in both the National Immunization Survey and NSCH. If the household had multiple children, only one child was randomly selected as the focus of the interview. All respondents provided verbal informed consent, and were offered $10 or $15 compensation for their time. After a respondent agreed to participate in both the NIS and NSCH, a single integrated survey was conducted, using the computer-assisted telephone interviews (CATI) system. The CATI is a program that guides interviewers to appropriate questions based on previous responses. As the interview is conducted, the responses are immediately entered into the computer program, which also provides online help screens to aid in the interview as needed. Currently, the NSCH is managed by the National Opinion Research Center at the University of Chicago.

The goal of the MCHB is to have a representative sample of children in each of the 50 states complete the NSCH. Gathering representative data on the children in each state allows data to be combined to create nationally representative estimates for survey responses. To meet this goal, a minimum of 1,700 completed surveys from each state were required. As with any survey, low response rates are a potential source of bias. The NSCH calculates the response rate by multiple the following proportion - (a) the resolution rate—of all phone numbers, the number of nonresponse calls known to be residential—; (b) the screener completion rate—of contacted households, the number without an eligible child—; and (c) the interview completion rate—of households with an eligible child, the number of completed interviews.

A total of 91,642 interviews were completed between April 2007 and July 2008. The national average rates of completion were 81%, 86%, and 66% for the resolution rate, screener completion rate, and interview completion rate, respectively. The overall response rate is the product of these three rates. The calculated national response rate for the NSCH was 47%.

Ethical Considerations

The NSCH is a de-identified publicly available dataset. A manual detailing the design, evolution, and operations of the survey is available (Blumberg et al., 2009). The survey was approved by the National Opinion Research Center's Institutional Review Board and was conducted in accordance with DHHS regulations (45 CFR 46). Participation was voluntary, and all data were collected in a manner assuring confidentiality. Unusual responses to questions regarding geography, race, language, height, weight, and family were coded to prevent identification of the participants.

The present study is a secondary analysis of an existing dataset. Because it did not involve original data collection, the study qualified for IRB exemption status under 45CFR 4 Section 101(b) Exemption 4. Exemption 4 concerns

> research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subject. (Code of Federal Regulations, 2011)

This study received exemption status approval from Temple University's Institutional Review Board (Appendix B).

Variables Used for Analysis

Dependent variable—Obesity. The dependent (outcome) variable for this study is obesity, as defined by age- and gender-specific body mass index (BMI) percentile, according to the CDC growth reference (Kuczmarski et al., 2002; Kuczmarski et al., 2000). In the NSCH dataset, extreme heights and weights were suppressed to protect individual children's confidentiality (Blumberg et al., 2009). An example provided in the NSCH manual indicated that a height of less than 43 inches for an 11-year-old child was recoded as 43 inches; a height of more than 68 inches for the same age were coded as 68 inches. To compensate for suppressed data, each child's BMI is calculated and grouped into four categories based on 2000 CDC BMI percentile grouping: (a) underweight, 0–5th percentile; (b) healthy weight, 6th–84th percentile; (c) overweight, 85th–94th percentile; and (d) obese, 95th to 100th percentile (Ogden & Flegal, 2010b). Only grouped data were available in the public dataset. This study focused on comparing children with excess adipose tissue to those without. BMI is an approximation of adiposity (Ogden et al., 2007). To reduce the likelihood of misclassifying youths without excessive adipose as obese, this study selected as an outcome BMI $\geq$ 95th percentile (obese) rather than BMI 85th percentile (overweight and obese) (Ogden & Flegal, 2010a; Ogden et al., 2010).

All heights and weights included in the NSCH are collected through parent report (Blumberg et al., 2009). A recent obesity study compared the prevalence of obesity using national estimates of parent-reported heights and weights from the 2003 NSCH to measured heights and weights from the National Health and Nutrition Examination Survey, which was collected at appropriately the same time (Akinbami & Ogden, 2009). The authors found that parents with children under the age of 10 significantly underestimated their child's height, leading to an overestimation of the number of overweight or obese children. Due to validity concerns, the NSCH 2007 dataset suppresses BMI for children younger than age 10. Because of the same concerns, this study will include only subjects between the ages of 10 and 17 (Blumberg et al., 2009). Therefore, the findings of this study are only generalizable to youths between the ages of 10 and 17.

Main independent variable—Youths with functional limitations. The intent of this study is to compare the prevalence of obesity in youths without any special needs to that in youths with functional limitations. The NSCH defines functional limitations as a parents' perception that their youth is limited in activities compared to their peers. As already noted in Chapter 2, the NSCH uses the Children with Special Health Care screener questionnaire to identify youths with activity limitations by asking a series of questions. The parent is first asked: "Is your youth [child] limited or prevented in any way in their ability to do the things most youths [children] of the same age can do." If the parent answers "Yes," he or she is asked whether their youth [child] has had this limitation for at least 12 months and whether it is due to any medical, behavioral, or health condition (Bramlett et al., 2009). The Design and Operation of the National Survey of the NSCH manual describes youths with activity limitations compared to their peers as having functional limitations, so for consistency, this study will do the same (Blumberg et al., 2009). It is important to note that, by default, any child identified as having functional limitations is also classified as having special needs. As described in the early, this definition is not specific to a medical diagnosis and is commonly used in population-based studies to identify children with disabilities (Jones & Lollar, 2008; Perrin et al., 1993; Stein et al., 1993). The present study focused only on comparing youths with functional limitations to youths without any other medical needs or at risk for having medical needs. Therefore, any youth identified as special needs without functional limitations were excluded from the analysis. For example, youths on medication and youths receiving psychological services but with no reported activity limitations were excluded from this study.

Potential mediating variables. A potentially mediating variable is an independent variable that is associated both with the main variable of interest (exposure) and the dependent variable (outcome), and is theoretically considered on the causal pathway between the exposure and outcome. In this study, the variable of interest is the presence of functional limitations, and the dependent variable is being obese. In this study, for an independent variable to be considered a mediator, it must theoretically be caused by or result from having functional limitations. In addition, the mediator must be a cause of obesity. For example, decreased levels of physical activity might be a potential mediator of the relationship between a youth having functional limitations and obesity. A youth with functional limitations has an increased risk of low physical activity levels compared to youths with no special needs, and having a low level of physical activities increases the risk of being obese. In other words, a youth's functional limitations prevent them from participating in physical activities, which thereby increases their risk of being obese. Furthermore, mediation has a temporal component, meaning it must come after the variable of interest but before the outcome. For example, a child's race cannot be a mediator because race is not the result of having functional limitations.

In this study, such variables as race are considered confounders when associated with both having functional limitations and obesity, but are not in the causal chain linking functional limitations and obesity. A more detailed description of mediation is described later in this chapter, under the heading of "Statistical Analysis." The following four variable domains will be evaluated as potential mediators of the relationship between a youth's functional limitations and obesity: (a) youth lifestyle, (b) parenting experience, (c) social capital, and (d) social participation.

Youth lifestyle. The youth lifestyle domain was addressed using six questions related to physical activity, TV habits, family meals together, and sleep habits. The survey included two questions about participation in physical activities. The first of these questions focused on sports participation. Respondents were asked to answer “Yes” or “No” to the following question: “During the past 12 months, was the [sc] on a sports team or did s/he take sports lessons after school or on weekends?” The second question asked respondents to quantify the amount of physical activity: “During the past week, on how many days did the [sc] exercise or participate in physical activities for at least 20 minutes that made him/her sweat and breathe hard, such as basketball, soccer, running or similar aerobic activities?” Physical activities were grouped into 0–2, 3–4, 5–6, and 7 days per week.

Two questions were asked about TV habits. First, respondents were asked, “On an average weekday, about how much time does [the youth] usually watch TV or watch videos?” Responses were based on minutes of TV watching per weekday, excluding weekend TV watching. Responses were grouped into the following categories: less than 1 hour, 1 hour, 2 hours, and $\geq$ 3 hours. The groupings chosen for TV watching allowed for comparisons between the current dataset and the already published statistically significant associations with obesity that were found using the NSCH 2003 dataset.[54] For the second TV question, respondents were asked to answer “Yes” or “No” to the question: “Is there a television in [the youth’s] bedroom?”

The information on meals eaten as a family was derived from a single question: “During the past week, on how many days did all the family members who live in the household eat a meal together?” Responses to this question did not have a linear association with obesity, so responses were grouped in a manner that best represented the distribution of their association with obesity. Responses were grouped into the following four categories: 0, 1–3, 4–6, and 7 days per week.

Finally, information on the quality of the youth's sleeping pattern was captured with the single question: "During the past week, on how many nights did [the youth] get enough sleep for a child [his/her] age?" Responses had a linear relationship with obesity so were grouped in a manner that best represented the linear relationship across responses: 0, 1–3, 4–6, and 7 days per week.

Parenting experience. The parenting experience domain was addressed with questions about parental aggravation (three questions), parental coping (one question), and social support (one question). The Parental Aggravation scale was derived using three questions from Abidin's Parenting Stress Index, which has been validated in previous studies (Abidin, 1997; Blumberg et al., 2009). The three questions were as follows: "During the past month, how often have you (1) felt [your child] is much harder to care for than most children [his/her] age, (2) felt [your child] has done things that really bother you a lot, (3) felt angry with [him/her]"? (Abidin, 1997). As recommended by the Design and Operation of the NSCH manual, if respondents answered "Usually" or "Always" to any of the three questions, they were given a positive score for parental aggravation (Blumberg et al., 2009). The coping question was as follows: "In general, how well do you feel you are coping with the day to day demands of parenthood/raising your children?" Responses were grouped as follows: "Very Well," "Somewhat Well," and "Not Well/Not Very Well." The final the emotional support question ("Yes/No") was “Is there someone you can turn to for day-to-day emotional help with parenthood/raising your child?”

Social capital. Social capital is a measure of a respondent’s perceptions of neighborhood social cohesion, trust, and reciprocity (Fields & Smith, 1998; McKay et al., 2007; Sampson et al., 1997; Singh et al., 2008). The NSCH used four statements from the Child's Well-Being Topical Module for the Survey of Income and Program Participation (Fields & Smith, 1998). The statements were developed to measure the perceived level of neighborhood social capital as related to the respondent’s child. The four statements were as follows: (a) “People in this neighborhood help each other out.” (b) “We watch out for each other’s children in this neighborhood.” (c) “There are people I can count on in this neighborhood.” (d) “If my child were outside playing and got hurt or scared, there are adults nearby who I trust to help my child.” For each statement, respondents were asked if they “Definitely Agreed,” “Agreed,” “Disagreed,” or “Definitely Disagreed” with the statement, and responses were scored from 1 (*disagree*) to 4 (*agree*). As recommended by Singh et al. (2008), the responses to the four statements were summed to create an index that ranged from 4 to 16. Using factor analysis, the existence of the single social capital scale has been confirmed (Singh et al., 2008). As per Singh et al. (2008), responses were grouped into four categories based on summed scores: Very Low (4), Low (5–7), High (8–10), and Very High ($\geq$ 11) (Singh et al., 2008).

Social participation. Social participation was measured using a single “Yes/No” question: “During the past 12 months, did [he/she] participate in any clubs or organizations after school or on weekends?" A youth was scored as having positive social participation if they answered "Yes" to this question.

Potential confounding variables. This study included six variables that might confound the association between having functional limitations and obesity. These variables were selected because they have been shown in prior studies or have been hypothesized to be related to both the exposure and outcome (Singh et al., 2008). Additionally, these variables were not considered mediators, because they are not the result of having functional limitations and, therefore, are not part of the causal chain linking having functional limitations to obesity.

The six potential confounding variables evaluated in this study were: youth gender, youth age, youth race/ethnicity, income-to-poverty line ratio, highest level of parent education, and family structure. The variable 'race/ethnicity' was created by NSCH to maintain the confidentiality of individual respondents. A youth identified as Hispanic was categorized as Hispanic regardless of the reported race. The race categories were: White non-Hispanic, Black non-Hispanic, and other non-Hispanic. The latter category included Asian, American Indian, Alaska Native, Native Hawaiian, Other Pacific Islander, or Multiple Races.

Household income was computed as the household income-to-poverty-line ratio, the ratio of the household income to the determined federal poverty level for the given household size in 2007. The federal poverty line is the amount of income that a family needs for food, shelter, clothing, and other necessities, after taking into account household family size (available at http://aspe.hhs.gov/poverty) (Blumberg et al., 2009).

DHHS sets the federal poverty line according to the specific year's national economic conditions adjusted for inflation. The income-to-poverty-line ratio could not be calculated in 8% of surveys due to (a) missing data, (b) respondents' refusal to answer income-related questions, or (c) responses of "Don't Know." The missing data were random and were related to health, neighborhood, and community characteristics and demographic variables (Blumberg et al., 2009). As described in the Design and Operation of the NSCH manual, multiple imputations were conducted to estimate the income-to-poverty-line ratio for the missing data. Imputation is an iterative process in which the underlying distribution of existing data is used to generate values for the missing values. The NSCH converted the final income-to-poverty-line ratio values from a continuous variable to an ordinal variable with the following ratio groups: $\geq$ 4.0, 2.0–3.99, 1.99–1.00, and < 1.00.

Highest household educational level was determined by combining the highest level of education between the mother, father, or other respondent. By survey design, responses were (a) Less than High School, (b) High School Graduate, and (c) Beyond High School. Also included in the analysis were the youth's age and gender. The information on age was divided into categories to facilitate presentation and interpretation of the data.

Family structure was a description of the relationships between the caregivers in the household and the youth. To protect confidentiality, only grouped responses were available in the public dataset. Responses to a series of questions regarding relationships of caregivers in the household were grouped into four mutually exclusive categories: (a) two parents, neither of whom was a step-parent, that is, the child was living with the biological or adoptive parents; (b) two parents, one of whom was step-parent; (c) a single parent, mother and no father; and (d) other family type, which would include a youth living with grandparents, single father or extended families.

Analytic Population

Of the 91,642 respondents who had completed the 2007 NSCH interview, 45,897 had a child between the ages of 10 and 17 (Figure 3). Of those, 44,101 had complete data for height and weight; therefore, BMI calculations were available. Of the youths who had BMI data and were between the ages of 10 and 17, 33,266 were not identified as having special needs. Of the 10,835 youth identified as having special needs, 8,531 did not have functional limitations and so were excluded from the analysis. This study included a total of 35,570 youths, 33,266 without specials needs, and 2,304 with special needs and functional limitations. In this study, those with special needs and functional limitations are considered the "exposed" group and will be referred to as simply "youths with functional limitations" (n = 2,304). Those without special needs will be considered the "non-exposed" group, and will be referred to as "youth with no special needs" (n = 33,266).

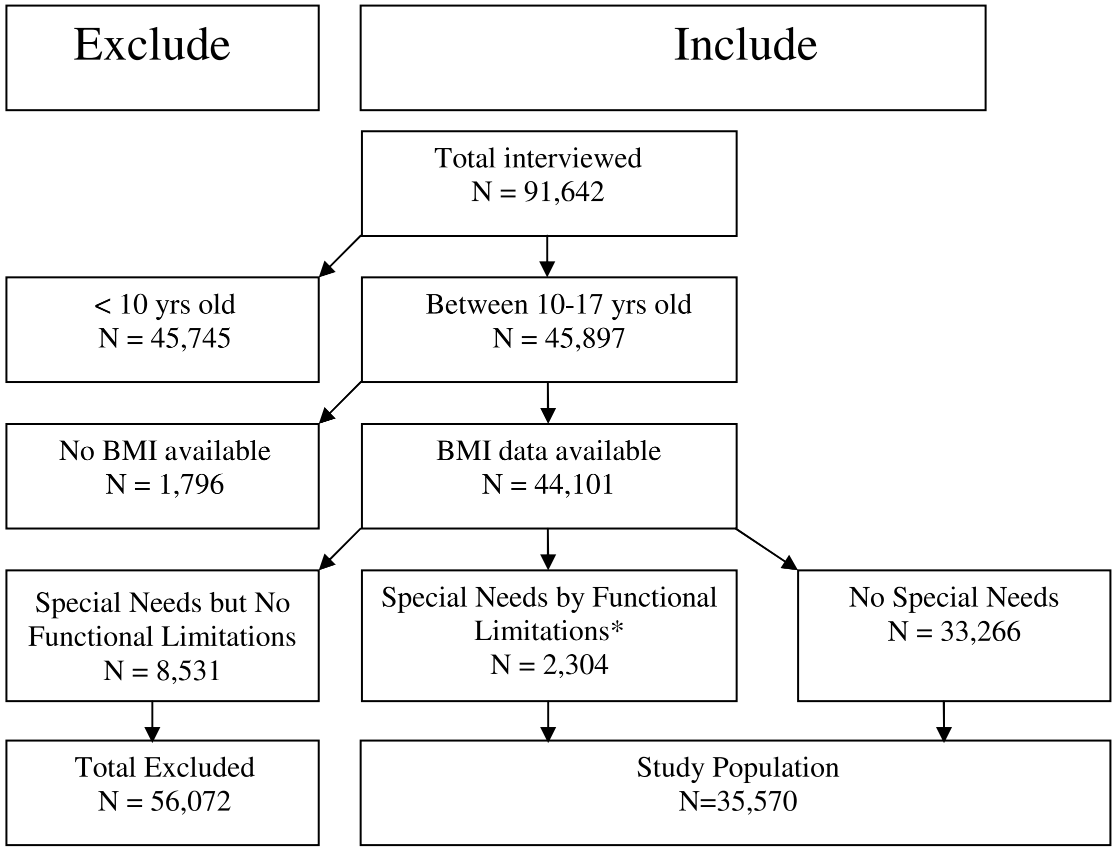


Figure 3. Diagram of the of Study Population.

* "Special Needs by Functional Limitations" is described in the chapters, tables, and figures as "functional limitations."

Statistical Analysis

Testing mediation. Statistical methods exist to determine whether a given variable mediates the relationship between an exposure and outcome. As initially described by Baron and Kenny (1986) and further detailed by MacKinnon, Fairchild, and Fritz (2007) and by Hayes (2009) *mediation* is a series of regression analyses that assesses the associations among the three variables. The first step in mediation is to establish a relationship between the main variable of interest (exposure) and a dependent variable (outcome). The association between the main independent variable and the dependent variable is described as the total effect and, in this study, is calculated as an odds ratio using a logistic regression, with obesity as the dependent variable and having functional limitations as the independent variable.

In Figure 4, the total effect is represented by *c* and is defined statistically as the coefficient of the independent variable in the regression model (MacKinnon, 2008).

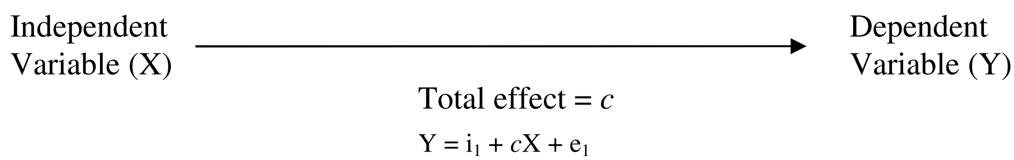
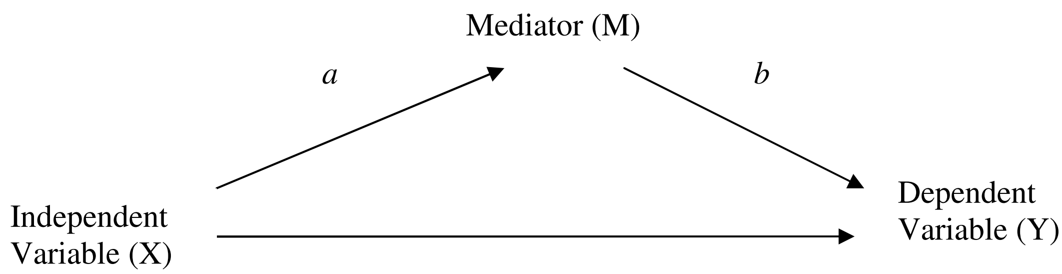


Figure 4. Total Effect. A graphical representation of the association between the independent variable (X) and dependent variable (Y). Below the figure is the regression formula that represents the independent variable predicting the dependent variable, where i_1 is the intercept, c is the regression coefficient of the independent variable, and e_1 is the coefficient of the unexplained variance in the regression formula.

In mediation analysis, the introduction of a third variable (mediator) changes the strength or direction of the total effect. To be considered a mediator, the third variable must lie along the causal pathway between the exposure variable and the outcome variable. In Figure 5, the former relationship (between independent variable and mediator) is represented by *a,* which is the regression coefficient of the independent variable of interest with the mediator as the dependent variable (MacKinnon, 2008).



Total effect = c`
Indirect effect= c- c` or $a*b$

$Y = i_2 + c' X + bM + e_2$

$M = i_3 + aX + e_3$

Figure 5. Indirect Effect. A graphical representation of the association between the independent variable (X), the mediator (M), and the dependent variable (Y). The first formula below the figure is the regression formula that represents the independent variable (X) and mediator (M) predicting the dependent variable (Y) where i_2 is the intercept, c' is the regression coefficient of the independent variable, b is the regression coefficient of the mediator and e_2 is the coefficient of the unexplained variance in the regression formula. The second formula is the regression formula that represents the independent variable (X) predicting the mediator (M) where i_3 is the intercept, a is the regression coefficient of the independent variable and e_3 is the coefficient of the unexplained variance in the regression formula. Modified from MacKinnon (2008), p. 49.

The latter relationship (between mediator and outcome) is represented by *b* and is the regression coefficient of the mediator with the outcome as the dependent variable after controlling for the exposure variable. The direct effect, represented by *c*`, is the relationship between the exposure and outcome variable in the presence of the mediator. It is important to note that both *b* and *c*` coefficients are derived from the same regression model (MacKinnon, 2008)..

In full mediation, the association between the exposure and outcome variables becomes non-significant, meaning the relationship is completely explained by the mediator. In partial mediation, the total effect either increases or decreases in the presence of the mediator. The amount of mediation or indirect effect is described as the difference between the total effect and direct effect (c-c'). It can also be described as the product of the effect of the exposure variable on the mediator and the mediator's effect on the outcome variable or *a*b* (MacKinnon, 2008). When all variables are interval, generalized linear regressions are used for the mediation analysis, and the mediating effect can be calculated by either method (*c-c′* or *a*b*) (MacKinnon, 2008). When the outcome is binary, a transformed generalized linear regression, known as a *logit regression* and a *logistic regression*, is used (Allison, 2003). A logistic regression calculates the probability or odds of occurrence of the outcome variable according to the predictors in the model. As described by Mackinnon (2008), due to differences in the covariance scaling between logistic regression models, the mediation effect is best described by calculating a*b. The indirect effect is, therefore, calculated with the formula *c`* = *c – (a*b)*. The percent mediation is calculated as follows: *c`* / (*c– (a*b)*) *100.

One criticism of Baron and Kenny's (1986) description of mediation is that it does not include a statistical test of the mediation effect (Hayes, 2009). The Sobel test uses regression coefficients *a* and *b* and their corresponding standard error estimates to calculate the standard error of the mediation effect,

$$\mathrm{SQRT}\ (a^2 * S_b^2 + b^2 * S_a^2),$$

where S_a and S_b are the squared standard errors of the regression coefficients *a* and *b*, respectively (MacKinnon, 2008). With a logistic regression, 95% confidence intervals are calculated using the formula (MacKinnon, Fairchild, & Fritz, 2007)

$$\exp(c\text{-}a*b) + \exp(1.96*\mathrm{SEM}),$$

where *c-(a*b)* is the indirect effect described earlier and SEM is the standard error of the mediated effect calculated by the Sobel test. If the calculated 95% confidence interval does not include zero, then the mediated effect is considered statistically significant ($p <$ 0.05) (MacKinnon, 2008). Although the Sobel test allows for testing for statistical significance, due to rescaling confidence intervals for the indirect effect cannot be calculated.

Lastly, to use the Sobel test, any identified mediator was to be grouped into a dichotomous variable. By collapsing data into a dichotomous variable, a single regression coefficient is created that can be entered in the Sobel test. Although SPSS has a module to test mediation, called AMOS, and SAS has available macros to test for mediation, neither is designed to be used with a complex survey design.

Testing for moderation. Whereas a mediator variable explains the relationship between an exposure variable and an outcome variable, a moderator variable determines whether a third variable changes the direction or strength of the exposure and outcome relationship (Baron & Kenny, 1986). In statistical terms, a moderator variable is described as an interaction between two independent variables (Kleinbaum, Kupper, & Muller, 1995). In a logistic regression, an interaction is tested in a model that includes both independent variables and a third term representing the interaction of the two independent variables:

$$\text{Logit (D)} = \beta_0 + \beta_1 x_1 + \beta_2 x_1 + \beta_3 (x_1 * x_2)$$

In the above formula, D is the dependent variable outcome, β_0 is the intercept, x_1 and x_2 are independent variables (main effects), and x_1*x_2 is the interaction of the independent variables (Kleinbaum et al., 1995). β_1, β_2, and β_3 are the corresponding standard estimates. If the interaction term is statistically significant, then the relationship between the exposure variable varies according to the level or intensity of the moderating variable. If an interaction is present in a mediation model, the total effect should be tested separately for each level of the variable identified as the moderator. In this study, all potential confounders were also tested for interaction with the exposure (functional limitations) variable. As suggested by Mackinnon (2008), any identified mediator was also tested for an interaction with the exposure variable. If an interaction is found, then the identified mediation would vary across levels of the moderator.

Multicollinearity. If two independent variables are highly correlated, they are said to be collinear. In a regression model, two highly correlated variables provide poor estimates of their effect on the outcome variable (Allison, 2003). A variance inflation factor (VIF) is used to test for multiple collinearity in a regression model. Because collinearity is a product of the relationship between independent variables, it can be tested using a generalized linear model, even if the dependent variable is binary (Allison, 2003). The VIF calculates how much larger the standard error is compared to what it would be if the independent variables were not correlated. If a variance inflation factor is greater than 10, collinearity is present, and dropping one of the collinear variables should be considered.

Creating National Estimates

The NSCH was designed to collect data on children's health and well-being that could be compared across states in addition to providing national estimates prevalences of various health conditions and health-related risk and protective factors (Blumberg et al., 2009). Estimates were developed using a complex sample survey design that accounts for probabilities of selection, variation in response rates across important subgroups, and departures from distribution for key variables known from outside sources know about the population. Specifically, by using a “raking adjustment” to external control totals, subject weights in the NSCH were adjusted for the probability that a subject was included or not based on sampling technique, nonresolution of telephone numbers (a telephone number nonresponse was determined not to be residential), nonresponses, subsampling of age-eligible children, multiple telephone lines, and noncoverage of children in households without landline telephones. *Raking* is a statistical adjustment applied at each stage of nonresponse in telephone surveys (either the screener interview nonresponse or extended interview nonresponse) (Cervantes & Brick, 2007). Raking uses data from an external source—in this case the U.S. Census Bureau population totals—to calculate the weighted representation of the individual to the expected population. Further, raking creates weights that account for the increasing use of cell phones (Maternal and Child Health Information Resource Center, 2001). Sample weights are calculated based on the number of primary sample units (PSU). In the case of the NSCH, the PSU is the household (Groves et al., 2009). In the NSCH dataset, a variable was included that provides the value for the youth’s sample weight, used to calculate national estimates. Further details regarding development of the weights are provided by the Design and Operation of the NSCH manual developed by Vital and Health Statistics (Blumberg et al., 2009).

All analyses for this study were completed by applying the provided sample weights using the Proc Surveryfreq and Proc Surveylogistic in SAS v9.2.(SAS Institute, 2008). To use these commands, which incorporate the weights for each subject to create national estimates, the analysis must be completed using the entire dataset. Therefore, subsetting the data is not appropriate for stratified analysis. Rather than using filtering commands to subset the data, data were stratified using the domain command in SAS. This command is specifically designed for use in complex sample design survey analysis, so that weights are properly utilized to create national estimates. This study included only households with youths over the age of 10 who either had no special needs or had functional limitations (n = 35,570). In the dataset, a new variable was created, labeled *target*. Any observation meeting the above criteria was coded with the number 1. Observations not meeting the inclusion criteria, i.e., youths with special needs but no functional limitations, or youths younger than age 10 or missing BMI data, were coded with the number 2 (n = 56,072). By using the code Domain = target, SAS calculated a separate analysis for each population in the variable target while maintaining the integrity of the weights.

To ensure consistency, data were coded such that the odds ratio generated from the data analysis represented the odds of having the event of interest (in this case, obesity). For the exposure variable, having functional limitations was the event of interest and, therefore, was coded to be the event. Thus, in the calculation of the total effect, the odds ratio created was the odds of a youth being obese if he or she had functional limitations.

When using data created by a complex sampling design with weights, standard adjustments are required to approximate variances around prevalence estimates. Doing so is necessary because data are combined across stratifications that have different variance estimates. This study used Taylor Series estimations to calculate variance estimates for all weight analysis (Groves et al., 2009). During analysis, particular attention was given to the number of interviewed subjects at each level (or stratum) for the independent variable being analyzed. As the sample size decreased, the estimated variances increased. As suggested by the lead author of the Design and Operation of the NSCH manual (Dr. Blumberg, personal e-mail communication, August 2010), sample size was kept at 50 or above when possible (Blumberg, 2009).

CHAPTER 4

RESULTS

Description of the Study Population

Of the 35,570 youths included in the study population, 13.3% were classified as obese, and 6.5% had special needs and functional limitations (Table 1). Male and female youths were equally represented. Approximately one-fourth of the youths were between 10 and 12 years old, and the remaining youths were approximately evenly split between two age groups: 13- to 15-year-olds and 16- to 17-year-olds. Most youths were white and non-Hispanic; 66.0% were living with a parent who had more than a high school education; 61.0% were living with two parents (non-step parent); and 30% were living in households with incomes at least 4 times the poverty line.

Of the six potential confounding variables, four were associated with a youth having functional limitations when compared to youths without special needs (Table 2). Males were 93% more likely to have functional limitations than females. Younger youths had a higher risk for functional limitations. Black non-Hispanics and other non-Hispanics had increased odds of having functional limitations when compared to White non-Hispanics. The risk of having functional limitations increased as household income decreased. Finally, family structure was also associated with having functional limitations.

Obesity was associated with all six of the potential confounders included in this study (Table 3). Males and younger youths were more likely to be obese. Youths who were classified as Black or as belonging to some other racial group had increased odds of being obese when compared to non-Hispanic whites.

Table 1. Demographic Characteristics of the Study Population

		N[a]	%[b]
Obesity			
	Not Obese	30,853	86.7
	Obese	4,717	13.3
Functional Limitations			
	No Special Needs	33,266	93.5
	Functional Limitations	2,304	6.5
Gender			
	Female	17,346	51
	Male	18,224	49
Age, years			
	16–17	11,286	35.8
	13–15	13,560	38.3
	10–12	10,724	25.9
Race/Ethnicity			
	White non-Hispanic	24,732	57.7
	Black, non-Hispanic	3,661	15.4
	Hispanic	3,650	17.4
	Other, non-Hispanic	2,925	8.1
Income-to-Poverty-Line Ratio			
	≥ 4.0	14,050	30.0
	2.0–3.99	12,380	33.4
	1.00–1.99	5,698	20.7
	<1.00	3,442	14.8

Table 1, Continued

Highest Level of Parent Education		
Less than High School	2,026	8.0
High School Graduate	6,186	25.0
Beyond High School	26,951	66.0
Family Structure		
Two Parents with no Step-parent	23,033	61.3
Two Parents with Step-parent	3,770	11.6
Single Mother and no Father	5,968	19.7
Other Family Type	2,598	6.8

[a] All sample sizes are unweighted. Totals sample size = 35,570, except for missing data in the following variables: race/ethnicity (n = 602); highest level of parent education (n = 407); family structure (n = 201).

[b] All prevalences are weighted to be nationally representative.

Table 2. Association between Demographic Characteristics and the Prevalence of Youths with Functional Limitations

	N (%)[a]	OR (95% CI)[b]	Adj[c] OR (95% CI)[b]
Gender			
Female	931 (4.6)	1.00	1.00
Male	1,373 (8.4)	**1.92 (1.57, 2.35)**	**1.93 (1.57, 2.36)**
Age, years			
16–17	685 (5.3)	1.00	1.00
13–15	916 (6.9)	**1.33 (1.00, 1.77)**	**1.38 (1.03, 1.84)**
10–12	703 (7.0)	**1.35 (1.01, 1.82)**	**1.43 (1.06, 1.93)**
Ethnicity/Race			
White, non-Hispanic	1,578 (6.9)	1.00	1.00
Black, non-Hispanic	266 (7.1)	1.03 (0.79, 1.33)	**0.69 (0.53, 0.91)**
Hispanic	193 (5.7)	0.82 (0.55, 1.22)	0.73 (0.50, 1.07)
Other, non-Hispanic	225 (6.5)	0.71 (0.49, 1.03)	**0.56 (0.39, 0.81)**
Income-to-Poverty-Line Ratio			
$\geq$ 4.04.0	657 (4.7)	1.00	1.00
2.0–3.99	740 (5.6)	1.20 (0.87, 1.67)	1.17 (0.83, 1.65)
1.00–1.99	506 (8.2)	**1.81 (1.32, 2.48)**	**1.82 (1.28, 2.59)**
<1.00	401 (9.8)	**2.22 (1.63, 3.01)**	**2.21 (1.50, 3.23)**

Table 2, Continued

Highest Level of Parent Education			
Less than High School	1,646 (6.1)	1.00	1.00
High School Graduate	470 (7.3)	1.22 (0.96, 1.55)	0.97 (0.75, 1.25)
Beyond High School	163 (8.0)	1.36 (0.88, 2.09)	1.00 (0.65, 1.56)
Family Structure			
Two Parents with no Step-parent	1,222 (5.2)	1.00	1.00
Two Parents with Step-parent	259 (7.1)	1.40 (0.90, 2.16)	1.33 (0.85, 2.09)
Single Mother and no Father	583 (9.1)	**1.82 (1.44, 2.30)**	**1.62 (1.25, 2.10)**
Other Family Type	228 (9.8)	**1.98 (1.36, 2.87)**	**1.82 (1.23, 2.71)**

Abbreviations: OR = odds ratio; CI = confidence interval

[a] All sample sizes are unweighted and prevalences are weighted to be nationally representative.

[b] Values in boldface are statistically significant at $p < 0.05$.

[c] Adjusted for the prevalence of the other 5 variables listed in the table.

Table 3. Association between Demographic Characteristics and the Prevalence of Obesity

	N (%)[a]	OR (95% CI)[b]	Adj[c] OR (95% CI)[b]
Gender			
Female	1,722 (13.6)	1.00	1.00
Male	2,995 (18.7)	**1.47 (1.25, 1.72)**	**1.54 (1.31, 1.81)**
Age, years			
16–17	1,095 (12.2)	1.00	1.00
13–15	1,647 (13.8)	1.16 (0.94, 1.43)	1.21 (0.98, 1.51)
10–12	1,975 (21.2)	**1.95 (1.58, 2.40)**	**2.18 (1.76, 2.71)**
Ethnicity/Race			
White, non-Hispanic	2,677 (12.2)	1.00	1.00
Black, non-Hispanic	845 (22.8)	**2.13 (1.79, 2.54)**	**1.61 (1.32, 1.97)**
Hispanic	411 (13.2)	1.08 (0.79, 1.47)	0.95 (0.7, 1.29)
Other, non-Hispanic	699 (24.3)	**2.33 (1.83, 2.95)**	**1.74 (1.35, 2.25)**
Income-to-Poverty-Line Ratio			
≥4.0	1,215 (9.3)	1.00	1.00
2.0–3.99	1,615 (14.3)	**1.63 (1.32, 2.01)**	**1.45 (1.16, 1.8)**
1.00–1.99	1,050 (21.4)	**2.65 (2.11, 3.34)**	**1.98 (1.54, 2.54)**
<1.00	837 (26.8)	**3.58 (2.83, 4.52)**	**2.17 (1.61, 2.94)**
Highest Level of Parent Education			
Less than High School	3,007 (12.8)	1.00	1.00
High School Graduate	1,143 (20.5)	**1.76 (1.47, 2.10)**	**1.28 (1.06, 1.55)**
Beyond High School	504 (29.7)	**2.89 (2.17, 3.85)**	**1.64 (1.18, 2.28)**

Table 3, Continued

Family Structure			
Two Parents with no Step-parent	2,521 (13.5)	1.00	1.00
Two Parents with Step-parent	537 (18.7)	**1.48 (1.13, 1.94)**	**1.35 (1.03, 1.78)**
Single Mother and no Father	1,146 (21.4)	**1.75 (1.44, 2.12)**	1.20 (0.95, 1.51)
Other Family Type	482 (19.3)	**1.53 (1.22, 1.93)**	1.17 (0.91, 1.49)

Abbreviations: OR = odds ratio; CI = confidence interval

[a] All sample sizes are unweighted and prevalences are weighted to be nationally representative.

[b] Values in boldface are statistically significant at $p < 0.05$.

[c] Adjusted for the prevalence of the other 5 variables listed in the table.

As household income decreased, the prevalence of obesity increased. Last, youths living in a two-parent family with a step-parent had increased odds of being obese, as compared to those in families with two parents and no step-parent.

The prevalence of obesity was significantly higher among youths with functional limitations (25.1%) than among youths without special needs (15.4%), and the association persisted after adjusting for the six potential confounders (Table 4; OR = 1.53; 95% CI = 1.21, 1.95). Each of the six confounders was examined as a potential effect modifier of the relationship between having functional limitations and obesity. A significant effect modification was found for gender. When stratifying by gender and adjusting for the other five covariates, the association between having functional limitations and obesity was significant only for females (OR = 2.59; 95% CI = 1.93, 3.42).

Table 4. Association between Functional Limitations and the Prevalence of Obesity by Gender

	N (%)[a]	OR (95% CI)[b]	Adj[c] OR (95% CI)[b]
All Youths			
Functional Limitations	575 (25.1)	**1.83 (1.45, 2.29)**	**1.53 (1.21, 1.95)**
No Special Needs	4,142 (15.4)	1.00	1.00
Females only			
Functional Limitations	227 (27.7)	**2.60 (1.93, 3.48)**	**2.53 (1.80, 3.56)**
No Special Needs	1,495 (12.9)	1.00	1.00
Males only			
Functional Limitations	348 (23.5)	**1.38 (1.01, 1.90)**	1.19 (0.87, 1.64)
No Special Needs	2,647 (18.2)	1.00	1.00

Abbreviations: OR = odds ratio; CI = confidence interval

[a] All sample sizes are unweighted and prevalences are weighted to be nationally representative.

[b] Values in boldface are statistically significant at $p < 0.05$.

[c] Adjusted for race/ethnicity, gender, family structure, income-to-poverty-line ratio, highest level of parent education and youth's age.

The prevalence of obesity was more than twice as high in female youths with function limitations (27.7%) compared to those without special needs (12.9%; Figure 3).

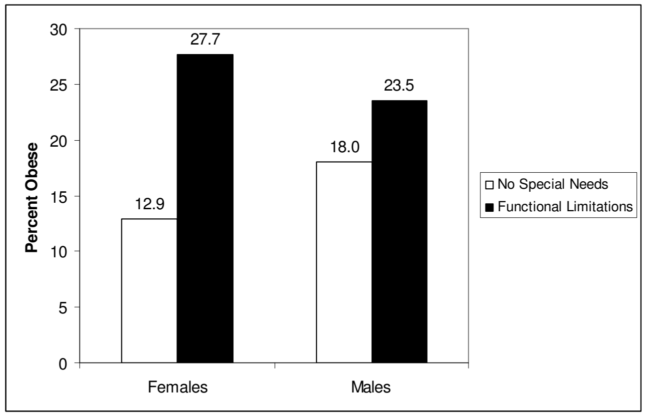


Figure 6. Prevalence of Obesity in Youths between the Ages of 10 and 17 with no Special Needs and those Youths with Functional Limitations by Gender.

For male youths, the prevalence of obesity between youths with functional limitations (23.5%) as compared to youths without special needs (18.2%) was not statistically significant after covariate adjustment (OR = 1.19; CI = 95% 0.87, 1.64). In terms of moderation analysis, the total effect (c), which is the increased odds of obesity due to having functional limitations, was only significant for female youths and not for male youths. For that reason, the mediation analysis was conducted only for female youths.

Prevalence of Mediation Variables

Over half (57.3%) of youths were identified as participating in after-school sports (Table 5). Respondents reported that 18.3% of youths participated in physical activity 7 days/week. Approximately 25% of youths were participating in physical activity 5–6 days/week or 3–4 days/week, and the remaining 29% participated in physical activities less than 3 days/week (Table 5). Concerning weekday TV watching, 23.0% of youths watched for less than 1 hour during weekdays, 35.0% watched for 1 hour, 24.3% watched for 2 hours, and 17.7% watched for 3 or more hours. Approximately half of the youths had a television in their bedrooms. Respondents reported that 34.8% of youths ate with their families every night, and 36.9% ate with their families 4–5 days/week. Most youths (60.1%) were reported to be getting enough sleep 7 days/week, and 29.3% were getting enough sleep 4–6 nights/week. In terms of the parenting experience, 9.5% of respondents were categorized as positive on the aggravation scale. 57.5% were coping very well with the day-to-day demands of raising their children, and 86.2% reported having emotional support that they could turn to for help. Of the respondents, 34.0% reported very high social capital, followed by 36.7% having high social capital and 17.5% having low social capital. Regarding social participation, most youths (63.6%) participated in an after-school club activity.

Association between Mediators and Functional Limitations

After adjusting for demographics, the only five potential mediators associated with a female youth having functional limitations were participation in physical activities, the number of nights getting enough sleep, parental aggravation, parents reporting not coping well, and participation in after-school activities (Table 6).

Table 5. Prevalence of Potential Mediators among Female Youths

	N [a]	% [b]
Lifestyle		
After-School sports		
Yes	10,723	57.30
No	6,610	42.6
Physical Activity, days/wk		
7	3,134	18.3
5–6	4,454	24.7
3–4	4,752	26.7
0–2	4,801	29.0
Weekday TV Viewing, hrs/day		
< 1	3,982	23.0
1	6,082	35.0
2	4,207	24.3
≥ 3	3,075	17.7
TV in Bedroom		
No	8,327	49.90
Yes	9,016	50.1
Family Meals, days/wk		
7	5,623	34.8
4 – 6	6,665	36.9
1 – 3	4,199	23.5
0	812	4.5

Table 5, Continued

Enough Sleep, nights/wk		
7	9,579	60.10
4 – 6	5,735	29.3
1 – 3	1,347	6.9
0	480	2.2
Parenting Experience		
Aggravation		
No	16,052	90.1
Yes	1,265	9.5
Coping		
Very well	9,959	57.50
Somewhat well	7,086	39.9
Not Well or Very Well	248	2.0
Emotional Support		
Yes	15,537	86.20
No	1,740	13.3
Social Capital Level		
Very high	6,638	34.0
High	6,528	36.7
Low	2,691	17.5
Very low	923	7.5

Table 5, Continued

Social Participation		
After-School Club Activities		
Yes	12,119	63.6
No	5,204	36.4

[a] All totals are unweighted

[b] All prevalences are weighted to be nationally representative. Percentages for each potential mediating variable have < 1% missing data, except for level of social capital (4.2%); nights with enough sleep (1.5%); and physical activity (1.3%).

Table 6. Association of Potential Mediating Variables with the Prevalence of Functional Limitations for Females Only

	N (%)[a]	OR (95% CI)[b]	Adj[c] OR (95% CI)[b]
Lifestyle			
After-School sports			
Yes	332 (2.8)	1.00	1.00
No	599 (7.1)	**2.74 (2.125, 3.54)**	**2.60 (1.96, 3.46)**
Physical Activity, days/wk			
7	137 (2.8)	1.00	1.00
5–6	162 (3.1)	1.12 (0.75, 1.67)	1.27 (0.84, 1.93)
3–4	213 (4.1)	**1.51 (1.03, 2.22)**	**1.76 (1.19, 2.61)**
0–2	410 (7.5)	**2.85 (2.01, 4.04)**	**3.06 (2.10, 4.48)**
Weekday TV Viewing, hrs/day			
<1	184 (3.9)	1.00	1.00
1	307 (4.3)	1.12 (0.79, 1.59)	1.04 (0.74, 1.46)
2	215 (5.0)	1.28 (0.90, 1.83)	0.79 (0.30, 2.02)
≥ 3	225 (5.4)	1.40 (0.967, 2.01)	1.19 (0.53, 2.70)
TV in Bedroom			
No	481 (4.8)	1.00	1.00
Yes	450 (4.4)	**1.84 (1.56, 2.16)**	1.01 (0.78, 1.3)
Family Meals, days/wk			
7	369 (5.5)	1.00	1.00
4 – 6	303 (4.0)	**0.72 (0.54, 0.96)**	0.79 (0.59, 1.05)
1 – 3	199 (3.9)	**0.71 (0.51, 0.97)**	0.73 (0.53, 1.01)
0	57 (6.6)	1.23 (0.66, 2.32)	1.13 (0.58, 2.22)

Table 6, Continued

Enough Sleep, nights/wk			
7	486 (4.2)	1.00	1.00
4 – 6	286 (4.4)	1.06 (0.81, 1.39)	1.10 (0.84, 1.44)
1 – 3	105 (7.0)	**1.75 (1.16, 2.63)**	**1.81 (1.20, 2.72)**
0	40 (11.9)	**3.14 (1.66, 5.95)**	**3.22 (1.65, 6.26)**
Parenting Experience			
Aggravation			
No	644 (3.6)	1.00	1.00
Yes	287 (14.6)	**5.85 (4.55, 7.51)**	**4.66 (3.43, 6.33)**
Coping			
Very Well	394 (3.5)	1.00	1.00
Somewhat Well	486 (5.8)	**1.67 (1.29, 2.16)**	**1.64 (1.24, 2.17)**
Not Well or Very Well	49 (13.7)	**4.38 (2.47, 7.75)**	**3.86 (2.15, 6.94)**
Emotional Support			
Yes	787 (4.5)	1.00	1.00
No	141 (5.1)	1.14 (0.82, 1.59)	1.08 (0.76, 1.53)
Social Capital Level			
Very high	276 (4.4)	1.00	1.00
High	323 (4.2)	0.97 (0.71, 1.32)	0.90 (0.66, 1.23)
Low	201 (5.6)	1.31 (0.93, 1.84)	1.12 (0.79, 1.57)
Very Low	98 (5.6)	1.30 (0.86, 1.98)	0.96 (0.61, 1.52)

Table 6. Continued

Social Participation			
After-School clubs			
Yes	519 (3.7)	1.00	1.00
No	411 (6.2)	**1.84 (1.56, 2.16)**	**1.55 (1.19, 2.02)**

Abbreviations: OR = odds ratio; CI = confidence interval

[a] All sample sizes are unweighted and prevalences are weighted to be nationally representative.

[b] Values in boldface are statistically significant at $p < 0.05$.

[c] Adjusted for race/ethnicity, gender, family structure, income-to-poverty-line ratio, highest level of parent education and youth's age.

Of those participating in after-school sports, 2.8% of youths had functional limitations while, for youths not participating in sports, 7.8% had functional limitations (Table 6; OR = 1.84; 95% CI = 1.56, 2.16). The prevalence of youths with functional limitations participating in physical activities less than 3 days/week was 7.5% to decreases to 2.8% of those participating in daily physical activity. Among those not getting enough sleep on any night, 11.9% had functional limitations, while among those getting enough sleep every night, 4.2% had functional limitations. After adjusting for demographics, having functional limitations was not associated with increased TV watching, having a TV in their bedroom, or eating fewer meals with their families.

For the parenting experience domain, parental aggravation and poor coping were associated with a youth having functional limitations. The prevalence of having a female youth with functional limitations increased from 3.6% of respondents reporting no parenting aggravation to 14.6% among those reporting aggravation. The prevalence of respondents having a youth with functional limitations increased from 3.5% of those coping very well to 13.7% among those not responding that they were not coping well or very well.

The level of social capital was not associated with the presence of functional limitations in youths. Having functional limitations was associated with a lack of participation in after-school activities. Of those participating in an after-school club, 3.7% had functional limitations, compared to 6.2% of those who did not participate in an after-school club. Each non-significant mediator was tested for and found not to be collinear with covariates.

Association between Mediators and Obesity

Among female youths, of the six potential mediators in the domain of youth lifestyle, three were associated with obesity after controlling for confounders (Table 7). The prevalence of obese youth participating in physical activities increased from a low of 10% at 7 days/week to 16.7% at 0–2 days/week. Of those participating in after-school sports, 9.4% of youths were obese, compared to 19.2% of youths not participating in sports. The prevalence of obesity in youths watching television increased from a low of 8.3% watching less than one hour during the weekday to 20.2% watching 3 or more hours a day. For the youths with a television in their bedroom, 16.6% were obese, compared to 10.6% of youths who did not have a television in their rooms. After adjusting for functional limitations and covariates, none of the variables across the domains of parenting experience, social capital, or social participation were associated with obesity. Each non-significant mediator was tested for and found not to be collinear with covariates.

Table 7. Association of Potential Mediating Variables with the Prevalence of Obesity for Females Only

	N (%)[a]	OR (95% CI)[b]	Adj[c] OR (95% CI)[b]
Lifestyle			
After-School sports			
Yes	725 (9.4)	1.00	1.00
No	996 (19.2)	**2.11 (1.53, 2.91)**	**1.51 (1.14, 1.99)**
Physical Activity, days/wk			
7	265 (10.0)	1.00	1.00
5–6	326 (11.3)	1.15 (0.77, 1.71)	**1.51 (1.02, 2.23)**
3–4	468 (14.8)	**1.58 (1.07, 2.32)**	**2.02 (1.38, 2.94)**
0–2	641 (16.7)	**1.82 (1.28, 2.58)**	**1.66 (1.17, 2.36)**
Weekday TV Viewing, hrs/day			
<1	241 (8.3)	1.00	1.00
1	500 (11.9)	1.50 (0.99, 2.27)	1.34 (0.89, 2.00)
2	487 (14.8)	**1.92 (1.27, 2.89)**	**1.63 (1.08, 2.47)**
≥ 3	494 (20.2)	**2.80 (1.84, 4.27)**	**1.87 (1.23, 2.84)**
TV in Bedroom			
No	1,047 (16.6)	1.00	1.00
Yes	675 (10.6)	1.14 (0.91, 1.43)	**1.35 (1.02, 1.79)**
Family Meals, days/wk			
7	682 (16.2)	1.00	1.00
4 – 6	544 (10.9)	**0.64 (0.47, 0.86)**	0.89 (0.65, 1.22)
1 – 3	390 (13.0)	0.78 (0.55, 1.10)	0.95 (0.68, 1.34)
0	100 (18.0)	1.14 (0.61, 2.11)	1.45 (0.76, 2.78)

Table 7, Continued

Enough Sleep, nights/wk			
7	1026 (14.7)	1.00	1.00
4 – 6	506 (12.2)	0.81 (0.60, 1.09)	1.10 (0.81, 1.48)
1 – 3	136 (11.4)	0.75 (0.50, 1.13)	0.93 (0.62, 1.40)
0	30 (10.9)	0.71 (0.36, 1.43)	1.09 (0.51, 2.34)
Parenting Experience			
Aggravation			
No	1,515 (12.7)	1.00	1.00
Yes	202 (21.8)	**1.79 (1.40, 2.29)**	1.33 (0.87, 2.05)
Coping			
Very Well	951 (13.3)	1.00	1.00
Somewhat Well	723 (13.5)	1.02 (0.79, 1.32)	1.02 (0.89, 1.32)
Not Well or Very Well	41 (14.5)	1.11 (0.63, 2.00)	0.78 (0.40, 1.49)
Emotional Support			
Yes	1,481 (12.6)	1.00	1.00
No	233 (19.9)	**1.73 (1.16, 2.57)**	1.09 (0.73, 1.64)
Social Capital Level			
Very High	533 (11.3)	1.00	1.00
High	619 (11.4)	1.02 (0.76, 1.36)	0.82 (0.62, 1.09)
Low	347 (14.0)	1.29 (0.88, 1.89)	0.88 (0.60, 1.30)
Very Low	149 (29.4)	**3.29 (2.01, 5.38)**	1.61 (0.98, 2.63)

Table 7, Continued

Social Participation			
After-School Clubs			
Yes	1,002 (10.9)	1.00	1.00
No	716 (18.3)	**1.84 (1.41, 2.30)**	1.07 (0.81, 1.41)

Abbreviations: OR = odds ratio; CI = confidence interval

[a] All sample sizes are unweighted and prevalences are weighted to be nationally representative.

[b] Values in boldface are statistically significant at $p < 0.05$.

[c] Adjusted for race/ethnicity, gender, family structure, income-to-poverty-line ratio, highest level of parent education and youth's age.

Final Mediation Model

Of the 11 variables in 4 domains that were potential mediators of the association between females youths with functional limitations and obesity, only participation in physical activities and participation in after-school sports were associated with both obesity and functional limitations, after controlling for confounders (Table 8).

Table 8. Summary Association between of Potential Mediating Variables and Obesity and Functional Limitations

	Functional Limitations[a]	Obesity[a]
Lifestyle		
After-School Sports	**Yes**	**Yes**
Physical Activity, days/wk	**Yes**	**Yes**
Weekday TV Viewing, hrs/day	No	**Yes**
TV in Bedroom	No	**Yes**
Family Meals, days/wk	No	No
Enough Sleep, nights/wk	**Yes**	No
Parenting Experience		
Aggravation	**Yes**	No
Coping	**Yes**	No
Emotional Support	No	No
Social Capital level	No	No
Social Participation	**Yes**	No

[a] 'Yes' indicates a statistically significant association using multivariate logistic regression

Physical activities and after-school sport were tested for and found not to be effect modifiers of the association between youths with functional limitations and obesity. After moderation by mediators was ruled out, the Sobel test was used to determine whether participation in physical activities and participation in after-school sports were statistically significant mediators. Because the Sobel test requires the use of binary mediators to provide accurate variance estimates with complex survey designs, participation in physical activities was collapsed into two categories of 6–7 and 0–5 days/week. While after-school sports and physical activity participation were related, they were not highly correlated. Among youths participating in after-school sports, 29% were participating in higher levels of physical activities (6–7 day per week), compared to 18% of youths not participating in after-school sports. After controlling for covariates, the odds of obesity among female youths with functional limitations were 2.53 (Figure 3). Using the Sobel test, this OR decreased to 1.91 when physical activity was examined as a mediator. Therefore, participating in physical activities mediated 24% of the initial total effect. After controlling for sports participation, the total effect was reduced from 2.53 to 1.77, a 29% reduction. Both mediated effects were statistically significant ($p < 0.05$) using the Sobel test for mediation.

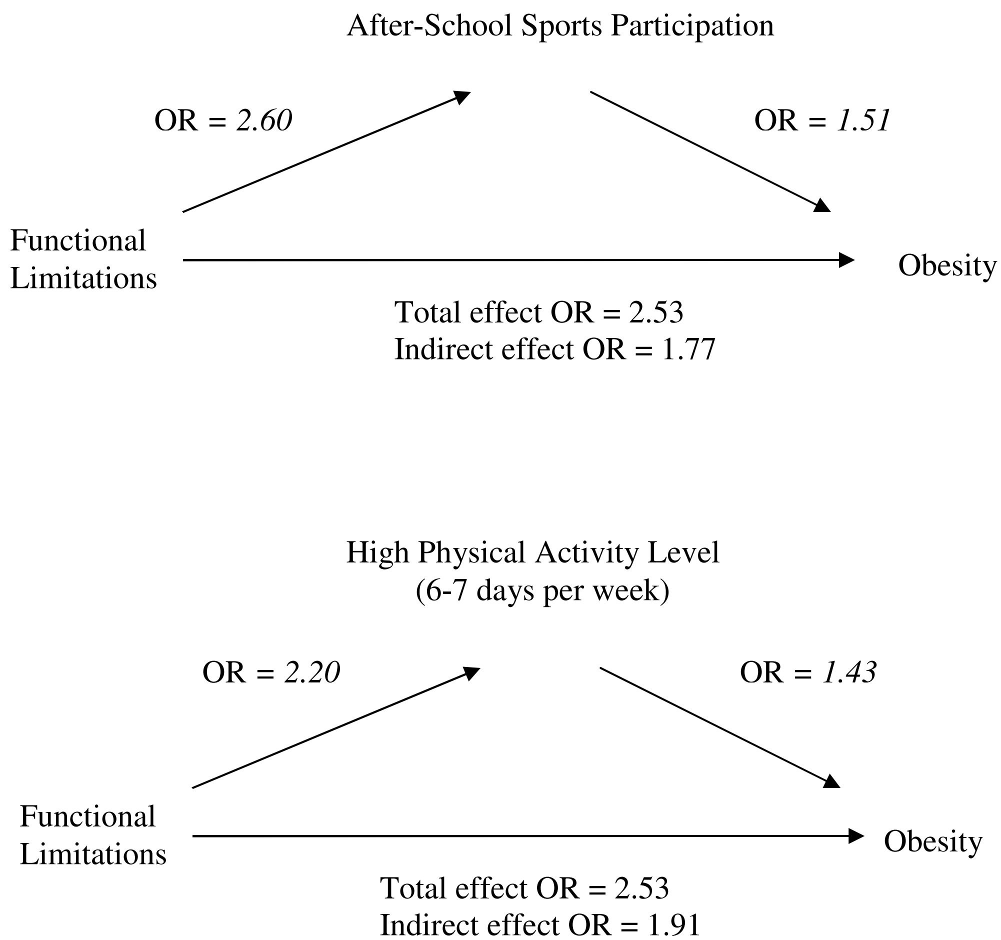


Figure 7. Mediating Effect of Participation in After-School Sports Participation and High Physical Activity Levels.

CHAPTER 5

DISCUSSION AND CONCLUSION

Summary of Results

This is the first study to use a nationally representative dataset to determine whether there is a difference in the prevalence of obesity among youths with functional limitations and those with no special needs. This study found that, for female (but not for male) youths between the ages of 10 and 17, obesity was more than twice as common among those with functional limitations than among those with no special needs. The association between a youth having functional limitations and obesity in females was partially mediated by participation in physical activities and after-school sports.

Study Strengths

Currently, the National Survey for Children's Health (NSCH) is the only nationally representative dataset that collects information on a wide range of domains and on several health outcomes in youths between the ages of 10 and 17. Unlike other national surveys, the NSCH collects heights and weights to calculate youths' body mass index (BMI); it also identifies youths with functional limitations. Through the comparison of these two groups, variables could be identified as potential causes of the increase of obesity in youths with functional limitations compared to those with no special needs. Furthermore, the findings of this study are not limited by a specific medical diagnosis or severity of medical condition. By not specifying a medical diagnosis, an at-risk population was identified in terms of functional status rather than medical condition. This represents a departure from the traditional medical model, where the exposure is typically disease-specific rather than related to activity or functional abilities.

Two important additional strengths of this study are related to its use of a nationally representative dataset. First, the complex sampling allows for the application of statistical methods such that each observation is weighted to create national estimates. For example, the target population of this study, youths with no special needs and those with functional limitations, included 35,346 observations. Using the statistically derived weights, this population represented 25,829,562 youths across the United States. Having such a large sample size allows for the study of relationships which would typically be underpowered for statistical analysis. Second, because the study population is representative of all youths in the United States, the results are generalizable to all youths in the United States. Therefore, the findings of this study can and should be used to guide national-level funding allocation and policy development.

Association between Functional Limitations and Obesity

In this study, the prevalence of obesity in youths with functional limitations was similar to that found by Chen et al. (2009), who used data from the 2003 NSCH. They reported that the obesity prevalence among all youths between the ages of 10 and 17 was 14.8%, but 22.4% in youths with physical impairments and developmental delays. Their study did not present separate obesity prevalences for youths with developmental delays and youths with physical impairments, nor did they specify which question had been used to determine physical impairments. Bandini, Curtin, Hamad, Tybor, and Must (2005), using data from the National Health and Nutrition Examination Survey (a different nationally representative dataset), found that children and youths with physical limitations were 2.29 times more likely to be obese than those without physical limitations, after adjusting for age, sex, and race-ethnicity. However, they did not adjust for socioeconomic variables. They reported that female youths with physical limitations had a higher prevalence of obesity than male youths with physical limitations, and that male youths without physical limitations had a higher prevalence of obesity than female youths without physical limitations. Unlike the present study, they did not find a statistically significant difference in the prevalence of obesity by gender and physical limitations (Bandini, Curtin, Hamad, Tybor, and Must, 2005). It is difficult to compare the findings of Bandini et al. (2005) directly to the findings of this study due to differences in age stratification. Further complicating the comparison of results are differences in the definition used to identify the study population of interested. In Bandini et al.'s (2005) study, physical limitations (i.e., functional limitations in this study) were assessed by asking the caregiver whether the child was limited in his or her ability to crawl, walk, play, or run. Lastly, unlike the current study, Bandini et al. (2005) used weights and heights as measured by nurses to the exclusion of child or youth unable to stand on his or her own.

In a third study, Rimmer et al. (2007) used self-reported activities, limitations, heights, and weights from the Youth Risk Behavior Survey. The survey of high school students indicated that the prevalence of obesity in adolescents with physical limitations was 16.7%, compared to 12.8% in their nondisabled peers. By gender, girls with disabilities were more obese (14.8%) than were girls without disabilities (9.5%); similarly, boys with disabilities were more obese (19.5%) than were boys without disabilities (15.9%). Rimmer et al.'s (2007) study did not report whether gender was acting as an effect modifier of the disability-obesity relationship.

As described in Chapter 2, the literature supports the conclusion of the present study that youths with functional limitations have a higher prevalence of obesity compared to those without special needs or disabilities. In this present study, the difference in obesity between those with functional limitations and no special needs was driven by the prevalence of obesity in female youths but not in male youths. However, that does not mean obesity is not an issue for male youths. In this study, the prevalence of obesity in male youths with no special needs was 18% as compared to 12.9% of female youths with no special needs (Figure 5). For those with functional limitations, the trend was the opposite, with male obesity being 23.5%, compared to female obesity at 27.7%. The gender-driven effect modification of obesity was a product of the low prevalence of obesity in females without special needs and the very high prevalence in those with functional limitations. The obesity prevalence in male youths was high, irrespective of the presence of functional limitations, especially compared to female youths without functional limitations. Because male youths make up a large portion of the total number of youths with functional limitations (8.4% versus 4.6%), obesity prevention in this group should not be ignored. However, for the purposes of this study, looking for mediators in male youths was not necessary, because the difference between those with no special needs and those with functional limitations was not significant (i.e., no total effect).

The doubling of the prevalence of obesity in females with no special needs compared to those with functional limitations was unexpected. The low prevalence of obesity in females without special needs may be partly attributed to data collection. Akinbami and Ogden (2009) found that parents' estimates of their children's height and weight lead to an overestimation of their youth's BMI in those aged 10–11, while underestimating BMI in youths aged 14–7. In this study, 75% of youths were older than 13, so the prevalence of obesity in females in this study may be underestimated. Caution should be taken when comparing these rates of obesity prevalence to other published reports, because this study excluded youths with special needs but no functional limitations. If this excluded population has an increased prevalence of obesity, it would increase the prevalence of obesity in female youths overall. This fact, along with parents' inaccurate reporting of their children's height and weight, might explain the unexpected lower prevalence of obesity in female youths without special needs, as compared to published reports for female youths in the general population (Ogden et al., 2008).

The lower than expected prevalence of obesity in female youths without special needs does not diminish the finding of this study that there is a higher prevalence of obesity in female youths with functional limitations. In an effort to understand the increased odds of obesity in female youths with functional limitations, this study used variables available in the NSCH to determine whether the increased odds were mediated by lifestyle, the parenting experience, social capital or social participation.

Mediators of the Association between Functional Limitations and Obesity

In this study, youth lifestyle was the only domain that had variables mediating the relationship between a youth having functional limitations and obesity. Within the lifestyle domain, only participation in physical activities and after-school sports was associated both with having functional limitations and with being obese. The relationships between obesity and participation in physical activities and after-school sports and was not unexpected, given similar findings by others using cross-sectional data (Must & Tybor, 2005; Wareham, 2007). Further, the association in this study of high-intensity physical activities with increased obesity has been confirmed using objective measure of physical activities and imaging of abdominal adiposity (Ness et al., 2007; Dencker et al., 2006). This finding supports previous studies that found reduced participation in structured and unstructured physical activities and sports when comparing youths with no functional limitations to youths with cerebral palsy, physical limitations, and developmental coordination disorders (Maher et al., 2007; Poulsen et al., 2007; Poulsen et al., 2008; Steele et al., 1996). The results of this study suggest that part of the association between functional limitations and obesity in female youths is explained by participation in fewer physical activities and after-school sports.

Variables Associated Only with Obesity

As supported by the literature, youth television watching and a youth having a television in the bedroom was associated with obesity (Anderson & Whitaker, 2010; Dietz, Jr. & Gortmaker, 1985; Jago, Baranowski, Baranowski, Thompson, & Greaves, 2005; Dennison, Erb & Jenkins, 2002). Although an association was found between television and obesity, television watching could not be considered a mediator, because female youths with functional limitations were no more likely to watch TV than female youths with no special needs. The lack of association between females with functional limitations and television watching was not completely unexpected. Using the Youth Risk Behavior Survey, Jones and Lollar (2008) found that high school students with self-reported disabilities did not watch more television than children without functional limitations. Using age-match controls, Mahr et al. (2007) also reported no difference in screen time (which included watching TV or videos, playing video games, or playing on a computer) in children with cerebral palsy. The lack of association between TV watching and functional limitations in female youths does not diminish the association with obesity in this population. It simply demonstrates that female youths with functional limitations are no more likely to watch more TV than females with no special needs; therefore, this finding cannot account for the increased prevalence of obesity in this population.

Variables Not Associated with Obesity

Within the youth lifestyle domain, neither having fewer family meals together nor not getting enough sleep at night was associated with increased obesity. Although previous studies have found associations with both constructs and obesity, recent studies have suggested that the relationship is age-dependent, having the weakest association in older youths (Cappuccio et al., 2008; Chen, Beydoun, & Wang, 2008). Additionally, in terms of the amount of sleep, the association is weakest and, in some studies, nonexistent for female youths (Gupta, Mueller, Chan, & Meininger, 2002; Knutson, 2005; Knutson & Lauderdale, 2007). The lack of association in this study between getting enough sleep at night or having family meals together and obesity is most likely a result of the study population. This study excluded youths under the age of 10 due to inaccurately reported heights and weights. Furthermore, male youths were excluded because those with functional limitations were not at increased risk of being obese. Hence, the population most likely to have an association between obesity and getting enough sleep and having family meals together were excluded from this analysis. Since this study found a very strong relationship between having functional limitations and getting enough sleep, it would be valuable to explore whether sleep mediates the association between children with functional limitations under the age of 10. If sleep and family meals were confirmed as mediators they would represent a modifiable lifestyle activity that could prevent obesity earlier in life and reduce future adulthood obesity levels.

Surprisingly, social capital was not associated with obesity. Several studies using the NSCH 2003 dataset, as well as other nationally representative datasets, have found associations between individual and state-level social capital and obesity (Cohen, Finch, Bower, & Sastry, 2006; Kim, Subramanian, Gortmaker, & Kawachi, 2006; McKay et al., 2007; Singh et al., 2008). The initial study using the 2003 NSCH dataset, by Singh et al. (2008), used a slightly different population (it did not exclude female youths with special needs and no functional limitations) and control variables not available in the public dataset. Applying the same inclusion criteria and control variable from this study to the NSCH 2003 dataset showed an association between social capital and obesity in female youths, demonstrating that the difference in the association was not methodological.

Like the parenting experience questions, the measures of social capital have strong face validity, but have not been subjected to reliability or validity testing. In addition, typically, social capital is analyzed at a community or state level. The current study and the study by Singh et al. (2008) analyzed the perceptions of social capital at the individual level, rather than combining responses to create a state-level measure of social capital. There is no clear reason for the loss of association between social capital and obesity between the 2003 and 2007 datasets. Further analysis is required to determine whether levels of social capital have changed with time and with respect to the prevalence of obesity.

In the domains of the parenting experience or social participation, none of the variables were associated with youth obesity. Previous studies examining the parenting experience were inconclusive. Several studies comparing families with obese children to families with non-obese children found that maternal stressors and family functioning were associated with children's weight (Gundersen, Lohman, Garasky, Stewart, & Eisenmann, 2008; Koch, Sepa, & Ludvigsson, 2008; Zeller et al., 2007). In contrast, others studies found no link between maternal or family stressors, parenting stress or maternal depression, and children' weight (Lohman et al., 2009; Surkan, Kawachi, & Peterson, 2008). The results of this study do not support the hypothesis that parental coping, emotional support, and parental aggravation are associated with obesity.

Past studies found a weak association between social participation and obesity. Studies suggest that obese youth are socially isolated and have fewer social networks, but no studies have examined the potential protective effect of participation in after-school clubs (Moore, Daniel, Paquet, Dube, & Gauvin, 2009: Strauss & Pollack, 2003). This study found no relationship between female youths' participation in after-school clubs and obesity. Although a strong association was found between having functional limitations and social participation, the lack of association with obesity prevents social participation from being a mediator of the relationship between functional limitations and obesity in female youths.

Limitations

It is important to recognize the limitations of this study. First and foremost, this study is cross-sectional; therefore, the direction of any causal links cannot be established. Thus, the association between functional limitations and obesity could be bidirectional. That is, some children might have been categorized as having functional limitations because of their obesity. Therefore, youth obesity may not cause a functional limitation, but it may cause a medical condition that, in turn, causes a functional limitation. The direction of the functional limitation and obesity relationship would best be examined through a longitudinal study that compares the incidence of obesity or weight gain in youths with and without functional limitations.

A similar directional issue exists between the two mediators in this study and their association with obesity. The two mediators are potentially associated with high-energy expenditure activities: after-school sports and participation in vigorous-to-moderate levels of physical activities 6–7 days a week. One assumption of this study is that youths not participating in after-school sports or high levels of physical activities have an increased risk of being obese. Focusing on high-intensity physical activities raises the danger of reverse causation, meaning that a youth's excessive adipose tissue is preventing participation in high-intensity exercise or sports (Reichert, Menezes, Wells, Dumith, & Hallal, 2009).

Another important limitation of this study was the manner in which each of the variables was measured. All data were collected over the phone through parent report and none through direct observation or monitoring equipment. Thus, this study used parent reported heights and weights to calculate youths' BMIs. A recent publication has demonstrated that parents frequently underestimate their children's height (Akinbami & Ogden, 2009). As a consequence, it was suggested that the 2003 NSCH overestimated the prevalence of obesity in children under the age of 10. Further, for youths between the ages of 14 and 17, parents tended to underestimate their youth's BMI. If the misclassification of BMI category is independent of the exposure, this study would be vulnerable to non-differential (random) misclassification, which would bias the study toward the null hypothesis.

No studies to date have examined the impact of youths having functional limitations on parent reported height and weight. That is, a parent may underestimate a youth's height in the presence of a neuromuscular scoliosis or lower limb contractures (e.g., from cerebral palsy or spina bifida) (Garshick, Ashba, Tun, Lieberman, & Brown, 1997). This underestimation would likely lead to overestimation of the prevalence and risk of obesity among youths with functional limitations compared to those without functional limitations. This point is driven home by a recent report comparing BMIs to DEXA scans in youths between the ages of 14 and 17 with cerebral palsy, spina bifida, or a spinal cord injury. The study found that, when BMI was used, 38.9% were classified as obese, whereas using the gold-standard DEXA scan resulted in 72.2% of the youths being classified as obese (Rimmer, Wang, Yamaki, & Davis, 2010). Conversely, BMI may not accurately reflect adipose tissue in youths with muscle wasting due to paralysis or in youths with missing limbs. These situations would lead to an underestimation of the prevalence and risk of obesity in youths with functional limitations. Both types of bias would be considered differential misclassifications. The former example underestimates the association between youths with functional limitations and obesity, and the latter overestimates the association.

A strength of this study is that it is a population-based study that did not specify a diagnosis and therefore was able to capture a large number of youths with health-related activities limitations. The disadvantage is that such a broad definition prohibits the development of diagnosis specific interventions. For example, the cause of activity limitations for youths with autism is mostly likely very different than for a youth with a spinal cord injury. The increased associations between a youth's with functional limitations, obesity, participation in sports and participations in physical activities is most likely a function of the underlying disease conditions. Further research is required to understand the composite of the medial conditions in the population and hence the most appropriate interventions.

All the youth lifestyle variables and social participation collected in this study were dependent on the respondents' ability to accurately report their youth's behaviors. Several studies have questioned the ability of individuals to accurately report their own participation in physical activities (Wareham, 2007; Pate, 1993). This study required caregivers to report on their youth's participation in physical activities. To date, no studies have demonstrated that parents can accurately report on the amount of or intensity with which a youth participates in physical activities. As a second example, sleep was assessed by asking parents how many nights their youth got enough sleep, in comparison to their friends. There is no evidence that parents know how well their youth is sleeping, can be a judge of what constitutes "enough sleep," or can compare their youth's sleeping habits to that of his or her friends.

Moreover, the content and construct validity of each of the mediators in this study is questionable. For example, physical activity is not a simple construct. As described by the 2008 Department Health and Human Services Physical Activity Guidelines for Americans, physical exercise and activity are not the same (U.S. Department of Health and Human Services, 2008). Physical activity refers to body movement that fits one of the categories: occupational, leisure time or recreational, household, self-care, and transportation or commuting activities. Exercise activities are planned, structured, and repetitive, and serve the purpose of improving or maintaining components of physical fitness (Caspersen, Powell, & Christenson, 1985). A full range of physical activity and exercise categories includes but is not limited to activities of daily living, aerobic exercise, anaerobic exercise, flexibility and balance-training (U.S. Department of Health and Human Services, 2008). To measure each of these activities comprehensively, daily frequency, intensity, duration, and mode are needed. Previous studies tended to use simple measures that did not capture the complexity of physical activities; thus, they were most likely to have poor estimates of true energy expenditure (Must & Tybor, 2005; Wareham, 2007; Wareham et al., 2003).

The construct validity of the variables within the domain of the parenting experience was particularly weak. Both parental coping and emotional support were measured by a single question created by the panel of experts who developed the NSCH. Although the questions have good face validity, these single questions could not possibly capture all aspects of the constructs they represent. For example, the COPE inventory is a common measure of adult coping. To assess coping, the COPE includes 60 questions that produce scores on 15 different subsections, each representing a different facet of parental coping and coping strategies (Carver, Scheier, & Weintraub, 1989).

Lastly, it should not be assumed that the association between low participation in physical activities or after-school sports and obesity is solely a reflection of a youth's decreased energy expenditure, which could lead directly to an increase in adipose tissue. As noted by Warem (2007), participation in physical activity could actually be a confounder, acting as a proxy for the youth maintaining a healthy lifestyle. That is, youths who participate in physical activities or after-school sports choose to eat healthier foods, consume fewer calories, and participate in fewer sedentary activities in general.

Study Implications

The finding of this study that female youths with functional limitations have lower participation in physical activity and after-school sports was not surprising, given the multiple environmental and social barriers that confront those with a disability (Rimmer, 2005; Rimmer et al., 2004). Female youths with disabilities face even greater challenges. DePauw and Gavon (2005) suggested that athletes are idealized as "white, middle/upper class, protestant, heterosexual and able-bodied males." DePauw and Gavon (2005) postulated that, early in the twentieth century, society viewed women, minorities, and people with disabilities as unfit to participate in sports, due to beliefs centered on fear, superstition, and perceptions of frailty. Further, they described the traditional model of sports as representing physical prowess, and those perceived as physically incapable were considered inferior, and as having no cultural need for competition beyond sport for rehabilitations or therapeutic reasons.

In general, few opportunities exist for females to participate in physical activities and even fewer for those with a disability (Maher et al., 2007; Minihan et al., 2007). In a longitudinal study comparing male and female persons with disabilities, girls and women had a greater decline in recreational and social participation with age, which was attributed to less supportive policy environments (i.e., lack of structured programs and structured physical activity opportunities) (King et al., 2009). Even in the school setting, the lack of adaptive equipment and large playing fields can prohibit inclusion of those with disabilities (Rimmer et al., 2004). In addition, large class sizes and insufficient time to adapt sporting activities are barriers to participation. These barriers are particularly problematic because it has been suggested that the school setting is the optimal place for large-scale interventions to increase physical activities (Wareham, 2007).

In the nondisabled population, self-efficacy is consistently associated with higher levels of physical activity (Van Der Horst, Paw, Twisk, & Van Mechelen, 2007). However, little research has explored physical activity self-efficacy in those with functional limitations. Although not a specific study of self-efficacy, a recent systematic review found that, compared to nondisabled youths, adolescent girls with cerebral palsy had a lower self-concept in the domains of physical appearance, social acceptance, and athletic competence (Shields, Murdoch, Loy, Dodd, & Taylor, 2006). Furthermore, socialization is thought to play a key role in developing a child’s identity as an athlete (Ruddel & Shinew, 2006). A key component to a child’s socialization is the existence of role models (socializing agents), who help to reinforce and model appropriate sport behaviors. Socializing agents can be individuals, teachers, parents, or environments (schools or community agencies) that shape the activities a child participates in (Van Der

Horst et al., 2007). For example, Shakib and Dunbar (2004) found that, for girls with disabilities, participation in high school basketball may be influenced by the perception that their mothers were not very athletic or did not enjoy sports. Besides being a role model, parental support in athletic activities can encourage participation by youths with functional limitations. In a series of interviews, Anderson found that parental support was an important facilitator for youths' participation in sports activities. As described by one youth with a disability, parent support was crucial to her initial participation in a sporting activity, despite their fear of her "breaking." This finding was supported by King et al. (2009), who suggested that family support via family cohesiveness potentially delayed the age-related decline of recreational participation in girls with functional limitations, as compared to boys.

However, parental support and modeling alone are not sufficient. Ruddel and Shinew (2006) interviewed female athletes and found that multiple socialization agents were an important component of sports participation. Their study found that friends, physical therapists, teachers, and parents could provide a pathway to a variety of athletic activities, supporting participation through encouragement and positive feedback. They noted that physical education teachers could socialize youths with disabilities into sports "but did not due to the lack of awareness and education." Lack of awareness of those around youths with functional limitations was a consistent barrier described by the female athletes interviewed. One female athlete was frustrated that her exposure to disability sports was not until her teenage years, stating "When I first found out that I could play and that there was an elite level, I was very frustrated that somebody didn't find me eight years ago."

Furthermore, society in general has not helped to provide meaningful role models for disabled children. Between 1996 and 1999, of the 7,092 photos printed in *Sports Illustrated for Kids*, only 24 editorial pictures featured athletes with disabilities (Hardin, Hardin, Lynn, & Walsdorf, 2001). Increasing exposure of disabled athletes through different social media venues could help raise expectations and acceptance of participation by disabled youths in sports. Lack of coverage is partly a reflection of the lack of female athletes. In the 1996 Atlanta Paralympic Games, 49 of 103 participating countries did not bring female athletes (Sherrill, 1997). Of those who did attend, only 25% were females. Increasing participation may help to develop role models for disabled youths, but only if their participation is covered by the media. As indicated by Golden (2003), a bias exists against covering competitive sporting events that include athletes with disabilities. The lack of media interest is exemplified by the comment of one American broadcaster: “They [the Paralympians] can’t compete on the same level as the Olympic athletes, so it’s a bone throw to them to make them feel better. It’s not a real competition, and I, for one, don’t see why I should have to cover it” (Golden, 2003).

Beyond having opportunities and appropriate role models, the quality of the sport or physical activity must be sufficient to have a positive health effect. As already suggested, a stereotype exists that those with functional limitations are not capable of exercising or benefiting from exercise. However, the literature does not support this conclusion and, in fact, indicates that, in adults with a variety of medical conditions, improvements were noted in cardio-respiratory fitness, lipid profiles, musculoskeletal health, and body composition (e.g., BMI, waist circumference) (U.S. Department of Health and Human Services, 2008). The benefit of exercise has also been found in studies of programs specially designed for youths with a variety of medical diagnoses (U.S. Department of Health and Human Services, 2008)

Finally, secondary coordination issues can also adversely impact participation in sports. Children with cerebral palsy, muscular dystrophy, and developmental delays typically have balance impairment and poor muscle coordination (David, 2000; Olney & Wright, 2000). Lack of participation at a competitive level with nondisabled peers may discourage disabled individuals from participating in sports-related activities (Rimmer et al., 2004). Rimmer et al. (2007) noted that the competitive atmosphere set by physical education teachers discourages participation by youths with disabilities. They further suggested that parents play a role as well by trying to protect their children from competitive activities that may result in failure or verbal abuse from other youths (Rimmer et al., 2007). Thus, community and educational settings will have to balance universal participation with the often competitive nature of sports.

Future Research

The relationship between a youth's functional limitations, participation in physical activities, participation in after-school sports, and obesity requires further clarification. The finding that female, but not male youths with functional limitations have an increased prevalence of obesity compared to their peers without special needs should be repeated with better measures. A population-based study could be conducted that utilizes the public school system. Recently, school districts are asking school nurses to record heights and weights of students and with that information are calculating BMIs for each student. This information could be used in conjunction with a parent questionnaire that identifies and better defines any existing youth activity limitations.

This population-based study could be used to confirm the mediating effect of gender on participation in physical activities and sports.

A second study that could be conducted in conjunction with the first would be to further define the construct of physical activities. As described earlier, current measures of physical activities are questionable, given the varying levels of intensity, frequency, and type of activities. In addition, there are no validated norm-referenced physical activity questionnaires spanning the ages of 5 to 17 that are designed to be used both with the disabled and the non-disabled population. Many of these issues could be addressed with the use of computer adaptive testing (Jette & Haley, 2005). Computer Adaptive Testing (CAT) uses a pool of questions and an iterative algorithm to measure a construct with fewer questions than would be required with a standard paper and pencil questionnaires. Currently the National Institute of Health has a publicly available set of CATs that measures (http://www.nihpromis.org/science/publications), both in child and adults, a variety of domains including but not limited to upper and lower extremity function, peer relationships, social isolation, participation in roles and activities (Cella, Gershon, Lai, & Choi, 2007). Obesity research and specifically research regarding youths with functional limitations would benefit from a variety of CATs specifically measuring healthy lifestyle activities including the domains of physical activities, sedentary activities and eating habits.

A third study that could be implemented might test the hypothesis that BMI can be reduced in females with a disability by increasing participation in community sports and physical activities. The study could be a hospital-based education program. The study could focus on the following objectives: (1) to identify barriers that prevent females from participating in high-intensity physical activities; (2) to implement an educational program for teachers and coaches that encourages full participation of females with disabilities in high-intensity physical activities; (3) to identify community role models to encourage participants to view themselves as athletes; and (4) to educate parents on the different opportunities that exist at home and in the community for participation in physical activities and sports. The outcome of the study would be changes in BMI status and participation of high-intensity activity by both parent report and accelerometer.

Policy and Practice

The main findings of this study were that:

- Youths with functional limitations have a higher prevalence of obesity than youths with no special needs.
- The relationship between youths with functional limitations and obesity is moderated by gender.
- Obesity is more than twice as common among female youths with functional limitations as it is among female youths with no special needs.
- The association between youths with functional limitations and obesity in females was partially mediated by participation in physical activities and after-school sports.
- Obesity in male youths with functional limitations is no more prevalent than in males with no special needs.
- TV watching, having a TV in the bedroom, family meals together, getting enough sleep, parent aggravation, parent coping, parent support, parent

perceived social capital and youth social participation are not mediators of the relationship between youths having functional limitations and obesity in females.

This is the first study to show that female youths, but not males, with functional limitations are at an increased risk for being obese, compared to peers with no special needs. This is also the first study to identify a modifiable lifestyle activity that mediates the relationship between functional limitations and obesity in females. Unlike those with functional limitations, youths without functional limitations have a variety of options for participating in physical activities, both structured and unstructured (King et al., 2003; Law et al., 2006; Poulsen et al., 2008; Poulsen et al., 2007). Barriers to participation include, but are not limited to, cost, access to specialized equipment, lack of nearby facilities, encouragement by community leaders, and availability of diagnosis-specific programs (Murphy & Carbone, 2008; Rimmer et al., 1996; Rimmer et al., 2007). Recognizing the protective effects of physical activity and after-school sports found in this study, it is important that parents, healthcare providers, and community leaders (i.e., teachers, ministers, etc.) be educated and encouraged to advocate for either full participation of female youths with functional limitations in a variety of physical activity programs or assist in the development of community programs tailored to the needs of disabled youths.

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APPENDIX A

Temple's Internal Review Board Approval

TEMPLE UNIVERSITY®

Office for Human Subjects Protections
Institutional Review Board
Medical Intervention Committees A1 & A2
Social and Behavioral Committee B

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MEMORANDUM

To: **WHITAKER, ROBERT CARROLL**
CHP-PUBLIC HEALTH (0910)

From: Richard C. Throm
Director, Office for Human Subjects Protection
Institutional Review Board Coordinator

Date: 02-Dec-2009

Re: Exempt Request Status for IRB Protocol:
12861: Associated Factors of Obesity in Children with and without Special Needs Using the National Survey for Children's Health

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It has been determined by Expedited Review that this study qualifies for exemption status as follows:

45 CFR 46 Protection of Human Subjects

Section 101 (b): Unless otherwise required by department or agency heads, research activities in which the only involvement of human subjects will be in one or more of the following categories are exempt from this policy:

Exemption 4: Collection or Study of Existing Data. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subject.

Nothing further is required from you at this time; however, if anything in your research design should change, you must notify the Institutional Review Board immediately.

If you should have any questions, please feel free to contact me at 215-707-8757.

Thank you for keeping the IRB informed of your clinical research.