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A Study Of The Associations Between Childhood Obesity And Three Forms Of Social Capital

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A STUDY OF THE ASSOCIATIONS BETWEEN CHILDHOOD OBESITY AND THREE FORMS OF SOCIAL CAPITAL

by

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DEDICATION

To my husband, Bill Brusilow. Thank you for love, humor, patience and calmness in the midst of all of this. You never doubted that I could actually finish my dissertation even when I started to doubt myself.

To Nick, Sam and Isabelle, my children and my heart. Your energy and enthusiasm for life continually inspire me. Thank you for unconditional love and affection.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES & CHARTS

CHAPTER 1

Introduction

Aim

The purpose of this study is to investigate predictors of childhood obesity in American children. It addresses gaps in previous research by examining the associations between obesity in children and three forms of social capital; personal social capital, family social capital and neighborhood social capital. Social capital, in the study of health, can be defined as resources[1] accrued and/or accessed from social relationships/social bonds at multiple levels including the individual, family, neighborhood, community or nation (Ferlander, 2007; Halpern, 2005; Macinko & Starfield, 2001).

The prevalence of obesity in American children and adolescents[2], 2-19 years, has been steadily increasing since 1980 and is currently reported to be 16.3% by the Centers for Disease Control and Prevention (CDC) (CDC/NCHS, 2009). It has been documented that obese children experience a substantially greater number of adverse medical, psychosocial and emotional events than their non-obese peers (Ferraro & Kelley-Moore, 2003; Must & Strauss, 1999; Strauss & Pollack, 2003). The medicalization of obesity has had the effect of focusing significant research attention on individually based explanations of obesity that inhibit broader sociological investigations (Peralta, 2003). Childhood obesity has numerous and strong associations with

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[1] Examples of the resources referred to throughout the social capital health literature include knowledge, information, emotional and instrumental support, companionship, confidence in others, values, attitudes (Ferlander, 2007).

[2] The term "obesity" for children throughout this paper is defined as a Body Mass Index (BMI) level at the 95th percentile or above for age and sex based on CDC growth charts and is a standardized measure. A more complete discussion and definition is provided in the first section of the Review of the Literature and titled *Measurement of Obesity in Children*. The growth charts and percentile cut-offs are available at http://www.cdc.gov/nchs/about/major/nhanes/growthcharts/clinical_charts.htm.

measures of socioeconomic status (SES). Thus, there is a continued and compelling need to understand the social factors that are related to obesity.

The aim of this dissertation study is to quantitatively test for associations between obesity and BMI in a nationally representative dataset of American children and three forms of social capital; personal social capital, family social capital and neighborhood social capital. Personal social capital will be measured using type of school the child attends (public or private), participation in activities outside of school, peer related social skills and stability of residence (i.e., how often the child has moved to a new home/residence). Social capital within the family will be quantified by measures of family structure, number of children in the family, connectedness of parents with the child and eating meals together. Neighborhood social capital will be quantified by perceptions of community safety, neighborhood social support and community type of residence (rural or urban/suburban).

The specific objectives of this dissertation are:

1) To investigate whether there are associations between measures of personal social capital and the likelihood of childhood obesity and a child's BMI after controlling for age, sex, race/ethnicity, parent education and household income.

2) To investigate whether there are associations between measures of family social capital and the likelihood of childhood obesity and a child's BMI after controlling for age, sex, race/ethnicity, parent education and household income.

3) To investigate whether there are associations between measures of neighborhood social capital and the likelihood of childhood obesity and a child's BMI after controlling for age, sex, race/ethnicity, parent education and household income.

4) To examine the relative strength of the associations between measures of personal based social capital, family based social capital and neighborhood based social capital with the likelihood of childhood obesity and a child's BMI after controlling for age, sex, race/ethnicity, parent education and household income.

Significance

This research is valuable for a number of reasons. First, there is a considerable amount of childhood obesity in the United States and childhood obesity is associated with numerous adverse consequences. Second, social factor research is crucial to describing a problem (childhood obesity) with such complex direct and indirect causes. Third, while there has been extensive research done in the area of childhood obesity, social capital has been underutilized as a framework for considering the broader social context of this particular health risk for children. Fourth, the rationale and motivation for this study is to contribute to the knowledge base used for ongoing policy development in a critical area of public health, childhood obesity. Each of these four reasons regarding the value of the research will now be discussed in greater detail.

First, this research is significant because the prevalence of childhood obesity in the United States is so high that it is routinely described as an epidemic and a major threat to public health (Ebbeling, Pawlak, & Ludwig, 2002; Evans, Renaud, Finkelstein, Kamerow, & Brown, 2006; Slyper, 2004). It has been suggested that the next generation of Americans may actually experience a decline in life expectancy because of the impact of obesity on longevity (Olshansky, et al., 2005). The prevalence rate of obesity has roughly quadrupled in American 6-11 year olds since 1965, growing from 4.2% to 17%

(CDC/NCHS, 2009). This prevalence suggests that some four million children, aged 6-11 years, are currently obese (United States Census Bureau, 2008).

Obese children are more likely to have health issues requiring clinical intervention than non-obese children (Must & Strauss, 1999). The Bogalusa Heart Study identified that 39% of obese children and adolescents in their study population had adverse levels of two or more cardiovascular risk factors including triglycerides, low-density lipoprotein (LDL), high-density lipoprotein (HDL), fasting insulin and hypertension (high blood pressure) as compared to only 19% for overweight[3] children and 5% of normal weight[4] children (Freedman, Mei, Srinivasan, Berenson, & Dietz, 2007). Obese children are stigmatized by other children, are liked less, have lower self-esteem, greater feelings of shame about themselves and are teased more often (Latner & Stunkard, 2003). Chronic obesity, defined as children who were obese during all or most of an 8 year longitudinal study, was associated with higher levels of psychiatric disorders including oppositional defiant disorder for both boys and girls and depression for boys compared to children with no obesity or only childhood obesity (Mustillo, et al., 2003). It is estimated that of all U.S. medical expenditures in 1988 for children from 4-17 years old, $124 million were directly attributable to obesity (E. Johnson, McInnes, & Shinogle, 2006).

Finally, the research suggests that obesity tends to continue into adulthood and adult obesity is linked with many diseases, as well as emotional suffering, prejudice,

[3] Overweight is defined as a BMI from the 85th to 94th percentile for age and sex based on CDC growth charts.
[4] Normal weight is defined as a BMI at the 84th percentile or below for age and sex based on CDC growth charts.

shame, depression, etc. (Freedman, Khan, Serdula, & Dietz, 2005; Wellman & Friedberg, 2002). Accordingly, obesity is a health problem of such magnitude and importance that it is one of the ten indicators used by the U.S. Department of Health and Human Services (HHS) to monitor the health of U.S. citizens, including children beginning at two years old (National Center for Health Statistics, 2007).

Second, social factor research related to childhood obesity is an important component in understanding such a multifaceted and widespread public concern. It is especially critical in the area of obesity because of its (obesity) individual/behavioral nature and presentation. Although there is a biological definition for obesity which is essentially an *energy imbalance*[5] in individuals, Wang and Beydoun concluded that "individual characteristics are not the dominant factor to which the rising obesity epidemic is ascribed" and suggest that "social environmental factors" appear to be most influential (Wang & Beydoun, 2007, p. 24). Their conclusion was based on an extensive review of multiple national surveys including the National Health and Nutrition Examination Surveys (NHANES), Behavioral Risk Factor Surveillance System (BRFSS), Youth Risk Behavior Surveillance System (YRBSS), National Longitudinal Survey of Adolescent Health (Add Health Study) and the Growth and Health Study of the National Heart, Lung and Blood Institute. Writing for the *Future of Children*, a research collaboration of the Woodrow Wilson School of Public and International Affairs at Princeton University and The Brookings Institution, Anderson and Butcher came to a

[5] The term energy imbalance is commonly used in the literature regarding obesity and it describes energy intake exceeding energy expenditure or more simply stated, more calories being consumed than calories being used by an individual.

similar conclusion as Wang and Beydoun, stating, "genetics alone cannot explain the increases in obesity in recent decades" and identify multiple areas of change in children's environments since 1980 that have contributed to the increase in obesity prevalence (P. M. Anderson & Butcher, 2006, p. 38).

House asserts that social factors are "arguably even predominant" over biological phenomenon in understanding physical health and population health (House, 2002, p. 126). For example, one study found that nutrition knowledge was only weakly associated with healthy eating and/or BMI across age, gender, race, education and income groups which suggested to the authors of the study that there are broader contextual influences involved in diet quality (healthy eating), and consequently obesity (Sapp & Weng, 2007). Clearly, the study of social factors is critical to a well-developed understanding of childhood obesity for researchers, clinicians, policy makers and other constituencies involved in designing effective programs and policies for children.

Third, social capital, measured at any level, has been underutilized as a framework for contextualizing the social origins of this particular health risk (obesity) for children. There are two specific areas where there are gaps in the research. The first is that there are very few studies that link any kind of social capital with childhood obesity, especially before 2003 (Ferguson, 2006). Second, most of the studies that do consider social capital are generally focused on neighborhood levels of social capital, relating measures of physical activity, BMI and/or obesity with characteristics of neighborhood such as trust, social support, mutual aid, reciprocity and safety (Lumeng, Appugliese, Cabral, Bradley, & Zuckerman, 2006; McKay, Bell-Ellison, Wallace, & Ferron, 2007;

Singh, Kogan, & van Dyck, 2008). Singh and his collaborators found that lower levels of neighborhood social capital (parents' perception of trust, reciprocity and helping each other/each others' children) significantly increased the odds of being obese in an analysis of obesity in children and adolescents (Singh, Kogan, & van Dyck, 2008). Another study of fifth-graders found that the neighborhood social environment (social ties, social cohesion, reciprocity, trust) was more strongly predictive of physical activity and obesity than the neighborhood physical environment (physical disorder, traffic, type of housing) (Franzini, et al., 2009).

As stated earlier, these studies and others have mostly considered social capital at the neighborhood level or larger geographic areas such as U.S. counties or States in the consideration of obesity (Kim, Subramanian, Gortmaker, & Kawachi, 2006). However, there is abundant evidence for the value of lower level measures, at both the individual based and family based levels (I. Kawachi, 2006; Winter, 2000). Individual level or personally owned social capital has been studied in relationship to multiple adult health measures including health related quality of life, mortality, cardiovascular risk, obesity; but, Morrow argues that there is a need to recognize that children can "generate, draw-on and negotiate their own social capital" apart from their parents and outside the family (Moore, Daniel, Paquet, Dube, & Gauvin, 2009; Morrow, 1999, p. 751). For example, the presence (or absence) of health "complaints" including headache, stomachache, sleeplessness, dizziness, backache and loss of appetite, in a group of 2-17 year olds, was related to an individual measure of the child's social capital, participation in clubs outside of school (Berntsson, Kohler, & Vuille, 2006). Measures of family social capital (neighborhood/social support, smaller family size and two parent household) were positively associated with developmental achievements in a group of very high risk 2-5 year olds (Runyan, et al., 1998). Furthermore, the home social environment and family social processes are both associated with the development of obesity in children (Sara Gable & Lutz, 2000; Strauss & Knight, 1999).

This project expands the use of social capital beyond the neighborhood level by contextualizing obesity risk for children at two additional levels. First, by considering children's personal social capital, through examining what social relationships/structures might be associated with reduced risk for obesity. Second, by considering family social capital, in investigating what family structures and distinguishing characteristics such as cohesion and relationships, might also be associated with reduced risk for obesity.

Fourth, the rationale and motivation for this study is to contribute to the knowledge base used for ongoing policy and intervention development in a critical area of public health, childhood obesity. The research is prolific and broad, but still seems bounded by traditional research paradigms of public health that look for individual, behavioral, economic and/or demographic characteristics to model health risks. Clearly, a portrayal of childhood obesity requires a broad lens. Link and Phelan have argued that considering social factors to be "fundamental causes" will help to identify the "factors that put people at risk of risks" and more importantly, provide substantial insight not available using more traditional analyses (Link & Phelan, 1995, p. 85).

This research, contextualizing social risk factors for childhood obesity, is both novel and essential. It is novel in its use of the personally owned social capital of children and the consideration of family social capital as it relates to childhood obesity. It will expand the body of knowledge needed to ultimately improve the health and lives of children, and consequently improving long term health and well-being across the lifespan for individuals and the population. Chapter 2 describes the literature related to the topic and explains the theoretical background for the design of the analyses.

CHAPTER 2

Literature Review & Theoretical Framework

Chapter 2 contains two sections presenting the background for the research. The first section, Review of the Literature, provides an overview of the current literature in two areas; 1) obesity in children and 2) social capital and children's health. This section is summarized by a discussion of emerging questions that provided the impetus for the objectives of the study. The second section, Theoretical Framework, offers a theoretical framework for the study's conceptual foundation, measures of social capital and a social capital model for obesity in children.

Review of the Literature - Obesity in Children

The Measurement of Obesity in Children. The internationally accepted standard for identification of obesity in individuals is the Body Mass Index (BMI). BMI is a straightforward calculation[6] that expresses a person's weight in relation to their height. Persons between 2 and 20 years of age are categorized as "overweight" if their BMI is between the 85^{th} and 95^{th} percentile and "obese" if their BMI is in 95^{th} percentile or above for their age and sex using the CDC BMI-for-age growth charts (CDC/NCHS, 2009)[7]. The cut-points for children were selected by an expert panel convened to develop a standard for international use (Bellizzi & Dietz, 1999). BMI has been validated as a measure for body density and body density is associated with adiposity (Prentice & Jebb, 2001).

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[6] BMI=weight (pounds) divided by height² (inches) multiplied by 703 (Bellizzi & Dietz, 1999).
[7] The terms overweight and obese for reporting on children and adolescents are not always used consistently throughout the literature; however, the use of percentile cut-offs is consistent. The CDC definitions for overweight and obese will be utilized for this research.

“True” measures of body fat using tools like hydro densitometry (underwater weighing), radiological studies and even bioelectrical impedance methods are time-consuming, expensive, impractical and difficult to use in clinical settings and population surveys (Ogden, Carroll, & Flegal, 2008; Sweeting, 2007). BMI is inexpensive, easy to use in many different settings and very reliable when conducted by trained personnel (Sweeting, 2007). Additionally, these standardized methods for calculating BMI and classifying obesity for children, with cut-points based on age and sex, are used consistently for clinical care, surveillance, research and reporting in the United States and internationally. These charts can be found at http://www.cdc.gov/growthcharts/.

Medical Consequences of Childhood Obesity. The consequences of childhood obesity can be understood across the life span and while many of the consequences are those which occur very late in adolescence or early adulthood, there is an already large and still growing body of research documenting the immediate sequelea (pathological consequences). Must and Strauss presented a comprehensive discussion of immediate health problems that often accompany obesity across a range of clinical areas (Must & Strauss, 1999). Some of the more striking examples include orthopedic problems caused due to excess pressure on growth plates resulting in damage to the femoral head (thigh bone) and growth disorders of the shin bone often requiring surgical intervention(s); neurological problems caused by intracranial hypertension with headaches, vomiting, blurred and double vision; pulmonary disorders ranging from decreased exercise tolerance, coughing and wheezing in obese children with or without the presence of asthma to abnormal sleep patterns associated with obstructive sleep apnea that appear to be linked with “clinically significant decrements in learning and memory function”; gastroenterological illness such as gallstones and increased rates of lipolysis (breakdown of fats) that can compromise short and long-term liver function; and endocrine disruptions including early-onset menarche, insulin resistance up to and including Type 2 diabetes in children as young as 10 years old (Must & Strauss, 1999).

The American Heart Association recently released study data that found plaque buildup in the neck arteries of obese children to be similar to those normally found in middle-aged individuals, about 45 years old ("Obese Kids' Artery Plaque Similar To Middle-Aged Adults," 2008). The Bogalusa Heart Study found substantial associations between five identified risk factors for cardiovascular disease[8] and obesity in their study population, average age 11.4 years; 39% had two or more risk factors for cardiovascular disease, 18% three or more and 5% four or more (Freedman, et al., 2007).

Another important area of child health is sexual growth and development. In American adolescents, obesity has been correlated with accelerated sexual maturation in girls and delayed maturation in boys (Wang, 2002). Furthermore, it appears that childhood obesity is often predictive of persistent obesity into adulthood and adult obesity has many well-known and significant associations with morbidity and mortality (Baker, Olsen, & Sorensen, 2007; Freedman, et al., 2005; Must & Strauss, 1999).

Psychosocial and Emotional Consequences of Childhood Obesity. In the previous section some of the immediate physical health issues for obese children were presented and they are numerous and serious. However, it is not hard to imagine that the

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[8] The risk factors considered in the study were triglyceride levels, LDL cholesterol, HDL cholesterol, insulin and blood pressure.

psychosocial and emotional effects are equally or more detrimental. The stigmatization of obese children by their peers has been well-documented since the early 1960's and the current research finds that stigmatization to be even stronger in today's society (Latner & Stunkard, 2003). Obese children are often rated as the "least desirable playmates" (Zametkin, Zoon, Klein, & Munson, 2004). Research with children as young as five years old has shown an inverse relationship between weight status and feelings of self-esteem coupled with decreased self perceptions of cognitive and physical abilities by obese children (Davison & Birch, 2001).

The stigma of obesity is one of the causal factors theorized across many studies that find low self-esteem correlated with a child's weight status, including one longitudinal analysis where obesity and lower self-esteem scores were related not only at baseline but that a higher baseline BMI could predict a drop in self-esteem at a future point in time (Hesketh, Wake, & Waters, 2004). In a community based sample assessing quality of life and weight status, obese children rated themselves lower in areas of self-esteem, social confidence, school abilities, self-regard, satisfaction with appearance and ability to get along with others; and their parents reported their obese children as having more anxiety and/or depression, exhibiting immature behavior and problems with schoolwork (Friedlander, Larkin, Rosen, Palermo, & Redline, 2003). Obese children have greater odds of being subjected to peer victimization via name-calling, teasing, hitting, kicking, pushing, losing friends and becoming targets of rumor spreading and lies (Janssen, Craig, Boyce, & Pickett, 2004).

Prevalence of Childhood Obesity in the United States. Health risk factors in the United States are monitored through the CDC. The National Center for Health Statistics (NCHS) reports a sizable increase over time in the prevalence of obesity, defined as a BMI at or above the 95th percentile for age and sex, in the population of American youth as shown in Table 1. The rates for this population, ages 2-19 years old, were relatively stable with only a small rise from the 1960's through the 1970's. The rates approximately doubled during the next measured time period, 1988-1994. The prevalence rate has continued to rise since that time with statistically significant incremental increases until 2003[9] (Ogden, et al., 2008).

Table 1. Prevalence of obesity[a] among American children and adolescents ages 2-19 years, for selected years 1963-65 through 2003-2006. National Health and Nutrition Examination Survey[b]

Age (years)	1963-1966	1976-1980	1988-1994	2001-2002	2003-2006
2-5	-	5.0	7.2	10.3	12.0
6-11	4.2	6.5	11.3	15.8	17.0
12-19	4.6	5.0	10.5	16.1	17.6

[a] Obesity defined as a BMI ≥ the 95th percentile for age and sex based on 2000 CDC BMI growth charts at http://www.cdc.gov/growthcharts. Note: While the use of BMI and the cut-points and use of the term "obesity" were not standardized until 2000, the NCHS as the repository for the original data, has standardized the prevalence rates to reflect current methodology and terminology (Ogden, et al., 2008).
[b] Prevalence rates obtained from the NCHS website for the National Health and Nutrition Examination Survey at http://www.cdc.gov/nchs/nhanes/nhanesmmwrs_obesity.htm

There are many complex and varied associations of weight status with race/ethnicity and sex. The differences most often noted of interest in the literature are summarized in Table 2 (Ogden, et al., 2008, p. 2403).

In all major and sub-groups for race and sex, there is a higher obesity rate associated with the older age groups. This is consistent given this paper's argument that obesity is mostly a function of non-biological influences, i.e., the longer an individual is

[9] The change in prevalence from the 2003-2004 survey to the 2005-2006 survey was not statistically significant. Therefore, the CDC has combined the data into a four year sample which provides for a larger sample size and greater stability for analysis (Ogden, et al., 2008).

exposed to these non-biological influences, whether they be social, cultural, economic, environmental, etc., the more likely obesity is to develop. These prevalence rates indicate that being obese for all age groups is more closely associated with being non-white for both boys and girls. Gender also matters and is different based on a child's race/ethnicity. Non-Hispanic white males and Hispanic males tend to have higher rates of obesity than non-Hispanic white and Hispanic females. Conversely, non-Hispanic black males have lower rates of obesity than their non-Hispanic black female age counterparts.

Obesity rates are, in general, lowest for non-Hispanic whites, especially girls when compared with non-Hispanic white boys and their non-white female age cohorts. These prevalence rates are not unexpected for a variety of reasons, especially the cultural pressure and preferences among white women for thinness and the transmission of this preference to their daughters (Oliver, 2006). Non-Hispanic white boys have only slightly lower rates than their non-Hispanic black age peers and both groups have markedly lower rates than Mexican American boys.

The prevalence of obesity in Mexican American boys, age 6-11, is at least 10 points higher than non-Hispanic white and non-Hispanic black boys of the same ages. In adolescence and early adulthood, 12-19 years old, this difference decreases rather dramatically and the three groups become more alike than dissimilar. This is consistent with research that finds a common belief of mothers and fathers in this ethnic group that heavier children are healthier, happier, "cuter" and safer (Kaufman & Karpati, 2007, p. 2186). Additionally, in one study, Hispanic mothers reported higher levels of concern than either white mothers or black mothers if they perceived their children were not eating enough (Kimbro, Brooks-Gunn, & McLanahan, 2007). It may be that males in this group are heavier as children when their parents have the most influence and as the boys become older they have more independence to make their own diet, exercise and health related decisions.

Non-Hispanic black females have higher rates of obesity than any other comparison group based on age/gender or age/race. For ages 2-19 years, their (non-Hispanic black females) rates are 77.2% higher than non-Hispanic white females (24.1% versus 13.6%), 30.2% higher than Mexican American females (24.1% versus 18.5%) and 38.5% higher than non-Hispanic black males (24.1% versus 17.4%). Significant research in the area of body image has consistently demonstrated a larger sized body cultural ideal by non-Hispanic black women and non-Hispanic black female adolescents. This is often coupled with a lack of awareness of how weight really can affect health (Caprio, et al., 2008; Parnell, et al., 1996).

Yet, the bottom line is that the rates for every group are too high. Even the *least* obese group, non-Hispanic white girls, had an overall (ages 2-19 years) obesity prevalence of 14.6% as shown in Table 2. Healthy People[10] 2010 goals include reducing obesity rates among *all* 6-19 year old Americans, with a target obesity prevalence rate of 5% (National Center for Health Statistics, 2007).

[10] *Healthy People* are national public health goals managed by the Office of Disease Prevention and Health Promotion, U.S. Department of Health and Human Services. National public health goals and priorities have been set and monitored since 1980. Information about Healthy People was obtained from their website at http://www.healthypeople.gov/.

Table 2. Prevalence of obesity [a] among American children and adolescents ages 2-19 years, by race[b] and sex, 2003-2006. National Health and Nutrition Examination Survey.

Age (years)	All	Non-Hispanic White	Non-Hispanic Black	Mexican American
2-19 Boys & Girls	16.3	14.6	20.7	20.9
Boys	17.1	15.6	17.4	23.2
Girls	15.5	13.6	24.1	18.5
2-5 Boys & Girls	12.4	10.7	14.9	16.7
Boys	12.8	11.1	13.3	18.8
Girls	12.1	10.2	16.6	14.5
6-11 Boys & Girls	17.0	15.0	21.3	23.8
Boys	18.0	15.5	18.6	27.5
Girls	15.8	14.4	24.0	19.7
12-19 Male & Female	17.6	16.0	22.9	21.1
Male	18.2	17.3	18.5	22.1
Female	16.8	14.5	27.7	19.9

[a] Obesity defined as a BMI ≥ the 95th percentile for age and sex based on 2000 CDC BMI growth charts at http://www.cdc.gov/growthcharts. Note: While the use of BMI and the cut-points and use of the term "obesity" were not standardized until 2000, the NCHS as the repository for the original data, has standardized the prevalence rates to reflect current methodology and terminology (Ogden, et al., 2008).
[b] The CDC provides race statistics for only three groups because of the small sample sizes for other identified racial groups such as Native Americans, Hispanic (other than Mexican American) and Asian/Pacific Islanders.

Socioeconomic Status and Childhood Obesity. Medical sociologists have long documented the differences in health status based on measures of socioeconomic (SES) status[11]. These differences appear to endure even in those countries with socialized medicine where there is a more equitable distribution of health care access and resources (Link & Phelan, 1995). Childhood obesity, understood as a risk factor (causal or corollary) for innumerable health, psychosocial and emotional problems, has many strong associations with individual and aggregate measures of SES. The simple stratification of childhood obesity rates by household income levels provides an instructive look at this association. Table 3 shows prevalence rates of obesity by ages and household income level (CDC/NCHS, 2009).

[11] Measures of SES are stratified measures of income, wealth, education and occupational prestige used either alone or aggregated (A. G. Johnson, 1995).

Table 3 demonstrates that obesity, like all health risk factors, is clearly related to one measure of SES, poverty. Poverty is linked to obesity across all age groups but appears to have an especially strong differential impact, both positive and negative, for children, 6-11 years old. This is consistent with research using more aggregated models of SES that suggest this age group is more vulnerable to the effects of family circumstances than older adolescents (Haas, et al., 2003).

Table 3. Prevalence of obesity[a] among American children and adolescents, ages 2-19, by household income[b], 2003-2006. National Health and Nutrition Examination Survey.

Age	All Income Levels	Below 100% Poverty Level	100-199% Poverty level	200% Poverty Level or more
All 2-19	16.3	18.9	17.4	14.4
2-5	12.4	14.1	12.7	11.1
6-11	17.0	22.0	19.2	13.5
12-19	17.6	19.3	18.4	16.3

[a] Obesity defined as a BMI ≥ the 95th percentile for age and sex based on 2000 CDC BMI growth charts at http://www.cdc.gov/growthcharts.

[b] Family income relative to U.S. federal poverty levels are those used by the U.S. Department of Health and Human Services (DHHS) and developed and maintained by the U.S. Census Bureau. A complete explanation of poverty measures can be found at http://aspe.hhs.gov/POVERTY/09poverty.shtml.

A review paper examined 45 studies of the relationship between SES measures including parent education, income, occupation and composite measures with adiposity in children and reported about 70% of the studies describing some type of "statistically significant" inverse relationship (Shrewsbury & Wardle, 2008). Shrewsbury and Wardle also noted that the consistently strongest correlate with childhood obesity was parent education level. They speculate that education is a more stable measure than income because incomes and occupations can change from year to year. Also, "wealth" is hard to accurately measure and the utility of occupational status rankings is questionable given that they were developed in the 1960's using a mostly white, male database (Burgard & Stewart, 2003).

The findings on the associations between SES and obesity stratified by race are inconsistent among different groups of children. Shrewsbury and Wardle concluded that inverse association between income or education and adiposity in children was most consistent for white girls, but had various associations in other groups (Shrewsbury & Wardle, 2008).

Summary of the Literature Review on Obesity in Children. This overview of childhood obesity substantiates that it (obesity) is a measurable health risk that causes and/or is correlated with a greater presence of health risk factors, poorer health and unfavorable psychosocial and emotional conditions. Its prevalence rate is regarded as too high across all groups of children in the United States. Furthermore, childhood obesity is one of the many health risks that is socially patterned and experienced disproportionately in greater numbers by racial/ethnic minorities, children with less educated parents and the poor (Singh, Kogan, & van Dyck, 2008).

Review of the Literature - Social Capital and Children's Health

Social Capital & Health. Social capital is a broadly defined and extensively used term across many disciplines; primarily, sociology and political science, but also public health, urban studies, criminology, business, economics and education (J. Field, 2008, p. 2; Halpern, 2005, p. 3). For the purposes of this study, *Social capital will be defined as resources*[12] *accrued and/or accessed from social relationships/social bonds at multiple levels including the individual, family, neighborhood, community or nation*

[12] Examples of the "resources" referred to throughout the social capital health literature include knowledge, information, emotional and instrumental support, companionship, confidence in others, values, attitudes (Ferlander, 2007).

(Ferlander, 2007; Halpern, 2005, pp. 1-40; Macinko & Starfield, 2001). In his seminal work, *Bowling Alone*, Putnam states emphatically that "social connectedness matters to our lives in the most profound way" in his discussion on the importance of social capital to health (Putnam, 2000, p. 326).

Ferlander defines social capital as "a resource accessed through social networks" where networks are "social connections" and the resources are reciprocity ("emotional, informational and instrumental support") and trust ("having confidence in other people") (Ferlander, 2007, p. 116). Kawachi explains that in the context of health social capital includes social cohesion and/or social networks that provide access to things like information about health resources, health promotion, support and informal control for healthy behaviors and knowledge about local services (I. Kawachi, 2006; Kim, et al., 2006, p. 1046). Moore, et al., define social capital to be "relational and refers to the material, information and affective resources to which individuals and potentially, groups have access through social connections" (Moore, et al., 2009).

Furthermore, there is general agreement that social capital has both individual and collective meaning, relevance and utility for health studies and research (Harpham, Grant, & Thomas, 2002; Kim, et al., 2006; Scheffler & Brown, 2008). In the nineteenth century, Emile Durkheim, used the framework of social capital, if not the term *social capital* itself, to argue that suicide was more than just a "personal tragedy, but sociologically predictable" given the extent to which a person is "integrated into society" and during times of "rapid social change" (Putnam, 2000, p. 326; Turner, 2003).

There have been many studies linking health and social capital. Social capital has been associated with mortality, sexually transmitted diseases, self-rated health, psychosomatic complaints, obesity, mental illness, depression, use of hypertensive medications, life expectancy, tuberculosis case rates, cardiovascular disease, binge drinking, and other health indicators (I. Kawachi, Kim, Coutts, & Subramanian, 2004). One of the most comprehensive studies relating obesity (in an adult population) to social capital, at the individual and two collective levels, found obesity and lack of leisure time physical activity related to social capital aggregated at the U.S. State level[13], associated with lower social capital aggregated at the local community level and associations with an individual's personal level of social capital (Kim, et al., 2006). These studies support the use of social capital is as a model for understanding the effects of social relationships/social bonds on health and health risk factors, including obesity.

Social Capital & Children. There are a number of studies that consider social capital and various childhood experiences and/or outcomes. The seminal work in this area is Coleman's study of social capital and children's educational outcomes. Coleman found that social capital in the family *and* social capital in the community were associated with whether or not a person remained in high school or dropped-out (Coleman, 1988). Also, as in the immediately preceding review of the literature on social

[13] Social capital was aggregated at the State, county and individual level with multiple indicators from various sources including the General Social Survey, U.S. Economic Census, U.S. Statistical Abstract, U.S. Census of Retail Trade, Roper Social and Political Trends Archive and the DDB Needham Lifestyle Surveys. Examples of the indicators include serving on a committee or as an officer of a club/local organization, attending a public meeting on town or school affairs, average number of group memberships, attending club meetings, entertaining in one's home, volunteering, percentage turnout in presidential elections, numbers of civic, social and non-profit organizations, visiting with friends and perceptions of trust and honesty in other people. (Kim, et al., 2006)

capital and health, Coleman's writing emphasizes that social capital "exists in the relations among persons" (Coleman, 1988, pp. S100-S101). Ferguson concluded in her extensive review article, that after poverty, social capital (family social capital and community social capital), is the "best predictor of children's welfare" (Ferguson, 2006, p. 8).

Putnam and Bourdieu, both acknowledged to be framers of social capital theory, contend that family and family life are the foundations of social capital and the principal location of the "acculturation and transmission" of social capital for children (Putnam, 2000)). Winter suggests that despite these assertions by Putnam, Bourdieu and many others, family has been "underemphasized" given the amount of time individuals spend with their families, versus in the voluntary associations (Winter, 2000). In a study of high-risk children and developmental outcomes, the results suggested to the authors that "social capital may be most crucial for those families who have fewer financial or educational resources" (Runyan, et al., 1998). Additionally, Putnam has proposed that an overall level of decline in social capital has been harmful for children and their families, communities, neighborhoods (Putnam, 2000).

The preceding discussion on social capital and children centers on how social capital is transmitted to children from their families and communities and portrays them as fairly passive agents. This is generally reflective of the literature. However, Morrow and Leonard each argue that this is problematic given that children also have the capacity to generate and utilize social capital through their own personal social relationships and social networks (Leonard, 2005; Morrow, 1999). For example, most studies consider the context of children's neighborhoods by asking their parents about neighborhood trust, reciprocity, etc. One interview survey conducted with 4-8 year olds successfully used a traditional model of personal social capital[14] with this population and found it to be viable and useful as a "methodological and analytic" tool while studying early childhood education and care (Farrell, Tayler, & Tennent, 2004). In summary, social capital has been shown to benefit children in many ways and is viably studied at both individual/personal or collective levels.

Social Capital and Children's Health. There are a number of studies wherein indicators/and or a scale of social capital were constructed as an independent variable in consideration of a dependent or outcome variable with measures of health or health related behaviors, in children and adolescents. Related to general health, a large cross-sectional study found social capital measured as children's participation in organized activities, experience of being "bullied" (or not), parent playing with the child and parents "occupying a position of trust" in an organization explained 75% to 85% of the variance in children's complaints of stomachache, headache, sleeplessness, dizziness, backache and loss of appetite (Berntsson, et al., 2006).

Adolescent participation in group activities like church choir, school clubs, student government, 4-H club, school band or doing volunteer work was associated with less alcohol or drug use and dependence (Winstanley, et al., 2008). In younger children, ages 2-5 years old, development delays were less pronounced for high risk children who

[14] The dimensions of social capital measured were participation in clubs/groups, visiting friends/relatives, visiting neighbors, trust of other people, feeling safe where they live, if they would pick up rubbish in the playground, helping others with their schoolwork and like being with people who are "different" (Farrell, Tayler, & Tennent, 2004, p. 626)

lived in families with neighborhood support, personal support, regular church attendance, two parents/parent figures in home and two or less children in the home (Runyan, et al., 1998). Social capital measured as neighbors' willingness to intervene in different situations such as children misbehaving, people throwing garbage on the street, kids skipping school, graffiti being painted, a fight on the block were found to be related to children's overall health, mental health and "resistance to illness" for young adolescents, aged 11 and 12 years old (Drukker, Kaplan, Feron, & van Os, 2003). Social capital has many benefits to health for children, as in the adult population.

Summary of the Literature Review on Social Capital & Children's Health. Social capital, in a wide variety of forms, provides for the accrual of advantages to children's health and well-being. It provides benefits for children and adolescents of all ages, from the very young to older teenagers on the verge of adulthood. The studies cited in the preceding section demonstrate how different forms of social capital, personal social capital, family social capital and neighborhood social capital appear to provide complementary yet unique advantages and benefits.

Prior Research Specific to Social Capital and Childhood Obesity

Related to childhood obesity, there are a limited number of studies that consider social capital per se. Children's lack of involvement in after school activities, which may lower personal social capital, was correlated with becoming overweight or obese in elementary school, regardless of family income or ethnicity in a group of children followed over time, from ages 2 to 12 years of age (O'Brien, et al., 2007).

Characteristics of families including regularly missing meals and family inactivity were found to be significant for adolescent obesity, over and above shared genetic traits (M. A. Martin, 2008). Various measures of family support and family cohesion have both been reported to have inverse associations with obesity in children from 7-16 years old across multiple studies (Kitzmann, Dalton, & Buscemi, 2008).

After controlling for neighborhood SES[15] a study in Los Angeles of 12-17 year old adolescents found a "significant relationship" between lower BMI levels and higher levels of social capital among adults in the neighborhood described as the presence of "adults that kids look up to," "people willing to help neighbors," "adults watch out that kids are safe," "would scold if kid showing disrespect" and "would do something if kid does graffiti" (Cohen, Finch, Bower, & Sastry, 2006, p. 774). Thus, as social capital has advantages for many aspects of health for children and adolescents, there is also evidence that various forms of higher levels of social capital are associated with lower levels of obesity.

Emerging Questions

There are emerging questions that arise from the existing literature. First, why is the prevalence of childhood obesity socially patterned? Fundamental cause theory as conceptualized by Link and Phelan may be useful to connect the dots between social factors and obesity in children (Link & Phelan, 1995) Second, measures of social capital

[15] The factors used to create a neighborhood index of SES included percent of households in poverty, number of female headed households, percent of residents on public assistance and rate of unemployed adult males (Cohen, Finch, Bower, & Sastry, 2006)

may be useful for expanding the understanding of the context of such a high prevalence rate of obesity (16.4%) in American children.

Fundamental Causes. Obesity research, including research on childhood obesity, has largely focused on the identification of individual situations/behaviors associated with risk. This is entirely consistent with the American cultural narrative of individualism and freedom to act. However, focusing only on the very direct behavioral associations with childhood obesity is dismissive of the pervasive and persistent social patterning of this condition. There is an ongoing need to "contextualize" personal level risk factors for poor health within broader social processes conditions (Link & Phelan, 1995, p. 80). Link and Phelan contend that social factors are "fundamental" causes of increased risk and/or disease and that these social factors are what put people at "risk for risks" (Link & Phelan, 1995, p. 80).

Social capital theory is an attractive model for describing the pathways between traditional demographic/SES measures, individual behaviors and health. The measures of social capital could explain, in part, how SES is a fundamental cause of disease, risk factors, etc. For example, one study based on fundamental cause theory, found almost no association between length of time until death/overall mortality from diseases where there is little prevention or treatment knowledge[16] and SES; but, there was a strong association between death from more preventable causes and SES (Phelan, Link, Diez-Roux, Kawachi, & Levin, 2004). Phelan, et al also noted that their findings were true

[16] A few of the many examples of low-preventability causes of death are brain, gallbladder, pancreatic and ovarian cancers, multiple sclerosis, organic psychotic conditions and cardiomyopathy. More preventable causes of death included chronic obstructive pulmonary disease (COPD), boating accidents, suicide, homicide and smoking related cancers.

across racial and gender divisions. In discussing the findings, the authors theorized that those in higher SES groups were able to "delay" death from more preventable causes by accessing various social resources. They described these social resources as knowledge, support, social connections, etc. to be those same things often described as social capital. Like social capital, these social resources are "general in nature" and can be used across a wide variety of situations related to health risk, disease, illness, etc. (Mechanic, Rogut, & Colby, 2005) Thus, it is plausible that social capital as a research concept can help unearth how fundamental causes theory applies to health risks factors such as the likelihood of obesity in childhood.

Social Capital. Social capital is both theoretically and evidentially related to the health of children (Ferguson, 2006). However, there has been little research that attempts to measure children's personal social capital because children are seen more often as recipients of social capital versus possessing their own agency to generate and access benefits from social relationships (Leonard, 2005). Children, of primary school age and older, spend enough time away from the home and family to be regarded, at least to some extent, outside the context of their families. Furthermore, the use of family social capital to understand health has been limited and most often used to understand educational achievements and/or adult socioeconomic outcomes. There have been a number of research studies linking the nutritional quality, physical activity and BMI in children to neighborhood contexts, often using social capital measures. This dissertation addresses the existing gap in the literature by analyzing the association between three types of social capital, personal, family and neighborhood social capital and obesity in children.

Theoretical Framework

Theory. There is a great deal of theory regarding the associations between health and social relationships, even though the term "social capital" itself was not broadly used until the 1980s and 1990s (J. Field, 2008, p. 15). The conceptual foundation for this project goes back more than a century to Durkheim's seminal work, *Suicide*, published in 1897 (Turner, 2003). Berkman, et al. note that Durkheim's principal objective was to describe the connection between individual health and "social dynamics" (Berkman, Glass, Brissette, & Seeman, 2000, p. 844). Durkheim's suicide studies emphasized the importance of social relationships and social cohesion; and both are understood to be key components of most definitions of social capital (Halpern, 2005; House, 2002; Turner, 2003).

Berkman et al. hypothesize that social ties/groups influence individual behavior/outcomes through social support, social influence, social engagement and access to material resources based on the work of Durkheim and others[17] (Berkman, et al., 2000). By definition, social capital measures these types of influential pathways. These are the influential pathways that can possibly describe some of the fundamental causes of childhood obesity.

The current research aims to examine three forms of social capital, personal, family and neighborhood, and test for associations with obesity. There is ample theoretical evidence for the inclusion of these three forms of social capital (personal, family and neighborhood) and specific indicators for assessment.

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[17] Berkman, et al. identify John Bowlby, developer of attachment theory as their other major influential theorist besides Durkheim (Berkman, et al., 2000).

Personal social capital. Bourdieu's work is prominent in discussions and presentation of personal social capital because his conception focused on the "benefits accruing to individuals by virtue of participation in groups" (Portes, 1998, p. 3). For children, personal social capital can be broadly defined as those voluntary social ties the child has outside the family. Participation in sports teams, clubs and organizations like Girl Scouts or Boy Scouts can build social capital for children (Offer & Schneider, 2007). The child's type of school may enhance social capital for its students. This may be especially true if the school's students, parents, teachers, staff, etc. have a high degree of social capital. The social capital of the milieu itself can bestow beneficial social influence, either deliberately or more casually (Berkman, et al., 2000).

Personal social capital, these types of community-based social ties, while weaker than family ties, link the person to the greater society at large and have been identified to be at least as beneficial to adult health as family ties (I. Kawachi, Kim, Coutts, & Subramanian, 2004; Putnam, 2000). There is even an argument for these types of ties being more important than family and friendship ties because they help to mitigate the "darker" side of social capital, such as the reinforcement of norms that may include unhealthy behaviors or activities (Portes, 1998). Another facet of personal social capital is simply the quality of individual relationships. Social capital at this "micro-level" can have a large influence on health (Halpern, 2005, p. 111).

In general, personal social ties have not been widely investigated in the non-adult population in the United States, especially in children younger than 12 years old.

Family social capital. Family social capital is the social capital provided to the child by their parents relative to family cohesion/family functioning and certain family structural characteristics. Family processes and family structure are both important (Halpern, 2005, pp. 145-148). Quantity without quality or quality with too little quantity may both hamper the child's access to social capital within a family. Family social capital is necessary for children to benefit from their families' financial capital (income/wealth) and human capital (education) (Coleman, 1988). Furthermore, the modeling of trust, reciprocity and cohesion begins in the family (where children spend a great deal of their time) and this modeling is a key factor in children's ability to learn and transfer these skills to the greater community at large in adulthood (Winter, 2000).

Additionally, there is some evidence that low family cohesion creates a climate where children are more likely to engage in unhealthy behaviors and/or that the stress associated with low family cohesion may induce a physiological response in children that is related to obesity (Dalton & Kitzmann, 2008). Family meal frequency can be used as a rough gauge of family closeness (Rhee, 2008). Putnam said that the "evening meal" was an "important form of family connectedness" (Putnam, 2000, p. 100). Another measure of family cohesion is the extent to which parents know their child's friends.

Finally, certain structural characteristics of the family provide social capital as a general resource for children. These structural characteristics used to gauge parental time are often conceived of in terms of number of children in the family and family structure[18] (Coleman, 1988). Coleman felt that family size was important because as the number of

[18] Family structure, relative to children, can be thought of as two parent biological/adoptive family, stepfamily or single parent.

children in a family increased, parental resources became more and more diluted. Research on family size is somewhat mixed in its conclusions regarding siblings and the impact on various aspects of children's well-being, especially in those areas related to social capital (Steelman, Powell, Werum, & Carter, 2002). Families of intact two parent families tend to have more social capital than step families and step families have been found to have more social capital than single parent, using a measure of mother's social capital (Ravanera & Rajulton, 2009). For example, children in single parent families and/or those without solid connections to both parents only have the opportunity to benefit from one adult's social network and connections (versus two) (Halpern, 2005, p. 249)

Finally, family social capital may also include the number of times the child/family has moved based on Coleman's contention that "the social relations that constitute social capital are broken at each move" (Coleman, 1988, p. S113). Some have argued that the overall impact of moving on children can be positive, since moving may be associated with longer term benefits such as higher family income or better neighborhood (J. Field, 2008, p. 105)

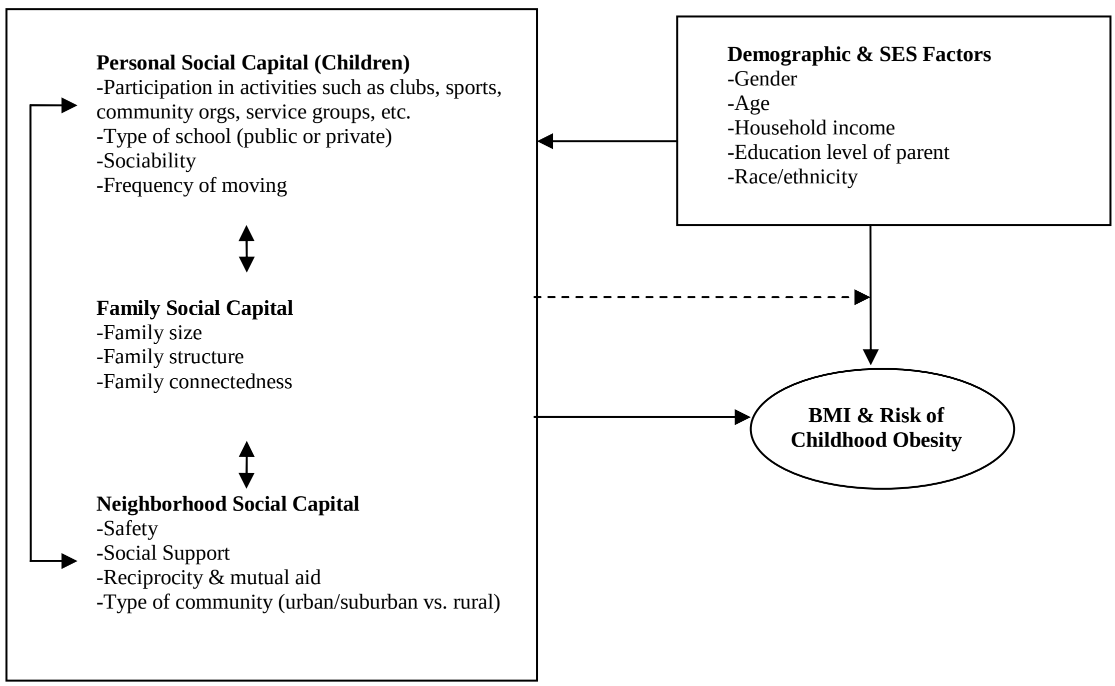
Neighborhood social capital. Neighborhood social capital has been widely documented to be related to not only obesity in children and adults, but to general well-being, happiness, overall health and other desirable outcomes. Kawachi and Berkman identify a number of possible mechanisms by which neighborhood/community social capital could benefit health, including more rapid "diffusion" of health knowledge and healthy behaviors, the application of social control over certain activities and the availability of psychosocial processes that benefit health (Kawachi & Berkman, 2000, pp. 184-185). Kawachi and Berkman cite the relatively low rate of teenage smoking in Japan despite the "ubiquitous presence of cigarette vending machines" as a result of high levels of social cohesion (Kawachi & Berkman, 2000, p. 185).

In areas with high levels of social capital, facilitative social structures provide opportunities for residents to more easily access information and support about behaviors that may subsequently reduce obesity levels (Kim, et al., 2006, p. 1046). Neighborhood level social capital also provides health benefits simply by giving adults and children (and the children's parents) a sense of safety and security, thus reducing stress and providing more opportunities for physical activity, walking versus driving and recreational resources (Franzini, et al., 2009).

Neighborhood social capital is people's perceptions of trust, reciprocity, social support, mutual aid and safety (Kawachi & Berkman, 2000, p. 178; Putnam, 2000, pp. 134-147). For example, these factors work alone and/or together to influence weight by establishing social norms regarding behavior related to diet and activity, providing (or diminishing) opportunities for individuals to engage in physical activity, providing adult role models (good and bad) for children and adolescents and influencing stress levels which in turn can influence BMI.

A model of social capital, socioeconomic/demographic factors, BMI & childhood obesity. This study will contextualize some significant and well-documented risk factors for childhood obesity in the United States including gender, race/ethnicity, household income and parent education with indicators of personal social capital, family social capital and neighborhood social capital. Figure 1 represents a simplified model depicting the proposed linkages between demographic & SES factors, three forms of social capital and children's BMI and risk of obesity.

FIGURE 1. A model of social capital, socioeconomic/demographic factors with a child's BMI & the risk of childhood obesity.



First, the model implies that different forms of social capital can affect each other. For example, children with high levels of involvement with an after school club like Boy Scouts, may positively influence their family's level of social capital by "drawing" their parents into club related activities and ultimately increasing the overall amount of time the parents are involved with the child and the child's friends. Another example of how this can work would be a neighborhood with high levels of poverty but also with high levels of social support. High levels of social support could conceivably increase a child's personal social capital by providing the right facilitative structures to be involved in a local club with shared transportation, child care, etc. This is also an example of how one type of social capital can impact another type of social capital. A family with high social capital as evidenced by their involvement with their child and the child's friends could improve the neighborhood's level of mutual aid by influencing other adults'/parents' involvement with neighborhood children.

Second, this model suggests that social capital can directly impact childhood obesity via the mechanisms previously discussed. Opportunities for physical activity in neighborhoods perceived to be safe with trustworthy adults, exposure to values and norms outside of one's immediate family/neighborhood, connected families that allow parents to influence children's behavior, families/neighborhoods with lower levels of stress and close social ties are just some of the many ways that social capital may impact a child's BMI.

Third, this model suggests that social capital may also modify the effects of certain SES and demographic risk factors on childhood obesity. It is well documented that there are numerous risk factors for obesity such as poverty, race/ethnicity, parent educational levels, etc.; social capital in any form may work to offset some of that risk. It is possible that children in poor families may have higher social capital within their families and/or higher personal social capital, thus offsetting some of the risk for obesity. Or, a child living in an economically disadvantaged household, with a greater risk of obesity, might have that risk reduced by higher personal social capital gained by participation in frequent activities. This participation might reduce the number of hours of screen time thus reducing the kind of "mindless" snacking and television watching that frequently accompanies obesity in this age group. The examples given in the above discussion are not meant to be exhaustive, but illustrative of how social capital might influence behavior and/or risk.

Social capital has the potential to operate differently dependent on the form being considered (personal, family or neighborhood) and also may influence risk differently in different SES and demographic groups. The study seeks to quantitatively measure specific indicators of each of the specified forms of social capital, personal social capital, family social capital and neighborhood social capital. The measures will be examined for associations with BMI and the likelihood of obesity. Chapter 3 will describe the methodological issues relevant to the research and hypotheses testing.

CHAPTER 3

Methodology

The aim of this dissertation study was to quantitatively test for associations between obesity and BMI in a nationally representative dataset of American children and three forms of social capital; personal social capital, family social capital and neighborhood social capital. This chapter will describe the research methodology used to achieve that aim. This will include reviewing the source of the data, dependent and independent variables, data screening, hypotheses and statistical procedures utilized. SPSS 17.0 was used for all statistical procedures.

Dataset

The data is from the 2003 National Survey of Children's Health (NSCH). This is a public use dataset and was originally accessed through the NSCH State and Local Area Integrated Telephone Survey website (National Center for Health Statistics, 2005). Additionally, the data is available from the Child and Adolescent Health Measurement Initiative and was downloaded from their site (Child and Adolescent Health Measurement Initiative, 2005).

The survey is part of the State and Local Area Integrated Telephone Survey Program (SLAITS) conducted by the CDC's National Center for Health Statistics (NCHS) and was funded by the Maternal and Child Health Bureau (MCHB) (Blumberg, Olson, Frankel, Srinath, & Giambo, 2005). A random-digit-dial sample of households with children under the age of 18 from all 50 states and the District of Columbia obtained 102,353 telephone interviews and were conducted over 18 months, beginning in January

2003, with an adult respondent who asserted that they were knowledgeable about the randomly selected child's health. The respondent was a parent in 96% of the interviews (80% mothers and 16% fathers) (Blumberg, et al., 2005).

All accompanying documentation, survey methodology, survey operation and dataset creation is also publicly available (Blumberg, et al., 2005). The research process is finely detailed including everything from development of the survey tool to data coding. This allows the researcher to become familiar with any particular strengths and/or weaknesses of the data. For example, the child's height and weight were reported by the survey respondent. This data was compared to height and weight data for the same age group, during the same time period which was collected by trained professionals for the National Health and Nutrition Examination Survey (NHANES). The comparison suggested that, in general, the stated heights and weights were underreported for height and over reported for weight in children 9 years old and younger but not for those ages 10-17 years (Child and Adolescent Health Measurement Initiative, 2005).

This survey collects personal information for the express purpose of research. All federal guidelines for the protection of respondents are applicable and were followed in the survey. Additionally, the NSCH reports that they take "extraordinary measures" to protect confidentiality because of the public release of the dataset including the exclusion or recoding of certain responses including household income, date of interview, child's age in months, respondent's relationship to child (if other than a parent) and the length of time that the child and/or parent have been living in the United States (Blumberg, et al., 2005). The only geographic data reported for all subjects is state of residence. For children living in 18 states, a variable indicating whether or not the family lived in a metropolitan statistical area (MSA) was included. This variable was eliminated from the public release dataset in the 16 states with smaller populations of less than 500,000 living in either MSA or non-MSA areas to further enhance and guarantee privacy (Blumberg, et al., 2005). The extensive de-identification process also included additional recoding for individual children where height, weight, medical condition(s), family structure, family size, race and/or other characteristics that present in such a unique manner, together or separately, that they could potentially be identifiable (Blumberg, et al., 2005).

This dataset has been widely used in the academic research community and published in many academic journals including, but not limited to, the *American Journal of Public Health, Pediatrics, Health Affairs, Annals of Epidemiology, Maternal and Child Health Journal*, *Journal of Community Health* and the *Archives of Pediatrics & Adolescent Medicine* (Child and Adolescent Health Measurement Initiative, 2005). The dataset has been used extensively including studies of U.S. State variations in breastfeeding rates, health care access and use among children of immigrant families, overweight and obesity rates of children diagnosed with autism and/or Attention Deficit Hyperactivity Disorder (ADHD), primary care use and connections for children with ADHD, independent and joint associations of the behavioral, socioeconomic and racial/ethnic determinants of obesity in children and adolescents, disparities in health and health care access for children who live in homes where English is not the primary language, social risk influence on the health of children, access to health care for children with asthma and insurance status, prevalence of learning disabilities for children with asthma or diabetes, family structure and children's health and the geographic prevalence of overweight children in the United States (Child and Adolescent Health Measurement Initiative, 2005).

Study Population

A subset of the entire 2003 National Survey of Children's Health 102,353 cases was used for the study. The population of analysis was all children reported to be 10 or 11 years old by the adult respondent and will be limited to those children for whom both weight and height data was available. This resulted in a dataset of 10,018 children. Children were represented from all 50 States and the District of Columbia ranging from 132 children (1.3% of total) in Utah to 237 (2.4% of total) in Louisiana.

First, limiting the population to these ages eliminates adolescents and will generally keep those later pubertal stage individuals out of the study population. This is relevant because puberty is a time of uneven maturation (sexual) among adolescents and sexual maturity is more related to body fat than chronological age, thus posing special problems and unnecessarily complicating the analysis to test the hypotheses of this dissertation (Daniels, et al., 1997).

Second, it is theorized that the family social processes are particularly associated with the development of obesity in children under the age of 12 (S. Gable, Chang, & Krull, 2007). Also, as the inclusion of personal social capital measures is being considered, it is theorized that 10 and 11 year olds (versus younger children) have greater personal influence on the decision to whether or not they participate in clubs or other activities.

Finally, while it might be desirable to also include children between the ages of 6 and 9 years old in a study of "children", it has been established that parent reported weights and heights for that age group (6-9 years old) in this study were not as accurate as those collected independently in another large scale national U.S. sample. Furthermore, the classification of obesity in younger children is best done with age reported in months (not years) and in this dataset age in months is not reported to protect privacy (Blumberg, et al., 2005; Child and Adolescent Health Measurement Initiative, 2009).

Dependent Variables

The primary dependent variables for the research are two measures of childhood weight status, Obesity and BMI. Obesity as the dependent variable is a dichotomous measure that identifies the weight status of each subject as *Obese* or *non-Obese* using the CDC's classification system for identification of obesity in persons 2-19 years old as a BMI in the 95th percentile and above (Bellizzi & Dietz, 1999)[19]. BMI (Body Mass Index) is a linear interval variable. BMI is a calculation that expresses a person's weight as a function of their height. Both alternative measures of the dependent variable are useful for hypotheses testing in the current research.

Obese or non-Obese. The dichotomous variable, Obese, is a desirable dependent variable because it clearly identifies the outcome variable of interest, obese children, those in the 95th percentile of BMI for age and sex. Some studies aggregate overweight children (those with a BMI from the 85th to 94th percentile for age and sex) with obese

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[19] The cut-points for defining obesity used by the CDC are the accepted standard used throughout the field by organizations such as the World Health Organization and American Academy of Pediatrics.

children in the specification of a dependent variable. However, prior research with children and youth indicate that the correlation between BMI and *true* obesity can vary based on ethnicity, age, maturation stage, waist to hip ratio, bone/muscle density, gender and actual BMI measure and is most reliable as the level of BMI increases to the 95th percentile level and above (Daniels, et al., 1997). Furthermore, in children and adolescents, immediate and/or long-term health consequences are much more associated with *obesity* versus *overweight* and the trend for the development of metabolic and other health risks is non-linear and escalates sharply for BMI levels in the obese category (Freedman, Khan, Serdula, Ogden, & Dietz, 2006; Must & Strauss, 1999). Accordingly, this study's dependent variable is defined as those children classified as obese (BMI for age and sex at the 95th percentile and above) only. These are the children most at risk for the adverse consequences related to obesity.

BMI (Body Mass Index). The linear variable, BMI was also utilized as measure of weight status for the dependent variable. BMI is a function of a person's weight based on height. The standard formula for BMI is weight (pounds) divided by height^2 (inches) multiplied by 703 (Ogden, et al., 2008). This measure of weight status, while alone does not provide an indication of the child's obesity, is desirable because it is an interval variable and can provide for additional types of statistical analyses for the dependent variable. There is a linear relationship between BMI and weight status, such that as the BMI becomes a larger number, the child will likely have greater levels of adiposity. Finally, utilizing BMI allows for OLS regression modeling across all ranges of weight status, versus the dichotomous Obese versus non-Obese expression of the dependent variable.

Independent Variables

Demographics & SES. These variables were used in the creation of a control model and for identifying some of the special groups for supplementary analyses after initial hypotheses testing. All information was reported by the respondent during the telephone survey. In 96% of the interviews a parent was the respondent and the other four percent were grandparents, aunts/uncles or siblings 18 years or older (Blumberg, et al., 2005).

Table 4 summarizes the demographic and socioeconomic status variables utilized. Each of the variables has a well documented relationship with children's weight status.

Table 4. Independent demographic and socioeconomic status variables used in the study. 2003 National Survey of Children's Health[a].

Independent Variable	Definition
Age	Age of child in years 10 or 11.
Sex	Identifies if child is female (coded as 0) or male (coded as 1).
Race/Ethnicity	Variable derived from consolidation of two variables identifying race and ethnicity. Child is coded as being non-Hispanic white, non-Hispanic black, non-Hispanic multiracial/other or Hispanic.
Parent Education	Identified highest level of education attained by anyone in the household, public use dataset reported in three levels. Parent education coded as 1<12 years, 2=12 years or 3=13+.
Household Income	Derived from household income and identifies if child lives in one of 3 levels based on the Department of Health and Human Services federal poverty guidelines for households[a] . Income coded as 1<200% of poverty level, 2=200 to 399% of poverty level, 3 ≥ 400% of poverty level.

[a] Blumberg SJ, Olson L, Frankel MR, Osborn L, Srinath KP, Giambo P. Design and operation of the National Survey of Children's Health, 2003. National Center for Health Statistics. Vital Health Stat 1(43). 2005.

[b] This data was reported in two variables; one identifying if the child was Hispanic or not and a second for race which did not include a Hispanic category. However, 38% of respondents who identified as Hispanic did not identify with another racial group. Given the strong association between Hispanic and obesity in children, it was important to include this as a race/ethnicity identification category.

Measures of Social Capital. The independent variables for measuring the various forms of social capital were operationalized based on the theoretical conceptions described in the previous chapter, prior research and availability in the dataset.

Table 5. Independent measures of social capital and coding used in the study. 2003 National Survey of Children's Health[a].

Variable	Social Capital Type	Definition
School Type	Personal	Identified if child attended a public school=0 or private school=1.
Gets along with peers	Personal	Parent response to how often child got along well with peers; always=4, usually=3, sometimes=2, never=1.
Participation in organized activities outside of school	Personal	Identified if during the last 12 months the child participated in one or more organized activities outside of school, such as sports teams or lessons, clubs or religious groups, reported as yes=1 or no=0.
Frequency of moving to new address	Personal	How many times the child has moved to a new address; reported as 0-11 times, 12 or more
Family size	Family	Identified the number of persons under the age of 18 living in the household; top coded at 4 to protect privacy.
Parent knows child's friends	Family	Parent response to what proportion of child's friends that parent has met; reported as all=1, most=2, some=3, none or "child has no friends"=4.
Family Structure	Family	Identified family structure in household to be two parent biological/adoptive family, two parent stepfamily or single parent/other. Dummy coding used.
Family eats together	Family	Identified how many days during the past week that the family ate at least one meal together; reported as 0 through 7 days
Neighborhood Safety	Neighborhood	Parent response to whether they felt that child is safe in community or neighborhood; coded as never/ sometimes=0, usually/always=1.
Neighborhood Social Support – helping each other	Neighborhood	Parent response to the statement, "People in this neighborhood help each other out," reported as definitely agree, somewhat agree, somewhat disagree, definitely disagree.
Community Type	Neighborhood	Identifies if child lives in a metropolitan (MSA) or non-metropolitan statistical area based on U.S. Census bureau definitions. Rural=0 or urban/suburban=1.
Social Capital Scale[b]	Neighborhood	Social capital for the neighborhood was coded as 1=lowest level of social capital, 2=average level of social capital, 3=highest level of social capital.

[a] Blumberg SJ, Olson L, Frankel MR, Osborn L, Srinath KP, Giambo P. Design and operation of the National Survey of Children's Health, 2003. National Center for Health Statistics. Vital Health Stat 1(43). 2005.

[b] The social capital index used in the research includes perceptions of neighbors helping each other, watching out for each other's children, being able to "count" on the neighbors and the belief that if the respondent's child was "hurt or scared" a neighbor would help the child. This index has been used in previous research with this survey and is a key indicator for the National Survey of Children's Health.

Statistical Approach

The statistical plan was designed to test the hypotheses regarding the inverse relationship between weight status in children and the various forms of social capital, i.e., that higher social capital will reduce the likelihood of being obese and/or predict a lower BMI. PASW 17.0 was used for statistical analyses and testing (SPSS, 2009).

Data Screening. The first step in the statistical analysis was preliminary data screening. Initial data screening normally consists of reviewing the accuracy of the data, considering missing data, looking for extreme values and examining normality (Mertler & Vannatta, 2002, pp. 25-65). The accuracy of this public use dataset was assumed given the description of the data collection process, coding and dataset compilation described by the statisticians from the CDC (Blumberg, et al., 2005).

Missing Data. In the dataset, there was some missing data associated with many of the variables. For most of the variables, the number of cases missing the data was minimal. There were three variables where the number of cases missing in the data required action for this study. The variables were BMI, race/ethnicity and MSA type of community. Cases missing BMI were eliminated from the study. Race and ethnicity, originally reported as two distinct measures were merged into a single race/ethnicity identifier. MSA type was imputed based on the State of residence. The following discussion describes the rationale behind the handling of each of these three variables.

The initial dataset included 10,828 cases of 10 and 11 year olds. The BMI score was missing on 810 (7.4%) children and they were excluded from the analysis, yielding a study population of 10,018. The cases without BMI data were similar in terms of age and sex. They appeared to more likely be Hispanic, non-White, in households below 200% of the federal poverty level and live in a household where the highest level of education was less than high school. Previous published research from a senior epidemiologist with the Maternal and Child Health Bureau suggests that exclusion is appropriate for this dataset versus estimation of the missing values (Singh, et al., 2008).

Respondents were asked two consecutive questions regarding race and ethnicity. First, respondents were asked if the child was of Hispanic or Latino origin. Second, the respondent was given seven possible racial categories and they were allowed to identify the child as belonging to one or more of the categories including White, Black/African American, American Indian, Alaska Native, Asian and Native Hawaiian or Pacific Islander. The final compilation of the dataset for all states reported only four races including White, Black/African American, Multiracial and Other to protect confidentiality (Blumberg, et al., 2005). However, of the 997 10 and 11 year old children identified as Hispanic or Latino, only 623 (62%) identified any other racial category. It may have been that those parents answering yes to the first question (Is the child of Hispanic or Latino origin?) felt the second question to be redundant. Also, Hispanic/Latino was not offered as an option in the second question that presented seven different racial categories. Therefore, these two questions were collapsed into a single variable identified as Race/Ethnicity which included four nominal designations including non-Hispanic white, non-Hispanic black, non-Hispanic multiracial/other and Hispanic. If a child was identified as Hispanic, they were assigned to that category regardless of any additional racial coding. If this consolidation had not been done, 374 cases would have been removed from almost all analyses due to missing racial data, even though the parent had already identified the child as being Hispanic. Also, Hispanic was an important variable to keep because this group of children is well known to be at an increased risk of obesity and should be represented as fully as possible in the dataset.

The second variable missing data which was changed was that for MSA type. For children living in 18 states, a variable indicating whether or not the family lived in a metropolitan statistical area (MSA) was included. This variable was eliminated from the public release dataset in the 16 states with smaller populations of less than 500,000 living in either MSA or non-MSA areas to further enhance and guarantee privacy. However, the NSCH gives recommendations to code children living in Connecticut, Delaware, Hawaii, Massachusetts, Maryland, New Hampshire, Nevada and Rhode Island as living in a metropolitan area (MSA) given the largely metropolitan nature of their relatively small geographic areas (Blumberg, et al., 2005). The remainder, per NSCH additional recommendations places children living in Alaska, Idaho, Maine, Montana, North Dakota, South Dakota, Vermont and Wyoming in non-MSA areas given the rural nature of those states (Singh, Kogan, & van Dyck, 2008). Given the inclusion of neighborhood social capital as a primary division of social capital and rural residence as a key component in the understanding of communities *and* childhood obesity, this change was necessary. Therefore, each case with a missing MSA designation was assigned as either MSA or non-MSA residence based on the recommendations for each state as just described.

Outliers. Extreme values were not found in the data given the forced choice nature of most of the survey questions and the top coding conducted by the CDC for many of the questions. Related to the dependent variable, BMI, extreme values for BMI were not an issue. All children with extremely large or small values for weight and/or height had their weight and/or height bottom coded or top coded to protect privacy. BMI calculations were somewhat controlled for extreme values because of this action. However, the bottom and top coding values were not so controlled that the range of calculated BMI's showed little variation. This will be evidenced in Chapter 4-Results where BMI data is presented. Related to the dependent variable, Obese (non-Obese) identifications were done by the CDC and provided with the dataset, so that their (CDC) suppression of the original data would not lead to misclassifications of weight status. Finally, other data which might have extreme values including number of children in the family and number of times moved were top-coded at four and 12, respectively, to protect privacy.

Normality. The final step in the initial univariate screening was to look at the normality of the data. Interval and ordinal variables should be distributed normally for inferential parametric statistical analysis (Mertler & Vannatta, 2002). Of the two dependent and 17 independent variables, ten were interval or ordinal; the remaining variables were nominal. Table 6 summarizes the skewness and kurtosis coefficients for the interval/ordinal variables in the study.

All absolute values of the skewness statistics are less than one and all absolute values of the kurtosis statistics are less than 1.5. Given the size of the sample, 10,018 cases, these values were deemed to be acceptable (Mallery & George, 2003; Mertler & Vannatta, 2002).

Table 6. Summary of normality screening for interval/ordinal variables in the study dataset.

Variable	Mean	Skewness	Kurtosis
BMI = weight (pounds) divided by height² (inches) multiplied by 703 (dependent variable)	20.1	.9480	.914
Parent Education 1 < 12 years, 2 = 12 years, 3 = 13+ (SES measure)	2.7	-1.900	1.900
Household Income 1 < 200% of poverty, 2 200 – 399 % of poverty 3 ≥ 400% of poverty (SES measure)	2.0	-.005	-1.40
Gets along with peers 1=never, 2=sometimes, 3=usually, 4=always (personal social capital)	3.4	-.981	.009
# of times moved (personal social capital)	2.2	.187	-1.350
# of children in household (top coded at 4) (family social capital)	2.0	.575	-.407
Parents know friends 1=all, 2=most, 3=some, 4=none/no friends (family social capital)	1.7	.776	.529
# of days in week eat meals together (family social capital)	5.2	-.876	-.265
Neighbors help 1=definitely agree, 2=agree, 3=disagree, 4=definitely disagree (neighborhood social capital)	1.9	.187	-1.352
Social Capital Score 1=highest level, 2=average level, 3=lowest level (neighborhood social capital)	2.2	-.291	-1.250

Nominal Data. Nominal data can not be screened using the statistical tools available for interval and ordinal data. However, the data can be reviewed to make sure that no one category contains more than 90% of the responses (Tabachnick & Fidell, 2001). Of the two dependent and 17 independent variables, nine were categorical. The frequency distributions are given in Table 7.

The review of the categorical variables indicates that a criterion of no one category containing a frequency of 90% or more was met. The most noticeably small group is the racial/ethnic category of non-Hispanic multiracial/other but given the importance of clearly identifying Hispanic children this weakness was accepted.

Table 7. Summary of frequency distributions for categorical variables in the study population

Variable	Categories	Frequency
Obese (dependent variable)	Obese Not Obese	20.4 79.6
Age (demographic measure)	10 years old 11 years old	49.3 50.6
Sex (demographic measure)	Female Male	48.9 51.1
Race/Ethnicity (demographic measure)	Non-Hispanic White Non-Hispanic Black Non-Hispanic Multiracial/Other Hispanic	71.1 10.3 7.3 10.0
Type of School (personal social capital)	Public Private	86.1 13.7
Participates in activities outside of school (personal social capital)	Yes No	84.1 15.9
Family Structure (family social capital)	2 parent bio/adoptive 2 parent stepfamily Single parent/other	59.1 11.6 26.5
Neighborhood Safety (neighborhood social capital)	Always/usually Never/sometimes	86.9 11.8
Community Type (neighborhood social capital)	MSA Urban/Suburban Not MSA Rural	65.7 34.3

Variables eliminated during screening. There were a number of independent variables initially identified for inclusion from the 2003 NSCH that were eliminated. One variable, *number of days per week child participates in outside activities*, was eliminated because there was a missing response in 1393 (13.9%) of the 10,018 cases. Eliminating that many cases to allow for the inclusion of this particular measure was not justifiable.

Additional variables were removed because the distribution of the responses was so extreme that inclusion lacked sufficient meaning. Table 8 summarizes those variables and the frequency distributions of the responses. Given the age group of the study population, it is relatively straightforward to understand why the responses are distributed in the manner reported in the table. These variables are probably more meaningful and produced a greater variability in the responses for the older age group that is part of the larger survey, not in the sample for the present study[20].

Table 8. Summary of frequency distributions for categorical variables ELIMINATED from the study dataset.

Variable	Categories	Frequency
Close relationship between parent & child (as reported by parent)	Very close	90.5
	Somewhat close	9.2
	Not very close	0.3
	Not close at all	0
Communicates with parent	Very well	79.7
	Somewhat well	19.3
	Not very well	0.8
	Not well at all	0.2
Family rules regarding television programs	Yes	92.8
	No	7.2
Parent has day-to-day help with parenting	Yes	89.8
	No	10.2

Descriptive Statistics. Statistics describing the study population's demographics (age, gender, race/ethnicity) and SES measures (parent education, household income) were conducted and are reported in Chapter 4 in the descriptive statistics section. Also, in that section, the obesity prevalence, odds ratios for the likelihood of obesity and mean BMI scores were calculated and are presented.

Bivariate analyses were conducted for all independent variables with the dichotomous dependent variable, Obese. Obesity prevalence was computed using the crosstabs function. Additionally, the chi-square statistic, Cramer's V, was calculated to test for associations between Obesity and the independent variables. The Cramer's V statistic was used because the Pearson chi-square statistic is not useful for determining the strength of the association because it (Cramer's V) accounts for sample size, whereas the chi-square only checks for its basic assumption of more than five cases in each

[20] The National Survey of Children's Health includes children ranging in ages from 0-17 years (Blumberg, et al., 2005).

resulting cell (A. Field, 2005, p. 693). Additionally, the Cramer's V statistic is constrained to fall between 0 and 1 and is recommended for categorical variables with more than two categories[21] (A. Field, 2005, p. 693). The results are reported in Chapter 4 in the descriptive statistics section.

Odds ratios are a measure of an event/condition occurring in one group compared to another for the same event/conditions (A. Field, 2005, p. 739). Odds ratios were produced at three levels; age and sex adjusted, age, sex and race/ethnicity adjusted and age, sex, race/ethnicity, parent education and household income adjusted. Odds ratios were calculated for all independent variables for the likelihood of childhood obesity using binary logistic regression modeling. They are located in Chapter 4 in the descriptive statistics section. Odds ratios were calculated because they can provide context in a way that can be lacking in simple prevalence measures due to the ease of adjustment for confounding factors. In this study, the confounding factors were age, sex, race/ethnicity, parent education and household income.

Finally, mean BMI's were produced for each of four demographic groups, 10 year old girls, 10 year old boys, 11 year old girls and 11 year old boys. In the population, aged 2-20 years, growth charts for BMI are specified for both age and sex (Bellizzi & Dietz, 1999). Thus, it is most useful to compare absolute BMI scores based on age and sex. Mean BMI was computed for each of the four age/sex cohorts overall and for these groups based on race/ethnicity, parent education and household income. The BMI scores are reported in Chapter 4 in the descriptive statistics section. Independent samples t-tests

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[21] Phi and Cramer's V are the same when there are only two categories for each variable in the contingency table (A. Field, 2005, p. 693).

were conducted for determine if the various groups and/or measures of the independent variable differed based on BMI.

All the independent variables identified were significantly associated with Obese vs. Non Obese and mean BMI's were significantly different based on statistical testing. These associations with Obesity and BMI score confirmed that their inclusion in the regression models was appropriate for estimating associations between the various measures of social capital and weight status in children. Additionally, this step of the statistical analysis provided an initial confirmation of the hypothesized relationship between indicators of social capital and childhood obesity.

Multivariate Modeling & Hypotheses Testing. Multiple regression techniques were used to fit a model of the independent variables measuring social capital in predicting two dependent outcome variables related to a child's weight status. Regression modeling of the two dependent variables, Obese and BMI, were conducted to test the hypotheses using PASW 17.0. Binary logistic regression was used to model the dichotomous dependent variable Obese. Linear regression, using ordinary least squares regression (OLS) was employed for fitting BMI. Both were conducted using a forced entry method that puts all specified covariates into the regression model simultaneously. This method was chosen because the literature review, theory and descriptive analysis provided sufficient evidence that all the predictors were meaningful (A. Field, 2005, p. 160). The results of the regression modeling are reported in Chapter 5 in the section on multivariate modeling and hypotheses testing.

Each independent variable was exclusively assigned to one of three forms of social capital - personal social capital, family social capital or neighborhood social capital. It is expected that these model(s) will allow for a meaningful interpretation of the hypotheses, including whether the higher levels of the various forms of social capital (personal, family, and neighborhood) are associated with lower levels of obesity and/or lower BMI. After building a basic model to adjust for known demographic/SES confounders, each identified type of social capital (personal, family or neighborhood) was individually tested. After testing each type of social capital individually, a full model was fit to the data containing all independent variables. Thus, five models were built for each form of the dependent variable, Obese and BMI, for a total of ten regression models in all. Each one of the five models used the same independent variables except for one of the measures in neighborhood social capital which differed and is explained in detail in the following discussion under Model 3. The models are now named and described.

Basic Model. Multivariate regression models for the likelihood of childhood obesity (binary logistic regression) and BMI score (OLS multiple regression) with age, sex, race/ethnicity, parent education and household income as the independent variables.

Personal Social Capital – Model 1. Multivariate regression models for the likelihood of childhood obesity (binary logistic regression) and BMI score (OLS multiple regression) with indicators of personal social capital including type of school (public or private), frequency of “getting along with peers” (always, usually, sometimes, never), participation in activities outside of school (yes or no) and number of times child has moved (0-12 times). The models were adjusted for age, sex, race/ethnicity, parent education and household income as specified in the control model. Model 1 was used to test Hypothesis 1 that there will be an inverse relationship between higher measures of a child's personal social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income.

Family Social Capital – Model 2. Multivariate regression models for the likelihood of childhood obesity (binary logistic regression) and BMI score (OLS multiple regression) with indicators of family social capital including number of children in family (1-4 children), family structure (2 parent biological/adoptive, 2 parent stepfamily, single parent/other), number of days in a week family eats a meal together (0-7 days) and parent knowing child's friends (all, most, some or none/no friends). The models were adjusted for age, sex, race/ethnicity, parent education and household income as specified in the control model. Model 2 was used to test Hypothesis 2 that there will be an inverse relationship between higher measures of a child's family social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income.

Neighborhood Social Capital – Model 3. Multivariate regression models for the likelihood of childhood obesity (binary logistic regression) and BMI score (OLS multiple regression) with indicators of neighborhood social capital including MSA type (urban/suburban or rural residence) and child safety in the community (always/usually or sometimes/never). In the binary logistic regression model an indexed measure of social capital[22] was employed with three levels; 1= highest level of social capital, 2=average level of social capital and 3=lowest level of social capital. In the OLS regression a statement regarding the respondents' agreement with a statement that "neighbors help each other out" (strongly agree, agree, disagree and strongly disagree) was used (Blumberg, et al., 2005). The models were adjusted for age, sex, race/ethnicity, parent education and household income as specified in the control model. Model 3 was used to test Hypothesis 3 that there will be an inverse relationship between higher measures of a child's neighborhood social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income.

Personal, Family & Neighborhood Social Capital - Full Model. Multivariate regression models for the likelihood of childhood obesity (binary logistic regression) and BMI score (OLS multiple regression) with all indicators of social capital from Models 1-3 (personal social capital, family social capital and neighborhood social capital). The models were adjusted for age, sex, race/ethnicity, parent education and household income as specified in the control model. The full model was used to test Hypothesis 4 that there will be an inverse relationship between higher measures of a child's personal social capital, family social capital and neighborhood social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income.

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[22] The social capital index used in the research includes perceptions of neighbors helping each other, watching out for each other's children, being able to "count" on the neighbors and the belief that if the respondent's child was "hurt or scared" a neighbor would help the child. This index has been used in previous research with this survey and is a key indicator for the National Survey of Children's Health (Singh, Kogan, Van Dyck, & Siahpush, 2008).

Multicollinearity. Multicollinearity was assessed during the regression analyses conducted during multivariate modeling and hypotheses testing. The Variance Inflation Factor (VIF) and tolerance statistics were reviewed. Collinearity diagnostics were produced by SPSS and Field's guidelines of a VIF value of less than 10 and a tolerance statistic greater than .2 were used (A. Field, 2005, p. 175). Specifically, if the VIF is less than 10 and the tolerance statistic is greater than .2, multicollinearity is not present. The results of the collinearity diagnostics are provided as part of the summary tables for BMI in Chapter 4 in the section on multivariate modeling and hypotheses testing. Although collinearity diagnostics are not produced for logistic regression in SPSS, it is still important to check for multicollinearity. Collinearity diagnostics for logistic regression models in SPSS should be conducted using the linear regression procedures in SPSS (A. Field, 2005, p. 260). Since the same independent variables were used in both the logistic and OLS regressions, the collinearity diagnostics produced in the OLS regression for each model were sufficient for both (the logistic and OLS regressions).

Human Subjects

All planned research involving human subjects must be presented and reviewed by the Human Investigation Committee (HIC) at Wayne State University. The HIC at Wayne State University is the designated Institutional Review Board (IRB) for all human participant research under federal regulations administered by the U.S. Department of Health and Human Services. The Medical/Behavioral Protocol Summary Form for Wayne State University was completed and submitted to the appropriate designee of the HIC.

The research was eligible for exemption from review by the Human Investigation Committee at Wayne State University under Exemption Category 4 as detailed on the Division of Research website at http://hic.wayne.edu/exemptcat.php:

> *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 subjects. (Note: To qualify for this exemption the data, documents, records, or specimens must be in existence before the project begins.)*

A copy of the approved exemption is located in the Appendix A.

Limitations with the Dataset

There were a small number of limitations to the methodological design of the study. First, the height and weight data were reported by the responding parent for the child and were not measured independently by a trained person. Second, the indicators used to assess personal social capital and family social capital were selected from the National Survey of Children's Health and are thus based on the convenience of their inclusion versus a purposeful measure of personal social capital or family social capital[23]. Third, the dataset for analysis was limited to 10 and 11 year olds and children of different ages may accrue and utilize the different forms of social capital in different ways.

Comment on Sampling Weights

When sampling weights are provided they can be used to enhance the credibility of statistical analyses, especially estimation of population means and prevalence. This

[23] Although, the indicators for neighborhood social capital have been extensively used and were originally designed for and are used by the Health and Human Service's Longitudinal Studies on Child Abuse and Neglect (Blumberg, et al., 2005, p. 6).

study was conducted without the use of the sampling weight, although a post-stratified adjusted sampling weight was provided. The decision to use the unweighted data was based on a number of important considerations. First, the weighting factor provided was calculated for the entire dataset of 102,353 parent interviews. This study was restricted to a subset of only 10,018 children, roughly 10% of the larger dataset. Second, the weighting factor is really meant for "population based estimates" and the research is not attempting to make any inferences about the population of all U.S. children or even all 10 and 11 year olds (Blumberg, et al., 2005, p. 12). Blumberg, et al. note that the weights were based on the State population estimates and this results in the sum of the weights being problematic based on their sheer size (Blumberg, et al., 2005; Winship & Radbill, 1994). Winship and Radbill go on suggest that one way to check the data is to fit the regression model with both the weighted and unweighted data and compare the parameter estimates. Two regression models, a logistic model and an OLS model, were fit using both formats of the data, weighted and unweighted. The results did produce "substantively similar" estimates of the parameters and when this occurs the recommendation is to use the unweighted data (Winship & Radbill, 1994).

Chapters 4 and 5 summarizes the results of the quantitative work done to examine the associations between selected measures of social capital and weight status in a population of 10 and 11 year old American children. Chapter 4 presents the descriptive and bivariate statistics of the study population. Chapter 5 reports on the multivariate modeling and hypotheses testing.

CHAPTER 4

Results – Descriptive & Bivariate Analyses

Chapter Overview

The overall purpose of the study was to quantitatively test for associations between weight status in American children and three forms of social capital; personal social capital, family social capital and neighborhood social capital. The quantitative analyses are presented in Chapters 4 and 5. This chapter, Chapter 4, presents the descriptive statistics and bivariate analyses of the study population of 10,018 US children, aged 10 and 11 years from the 2003 National Survey of Children's Health. The descriptive statistics presented are on obesity prevalence, odds ratio for obesity, and BMI. Obesity was defined using the CDC definition of a BMI for age and sex that is at the 95^{th} percentile or above. BMI (Body Mass Index) was calculated using the equation of BMI = weight (pounds) divided by $height^2$ (inches) multiplied by 703 (Bellizzi & Dietz, 1999).

Obesity Prevalence in the Study Population

Descriptive statistics of the dataset were compiled. These statistics confirm the association of the individual independent variables used for the research and verify each measure as an individual risk factor for childhood obesity.

Table 9 provides an overview of the study population's demographics (age, gender, race/ethnicity), SES measures (parent education, household income) and obesity prevalence. In addition, for each variable, the Cramer's V statistic, a measure of the strength of association is included.

The prevalence rates in Table 9 are consistent with current literature and research describing obesity in children. About 20% of the children in this nationally representative dataset of 10,018 ten and eleven year olds, from the 2003 National Survey of Children's Health, are obese. Obese is defined as a BMI adjusted for age and gender that is at the 95th percentile or above. Boys had significantly higher levels of obesity than girls ($p<.001$) and ten year olds had significantly higher levels of obesity than eleven year olds ($p<.001$). The boy-girl difference in obesity prevalence, regardless of other demographic/SES factors has previously been documented. The obesity prevalence was highest for non-Hispanic black children (34.8%), Hispanic children (28.6%) and children living in households with income below 200% of the federal poverty level (28.8%). Parent education was measured as the highest level of education by anyone in the household and is a proxy for parent education level. Children with at least one parent with 13+ years of education had the lowest levels of obesity (17.4%) compared to children with at least one parent with a high school degree (28.6%) and children where neither parent completed high school (34.1%).

Race, education and income are consistently found to be associated with health risks and health disparities among children and adults (Link, 2008). The prevalence of childhood obesity just presented from the study population is yet another example of a health disparity that is also associated with race, education and income. In addition to the prevalence rates, the column in Table 9 labeled "% of Obese Population" further highlights the unequal distribution of obesity among children from different demographic/SES cohorts. If obesity were equally distributed among demographic/SES groups, it is expected that the percentage of the total population would be roughly equal to the percentage of the obese population. For example, while non-Hispanic black children comprise only 10.3% of the study population, they make up 18% of the obese children in the population. Hispanic children represent 10% of the study population and over 14% of the obese children in the study. Conversely, in the dataset, children living with a parent with 13+ years of education comprise roughly 75% of the study population and only about 65% of the obese children. Given the large sample size of 10,018 and the sampling rigor used by the National Survey of Children's Health, it is reasonable to assume that these percentages are fairly representative of the country as a whole.

The Cramer's V statistic, a measure of association for categorical variables is provided. Cramer's V is constrained to fall between 0 and 1 and provides a measure of the strength of association between obesity and demographic characteristics (Field, p. 693). Race/ethnicity and household income are equivalent in size (.152, .149) with parent education very close in magnitude (.131). Age and gender have smaller effect sizes (.053, .080). Cramer's V was significant for all five of the demographic/SES variables tested with obesity, confirming the apparent associations observed in the numerical prevalence measures.

TABLE 9. Obesity[a] prevalence among US children, aged 10-11 years by selected demographic and socioeconomic characteristics. 2003 National Survey of Children's Health

Characteristic	N	% of Total Study Population	% of Obese Population	Obesity Prevalence	Cramer's V Statistic	p-value
Population	10,018	100%		20.4		
Age					.053	.000
10 years old	4941	49.3	54.6	22.5		
11 years old	5077	50.6	45.4	18.2		
Missing	0					
Sex					.080	.000
Male	5116	51.1	59.0	23.5		
Female	4902	48.9	41.0	17.0		
Missing	0					
Race/Ethnicity					.152	.000
Non-Hispanic White	7120	71.1	60.6	17.1		
Non-Hispanic Black	1035	10.3	18.0	34.8		
Non-Hispanic Multi/Other	727	7.3	7.1	19.7		
Hispanic	997	10.0	14.3	28.6		
Missing	139					
Parent Education[b]					.131	.000
<12	337	3.4	5.7	34.1		
12	2099	21.0	29.6	28.6		
13+	7553	75.4	64.7	17.4		
Missing	29					
Household Income					.149	.000
<200% Poverty Level	2873	28.7	44.2	28.8		
200-399% Poverty Level	3444	37.4	34.0	18.5		
≥ 400% Poverty Level	2898	31.4	21.8	14.0		
Missing	803					

[a] Obesity defined as a BMI ≥ the 95[th] percentile for age and sex based on 2000 CDC BMI growth charts at http://www.cdc.gov/growthcharts

[b] Parent education is highest level of education attained by anyone in household and is used as a proxy for parent education.

Table 10 is structured the same manner as Table 9 for the measures of social capital utilized in the study and shows the independent variables. Table 10 highlights the variations in the prevalence of obesity based on specific measures of personal social capital, family social capital and neighborhood social capital. Groups with noticeably low rates of obesity include children in private schools (14%), children living with 2 biological/adopted parents (17%), children who live in communities where parents definitely agreed that "neighbors help each other out" (17.1%) and children living in a neighborhood with a high composite measure of social capital (16.3%)[24]. Alternatively, groups with especially high prevalence rates include children who do not participate in any activities outside of school outside of school (29.1%), children who "never or sometimes" get along well with their peers (27.8%) and children whose parents reported knowing "some or no" friends of the child (31.2%). Furthermore, 30.2 % of the children who live in areas that their parents rated as "never or sometimes" safe were obese, compared to an obesity prevalence of 18.9% for those living in areas rated as "always or usually" safe.

The Cramer's V statistic was used to test for an association between obesity and categorical measures of social capital. Cramer's V, constrained to fall between 0 and 1, is a standardized measure of the strength of the association. As with the demographic/SES covariates, all measures of social capital in the study were significant and have p-values $\leq .05$. The strongest associations were for parents knowing child's friends (.114), family structure (.098), participating in activities outside of school (.095) neighbors helping each other (.092), child's safety in the community (.091) and the social capital index (.086). The weakest association was with MSA type, rural versus urban/suburban (.019) and also was the only p-value >.000. The remaining associations, while all significant, were relatively similar in size to each other ranging from .052 to .068.

[24] The composite social capital index was based on four questions from the National Survey of Children's Health survey regarding neighbors helping each other out, if neighbors look out for each other's children, if the respondent had neighbors they could count on and if the neighbors would help a child who was hurt or scared. The four questions were designed by the NSCH to be used separately or as a composite index. The composite index is used as by the NSCH to report data and the indexed composite measure used in previously published research by a senior epidemiologist from the CDC (National Center for Health Statistics, 2005; Singh, Kogan, & van Dyck, 2008).

Table 10. Obesity prevalence among US children, aged 10-11 years by selected characteristics of social capital. 2003 National Survey of Children's Health (N=10,018) Obesity defined as BMI at 95th percentile and above for age and sex.

Characteristic	N	% Study Population	% Obese in Study Pop.	Obesity Prevalence	Cramer's V Statistic	p-value
Type of School					.062	.000
Public	8629	86.1	90.5	21.3		
Private	1370	13.7	9.5	14.1		
Missing	6					
Gets along well with peers					.068	.000
Never/ Sometimes	990	10.0	13.5	27.8		
Usually	3270	32.6	29.9	18.6		
Always	5751	57.4	56.6	20.0		
Missing	7					
Participates in activities outside of school					.095	.000
Yes	8412	84.1	77.2	18.7		
No	1589	15.9	22.8	29.1		
Missing	17					
# of times child has moved					.052	.000
Never	2294	23.1	23.9	20.9		
One	2397	24.1	20.3	17.1		
Two	1640	16.5	18.3	22.4		
Three	1534	15.5	17.3	22.6		
Four or more times	2063	20.8	20.2	19.7		
Missing	90					
Family Size					.068	.000
1 child	3079	30.7	36.9	24.4		
2 children	4293	42.9	38.4	18.1		
3 children	1884	18.8	17.4	18.8		
4 or more children	762	7.6	7.3	19.4		
Missing	0					
Parents know friends					.114	.000
All friends	4336	43.3	38.1	17.9		
Most friends	4432	44.3	42.4	19.5		
Some/No friends	1243	12.4	19.0	31.2		
Missing	7					
Family Structure					.098	.000
2 parent bio/adopt	5918	59.1	51.6	17.0		
2 parent stepfamily	1165	11.6	13.1	22.0		
Single/other	2656	26.5	35.3	26.0		
Missing	279					
Eat meals together (days per week)					.056	.000
0-3 days	2141	21.3	22.5	21.4		
4-6 days	3385	33.8	29.0	17.4		
Everyday	4485	44.8	48.5	22.1		
Missing	7					
MSA Type					.019	.050
Rural	3440	34.3	36.2	21.4		
Urban/suburban	6578	65.7	63.8	19.7		
Missing	0					
Neighbors help each other					.092	.000
Definitely agree	4539	45.3	39.7	17.1		
Somewhat agree	4040	40.3	43.1	20.9		
Somewhat disagree	706	7.0	9.3	25.7		
Definitely disagree	491	4.9	7.9	31.8		
Missing	242					
Social Capital Index					.083	.000
1 Lowest level	2170	21.7	28.1	24.9		
2 Average	3669	36.6	40.0	20.8		
3 Highest level	3754	37.5	31.9	16.3		
Missing	425					
Child is safe in community					.091	.000
Never or Sometimes	1188	11.8	17.9	30.2		
Always or Usually	8710	86.9	82.1	18.9		
Missing	120					

The preceding tables, Table 9 and Table 10, confirm that demographic/SES measures and social capital covariates have significant and important relationships to a child's obesity status. Although, it is important to remember that these are bivariate relationships only and have not been adjusted for known demographic and/or SES risk factors for childhood obesity.

Odds Ratios for Obesity in the Study Population

The preceding presentation and description of the prevalence of obesity in the study population provide enough evidence of association to begin multivariate analysis. However, it is common in public health research and medical literature to compute and examine odds ratios. Odds ratios are a measure of an event/condition occurring in one group compared to another for the same event/conditions (A. Field, 2005, p. 739). In this analysis the "event" is the presence of obesity. For example, for 10 year old children, a boy is 1.492 times more likely to be obese than a girl with everything else being equal. Odds ratios are often easier to communicate and provide context in a way that can be lacking in simple prevalence measures.

The odds ratios for the presence of obesity in the dataset were calculated for each individual demographic/SES and social capital covariate in the study using a binary logistic regression modeling procedure[25]. Each independent variable has one group identified as the reference group. The reference group is the group whose odds are set at 1.0 and against which the other(s) is compared. Odds ratios that have been adjusted are presented in next two tables, Tables 11 and 12. The first column of odds ratios are

[25] Binary logistic regression is simply multiple regression with an "outcome variable that is a categorical dichotomy" and the probability of an event occurring are part of logistic modeling (A. Field, 2005)

adjusted for age and sex only. They are the most basic "crude" odds because age and sex are the two demographic variables adjusted for in the classification of weight status (i.e. underweight, normal weight, overweight and obese) in the population aged 2-17 years (CDC, 2000). The second set of odds ratios adjusts for age, sex and race/ethnicity. Race/ethnicity has a well documented relationship with obesity in children and may be expected to change odds ratios for other covariates. Third, parent education and household income were added to the adjustment for age, sex and race/ethnicity for a "fully adjusted" set of odds ratios. Odds ratios do not imply or prove causation for either groups or individuals, but they definitely function as "red flags" for identification of health risk factors.

There are two ways to consider the tables of odds ratios. First, it is expedient to simply review the absolute sizes of various odds ratios. Second, it can be instructive to look across rows and consider whether the odds becomes larger, smaller or stay the same as the various adjustments for known confounders are added (i.e., race/ethnicity and race/ethnicity, parent education and household income). The significance of the odds ratios is identifiable by whether the confidence intervals of the odds ratio (provided in the tables) straddle 1.0.

The largest odds are for non-Hispanic black children, Hispanic children, children with parents who have $\leq$ 12 years of education, those who live in households with incomes below 200% of the federal poverty guidelines and those who live in single-parent households. Children who do not participate in any activities outside of school and those attending public school have higher odds of obesity. Children with parents who know some or none of the child's friends are also at greater risk for obesity. Children who live in communities regarded as "never or only sometimes" safe and where neighbors are viewed as "not helping each other" also have higher odds for obesity.

Adjusting for race/ethnicity (from the crude odds) and the fully adjusted model produced diverse effects on the various odds ratios. The greater risk to boys (versus girls) and 10 year olds (versus 11 year olds) changed very little regardless of adjustments for race/ethnicity, parent education and household income. This is predictable given that these are the two characteristics controlled for on the CDC growth charts for identifying obesity in children. Additionally, this verifies the validity of the CDC growth charts across various demographic/SES populations in the US.

The odds of obesity for children where the proxy measure for parent education was less than 12 years and for children living in the poorest households (<200% federal poverty level) dropped when adjusted for race/ethnicity. The reduction in the odds for these two groups was not equal and it appears that in this study population that household income is exerting a somewhat greater risk for childhood obesity than parent education. However, the data was collected to reflect only three levels of education, <12 years, 12 years or 13+ years. This is a very broad categorization, especially for the 13+ years of education group that represent 75% of the study population. The odds ratios for non-Hispanic black children and Hispanic children were also reduced in the fully adjusted model, but the reductions were more modest in comparison to those just described for parent education and household income. Thus, it appears that in the study population, race is exerting a stronger influence on the odds of obesity than parent education and/or household income. Or it may be that the whatever benefits are derived from education and income in reducing the odds of obesity in 10 and 11 year old children are more accessible to non-Hispanic white children than the non-Hispanic black or Hispanic children.

Almost all of the individual characteristics of personal, family and neighborhood social capital had smaller odds ratios when fully adjusted for sex, age, race/ethnicity, household income and parent education. For example, children who attend public schools had a modest drop in the odds of obesity with the fully adjusted model, as did children with siblings (versus only children). However, children attending public schools still had almost 140% greater risk of being obese with all demographic/SES variables held equal. Or, living in a community rated as basically unsafe (for the child) increases their risk of obesity by 120% regardless of age, sex, race/ethnicity, parent education or household income. This suggests that while *all* risk can not be eliminated, greater parent education and higher household income do reduce the differences across the groups for the odds of obesity.

Very few odds ratios increased after controlling for the demographic/SES variables. Living in a rural community increased the odds for children in the study population when race/ethnicity was added, from 1.018 to 1.278 and then decreased to 1.106 after controlling for parent education and household income. It may be that that any protective associations from race (i.e. being a non-Hispanic white child) are outweighed by not residing in an urban/suburban community. Another odds ratio that had a small increase when fully adjusted was for children who had *never* moved.

Regarding health behavior and risk, especially for children with lower SES circumstances, some research suggests that moving is advantageous because these children often move to “better” neighborhoods and/or more diverse communities (Pettit & McLanahan, 2003). These observations regarding community type of residence (MSA or non-MSA) and moving serve to demonstrate that not all social factors impact all individuals and/or population groups in the same manner.

Overall, the odds ratios reflect current literature in the field. Also, the odds ratios complement the previous findings in this study, the prevalence data, regarding the associations between individual measures of social capital and the risk of obesity in US children.

Table 11. Adjusted odds of obesity among US children, aged 10-11 years by selected demographic/SES characteristics. 2003 National Survey of Children's Health (N=10,018)

Characteristic	(Crude) Age & Sex Adjusted Odds	Age, Sex & Race/Ethnicity Adjusted Odds	(Fully Adjusted) Age, Sex, Race/Ethnicity & SES[b] Adjusted Odds
	OR (95% CI)*	OR (95% CI)*	OR (95% CI)*
Age [a]			
10 years old	1.299 (1.178-1.433)	1.305 (1.181-1.442)	1.305 (1.175-1.450)
11 years old (Reference)	1.00	1.00	1.00
Sex [a]			
Male	1.492 (1.352-1.646)	1.543 (1.395-1.706)	1.568 (1.410-1.743)
Female (Reference)	1.00	1.00	1.00
Race/Ethnicity			
Non-Hispanic white (Reference)	1.00	1.00	1.00
Non-Hispanic black	2.680 (2.322-3.092)	2.680 (2.322-3.092)	2.283 (1.985-2.662)
Non-Hispanic multiracial/other	1.188 (.978-1.442)	1.188 (.978-1.442)	1.135 (.926-1.392)
Hispanic	2.018 (1.735-2.348)	2.018 (1.735-2.348)	1.681 (1.426-1.983)
Parent Education			
<12	2.446 (1.935-3.092)	1.870 (1.460-2.394)	1.455 (1.109-1.908)
12	1.949 (1.742-2.181)	1.832 (1.633-2.056)	1.563 (1.376-1.774)
13+ (Reference)	1.00	1.00	1.00
Household Income			
<200% Poverty Level	2.483 (2.174-2.836)	2.113 (1.842-2.424)	1.784 (1.541-2.066)
200-399% Poverty Level	1.392 (1.214-1.594)	1.340 (1.168-2.056)	1.260 (1.097-1.448)
≥ 400% Poverty Level (Reference)	1.00	1.00	1.00

* 95% CI is the 95% confidence interval for the calculated odds ratio.

[a] Age adjusted for sex and sex adjusted for age.

[b] SES measures are household income and parent education.

Table 12. Adjusted odds of obesity among US children, aged 10-11 years by selected social capital characteristics. 2003 National Survey of Children's Health (N=10,018)

Characteristic	(Crude) Age & Sex Adjusted Odds	Age, Sex & Race/Ethnicity Adjusted Odds	(Fully Adjusted) Age, Sex, Race/Ethnicity & SES[a] Adjusted Odds
	OR (95% CI)*	OR (95% CI)	OR (95% CI)
Type of School			
Public	1.659 (1.413-1.949)	1.606 (1.363-1.803)	1.379 (1.159-1.641)
Private	1.00	1.00	1.00
Gets along well with peers[b]			
Never/ Sometimes	1.483 (1.271-1.730)	1.401 (1.201-1.649)	1.281 (1.083-1.514)
Usually	.896 (.803-1.00)	.981 (.8796-1.097)	1.032 (.917-1.161)
Always	1.00	1.00	1.00
Participates in outside activities			
Yes	1.00	1.00	1.00
No	1.824 (1.614-2.060)	1.612 (1.421-1.829)	1.371 (1.197-1.571)
# of times child has moved			
Never	1.064 (.917-1.234)	1.125 (.967-1.308)	1.249 (1.065-1.464)
One	.826 (.709 - .962)	.865 (.741-1.010)	.949 (.806-1.117)
Two	1.165 (.994-1.367)	1.118 (.950-1.315)	1.214 (1.024-1.439)
Three	1.188 (1.010-1.397)	1.131 (.959-1.333)	1.143 (.963-1.358)
Four or more times	1.00	1.00	1.00
Family Size			
1 child	1.00	1.00	1.00
2 children	.683 (.610-.765)	.711 (.633-.798)	.686 (.607-.775)
3 children	.716 (.621-.826)	.715 (.618-.827)	.656 (.562-.765)
4 or more children	.739 (.606-.900)	.692 (.565-.847)	.552 (.444-.684)
Parents know friends			
All friends	1.00	1.00	1.00
Most friends	1.119 (1.004-1.246)	1.083 (.971-1.209)	1.069 (.953-1.200)
Some/No friends	2.116 (1.877-2.499)	1.839 (1.584-2.134)	(1.659 (1.417-1.942)
Family Structure 2 parent bio/adopt	1.00 (R)	1.00 (R)	1.00 (R)
2 parent stepfamily	1.377 (1.179-1.608)	1.319 (1.127-1.543)	1.207 (1.024-1.423)
Single/other	1.718 (1.539-1.919)	1.471 (1.310-1.652)	1.231 (1.084-1.398)
Eat meals together (days per week)			
0-3 days	1.00	1.00	1.00
4-6 days	.773 (.674-.886)	.842 (.732-.986)	.864 (.747-.999)
Everyday	1.034 (.912-1.173)	1.052 (.925-1.196)	.979 (.856-1.121)
MSA Type			
Rural (non MSA)	1.018 (1.001-1.227)	1.278 (1.149-1.421)	1.106 (.987-1.239)
Urban/suburban (MSA)	1.00	1.00	1.00
Neighbors help each other			
Definitely agree	1.00	1.00	1.00
Somewhat agree	1.286 (1.154-1.434)	1.195 (1.070-1.334)	1.112 (.990-1.249)
Somewhat disagree	1.687 (1.400-2.033)	1.445 (1.194-1.749)	1.197 (.977-1.467)
Definitely disagree	2.229 (1.814-2.740)	1.743 (1.407-2.154)	1.416 (1.127-1.778)
Social Capital Index			
(1)Lowest level	1.696 (1.488-1.933)	1.428 (1.247-1.636)	1.243 (1.077-1.436)
(2) Average	1.361 (1.209-1.531)	1.273 (1.129-1.435)	1.213 (1.070-1.375)
(3) Highest level	1.00	1.00	1.00
Child is safe in community			
Never or Sometimes	1.890 (1.649-2.165)	1.492 (1.293-1.721)	1.235 (1.059-1.441)
Always or Usually	1.00	1.00	1.00

* 95% CI is the 95% confidence interval for the calculated odds ratio.
[a] SES measures are household income and parent education.

Mean BMI in the Study Population

The next comparison of the various groups in the study population is based on BMI. BMI is one of the dependent variables utilized in the multivariate analyses and hypotheses testing. Therefore, a review of BMI in the study population was warranted.

BMI (Body Mass Index) is a calculation whereby a person's weight is expressed as a function of height (BMI = weight (pounds) divided by height^2 (inches) multiplied by 703 (Bellizzi & Dietz, 1999). In the population, aged 2-20 years, growth charts for BMI are specified for both age and sex (CDC, 2000). They differ for sex because the amount of body fat differs between boys and girls. They differ for age because the amount of body fat in children changes over time. Body fat in children should decrease beginning at around age 2, reach its low point at 5 years of age and then begin to rise again (Cole, 2004). This growth pattern in children is called the adiposity rebound (Cole, 2004). The CDC growth charts for the population, aged 2 to 20 years, for both boys/males and girls/females are provided in the appendix.

In a study population of boys and girls of different ages, comparison of BMI is most meaningful when the group is subdivided into age/sex cohorts. For the dataset the subsets are 10 year old girls, 10 year old boys, 11 year old girls and 11 year old boys for the reasons just stated. Table 13 provides a comparison of BMI means for these four groups based on demographic/SES measures[26].

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[26] The relationships between BMI and the social capital variables will be addressed in the discussion of the linear regression modeling of the dependent variable, BMI and in the subsequent discussion on the differences between age and gender.

The median of each of the age/sex cohorts is lower than its corresponding mean. This suggests that there is a positive skew to the data with larger BMI measures pushing up the mean. An examination of the skewness of the means for each population group reveals that all skewness statistics < 1.0. The overall BMI mean for each group showed that while there is some variation, it was not significant between all groups with a common characteristic of age or gender.

An analysis of the mean BMI's for each age/sex group, using an ANOVA procedure, confirmed that for race/ethnicity, the difference in means was significant. This was also true for the mean BMI's based on parent education and household income for each of the age/sex groups. All F statistics and p-values for this analysis are reported in Appendix C.

The review of BMI means adds to the study in considering differences between groups. The review confirms that BMI is a practical measure for examination of differences in *weight for height* among the children in various subgroups in the dataset. BMI means differ based on the same type of demographic/SES covariates used for prevalence and odds ratio analyses.

Table 13. Mean and Median BMI[a] scores for US children, aged 10-11 years by selected demographic/SES characteristics. The 2003 National Survey of Children's Health. (N=10,018)

Characteristic	10 y/o Girls Mean (95% CI) & Median BMI (N=2386)	10 y/o Boys Mean & Median BMI (N=2550)	11 y/o Girls Mean & Median BMI (N=2513)	11 y/o Boys Mean & Median BMI (N=2562)
Study Population Mean	19.9 (19.7-20.1)	20.1 (19.9-20.3)	19.9 (19.8-20.1)	20.6 (20.4-20.7)
Study Population Median	19.1	19.3	19.3	19.5
Race/Ethnicity Mean				
Non Hispanic White	19.5 (19.3-19.7)	19.7 (19.4-19.9)	19.5 (19.3-19.7)	20.1 (19.9-20.3)
Non Hispanic Black	22.1 (21.4-22.9)	22.0 (21.3-22.3)	21.7 (21.0-22.0)	22.4 (21.7-23.1)
Non Hispanic Other	19.7 (18.9-20.5)	19.7 (19.0-20.3)	20.4 (19.0-20.3)	21.0 (20.3-21.7)
Hispanic	20.6 (20.0-21.3)	21.5 (20.8-22.1)	20.9 (20.3-21.4)	22.1 (21.4-22.8)
Education Level Mean				
<12	22.5 (21.0-23.4)	22.2 (20.9-23.4)	22.3 (20.9-23.6)	22.9 (21.7-24.2)
12	21.3 (20.7-21.7)	21.3 (20.8-21.7)	20.9 (20.5-21.3)	21.6 (21.1-22.0)
13+	19.4 (19.2-19.6)	19.7 (19.4-19.9)	19.6 (19.4-19.7)	20.2 (20.0-20.4)
Household Income Mean				
<200% Poverty Level	21.2 (20.7-21.6)	21.1 (20.7-21.4)	21.0 (20.6-21.3)	21.6 (21.2-22.0)
200-399% Poverty Level	19.5 (19.1-19.8)	19.8 (19.5-20.1)	19.8 (19.5-20.1)	20.4 (20.1-20.7)
≥ 400% Poverty Level	19.1 (18.8-19.4)	19.3 (19.0-19.6)	19.1 (18.9-19.4)	19.7 (19.4-20.0)

[a] BMI = weight (pounds) divided by height² (inches) multiplied by 703

In summary, the demographic/SES covariates associated with the prevalence of obesity and the odds of obesity are the same ones that are associated with a larger mean BMI's for various population groups. Sex, race/ethnicity, parent education and household income have significant associations with obesity and BMI in the dataset. Also, the various measures of personal social capital, family social capital and neighborhood social capital selected for the study from the National Survey of Children's Health have significant relationships with obesity in the study population. Chapter 5 addresses hypothesis testing with multivariate analysis.

CHAPTER 5

Results - Hypothesis Testing

Review & Outline of the Chapter

Chapter 5 section reports on the hypothesis testing for the dissertation research. The aim of this dissertation study was to quantitatively test for associations between obesity and BMI in a nationally representative dataset of American children and three forms of social capital; personal social capital, family social capital and neighborhood social capital. Social capital, in the study of health, was defined as resources accrued and/or accessed from social relationships and social bonds. There were four hypotheses examined.

Hypothesis 1 - There will be an inverse relationship between higher measures of a child's personal social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Model 1).

Hypothesis 2 - There will be an inverse relationship between higher measures of a child's family social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Model 2).

Hypothesis 3 - There will be an inverse relationship between higher measures of a child's neighborhood social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Model 3).

Hypothesis 4 – There will be an inverse relationship between higher measures of a child's personal social capital, family social capital and neighborhood social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Full Model).

Each hypothesis was tested using both the dichotomous modeling of childhood weight, Obese (or not Obese) and the linear modeling of BMI where weight is a function of height. Regression modeling of the two dependent variables, Obese and BMI, was conducted to test the hypotheses using PASW 17.0. Binary logistic regression was used to model the dichotomous dependent variable Obese. Linear regression, using standard least squares regression (OLS) was employed for fitting BMI. Both were conducted using a forced entry method that puts all covariates into the regression model simultaneously. This method was chosen because the literature review, theory, data screening and descriptive analyses provide sufficient evidence that all the predictors were meaningful (A. Field, 2005, p. 160). A summary of the logistic and linear models is provided in Appendix E.

Basic Model - Demographic/SES

The demographic variables associated with childhood obesity are well-known and documented. They include sex, race/ethnicity, family income and parental education. While age has been shown to be associated with childhood weight status it was not expected to be predictive in the dataset. Age differences in obesity rates tend to be identified between broadly defined groups such as early childhood (children 2-5 years old) versus teenagers (children 15-17 years old). This dataset was limited to only 10 and 11 year olds and the initial selection of the group carried with it the assumption that 10 and 11 year olds were relatively equivalent in weight status. However, and unexpectedly, age was a consistent and significant predictor variable. Therefore, it was included as a control variable. These models were built first to provide a base upon which to test the various hypotheses regarding the different types of social capital.

Likelihood of Obesity & Demographics/SES Predictors. Binary logistic regression was conducted with Obese as the dependent variable. Age, sex, race/ethnicity, parent education and household income are the independent variables. Age[27], sex and race/ethnicity were entered as categorical variables. Parent education and household income were given as linear variables. The regression confirmed the expected significant relationships associated with demographics/SES and the likelihood of childhood obesity. The summary of the logistic regression is shown in Table 14.

The model chi square statistic for this group of variables is significant for predicting the likelihood of obesity and the calculated pseudo R^2 for this model is .049. All covariates have significant p-values, except for non-Hispanic multiracial/other. This is not surprising given that this was essentially a catch-all group for particular small subsets of the study population where specific identification could have compromised anonymity of the participants. That is, the category contained a small number of children of various racial/ethnic groups whose identity had to be protected because of privacy concerns. Also, included in the non-Hispanic multiracial/other were groups associated with increased obesity rates in children such as Native Americans *and* groups associated with below average obesity such as Asian children. Furthermore, some children included

[27] Age was modeled as a categorical variable as there were only two possible values for this variable, 10 or 11 years.

in this group are multiracial and may have one or both parents belonging to a racial/ethnic group at greater and/or lesser odds for obesity.

The group at greatest risk for being obese was non-Hispanic black children with an odds ratio of 2.289 compared to the reference group, non-Hispanic white children when all other demographic/SES variables are held constant. Hispanic children had a significant odds ratio of 1.636 compared to non-Hispanic whites. Also, boys had a greater risk than girls (1.56) and 10 year olds had higher odds than 11 year olds (1.30) for the likelihood of being obese.

Parent education and household income were very similar in the produced odds ratios and B-values. This is not surprising given that these two variables are often used singly as proxies for SES. Overall, the demographic and SES variables functioned as expected.

Table 14. Basic Model **-** Summary of demographic/SES variables with dependent variable Obese[a]

Variable	B	OR	CI lower	CI upper	p-value
Age (Ref =11 year olds)	.263	1.301	1.172	1.445	.000
Sex (Ref = Female)	.445	1.561	1.404	1.735	.000
Race/Ethnic (Ref group NH White)	R	1.00	R	R	.000
Non-Hispanic Black	.825	2.283	1.958	2.662	.000
Non-Hispanic Multiracial/Other	.127	1.135	.926	1.392	.222
Hispanic	.519	1.681	1.426	1.983	.000
Parent Education (↑)[b]	-.328	.720	.652	.797	.000
Household Income (↑)[c]	-.301	.740	.688	.797	.000
Constant	-.456	.634			.001

N=9163; pseudo R^2=.049[28]; Cox & Snell R^2=.048; Nagelkerke R^2=.076; model chi-square=453.122, 7_{df}, .000; -2LL=8787.238; Hosmer & Lemeshow test=.764; Obese correctly identified 2.7%, Not obese correctly identified 99.2%.
[a] Obese defined as a BMI ≥ the 95th percentile for age and sex based on 2000 CDC BMI growth charts. http://www.cdc.gov/growthcharts
[b] Parent education coded as 1<12 years, 2=12 years or 3=13+
[c] Household income coded as 1<200% poverty level, 2=200 to 399% of poverty level, 3 ≥ 400% poverty level.

[28] Pseudo R^2 calculated as model chi-square/initial -2LL (Field, p. 239)

Body Mass Index (BMI) & Demographics/SES Predictors. Linear regression was conducted with BMI as the dependent variable and age, sex, race/ethnicity, parent education and household income as the independent variables. Age and sex were modeled as dichotomous categorical variables. Race/ethnicity used standard dummy variable coding. There were three dummy variables for race/ethnicity; non-Hispanic white vs. non-Hispanic black, non-Hispanic white vs. non-Hispanic multiracial/other and non-Hispanic white vs. Hispanic. Parent education and household income were defined as linear variables. The regression confirmed the expected significant relationships associated with demographics/SES and BMI. The summary of the linear regression is shown in Table 15.

Linear regression for BMI fitted a model with an adjusted R^2 of .057, meaning that these variables explain approximately 6% of the variation in BMI scores for the study population of 10 and 11 year olds. The model itself is significant for predicting BMI and all the independent variables included made significant contributions to the model. This model produced very similar results to the logistic modeling of Obese except for the significance of non-Hispanic multiracial/other. This category for race/ethnicity was *not* significant for predicting the likelihood of obesity in the logistic regression model, although it was significant in the OLS model for BMI, albeit with a lower p-value (.038) than the other predictors. The largest beta-value was for the dummy variable non-Hispanic white versus non-Hispanic black (.130) with all other predictors held constant. Parent education level and income had comparable values (-.102, -.094) and both were stronger predictors than age, sex, non-Hispanic white vs. non-Hispanic multiracial/other and non-Hispanic white vs. Hispanic. Sex was significant and this is consistent with the literature which almost always finds BMI to be higher in boys than girls for children of this age.

Table 15. Basic Model - Summary of demographic/SES variables with dependent variable BMI[a]

Variable	B	Beta	CI lower (B)	CI upper (B)	p-value
Constant	20.156		18.079	22.133	.000
Age in years	.296	.032	.111	.482	.002
Sex (Female=0, Male=1)	.417	.045	.232	.603	.000
Parent Education (↑)[b]	-.935	-.102	-1.133	-.738	.000
Household Income (↑)[c]	-.551	-.094	-.679	-.423	.000
NH[d] White vs. NH Black	1.984	.130	1.672	2.297	.000
NH[d] White vs. NH Multiracial/Other	.379	.021	.020	.737	.038
NH[d] White vs. Hispanic	1.073	.069	.751	1.395	.000

N=9156; R^2=.058; Adjusted R^2=.057; ANOVA sig. =.000; F change sig. = .000 Durbin-Watson=1.987; all VIF statistics fall between 1.001 and 1.194[29].

[a] BMI = weight (pounds) divided by height² (inches) multiplied by 703.

[b] Parent education coded as 1<12 years, 2=12 years or 3=13+

[c] Household income coded as 1<200% of poverty level, 2=200 to 399% of poverty level, 3 ≥ 400% of poverty level.

[d] NH = non-Hispanic

Summary of Demographics/SES Predictors. In both models, the independent variable with the greatest predictive power is non-Hispanic black when all other variables are held constant. This finding is consistent with previous research in childhood obesity. The literature suggests that non-Hispanic blacks of all ages in the US continually fare *worse* in all measures of health risk, including obesity, even after adjustments for education and income are made. This research adds to that evidence.

Education and income (relative to federal poverty levels) are similar in both regressions, -.102 and -.094 (respectively) beta-values in the linear BMI model and OR's of .720 and .740 (respectively) in the Obese model. These two variables are strong predictors in many different measures of health status including childhood obesity.

[29] In the linear regression output from SPSS 17.0 an assumption of no multicollinearity can be made when Variance Inflation Factors (VIF) statistics from the Coefficients table are below 10.

While some studies use either education *or* income to characterize SES, testing for multicollinearity between the variables in this dataset was negative and the decision was made to include both measures. Furthermore, in the analysis of health there is an argument for using both income and education because neither one is strong enough to represent the totality of SES. Education and income tend to characterize different social processes especially in the consideration of children and their families (Wen, 2008). Age and sex were similar in magnitude to each other in both regression models.

Age and sex were stronger predictors of the likelihood of being obese, whereas education and income were stronger predictors in estimating BMI. These differences are most likely the result of the form of the dependent variable. The dependent variable, Obese, is simply identifying the presence of a condition and therefore, underweight, normal weight and overweight children are all classified as non obese[30]. BMI is more comprehensive and linear regression models can more fully capture the variables associated with all levels of weight status, regardless of whether the child is underweight, normal weight, overweight or obese. For example, parent education and income can predict family food insecurity and family food insecurity has been associated with underweight *and* overweight for children (K. S. Martin & Farris, 2007). These distinctions will probably not be captured in a binary logistic regression and could become obvious in a linear model. The more comprehensive nature of BMI may also explain why non-Hispanic multiracial/other was significant for the regression model with

[30] “Overweight” was categorized as Non Obese for the purposes of the study because the research suggests that negative health, social and other outcomes are most clearly associated with Obese and associations with “Overweight” are generally weak, especially in children.

BMI (linear regression) as the dependent variable but not significant in the model with Obese (logistic regression) as the dependent variable.

On the whole, the impact of demographics explains approximately 6% of the variation in both the likelihood of being obese and BMI. The expected demographic variables are all significantly related. While some of the differences in their contributions to the models vary, the base from which to build and test the various forms of social capital are essentially equivalent in their ability to predict obesity and/or BMI in explaining overall demographic/SES influence measured by age, sex, parental education, income level (relative to poverty) and race/ethnicity.

Personal Social Capital

Hypothesis 1 - There will be an inverse relationship between higher measures of a child's personal social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income.

The hypothesis was true for three of the four variables utilized to measure personal social capital. Children who attended private school (versus public), those with higher sociability as measured by getting along with peers and children who were involved in activities outside of school had a lower likelihood of obesity and lower BMI. The fourth independent variable in this analysis, the number of times a child has moved was also significant, but in the opposite direction hypothesized; that is the greater number of times a child had moved, the lower their likelihood of obesity and lower BMI. The results in this section were obtained by adjusting for demographic/SES covariates established in the basic first model at the level measured in the study population.

Likelihood of Obesity & Personal Social Capital (Model 1). Binary logistic regression established the hypothesized relationship between the likelihood of obesity and higher levels of personal social capital for three of the four independent variables fit to the model. Binary logistic regression was conducted with Obese as a dichotomous categorical dependent variable. The demographic/SES variables were entered into the model in the first block and the measures of personal social capital were entered into the model in the second block. They were entered using the two step approach to test the significance of the unique contribution of the personal social capital variables to predicting the likelihood of obesity.

The individual measures of personal social capital were type of school (public or private), participation in activities outside of school (yes or no), parent's appraisal of how often the child gets along well with peers (never, sometimes, usually or always) and the number of times the child has moved. School type and participation in outside activities were modeled as categorical variables. Getting along with peers and the number of times moved were given as linear variables. The summary of the logistic regression is shown in Table 16. Unadjusted odds ratio values for the variables in the regression are provided in the first column for comparison.

The model chi square statistic for personal social capital adjusted for demographic/SES confounders is significant for predicting the likelihood of obesity. The calculated pseudo R^2 for this model is .057 compared to .049 for the first basic model. In addition to the overall model, the group of personal social capital variables was significant as a step in the regression. Furthermore, the block of personal social capital variables were significant by themselves, without demographic/SES covariates, for predicting the likelihood of obesity in the study population.

Three of the four of the variables associated with increased likelihood of obesity were public school (versus private); a child's decreasing ability to get along with peers and lack of involvement with activities outside of school. The largest odds ratio after controlling for demographics/SES was attending a public school, increasing a child's risk of obesity by 139%.

The fourth variable measured, frequency of moving, was also significantly related to the likelihood of obesity, but in the opposite direction hypothesized. That is, for every time a child moved, their likelihood of being obese decreased by 3.5% adjusted for demographics/SES and holding all other variables constant. There are certain benefits for children in moving such as the possibility of a better neighborhood, better schools, and the move being associated with a parental job change with increasing household income, etc. It may be that these benefits outweigh any loss of social capital associated with the social ties that are broken when an individual/family moves to a new residence. However, the database does not provide reasons for the moving, so the aforementioned reasons are speculative.

Table 16. Model 2 - Summary of independent variables of personal social capital with dependent variable Obese adjusting for demographic/SES influence

Variable	Unadjusted OR*	B**	OR	CI lower	CI upper	p-value
Age (Ref =11 year olds)	1.301	.262	1.300	1.169	1.444	.000
Sex (Ref = Female)	1.561	.432	1.539	1.383	1.712	.000
Race/Ethnic (Ref NH White)	1.00	R	1.00	R	R	.000
Non-Hispanic Black	2.283	.792	2.208	1.891	2.579	.000
Non-Hispanic Multi/Other	1.135 [c]	.102	1.107	.902	1.360	.330
Hispanic	1.681	.477	1.612	1.364	1.904	.000
Parent Education (↑)[a]	.720	-.285	.752	.679	.833	.000
Household Income (↑) [b]	.740	-.272	.762	.706	.822	.000
Type of School (Ref =Private)	1.587	.329	1.389	1.166	1.655	.000
Gets along well with peers (↑)	.882	-.104	.900	.835	.970	.006
Participates in activities outside of school (Ref =yes)	1.763	.318	1.374	1.198	1.575	.000
# of times child has moved (↑)	.983 [d]	-.035	.966	.942	.990	.007
Constant		-.196	.595			.021

N=9114; pseudo R^2=.057[31]; Cox & Snell R^2=.053; Nagelkerke R^2=.083; Step and Block Chi-squares= 47.863, 4df, .000; Model Chi-square=494.358, 11_{df}, .000; -2LL=8679.959; Hosmer & Lemeshow test= .287; Obese correctly identified 2.8%, Not obese correctly identified 99.1%.

↑ Indicates that measure is increasing for that variable.

*Odds ratios for the demographic/SES variables are from the basic model and are "unadjusted" for personal social capital. The odds ratios for the measures of personal social capital are those calculated with NO adjustment for the demographic/SES covariates. P-values for all variables are < .05 except where noted.

**Values for dichotomous variables in regression equation; Age 11=0, 10=1; Sex Female=0, Male=1; School Private=0, Public=1; Activities Yes=0, No=1.

[a] Education coded as 1<12 years, 2=12 years or 3=13+

[b] Household income coded as 1<200% of poverty level, 2=200 to 399% of poverty level, 3 ≥ 400% of poverty level.

[c] Non-Hispanic Multiracial/Other had a p-value of .222 in Control Model.

[d] The number of times a child has moved had a p-value of .140 when not adjusted for demographic/SES covariates.

Body Mass Index (BMI) & Personal Social Capital (Model 1). Linear regression verified the hypothesized relationship between higher levels of personal social capital with lower BMI. This was evident for three of the four independent variables fit to the model. Linear regression was conducted with BMI as the dependent variable. The demographic/SES variables were entered into the model in the first block and the measures of personal social capital were entered into the model in the second block.

[31] Pseudo R^2 calculated as Model Chi-square/Initial -2LL (Field, p. 239)

They were entered using the two step approach to provide an assessment of the unique contribution of the group of personal social capital variables to predicting BMI.

The individual measures of personal social capital were type of school (public or private), participation in activities outside of school such as clubs or sports (yes or no), parent's appraisal of how often the child gets along well with peers (never, sometimes, usually or always) and the number of times the child has moved. School type and participation in outside activities were modeled as categorical variables. Child getting along with peers and the number of times moved were given as linear variables. The summary of the linear regression is shown in Table 17. Unadjusted beta-values are shown in the first column for comparison.

The linear model with independent variables of personal social capital, controlling for demographic/SES confounders, is significant for predicting the dependent variable BMI. The adjusted R^2 for demographic/SES was .057 and the addition of four personal social capital variables increased it to .063. The increase in the adjusted R^2 of .006 was significant. All four individual measures of personal social capital were significantly related to BMI. Attending private school, getting along well with peers and participating in activities outside of school reduced BMI. An increased in the number of times moving also reduced BMI score, but this is the opposite of the hypothesized association. This is consistent with the results from the logistic regression modeling of Obesity as the binary dichotomous dependent variable.

Participating in activities outside of school had the largest beta-value of -.053. All outside activities were counted including sports, clubs, civic groups, religious organizations, etc. The comparative size of the beta-value may be due to two influences. First, sport activities generally involve at least some type of physical activity and hours of physical activity have repeatedly been found to be associated with lower BMI in children (Anderson, 2008). Second, regardless of whether the child is involved with a club, a sport or both, the involvement could likely decrease their screen time (watching television and playing video games). Screen time was found to be associated with low active play and obesity in a US national sample of 4-11 year olds in the 2001-2004 National Health and Nutritional Examination Survey (Anderson, 2008).

Attending private school and getting along well with other children reduced BMI and had similar beta-values (-.034, -.037). The last independent variable, number of times moving, reduced BMI. As with the logistic modeling of Obese, this variable was significant, but in the opposite direction hypothesized.

Table 17. Model 2 - Summary of independent variables for personal social capital with dependent variable BMI* adjusting for demographic/SES influence

Variable	Unadjusted Beta**	Beta***	B	CI lower (B)	CI upper (B)	p-value
Constant			20.001	19.165	23.330	.000
Age in years	.032	.032	.301	.116	.486	.001
Sex (Female=0, Male=1)	.045	.041	.380	.194	.565	.000
Parental Education (↑)[a]	-.102	-.091	-.834	-1.034	-.634	.000
Household Income (↑)[a]	-.094	-.084	-.494	-.625	-.362	.000
NH White vs. NH Black	.130	.126	1.929	1.615	2.242	.000
NH White vs. NH Other	.021	.020	.361	.002	.721	.049
NH White vs. Hispanic	.069	.068	1.060	.737	1.383	.000
School Type (Public=0, Private=1)	-.061	-.034	-.462	-.736	-.187	.001
Gets along well with peers (↑)[a]	-.044	-.037	-.253	-.391	-.115	.000
Activities outside of school (No =0, Yes=1)	-.102	-.053	-.338	-.473	-.204	.000
# of times child has moved (↑)[b]	-.007	-.029	-.093	-.158	-.028	.005

N=9132; R^2=.064; Adjusted R^2=.063; ANOVA sig. =.000; F change sig. = .000 Durbin-Watson=1.986; all VIF statistics fall between 1.002 and 1.265[32].
*BMI=weight (pounds) divided by height² (inches) multiplied by 703.
**Unadjusted beta for the demographic/SES variables are from the basic model and beta-values for the measures of personal social capital are those calculated with NO adjustment for the demographic/SES covariates. P-values for all variables are less than .05 except where noted.
***Beta is the complete model personal social capital and sociodemographics.
[a] ↑ represents that the measure is increasing for that variable; parental education from low (<12 years) to higher (+13), household income from low (<200% of the federal poverty level) to highest (≥400% of the federal poverty level), gets along well with peers from lowest (never=1) to highest (always=4), moving coded numerically from 0-12 times.
[b] The number of times a child has moved had a p-value of .483 when not adjusted for demographic/SES covariates.

Summary – Personal Social Capital. The three personal social capital variables associated with a greater likelihood of obesity and higher BMI, after controlling for demographics/SES, were public school attendance, not participating in clubs/sports outside of school and not getting along well with peers. These three variables were relatively similar in magnitude of their effect. All were significant in both forms of the dependent variable, Obese and BMI.

Attending a private school, after controlling for demographics/SES appears to have a constructive effect impact on children’s weight status. Malley, et al, concluded

[32] In the linear regression output from SPSS 17.0 an assumption of no multicollinearity can be made when Variance Inflation Factors (VIF) statistics from the Coefficients table are below 10.

that an aggregate SES measure of a school was associated with BMI after controlling for individual-level SES and race/ethnicity (Malley, etc. 2007). Private schools can provide a conduit for children to some of the benefits of social capital associated with SES, over and above their families. Private schools may be particularly beneficial for less advantaged children in high risk groups (for obesity) because they have greater SES diversity in their social connections. This “SES diversity” may give children access to a broader range of influential people, children and adults, than local public schools. Also, this may give children exposure to different lifestyle behaviors, peer pressure for healthier behaviors, different cultural preferences/standards, etc. ultimately resulting in less obesity. Alternatively, children in high risk groups attending neighborhood public schools, with classmates/families almost exclusively from the same high risk groups, may be more likely learn and adopt high risk behaviors for obesity.

There may other pathways involved in the school type association. Is there some particular quality of parents of children in high risk groups not being measured? How do some parents overcome the various challenges to enrolling children in a private school? Are these same qualities associated with children’s weight status? Private schools have more flexibility in curriculum and may be able to offer more physical education hours and recess time than public schools. Children at risk of obesity based on their race/ethnicity may benefit from attending private schools that are more racially diverse than their local public school. For example, Bernell et al, found that non-Hispanic black and Hispanic adolescent girls who attended schools that were more than 50% non-

Hispanic white had BMI's that were lower than their race/ethnicity and SES counterparts in predominately minority schools (Bernell, etc. 2009).

Not participating in activities outside of school (clubs and/or sports) was associated with a greater likelihood of obesity and larger BMI. It is easy to conceive that sports participation, lessons or team play, will reduce the risk of obesity because of an increase in physical activity. However, Lajunen et al, argue that categorizing leisure activity based simply on "energy expenditure" is too "simplistic" (Lajunen, et al 2009, p. 1098). She goes on to suggest even children with more sedentary activities are happier and not seeking pleasure from food or that some sedentary activities like playing a musical instrument are impossible to do and eat at the same time. Also, outside pursuits can connect children with other children and adults who role model healthy behaviors. Some of these influences may be similar to those described in the previous discussion on school type. Again, personal social capital is clearly improved for children who are provided with opportunities to be connected with people of all ages outside of their families, local schools and immediate neighborhoods. These positive influences may serve to reinforce behaviors modeled at home or provide alternatives to those in the child's home environment.

Getting along well with peers also was significantly associated with a reduced likelihood of obesity and lower BMI. Sociability is a characteristic of individuals with higher levels of personal social capital. Research with adults has shown that this greater degree of "getting along" allows individual's health to benefit from social relationships by providing access to information, knowledge and other beneficial resources. Children in this age group may be limited in personally accessing a full range of health resources without parental/adult assistance. However, it is reasonable to assume that they are able to benefit in some ways, especially when the resources are knowledge or behavior related. For example, a child might not be able to attend a local health fair (health resource) without participation of a parent or other adult but they could probably increase their physical activity (health knowledge and behavior) on their own. Additionally, as causation/direction can not be inferred from the statistical analysis, this variable may simply be corroborating previous research findings that overweight children are less well liked by their peers.

Lastly, moving was described by Coleman as detrimental to social capital because it breaks ties that must be remade every time a move occurs and social capital has been connected to weight. There may be multiple explanations for the association with lower BMI and lower likelihood of childhood obesity. First, moving may not impact the specific resources associated with social capital that are beneficial to weight. Second, when poor children move into more middle class and/or "better"/safer neighborhoods the benefits to health may outweigh the detriments to social capital. Third, the personal social capital of children may not suffer in the same way as adults because they (children) are provided with immediate social connections with peers and other adults in the school environment. Thus, while moving is theoretically sound for inclusion in a study of social capital and a health issue, the statistical analysis did not support the hypothesis in the study of children and obesity. Coleman's assertion may not be broadly applicable to a demographically diverse study population. Finally, it appears that the variable was simply modeled incorrectly or “backwards”; that is more moving is associated with a lower likelihood of obesity and a lower BMI not a higher likelihood of obesity and/or a higher BMI.

The findings from the logistic regression modeling of Obesity and the linear regression modeling of BMI produced similar results in predictive power and identified the same significant predictive variables. Overall, the hypothesis is accepted and in this group of 10,018 ten and eleven year old children, there is an inverse relationship between some measures of personal social capital and the likelihood of obesity and BMI.

Family Social Capital

Hypotheses 2 – There will be an inverse relationship between higher measures of a child’s family social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Model 2).

The hypothesis was true for two of the four variables utilized to measure family social capital. There was an association between the type of family structure (two parent adopted/biological family, two parent stepfamily, single parent/other) and both the likelihood of obesity and BMI. There was an inverse relationship between how many of the child’s friends their parents reported knowing with both the likelihood of obesity and a higher BMI. There was a direct and significant relationship between family size and the likelihood of obesity and BMI, the direct opposite of the relationship hypothesized. There was no relationship between the number of days per week the family ate a meal together and the likelihood of obesity or BMI.

The results in this section were obtained by including all the demographic variables so that measures of family social capital are adjusted for demographic/SES influence.

Likelihood of Obesity & Family Social Capital (Model 2). Binary logistic regression established the hypothesized relationship between the likelihood of obesity and higher levels of family social capital for three of the four independent variables fit to the model. Binary logistic regression was conducted with Obese as a dichotomous categorical dependent variable. The demographic/SES variables were entered into the model in the first block and the measures of family social capital were entered into the model in the second block. They were entered using the two step approach to test the significance of the unique contribution of the family social capital variables to predicting the likelihood of obesity.

The individual measures of family social capital were family size (total number of children under 18 in the household top coded at four), to what degree parents know their child's friends (no friends, some friends, most friends, all friends), family structure (two parent biological/adopted, two parent stepfamily or single parent/other) and number of days per week the entire family ate a meal together (0-7 days). Family structure was modeled as a categorical variable. Parents knowing friends, family size and eating meals were entered into the model as linear variables. The summary of the logistic regression is shown in Table 18. Unadjusted odds ratios for all variables in the regression are provided in the first column for comparison.

Family social capital was significantly related to a child's likelihood of obesity in the dataset. The calculated pseudo R^2 increased from .049 to .062 with the addition of measures of family social capital to the first (basic) model. The block was significant by itself and improved the model significantly.

The two variables significant for a higher likelihood of obesity were parents that report not really knowing their child's friends (no or only some friends) and family structure. Parents who report knowing all or most of their children's friends may be a proxy for family connectedness, especially for the study population. Ten and 11 year olds arrange and manage their own friendships and peer connections but parents have to facilitate them. Presumably these parent(s) have to be relatively engaged with their children to be familiar with most or all of their child's friends. There was a significant association between having a lower likelihood of obesity and parents who knew all or most of their children's friends. This likely represents at least one aspect of cohesion in a family.

The second significant variable, family structure was examined with three nominal types; two parent biological/adopted, two parent stepfamily and single mother/other. Living in a two parent biological/adoptive family was significant as the reference group (odds ratio = 1.0) and children in two parent stepfamilies had an odds ratio of 1.200 for being obese. Both of these family structures were significant after controlling for demographic/SES influences. This variable did not measure length of time a child had lived in a stepfamily. However, children in stepfamilies have usually had at least some amount of family disruption and transitions in household composition and/or living situation (Wen, 2008). Disruptions can reduce family social capital and increase stress. As noted earlier, stress is associated with childhood obesity and/or poor eating behaviors leading to obesity (Garasky et al, 2009). While single parent families were not significant in the logistic regression, the p-value was .063 with the bottom end of the 95% confidence interval very close to 1.0 (.993) with a range ending at 1.285.

The number of children in the family was significantly related to the likelihood of obesity but in the opposite direction hypothesized. Coleman suggested that children from smaller families have higher social capital because the children have more parental time and attention available to them. The hypothesis for this research extended Coleman's theory to posit that smaller families with theorized higher internal family social capital would be inversely related to the odds of being obese. However, there was not an inverse relationship between number of children and likelihood of obesity, but instead a direct relationship. Like the measure of moving, this variable is a reasonable assessment social capital, but appears to work differently for health risk versus Coleman's work regarding educational outcomes (Coleman, 1988).

Finally, the number of days per week that a family ate a meal together was not significantly related to the likelihood of obesity. This measure was selected to be a gauge of family connectedness and theorized that eating more meals together would be a healthy influence on a child's weight status. However, it was not statistically significant for the likelihood of obesity in the multivariate analysis.

Table 18. Model 2 - Summary of independent variables for family social capital with dependent variable Obese [a] adjusting for demographic/SES influence

Variable	Unadjusted OR*	B**	OR	CI lower	CI upper	p-value
Age (Ref =11 year olds)	1.301	.279	1.322	1.188	1.472	.000
Sex (Ref = Female)	1.561	.442	1.556	1.396	1.734	.000
Race/Ethnic (Ref NH White)	1.00	R	1.00	R	R	.000
Non-Hispanic Black	2.283	.725	2.064	1.751	2.433	.000
Non-Hispanic Multi/Other	1.135	.058	1.060	.861	1.305	.583
Hispanic	1.681	.463	1.589	1.344	1.878	.000
Parent Education (↑)[b]	.720	-.292	.747	.673	.829	.000
Household Income (↑)[c]	.740	-.338	.713	0659	.772	.000
Family Size (↑)	.877	-.220	.803	.754	.854	.000
Parents know friends (↓)	1.334	.202	1.224	1.136	1.318	.000
Family- 2 parent bio/adopt	1.00	R	1.00	R	R	.043
2 parent step	1.334	.182	1.200	1.017	1.416	.031
Single parent/other	1.583	.122	1.130	.993	1.285	.063
Eat meals together (↑)[d]	1.003	-.008	.992	.967	1.018	.559
Constant		.047	.673			.050

N=8963; pseudo R^2=.062[33]; Cox & Snell R^2 = .058; Nagelkerke R^2 = .091; Step and Block Chi-squares=90.831, 5_{df}, .000; Model Chi-square=533.678, 12_{df}, .000; -2LL=8452.992; Hosmer & Lemeshow test=.600; Obese correctly identified 3.8%, Not obese correctly identified 99.4%.

↑ Indicates that measure is increasing.

↓ Indicates that measure is decreasing.

*Odds ratios for demographic/SES variables are from the basic model and are "unadjusted" for family social capital. The odds ratios for measures of family social capital are those calculated with NO adjustment for the demographic/SES covariates. P-values for all variables are less than .05 except where noted.

**Values for dichotomous variables in regression equation; Age 11=0, 10=1; Sex Female=0, Male=1.

[a] Obese defined as a BMI ≥ the 95th percentile for age and sex based on 2000 CDC BMI growth charts. http://www.cdc.gov/growthcharts

[b] Parent education coded as 1<12 years, 2=12 years or 3=13+

[c] Household income coded as 1<200% of poverty level, 2=200 to 399% of poverty level, 3 ≥ 400% of poverty level.

[d] Eating meals together had a p-value of .802 when not adjusted for demographic/SES covariates.

Body Mass Index (BMI) and Family Social Capital (Model 2). Linear regression verified an association between higher levels of family social capital and lower BMI. Three of the four independent variables fit to the model as hypothesized. Linear regression was conducted with BMI as the dependent variable. The demographic/SES variables were entered into the model in the first block and the measures of family social capital were entered into the model in the second block. They were entered using the two

[33] Pseudo R^2 calculated as Model Chi-square/Initial -2LL (Field, p. 239)

step approach to provide an assessment of the unique contribution of the group of family social capital variables to predicting BMI.

The individual measures of family social capital were family size (total number of children under 18 in the household top coded at four), to what degree parents know their child's friends (no friends, some friends, most friends, all friends), family structure (two parent biological/adopted, two parent stepfamily or single parent/other) and number of days per week the entire family ate a meal together (0-7 days). Family structure was modeled as two dummy variables (two parent biological/adoptive family versus two parent stepfamily and two parent biological/adoptive family versus single parent/other). Parents knowing friends, family size and eating meals are linear variables. The summary of the linear regression is shown in Table 19. Unadjusted beta-values for all variables in the regression are provided in the first column for comparison.

Linear regression for the measures of family social capital produced a significant change in the adjusted R^2 from .056 (demographics/SES only) to .067 and the change was significant.

As with the dichotomous modeling of Obese, the two variables significant for a lower BMI score were parents reporting knowing the child's friends and family structure. The first significant variable, parents knowing friends, was measured on a four point ordinal scale. Every unit change moving down the scale (i.e., knowing fewer friends) resulted in an incremental increase in BMI of .370. Parents who know their children's friends may be more connected to them in ways that provide for them to influence behaviors which impact BMI levels. The variable may be also measuring communication and other positive parent/family-child relationship variables beyond connectedness. In addition to this aspect of family cohesion, reduced stress (for the child) may be associated with positive parent-child relationships.

Family structure was also significant for BMI. However, for BMI only single parent family was significant whereas only two parent stepfamily was significant in the logistic regression for the likelihood of obesity. It has been suggested that children have less social capital in single parent families simply because two adults have more social connections and resources for children to draw upon than one adult (Ravanera & Rajulton, 2009).

Family size was also significant but provided for reductions in BMI versus the theorized increase. Children from families with at least one or more siblings have more opportunity for physical activity (Classen & Hokayem, 2005). The fact that the relationship is linear suggests that the more siblings, the more opportunities for physical activity. Physical activity has repeatedly been shown to be associated with lower BMI.

The number of meals eaten together as an entire family in a week was not significant for explaining variation in BMI.

Table 19. Model 2 - Summary of independent variables for family social capital with dependent variable BMI* adjusting for demographic/SES influence

Variable	Unadjusted Beta**	Beta	B	CI lower (B)	CI upper (B)	p-value
Constant			20.822	18.725	22.919	.000
Age in years	.032	.026	.245	.058	.431	.010
Sex (Female=0, Male=1)	.045	.043	.404	.218	.590	.000
Parental Education Level (↑)	-.102	-.092	-.848	-1.050	-.647	.000
Income Level (↑)	-.094	-.102	-.602	-.739	-.466	.000
NH White vs. NH Black	.130	.115	1.804	1.474	2.133	.000
NH White vs. NH Other	.021	.015	.259	-.103	.620	.160
NH White vs. Hispanic	.069	.065	1.007	.683	1.331	.000
Family Size (↑)	-.053	-.082	-.425	-.533	-.318	.000
Parents know friends (↓)	.088	.056	.370	.235	.506	.000
2 parent bio/adopt vs. 2 parent step	.034	.015	.210	-.086	.506	.165
2 parent bio/adopt vs. single parent	.101	.026	.272	.038	.505	.023
Eat meals together (↑)[a]	.000	-.011	-.025	-.071	.020	.279

N=8957; R^2=.068; Adjusted R^2=.067; ANOVA sig. =.000; F change sig. = .000 Durbin-Watson=1.975; all VIF statistics fall between 1.002 and 1.340[34].
↑ Indicates that measure is increasing.
↓ Indicates that measure is decreasing.
*BMI=weight (pounds) divided by height² (inches) multiplied by 703.
**Beta for demographic/SES variables are from the basic model with no "adjustment" for family social capital. Betas for measures of family social capital were calculated with NO adjustment for the demographic/SES covariates. P-values for all variables are less than .05 except where noted.
[a] Eating meals together had a p-value of .802 when not adjusted for demographic/SES covariates.

Summary- Family Social Capital. Family social capital was the most powerful of the three types of social capital considered in the research based on the regression models. This is not surprising given the age group in the study population, 10 and 11 year olds. Personal social capital, in this age group, is a viable measure. However, the skills to accrue and access social capital will still be developing and are going to be somewhat dependent on family circumstances. Children will possess greater personal autonomy in developing social connections as they age into older adolescence and young adulthood. Also, neighborhood social capital will influence not only health measures like

[34] In the linear regression output from SPSS 17.0 an assumption of no multicollinearity can be made when Variance Inflation Factors (VIF) statistics from the Coefficients table are below 10.

obesity in children, but also family social capital as the acquisition and accession of social capital are, in part, community based.

The four variables used to measure family social capital can be conceived as pairs, estimating two distinct dimensions. The first pair can be thought of as those variables measuring family connectedness including (1) parents knowing child's friends and (2) weekly frequency of the entire family eating a meal together. The second pair can be thought of as those variables that measure family construct including (1) family structure and (2) family size. At least one variable from each of the two pairs described, connectedness and family construct, was significant in both of the regressions conducted and in a direction that supported the hypothesis. Parents knowing the child's friends (connectedness) and family structure (family construct) were significant for predicting a child's likelihood of obesity and BMI. This suggests that both of these components of family social capital (family connectedness and family construct) are relevant and consequential.

Cohesive family environments characterized by connectedness are less stressful. This may be crucial because stress can induce a physiological response that is related to obesity for children via higher levels of cortisol and/or metabolic disruptions (Garasky, 2009). Also, Coleman suggested that a family must have internal social capital for parents to be able to transfer the benefits of their human capital (education) to their children and parental education is consistently associated with lower rates of childhood obesity (Coleman, 1988). Family connectedness has been associated with healthy behaviors related specifically to weight status (Mellin et al, 2002). A lack of parental involvement with their children has also been linked to childhood overweight (Rhee, 2008).

Family structures were important in both models of childhood weight status after controlling for demographic/SES influence. Wen found that children fared better on health measures in any form of two parent families (biological/adoptive or stepfamilies) than children in single parent families (Wen, 2008). Although Wen's data suggested that children in two parent biological/adoptive families were better off than children from two parent stepfamilies and children from two parent step families were better off than children from single parent families.

In the Obese model, children in stepfamilies had a greater risk for obesity. The literature suggests that the creation of stepfamilies includes a period of crisis when the "new" family unit is formed and this is stressful for children in the family regardless of other positive outcomes such as a reduction in maternal stress, greater overall family income, etc. (Wen, 2008). In the BMI model children from single parents had significant increases in BMI over children from 2 parent biological/adoptive families. The ability of single parents to create and maintain high levels of family social capital may be compromised simply by lack of available time to do so. Also, Gable and Lutz note that children in single parent household more often make their own meals and these tend to be "prepared food items" which are implicitly less healthy and often more caloric (Gable & Lutz, 2000). Overall, this implies that children living with 2 parent biological/adoptive parents are most protected from becoming obese. Resources available in the form of parental time, attention, affection, etc., coupled with lower levels of parental/child stress and appear to be associated with lower weight status in a national sample of 10 and 11 year old children.

Family size functioned as a protective factor versus a risk factor and was the opposite predicted in the hypothesis. Much of the research on family social capital has been a continuation of Coleman's work in education and this research has repeatedly confirmed that children from smaller families perform better in school, both academically and socially. However, these and other school behavior related measures are not related directly to health, of which weight status is an important component. Classen and Hokayem concluded that bigger family size was related to less obesity using the National Longitudinal Survey of Youth from 1986 to 2002 (Classen & Hokayem, 2005). One study on family size found that children with siblings have more opportunities to engage in physical activity than only children (Duncan, Duncan, Strycker and Chaumeton, 2004). Therefore, it may be that the benefits from extra parental attention that might be used for activities that support a healthy weight do not outweigh the benefits of extra physical activity for children in this age group.

Finally, eating meals together is an oft cited factor in maintaining close-knit families with good communication, healthy eating, etc. Patrick and Nicklas report that diet quality can be directly related to mealtime structure and families eating together (Patrick and Nicklas, 2005). Research from the Early Childhood Longitudinal Study suggested that eating family meals is associated with lower obesity in children (Gable, Chang, Krull, 2007). However, eating meals together was not significant in either regression model for the study population. Family eating behaviors and styles have many varied and complex associations with weight in children. Thus, this measure of social capital may be too nuanced given the relatively simple model used in the study.

The findings from the logistic regression modeling of Obesity and the linear regression modeling of BMI produced similar results in predictive power and identified the same significant predictive variables. Overall, family social capital was the most powerful type of social capital after adjustments for demographics/SES influence in predicting the likelihood of obesity and BMI in a nationally representative dataset of 10,018 ten and eleven year olds.

Neighborhood Social Capital

Hypotheses 3 – There will be an inverse relationship between higher measures of a child's neighborhood social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Model 3).

This hypothesis was true for all three variables utilized to measure neighborhood social capital. There was an inverse relationship between a neighborhood social capital index scale and safety with the likelihood of obesity. There was an inverse relationship between the degree to which neighbors help each other out and safety with a higher BMI. Additionally, the metropolitan statistical area (MSA)[35] type of the child's neighborhood of residence was associated with the likelihood of obesity and BMI. Children in rural communities had a greater likelihood of obesity and higher BMI's than children residing

[35] MSA type refers to the US Census Bureau's definition of whether the child's household was in a MSA or in a non MSA. MSA refers to a geographic area with a core urban population of at least 50,000 people. Households in a non MSA are generally considered to be rural. US Census Bureau definitions at http://www.census.gov/population/www/metroareas/metroarea.html

in urban/suburban neighborhoods in the study population. This finding was expected and is consistent with previous research that finds rural children to have greater odds of obesity (Liu, Bennett, Harun, & Probst, 2008). The results in this section were obtained after adjusting for demographic/SES influence.

Likelihood of obesity and neighborhood social capital. Binary logistic regression established the hypothesized relationship between the likelihood of obesity and higher levels of neighborhood for all three of the independent variables fit to the model. Binary logistic regression was conducted with Obese as a dichotomous categorical dependent variable. The demographic/SES variables were entered into the model in the first block and measures of neighborhood social capital were entered into the model in the second block. They were entered using the two step approach to provide an assessment of the individual contribution of the group of neighborhood social capital variables to predicting the likelihood of obesity.

The individual measures of neighborhood social capital were MSA type (rural or urban/suburban), an index of social capital[36] (1=lowest level of social capital, 2=average level of social capital and 3=highest level of social capital) and the parent perception of whether the child is safe in the community (sometimes/never or usually/always). Age, sex, race/ethnicity, parent education and household income were included to adjust for demographic/SES influence on the likelihood of obesity. The summary of the logistic

[36] The social capital index used in the research includes perceptions of neighbors helping each other, watching out for each other's children, being able to "count" on the neighbors and the belief that if the respondent's child was "hurt or scared" a neighbor would help the child. This index has been used in previous research with this survey and is a key indicator for the National Survey of Children's Health.

regression is shown in Table 20. Unadjusted odds ratios for all variables in the regression are provided in the first column for comparison.

The pseudo R^2 was increased from .049 (demographics/SES only) to .054 with the addition of neighborhood measures. The block of neighborhood variables was both significant by itself and as an addition to the basic demographic/SES Control Model. After adjustments for demographic/SES influence, higher levels of neighborhood social capital was a significant contributor to a lower likelihood of obesity.

All three measures available for measuring neighborhood social capital were significant in the analysis. Higher social capital, neighborhood safety and living in an urban/suburban residence were associated with a lower likelihood of obesity.

A higher neighborhood social capital index reduced a child's odds of obesity. The social capital index was coded as "1" for lowest levels of social capital, "2" for average and "3" for highest levels. The B (beta) value in regression results was -.100. Therefore, the likelihood of obesity is reduced by 20% (2 x -.100) for children living in neighborhoods with "average" social capital and by 30% (3 x -.100) for children living in neighborhoods with the highest levels of social capital. The composite index for neighborhood social capital used in the study was the same index used in a previously published study that also utilized the 2003 National Survey of Children's Health data set. The composite index provides a "collective neighborhood effect" for influence on childhood obesity (Singh, 2008, p. 692). Collective neighborhood effect includes features of more opportunities for physical activity, more diversity of adult and peer role models and greater and easier linkage to the community at large.

Neighborhood safety was associated with the lower likelihood of obesity in the study and this is consistent with previous research. Some of the same mechanisms discussed regarding higher neighborhood social capital are likely applicable when thinking about safety. Perceptions of safety may allow children more access to outdoor, physical play. Also, feeling safe and feeling that your children are safe in one's neighborhood can reduce overall stress which has been linked to increased obesity.

Finally, children in rural communities had significantly increased the odds of obesity. Rural communities often experience greater rates of obesity for both adults and children, but this is largely attributable to higher rates of poverty and lower education levels. This variable proved to be significant even after controlling for those and other risk factors. Social capital connecting individuals, adults and children, to communities and neighborhoods is typically lower in rural communities (Lumeng, et al., 2006).

Table 20. Model 3 - Summary of independent variables for neighborhood social capital with dependent variable Obese [a] adjusting for demographic/SES influence

Variable	Unadjusted OR*	B**	OR	CI lower	CI upper	p-value
Age (Ref =11 year olds)	1.301	.276	1.318	1.184	1.467	.000
Sex (Ref = Female)	1.561	.450	1.568	1.407	1.748	.000
Race/Ethnic (Ref NH White)	1.00	R	1.00	R	R	.000
Non Hispanic Black	2.283	.806	2.239	1.901	2.637	.000
Non Hispanic Multi/Other	1.135	.069	1.072	.868	1.324	.520
Hispanic	1.681	.440	1.553	1.306	1.846	.000
Parent Education (↑)[b]	.720	-.306	.737	.664	.818	.000
Household Income (↑) [c]	.740	-.265	.767	.710	.829	.000
MSA Type (Ref=urban/suburban)	1.183	.135	1.145	1.019	1.286	.023
Social Capital Index (↑)[d]	.816	-.100	.904	.840	.973	.007
Safety (Ref=usually/always safe)	1.681	.184	1.202	1.021	1.416	.027
Constant		-.445	.641			.010

N=8851; pseudo R^2=.054[37]; Cox & Snell R^2 = .050; Nagelkerke R^2 = .079; Step and Block Chi-squares=19.088, 3_{df}, .000; Model Chi-square=455.697, 10_{df}, .000; -2LL=8415.015; Hosmer & Lemeshow test=8_{df}, .466; Obese correctly identified 2.9%, Not obese correctly identified 99.3%.

↑ Indicates that measure is increasing.

*Odds ratios for the demographic/SES variables are from the basic model and are “unadjusted” for neighborhood social capital. The odds ratios for the measures of neighborhood social capital are those calculated with NO adjustment for the demographic/SES covariates. P-values for all variables are less than .05 except where noted.

**Values for dichotomous variables in regression equation; Age 11=0, 10=1; Sex Female=0, Male=1.

[a] Obese defined as a BMI ≥ the 95th percentile for age and sex based on 2000 CDC BMI growth charts. http://www.cdc.gov/growthcharts

[b] Parent education coded as 1<12 years, 2=12 years or 3=13+

[c] Household income coded as 1<200% of poverty level, 2=200 to 399% of poverty level, 3 ≥ 400% of poverty level.

[d] Social capital was coded as 1=lowest level of social capital, 2=average level of social capital, 3=highest level of social capital.

Body Mass Index & Neighborhood Social Capital (Model 3). Linear regression results supported the acceptance of the hypothesis of an inverse relationship between higher levels of neighborhood social capital and lower BMI. All three of the independent variables had a significant fit to the model, in the direction theorized. Linear regression was conducted with BMI as the dependent variable. The demographic/SES variables were entered into the model in the first block and the measures of neighborhood social capital were entered into the model in the second block. A stepped approach

[37] Pseudo R^2 calculated as Model Chi-square/Initial -2LL (Field, p. 239)

provides an assessment of the unique contribution of the group of family social capital variables to predicting BMI.

The individual measures of neighborhood social capital were MSA type (rural or urban/suburban), a measure of neighborhood social support asking if neighbors "help each other out" (rated with a four point Likert scale from strongly agree to strongly disagree) and the parent perception of whether the child is safe in the community (sometimes/never or usually/always). MSA type and safety are dichotomous categorical variables. "Neighbors help each other" was entered with the assumption of linearity for an ordinal scaled variable. Age, sex, race/ethnicity, parent education and household income were included to adjust for demographic/SES influence on BMI. The summary of the linear regression is shown in Table 21. The unadjusted beta-values for all variables in the regression are provided in the first column for comparison.

Linear regression modeling produced a significant predictive equation for BMI and neighborhood social capital with an adjusted $R^2 = .057$. The adjusted R^2 increase, after controlling for demographics/SES, was only .002, but still significant. The amount of variation explained by neighborhood social capital was smaller than that explained by either personal or neighborhood social capital, after adjusting for demographic/SES influence. This model was significant for a measure of neighborhood social support, perceived neighborhood safety and MSA type.

Whereas the logistic regression model likelihood of BMI used a social capital index[38], this model used a single variable of the respondent's rating of how much neighbors help each other as a proxy for social support. During the initial screening of the variables, the full social capital index did not produce a variable that was significant within the OLS predictive model. However, when the four questions used in the social capital index were considered separately, the question selected regarding social support was the only one with a significant relationship to BMI. The question used was the respondent's forced choice answer to how much they agreed with the statement "People in the neighborhood help each other out[39]." BMI increased by .170 for each unit increase in the scale, from 1 thru 4. For example, a response of "Strongly Disagree" to the statement of neighbors helping each other yields a .68 increase in BMI. The ability of neighbors to help each other may connect children with social resources beyond what their family can provide alone.

Perceptions of neighborhood safety were significant for BMI, as they were for likelihood of obesity. Clearly, safety is important for the social capital of a neighborhood and is associated with lower BMI. There were no problems with multicollinearity between neighborhood social capital as measured by neighbors helping each other out and perceptions of neighborhood safety.

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[38] The social capital index used in the research includes perceptions of neighbors helping each other, watching out for each other's children, being able to "count" on the neighbors and the belief that if the respondent's child was "hurt or scared" a neighbor would help the child. This index has been used in previous research with this survey and is a key indicator for the National Survey of Children's Health.

[39] Possible responses included "Strongly Agree, Somewhat Agree, Somewhat Disagree and Strongly Disagree." 2003 National Survey of Children's Health.

The type of community, rural or urban/suburban, also influenced BMI. Living in an urban/suburban neighborhood as classified with the US Census Bureau's MSA typology, reduced a child's BMI by .414. Social support in rural communities is often centered on kinship relations. Social connections centered totally or mostly around extended family may or may not be helpful for adopting certain kinds of health behaviors. Their degree of helpfulness will be dependent on behaviors and family norms around physical activity and/or eating (Hofferth & Iceland, 1998).

Table 21. Model 3 - Summary of independent variables for neighborhood social capital with dependent variable BMI* adjusting for demographic/SES influence

Variable	Unadjusted Beta**	Beta***	B	CI lower (B)	CI upper (B)	p-value
Constant			20.069	18.006	22.133	.000
Age in years	.032	.031	.291	.105	.477	.002
Sex (Female=0, Male=1)	.045	.044	.411	.225	.597	.000
Parental Education Level (↑)	-.102	-.095	-.873	-1.073	-.673	.000
Income Level (↑)	-.094	-.078	-.456	-.589	-.323	.000
NH White vs. NH Black	.130	.126	1.935	1.609	2.260	.000
NH White vs. NH Other	.021	.017	.306	-.057	.668	.098
NH White vs. Hispanic	.069	.063	.981	.652	1.311	.000
MSA Type (0=rural, 1=urban/suburban)	.-.038	-.029	-.282	-.485	-.079	.007
Neighbors help each other (↓)	.076	.030	.170	.046	.294	.007
Safety (0=sometimes/never, 1= usually/always)	-.079	-.029	-.414	-.728	-.101	.010

N=9005; R^2=.058; Adjusted R^2=.067; ANOVA sig. =.000; F change sig. = .000 Durbin-Watson=1.989; all VIF statistics fall between 1.001 and 1.280[40].
↑ Indicates that measure is increasing.
↓ Indicates that measure is decreasing.
*BMI=weight (pounds) divided by height² (inches) multiplied by 703.
**Beta for the demographic/SES variables from the basic model and are "unadjusted" for neighborhood social capital. The beta-values for measures of neighborhood social capital are calculated with NO adjustment for the demographic/SES covariates. P-values for all variables are less than .05 except where noted.
***Beta for complete model with adjustments for SES/demographic influence.

Summary – Neighborhood Social Capital. The literature review suggested that neighborhood social capital has been studied more often in relation to health, than the

[40] In the linear regression output from SPSS 17.0 an assumption of no multicollinearity can be made when Variance Inflation Factors (VIF) statistics from the Coefficients table are below 10.

other two forms of social capital conceptualized for the research. This is true of studies of both adults and children. In the current study, neighborhood social capital had the smallest, although still significant, impact on the models for both likelihood of obesity and BMI.

The social context of a community and/or neighborhoods has many implications for health. Neighborhood social capital provides knowledge, opportunities and resources for improving health status, including having a healthy weight as measured by the presence or absence of obesity and/or BMI. The relatively "weak" position of neighborhood social capital in this particular analysis may be in part due to the structure of previous studies. While almost all studies adjust for known risk factors such as sex, race, poverty, etc. a discussion or comparison of other forms of social capital is not included. Or, it may be that the available data was not sufficient to capture the full effect of neighborhood social capital on childhood obesity and BMI. Nevertheless, the three variables measured were all significant, consistent with the hypothesis and provide insight.

Higher levels of social capital were measured with a social capital index for likelihood of obesity and perception of neighbors helping each other for BMI. Both had inverse relationships as predicted. An increase in physical activity levels is one mechanism by which higher levels of neighborhood social capital may reduce obesity in children. Franzini, et al, found that neighborhood *social* environment is even more important than neighborhood *physical* environment in predicting children's physical activity resulting in lower levels of obesity and this research supports that assertion

(Franzini, et al., 2009). It appears that even if a child is living in a neighborhood with a disadvantageous physical environment, greater amounts of social capital provide enough social support to overcome some of the common barriers to physical activity. For example, if neighbors are willing to help each other out by watching kids, playing with them, etc. parents may be more likely to allow children more freedom to be outdoors playing despite the presence of neighborhood disorder and "broken windows."

In neighborhoods with higher social capital children may have opportunities to become engaged with role models for health behaviors outside their immediate family and/or join in activities previously unknown to them/their families. For example, a child's opportunity to participate in an after-school recreation club may be dependent on neighborhood parents' car pooling or willingness to walking with children. Or, if the perception of a neighborhood is unsafe without adult supervision for outdoor play, helping each other to watch children may give children more opportunities for physical activity. Neighborhood social capital may promote more time in social interactions that provide a substitute for watching television, playing video games, eating/overeating. These sedentary habits are all activities with a well established association to obesity and BMI (Cohen, et al., 2006). The benefits to neighborhood social capital are numerous and provide various pathways suggesting lower rates of obesity and lower BMI.

The importance of safety to a neighborhood's social capital *and* reductions in childhood obesity has been well documented. This variable was the respondent's rating of neighborhood safety and not verified and/or correlated with any objective measure of crime, violence, etc. One study, involving ten States found that perceived neighborhood safety was related to children's risk of obesity as parents promote more indoor, sedentary activities which Lumeng, et al suggests promotes greater snacking and higher calorie consumption (Lumeng, et al., 2006). In the same study, even a perception of strong neighborhood cohesion did not alter the association perceived safety and overweight.

The perception of safety in the ongoing segregation of many communities across the United States may be one of the fundamental cause pathways that continue to link minorities to poorer health status such as greater levels of obesity. For example, with this dataset, a logistic regression was conducted with safety as the dichotomous dependent variable and controlling for urban/suburban versus rural community, parent education and household income. Race ethnicity was significant for perception of neighborhood safety for children. The parents of non-Hispanic black children in the dataset rated their neighborhood as never/only sometimes safe over non-Hispanic whites by approximately 30%. Hispanics had even greater odds of 40% as rating their neighborhood generally unsafe for children. Furthermore, Lumeng et al, found that even after controlling for SES and other potentially "protective" factors such as the availability of after-school activities, high neighborhood social capital and a favorable home environment, there was an association between neighborhood safety perception and overweight in children (Lumeng, et al., 2006, p. 29). It appears that these perceptions are translating directly into parental behaviors that influence children's weight status.

Finally, MSA type, urban/suburban versus rural was a significant factor for the likelihood of obesity and BMI. The social capital of rural areas is more family-based and weaker in the type of social ties that connect people to communities and neighborhoods

(Hofferth & Iceland, 1998). Thus, the exposure to and support from non-family members would be weaker for children in rural areas. This limits their opportunities to experience different models of weight related behaviors and norms outside their families.

The greater geographical dispersion of rural populations may limit children's opportunities to participate in more physical activity and/or outside groups; both associated with less obesity. Children in rural areas may spend more time in cars and buses than children in urban/suburban neighborhoods who can walk to school, playgrounds, etc. While it is not unexpected to find rural residence a risk factor for obesity in children, thinking about social capital as one of the mediating paths between rural residence and obesity provides greater insight. This is especially true in this model as it was adjusted for other well known demographic/SES influences.

The findings from the logistic regression modeling of Obesity and the linear regression modeling of BMI produced similar results in predictive power and identified the same significant predictive variables. Overall, neighborhood social capital was a significant predictor in two models for the likelihood of obesity and BMI in a nationally representative sample of 10,018 ten and eleven year old American children, after adjusting for known demographic risk factors.

Personal Social Capital, Family Social Capital & Neighborhood Social Capital

Hypotheses 4 **–** There will be an inverse relationship between higher measures of a child's personal social capital, family social capital and neighborhood social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Full Model).

The hypothesis was true for eight of the eleven variables used to fit a logistic regression model for likelihood of obesity. The hypothesis was true for ten of the twelve variables used to fit a linear regression model for BMI. There was a large degree of overlap of significance of variables when modeling likelihood of obesity and the regression model for BMI. In total, eight variables were significant for both models of the dependent variable. Adjusted (for demographics/SES) measures of social capital were significant for explaining more variation than demographic/SES influence alone.

The results in this section were obtained by including all the same variables of social capital identified in the previous sections of this discussion. The variables for personal based social capital were (1) whether the child attends a private school or public school, (2) sociability as measured in getting along with peers, (3) child's involvement in activities outside of school and (4) the number of times a child has moved. The variables for family based social capital were (1) family structure, (2) how many of the child's friends their parents reported knowing, (3) family size and (4) the number of days per week the family ate a meal together. The variables for neighborhood based social capital were (1) a neighborhood social capital measure, (2) child's safety in the community and (3) MSA type. The results in this section were obtained by adjusting for demographic/SES influence.

Likelihood of Obesity and Social Capital (Personal, Family & Neighborhood). Binary logistic regression established the hypothesized relationship between the likelihood of obesity and higher levels of three bases of social capital; personal, family and neighborhood. Binary logistic regression was conducted with Obese as a dichotomous categorical dependent variable. The demographic/SES variables were entered into the model in the first block and measures of personal social capital, family social capital and neighborhood social capital were entered into the model in the second block. They were entered using the two step approach to provide an assessment of the individual contribution of the group of social capital variables to predicting the likelihood of obesity.

The measures of social capital used in this analysis include those already defined in the previous discussions and in the methods section. Age, sex, race/ethnicity, parent education and household income were included to adjust for demographic/SES influence on the likelihood of obesity. The summary of the logistic regression is shown in Table 22. This chart includes three of the relevant odds ratios to present the change in magnitude as additional covariates are added to the model.

The pseudo R^2 increased from .049 (demographics/SES only) to .067 with the addition of personal, family and neighborhood measures. The block of social capital variables was both significant by itself and as an addition to the basic demographic/SES from Control Model. After adjustments for demographic/SES influence, higher levels of personal social capital, family social capital and neighborhood social capital were significant contributors to a lower likelihood of obesity.

The model was only able to predict obesity 4.4% of the time, despite its significance as a model and the significance of seven out of eleven adjusted measures of social capital. However, this finding does not discount the importance of the individual covariates or social capital's impact on the likelihood of obesity. It simply means that by themselves, this specific set of measures do not lend themselves to predicting obesity in a dataset of 10 and 11 year old US children. Its real utility may be in other research activities with an expanded group of variables, different specifications of the variables, as the description of one part of a more complete model, etc.

In Model 1, all four variables measuring personal social capital were significant. In the final model, Model 4, three of the variables remained significant. The two variables remaining significant for increased likelihood of obesity were attending a public school (versus private) and not participating in activities outside of school. The third significant variable, moving, was also significant, but in the opposite direction proposed (as in Model 1). More moves reduced the odds of obesity versus increasing the odds of obesity. The fourth variable in this group, getting along with one's peers was significant for Model 1 but dropped out when the other covariates of social capital were included.

In Model 2, family social capital, three of the four variables were significant and two were inversely associated with a likelihood of obesity. The same held true for the full model incorporating all the measures. Family size, family structure and parents knowing the child's friends remained predictive of the presence of obesity. Their consistent presence in both models is not surprising given that family social capital had the biggest impact on the pseudo R^2 measure. Eating meals together was not significant in either analysis.

In Model 3, neighborhood social capital, all three of the predictor variables were significant. However, in this final model, only MSA type remained significant. Rural children are still at greater odds of obesity than children living in an urban/suburban community. The odds of a child who lives in a rural community being obese increased from 145% to 155% in the final model. It appears that there was a small amount of shared variation "left over" that was fit to the MSA type variable.

Overall, multiple measures of higher personal social capital; higher family social capital and higher neighborhood social capital were inversely associated with the likelihood of obesity. Two of the measures, family size and number of times moving were associated in the opposite direction where the likelihood of obesity with larger family size and greater number of times moving. These results apply to the US study population of 10,018 ten and eleven year olds.

Table 22. Full Model - Summary of independent variables for personal, family and neighborhood social capital with dependent variable Obese* adjusted for demographic/SES influence

Variable	Unadjusted OR**	Initial Model OR***	Full Model OR	OR Δ Initial to Full Model	B	p-value
Age (Ref =11 year olds)	1.301	1.301	1.333	+.029	.287	.000
Sex (Ref = Female)	1.561	1.561	1.548	-.013	.437	.000
Race/Ethnic (Ref NH White)	1.00	1.00	1.00		R	.000
Non Hispanic Black	2.283	2.283	2.021	-.262	.703	.000
Non Hispanic Multi/Other	1.135	1.135	1.015	n/a	.015	.896
Hispanic	1.681	1.681	1.528	-.153	.424	.000
Parent Education (↑)[a]	.720	.720	.788	+.068	-.239	.000
Household Income (↑)[b]	.740	.740	.754	+.014	-.283	.000
Type of School (Ref =Private)	1.587	1.389	1.319	-.070	.277	.003
Gets along well with peers (↑)	.882	.900	.938	n/a	-.064	.125
Participates in activities outside of school (Ref =yes)	1.763	1.374	1.329	-.045	.284	.000
# of times child has moved (↑)	.983[d]	.966	.959	-.007	-.042	.003
Family Size (↑)	.877	.803	.813	+.010	-.207	.000
Parents know friends (↓)	1.334	1.224	1.158	-.066	.147	.000
Family- 2 parent bio/adopt	1.00	1.00	1.00		R	.022
2 parent step	1.334	1.200	1.247	+.047	.221	.014
Single parent/other	1.583	1.130	1.145	+.015	.136	.049
Eat meals together (↑)[d]	1.003	.992	.993	n/a	-.008	.580
MSA Type (Ref=urban/suburban)	1.183	1.145	1.155	+.010	.144	.018
Social Capital Index (↑)	.816	.904	.945	n/a	-.057	.151
Safety (Ref=usually/always safe)	1.681	1.202	1.182	n/a	.167	.050
Constant			.595		-.519	.079

N=8625; pseudo R^2=.067[41]; Step and Block Chi-squares=130.717, 12_{df}, .000; Model Chi-square=548.456, 19_{df}, .000; -2LL=8044.527; Hosmer & Lemeshow test=8_{df}, .104; Obese correctly identified 4.4%, Not obese correctly identified 99.1%.

↑ Indicates that measure is increasing.

↓ Indicates that measure is decreasing.

* Obese defined as a BMI ≥ the 95th percentile for age and sex based on 2000 CDC BMI growth charts. http://www.cdc.gov/growthcharts

**Odds ratios for the demographic/SES variables are from the basic model that included only demographic/SES influence. Odds ratios for measures of personal, family and neighborhood social capital are those calculated with NO adjustment for the demographic/SES covariates. P-values for all variables are less than .05 except where noted.

***Odds ratio from model without other forms of social capital included Base Model (demographics/SES only) for age, sex, race/ethnicity, parent education, household income, Model 1 (Personal Social Capital) type of school, gets along with peers, participates in activities, # of times moved, Model 2 (Family Social Capital) family size, parents know friends, family structure, eat meals and Model 3 (Neighborhood Social Capital) MSA type, social capital index, safety.

[a] Parent education coded as 1<12 years, 2=12 years or 3=13+

[b] Household income coded as 1<200% of poverty level, 2=200 to 399% of poverty level, 3 ≥ 400% of poverty level.

[c] Getting along with peers had a p-value >.05.

[d] Eating meals together had a p-value > .05.

41 Pseudo R^2 calculated as Model Chi-square/Initial -2LL (Field, p. 239)

Body Mass Index and Social Capital (Personal, Family & Neighborhood). Linear regression confirmed the hypothesized relationship between BMI and higher levels of three bases of social capital; personal, family and neighborhood. Linear regression was conducted with BMI as the dependent variable. The demographic/SES variables were entered into the model in the first block and measures of personal social capital, family social capital and neighborhood social capital were entered into the model in the second block. They were entered using the two step approach to provide an assessment of the individual contribution of the group of social capital variables to predicting the likelihood of obesity.

The measures of social capital used in this analysis include those already defined in the previous discussions and in the methods section. Age, sex, race/ethnicity, parent education and household income were included to adjust for demographic/SES influence on the likelihood of obesity. The summary of the linear regression is shown in Table 23. The first two data columns in the table show earlier model beta-values to highlight the changes (or lack thereof) in magnitude as additional covariates are included in the model.

The adjusted R^2 was increased from .057 (demographics/SES only) to .069 with the addition of personal, family and neighborhood measures. The block of social capital variables was both significant by itself and as an addition to the basic demographic/SES Control Model. Ten of the twelve social capital variables were significant in the regression. After adjustments for demographic/SES influence, higher levels of personal social capital, family social capital and neighborhood social capital were significant contributors to a reduction in BMI. This model explains about 7% of the variation in

BMI for the study population. However, as noted in the immediately preceding discussion on the likelihood of obesity, the finding of small predictive values as represented by the adjusted or pseudo R^2 does not discount the importance of either the individual covariates or social capital measures associational importance.

Linear regression modeling produced significant results for all four of the individual measures of personal social capital in the final model, Model 4. All four measures of personal social capital were also significant in the initial model, Model 1. Type of school, involvement with activities outside of school and getting along with one's peers were inversely related to BMI. The fourth significant variable, moving, was also significant, but in the opposite direction hypothesized as in its initial inclusion. That is, moving reduced BMI.

In Model 2, family social capital, four of the five variables were significant and three were inversely associated with a lower BMI and in Model 4, the full model, three of the five variables were significant and two were inversely associated with lower BMI. In the final model, the family structure dummy variable, 2 parent biological/adopted vs. 2 parent stepfamily, did not remain significant. Family size, family structure (2 parent biological/adopted vs. single parent) and parents knowing the child's friends remained predictive. Eating meals together was not significant in either analysis.

In Model 3, neighborhood social capital, all three of the predictor variables were significant. However, in this final model, neighbors helping each other did not remain significant. Safety and MSA type were retained in Model 4, the full model. The beta-value for MSA type did not change from Model 3 (neighborhood social capital) to Model

4 (-.029). This was the only social capital covariate to do so from among all three groupings, personal social capital, family social capital and neighborhood social capital.

Overall, the vast majority of the study measures of higher personal social capital, higher family social capital and higher neighborhood social capital were inversely associated with BMI. Two of the measures, family size and number of times moving were associated in the opposite direction where lower BMI was associated with larger family sizes and greater number of times moving. These results apply to the study population of 10,018 American 10 and 11 year olds.

TABLE 23. Full Model - Summary of independent variables for personal, family and neighborhood social capital with dependent variable BMI* adjusting for demographic/SES influence

Variable	Unadjusted Beta**	Initial Model Beta	Full Model Beta	Beta Δ Initial -Full Model***	B	p-value
Constant					21.198	.000
Age in years	.032	.032	.027	-.005	.246	.010
Sex (Female=0, Male=1)	.045	.045	.042	-.003	.387	.000
Parental Education Level (↑)	-.102	-.102	-.080	.022	-.739	.000
Income Level (↑)	-.094	-.094	-.083	.011	-.486	.000
NH White vs. NH Black	.130	.130	.110	-.120	1.739	.000
NH White vs. NH Other	.021	.021	.012	n/a	.210	.261
NH White vs. Hispanic	.069	.069	.062	-.007	.963	.000
School Type (Public=0, Private=1)	-.061	-.034	-.024	-.010	-.324	.023
Gets along well with peers (↑)	-.044	-.037	-.026	-.011	-.177	.015
Activities outside of school (No =0, Yes=1)	-.102	-.053	-.039	-.014	-.501	.000
# of times child has moved (↑)	-.007[a]	-.029	-.036	.007	-.112	.001
Family Size (↑)	-.053	-.082	-.075	-.007	-.391	.000
Parents know friends (↓)	.088	.056	.042	-.014	.279	.000
2 parent bio/adopt vs. 2 parent step	.034	.015	.020	n/a	.282	.075
2 parent bio/adopt vs. single parent	.101	.026	.030	.004	.312	.011
Eat meals together (↑)	.000[a]	-.011	-.007	n/a	-.016	.502
MSA Type (0=rural, 1=urban/suburban)	.-.038	-.029	-.029	0	-.276	.008
Neighbors help each other (↓)	.076	.030	.016	n/a	.094	.145
Safety (0=sometimes/never, 1= usually/always)	-.079	-.029	-.024	n/a	-.345	.033

N=8790; R^2=.070; Adjusted R^2=.069; ANOVA sig. =.000; F change sig. = .000 Durbin-Watson=1.989; all VIF statistics fall between 1.001 and 1.455[42].

↑ Indicates that measure is increasing.

↓ Indicates that measure is decreasing.

*BMI weight (pounds) divided by height^2 (inches) multiplied by 703.

**Beta-values for the demographic/SES variables are from the basic model that included only demographic/SES covariates. Beta for the measures of personal, family and neighborhood social capital are those calculated with NO adjustment for the demographic/SES covariates. P-values for all variables are less than .05 except where noted.

*** This is the difference in beta-value from the initial models - Control Model, Model 1, Model 2 and Model 3

[a] Getting along well with peers had a p-value of .138 when not adjusted for demographic/SES covariates.

[b] Eating meals together had a p-value of .951 when not adjusted for demographic/SES covariates.

Summary – Personal Social Capital, Family Social Capital and Neighborhood Social Capital. The hypothesis that higher measures of social capital based on personal social capital, family social capital and neighborhood social capital

[42] In the linear regression output from SPSS 17.0 an assumption of no multicollinearity can be made when Variance Inflation Factors (VIF) statistics from the Coefficients table are below 10.

were inversely related to the likelihood of obesity and BMI was confirmed. In general, the measures of social capital available in the dataset, controlled for demographic/SES influence, predicts approximately 7% of the variation in the likelihood of obesity and BMI.

The measures of social capital that remained significant across the multivariate analyses for both forms of the dependent variable, Obese and BMI are:

Personal Social Capital	Family Social Capital	Neighborhood Social Capital
Type of School	Parents know Friends	Safety
Activities outside School	Family Structure	MSA Type
Moving	Family Size	

Attending a private school, participating in either clubs or sports (or both) outside of school, parents knowing all or most of the child's friends, two parent biological/adoptive families, living in a neighborhood perceived to be usually or always safe and residing in a metropolitan area (urban/suburban) were all associated with the a lower likelihood of obesity and lower BMI. These variables were specified as *higher* levels of social capital and were inversely associated with the dependent variables. The association of these variables with the likelihood of obesity and BMI was consistent with the hypotheses. While, the greater number of times a child has moved and a larger family size were hypothesized to represent lower levels of social capital and would be expected to be associated with a higher likelihood of obesity and a higher BMI. However, they (more moves and larger family size) were associated with a *lower* likelihood of obesity and *lower* BMI. The association of these variables with the likelihood of obesity and BMI were inconsistent with the hypotheses.

The association of the independent variables with obesity and BMI were described in the earlier discussions in this chapter as operating via multiple interactions and processes. Social capital links children to others (children and adults) beyond their immediate families and neighborhoods when they attend private schools and participate in activities outside of school. Social capital, as the type described among cohesive families, may provide children with consistent and strong social supports. Parents knowing most of a child's friends could be one proxy measure for a family with a higher degree of connectedness. Additionally, family structure itself as source of social capital, especially for children, may be stronger in two parent biological/adoptive families.

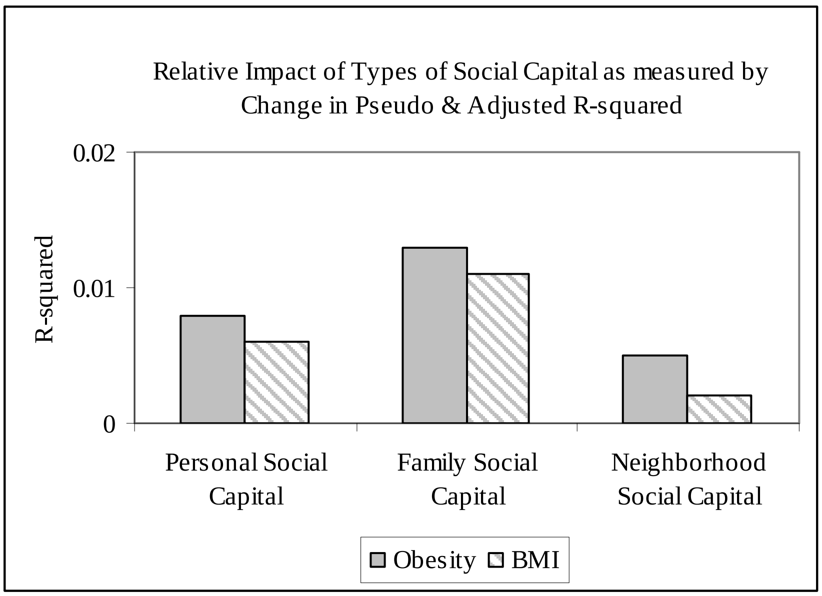
Moving and larger family size were associated with lower likelihood of obesity and lower BMI. It is likely that moving operates differently among different demographic/SES groups. For example, for some children living in poorer households, moving to a more advantaged neighborhood increases opportunities for social capital development and subsequently reduction of risk factors for obesity (Pettit & McLanahan, 2003). For other children, if moving is associated with an increase in household income, benefits may ensue. If a child moves to an area with different cultural values about obesity than their current neighborhood and/or family, this too may favorably impact BMI. The significance of larger family size may be attributed not only to the greater opportunities available for physical activity, but also as a result of necessary social skills children develop to live with one or more siblings. Finally, it is feasible to imagine that some sibling relationships provide some of the same benefits to children in terms of social capital that parents provide. Pettit and McLanahan also note that families that move more often may be more successful at developing social ties than those that move less often (or not at all) (Pettit & McLanahan, 2003).

While the seemingly direct measures of neighborhood social capital did not remain significant in the final regression analyses, two important measures, safety and MSA type function as reasonable proxies. Perceptions of safety in a neighborhood will have some overlap with social capital depending on the degree to which neighbors are known, trusted, regarded as helpful, etc. Rural communities have long been identified as a risk factor for obesity in many ways. A social capital framework suggests that one key mechanism is a lack of weak ties, those outside of kinship groups. This can contribute to childhood weight status through limited personal exposure to a wide range of other children and adults, lack of opportunities for participation in outside activities and the absence of neighborhoods that could potentially provide additional knowledge, instrumental support, etc.

Each form of social capital examined improved the model, but by varying degrees. The relative influence of each form of social capital is presented in Chart 1. Family social capital provided the most improvement to the control model, followed by personal social capital. Neighborhood social capital increased the model by the smallest amount of the three forms of social capital examined. This is not particularly unexpected, given the age demographic of the study population, 10 and 11 year olds.

It was expected that neighborhood social capital would be a more powerful predictor than personal social capital. However, MSA type might have *pushed* the neighborhood social capital measures measure into insignificance. MSA type is often given as a demographic control variable as living in a rural area is by itself a risk factor for obesity, albeit usually a small risk factor when adjusted for income and education. However, MSA type is also strongly associated with the type and magnitude of social capital of a community (Hofferth & Iceland, 1998). Thus, it was theoretically valid as a measure of neighborhood social capital. Also, the study population may have been too young to experience the full amount of stress related to neighborhoods bereft of social capital.

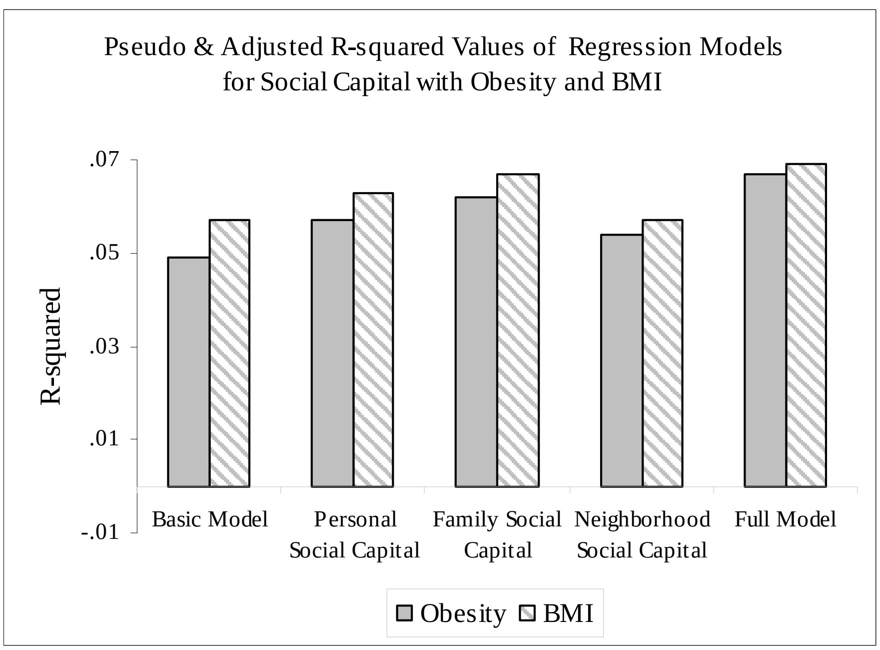
Chart 1. Improvement in regression predictions by different forms of social capital from base model of demographic/SES predictors



Five different regression models were fit to the data for each form of the dependent variable. The five models were the Basic Model (demographic/SES predictors), Personal (personal social capital adjusted for demographic/SES), Family (family social capital adjusted for demographic/SES), Neighborhood (neighborhood social capital adjusted for demographic/SES) and the Full (all social capital variables adjusted for demographic/SES). The models were generally equivalent for Obese and BMI as the dependent variables for significant independent variables and the amount of variation predicted by the regression. Chart 2 provides a graphical view of the pseudo and adjusted R^2 values for the five models. All models were adjusted for demographic/SES influence.

The Full Model, with all the measures of social capital entered and adjusted for demographic/SES influence, provided the largest predictive value of roughly 7%. Chart 2 suggests that much of the variation in the likelihood of obesity and BMI is predicted by the basic model of demographic/SES influence. However, social capital, while only improving predictive models by a small amount, is also a way to construct the pathways in which the demographic/SES measures associated with obesity and BMI operate.

Chart 2. Comparison of models by applicable values of R^2



Overall, independent measures of personal social capital, family social capital and neighborhood social capital are associated with the likelihood of obesity and BMI in a representative study population of 10,018 10 and 11 year olds in the United States. The next chapter will conclude the report on the research. Chapter 6 will summarize the overall findings, present conclusions, address the study limitations, offer future research recommendations and suggest policy implications.

CHAPTER 6

Conclusions

The chapter will begin with a very brief overview of the research project and results. This is followed by an overall discussion of the research findings. Study limitations will be identified. Finally, the chapter and dissertation will be concluded with recommendations for future research and policy implications.

Research Aims

The purpose of the study was to expand the understanding of childhood obesity[43] in American children by examining the associations between obesity in children and measures of social capital. Social capital, in the study of health, can be defined as *resources*[44] accrued and/or accessed from social relationships/social bonds at multiple levels including the individual, family, neighborhood, community or nation (Ferlander, 2007; Halpern, 2005; Macinko & Starfield, 2001). The research quantitatively analyzed the associations between the likelihood of childhood obesity and Body Mass Index (BMI) with personal social capital, family social capital and neighborhood social capital. The specific objectives of the work were:

1) To investigate whether there are associations between measures of personal social capital and the likelihood of childhood obesity and a child's BMI after controlling for age, sex, race/ethnicity, parent education and household income.

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[43] Persons between 2 and 20 years of age are categorized as "obese" if their BMI is in 95th percentile or above for their age and sex using the Center for Disease Control and Prevention (CDC) BMI-for-age growth charts (CDC/NCHS, 2009).
[44] Examples of the resources referred to throughout the social capital health literature include knowledge, information, emotional and instrumental support, companionship, confidence in others, values, attitudes (Ferlander, 2007).

2) To investigate whether there are associations between measures of family social capital and the likelihood of childhood obesity and a child's BMI after controlling for age, sex, race/ethnicity, parent education and household income.

3) To investigate whether there are associations between measures of neighborhood social capital and the likelihood of childhood obesity and a child's BMI after controlling for age, sex, race/ethnicity, parent education and household income.

4) To examine the relative associations between measures of personal based social capital, family based social capital and neighborhood based social capital with the likelihood of childhood obesity and a child's BMI after controlling after controlling for age, sex, race/ethnicity, parent education and household income.

Background

Obesity prevalence has more than quadrupled in the last 40 years in the United States for children. The prevalence rate is 17.0% for children ages 6-11 years (Ogden, et al., 2008). Childhood obesity is associated with numerous immediate and long-term adverse physical, emotional and psychosocial consequences. Additionally, childhood obesity is more prevalent among racial/ethnic minorities, children with less educated parents and the poor (Singh, et al., 2008).

Social capital is generally described as a resource accrued from and accessed through social relationships and is related to the health of children (Ferguson, 2006). Social capital is a practical construct to describe the pathways that link socially patterned health risks and demographic/SES measures in children from a fundamental causes perspective.

The research tested for associations of personal, family and neighborhood social capital indicators with the likelihood of childhood obesity and BMI in children. A comprehensive literature review did not find previous quantitative studies examining associations between multiple forms of social capital and childhood obesity in a single study. The research was designed to fill that gap.

Methodology

The research was conducted with a public use dataset from the 2003 National Survey of Children's Health. A dataset for the study was created for 10,018 10 and 11 year olds for whom height and weight was available[45]. The demographic/SES data was used to build a base model. Subsequently, the base model was used to adjust (control) for these known demographic/SES risk factors for childhood obesity during the testing of the social capital indicators.

Logistic and OLS multiple regression models were employed for hypotheses testing. Eleven indicators of social capital were identified as viable measures and appropriate for the statistical testing based on previous research, theory and data screening. The variables for personal based social capital were (1) whether the child attends a private school or public school, (2) sociability as measured in getting along with peers, (3) child's involvement in activities outside of school and (4) the number of times a child has moved. The variables for family based social capital were (1) family structure, (2) how many of the child's friends their parents reported knowing, (3) family

[45] The initial dataset included 10,828 cases of 10 and 11 year olds. The BMI data was missing on 810 (7.4%) children and they were excluded from the analysis, yielding a study population of 10,018. Previous published research from a senior epidemiologist with the Maternal and Child Health Bureau suggests that exclusion is appropriate for this dataset versus estimation of the missing BMI values (Singh, et al., 2008).

size and (4) the number of days per week the family ate a meal together. The variables for neighborhood based social capital were (1) a neighborhood social capital measure, (2) child's safety in the community and (3) MSA type.

The study population had an obesity prevalence of 20.4%. The mean BMI for the study population was 20.1. Logistic regression was used to model the indicators of social capital with a dichotomous dependent variable, Obese (not Obese). OLS multiple regression was used to model BMI as a linear dependent variable with measures of social capital. Three forms of social capital, personal social capital, family social capital and neighborhood social capital were fit individually with regression models. A fourth comprehensive, "full model" was created with all measures of social capital included. All models were adjusted for demographic/SES influences.

Test of the Hypotheses

Hypothesis 1. There will be an inverse relationship between higher measures of a child's personal social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Model 1). This hypothesis was accepted because all of the four measures of personal social capital were associated with a greater likelihood of obesity and higher BMI, after controlling for demographics/SES. Attending a private school, participating in clubs/sports outside of school and getting along well with peers were considered positive or "higher" measures of personal social capital. Thus, children who attended public schools, who did not participate in clubs/sports outside of school and did not getting along well with peers had a greater likelihood of obesity and higher BMI in the study population after adjusting for demographics/SES influence. These three variables were relatively similar in magnitude of their effect.

The fourth variable, moving, had a direct association with the dependent variables, Obese and BMI. The greater number of times a child moved, the lower their likelihood of obesity and the lower their BMI.

Hypothesis 2. There will be an inverse relationship between higher measures of a child's family social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Model 2). This hypothesis was accepted because three of the four measures of family social capital were associated with a greater likelihood of obesity and higher BMI, after controlling for demographics/SES. Living with two biological/adoptive parents and parents knowing the child's friends were considered positive or "higher" measures of family social capital and both had inverse relationships with the likelihood of obesity and BMI.

A smaller family size was hypothesized to be higher in family social capital. However, there was a direct relationship with the likelihood of obesity and BMI and a "higher" measure of family social capital based on family size. That is, children from smaller families or only children had a higher likelihood of obesity and higher BMI predicted from the regression models. Eating meals together was not related to the likelihood of obesity or BMI for the study population.

Hypothesis 3. There will be an inverse relationship between higher measures of a child's neighborhood social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Model

3). This hypothesis was accepted because all three of variables utilized to measure neighborhood social capital demonstrated an inverse relationship between neighborhood social capital with the likelihood of obesity and BMI. A higher measure of social capital in a neighborhood and greater safety had an inverse relationship with the likelihood of obesity. A perception of a greater degree of neighbors helping each other out and greater safety was associated with a lower BMI.

Additionally, the metropolitan statistical area (MSA) type of the child's neighborhood of residence was associated with the likelihood of obesity and BMI. Living in a rural community was considered to be associated with lower neighborhood/community social capital. Children in rural communities had a greater likelihood of obesity and higher BMI's than children residing in urban/suburban neighborhoods.

Hypothesis 4. There will be an inverse relationship between higher measures of a child's personal social capital, family social capital and neighborhood social capital and the likelihood of obesity and BMI when controlling for age, sex, race/ethnicity, parent education and household income (Full Model). This hypothesis was accepted because eight of the eleven variables used to fit a logistic regression model for likelihood of obesity were significant and ten of the twelve variables used to fit the OLS regression model for BMI were significant. The significant variables for this model came from all three types of social capital characterized for the research; personal social capital (three of four variables), family social capital (three of four variables) and neighborhood social capital (two of three variables).

Variables measuring the type of school the child attended, involvement for activities outside of school and moving were associated with the presence of obesity and BMI in a study population of 10 and 11 year old children living in the United States and their personally owned social capital. Regarding family social capital, variables measuring family size, parents knowing friends and family structure were significant for children in the study dataset with obesity and BMI. MSA type (rural versus urban/suburban) and neighborhood/community safety perceptions had statistically meaningful associations with obesity and BMI in the research. Overall, numerous and diverse measures of social capital were associated with the likelihood of obesity and BMI in 10 and 11 year old children.

Discussion

The overall study and quantitative analyses generated several key observations. Some of the observations confirm current research related to the demographics/SES of childhood obesity. Some of the observations provide novel ideas of social capital in the study of childhood obesity as identified in the aims of the research.

The demographic and SES measures used as part of the first (basic) model were significant across all multiple regression models. These predictors included sex, race/ethnicity, parent education and household income. These are well-known and widely accepted as risk factors for childhood obesity in the United States. Boys, non-Hispanic black children, Hispanic children, children with parents with lower levels of education and children living in households with lower incomes were all at greater risk for obesity in the study population of 10 and 11 year old American children. These findings confirm current thinking that childhood obesity is socially patterned.

In the study, there were eight (of eleven) measures of social capital that were particularly noteworthy because they were significantly associated with childhood obesity and BMI in both full models after controlling for demographic/SES influence. These include type of school, participating in outside activities, moving, family size, parents knowing friends, family structure, MSA type and neighborhood/community safety. The findings are discussed in detail below.

Type of School (Personal Social Capital). Attending a public school (versus a private school) was associated with an increased risk of obesity for children in the study population. There are a number of pathways that could be relevant. Private schools may be providing all students *but* especially those at greater risks for obesity with social connections that promote a healthy weight status. School "connectedness" has been associated with more positive health outcomes (Thompson, Iachan, Overpeck, Ross, & Gross, 2006). Private schools may provide that *connected* environment with smaller class sizes, smaller overall school size, parent involvement and greater feelings of being part of a community (Keigher, 2009).

Participation in activities outside of school (Personal Social Capital). This variable measured both participation in sports activities and other clubs such as scouting, church groups, music lessons, etc. Given that physical activity is associated with weight status in children, there may be some direct bias in this indicator outside of social capital because some outside activities may include sports and the child is simply getting more exercise. That being said, participation in any activity, regardless of its physical movement component, also has the potential to increase a child's social capital by generating greater connectedness with peers and/or adult role models outside of their immediate families.

For example, if a child is at a choir practice, a Boy Scout meeting or neighborhood soccer, they are being exposed to peers and adults outside of their immediate family and school context. It is possible that these exposures develop social relationships that are beneficial to healthy behaviors and reduced likelihood of obesity. Their choir leader might be a physical education teacher, their scout leader may be a pediatrician or their soccer coach particularly inspires them to practice their soccer moves outside of regular practice time. Any of these additional adult influences could yield positive benefits to the child's weight.

Moving (Personal Social Capital). Coleman's theorizing on family social capital and the social capital of children has continued to dominate the literature in this area; he believed that social capital was lessened each time a family moves because of the disturbance in social ties (Coleman, 1988). As previously stated, the original hypothesis of the study suggested that the more times a child had moved, the lower their social capital and thus the greater likelihood of obesity. Moving was consistently related to the likelihood of obesity and BMI, but contrary to my hypothesis more frequent moving was related to a *lower* likelihood of obesity, not higher.

Pettit and McLanahan, considered a group of families that left public housing to move to other types of housing and found that while a residential move appeared to generally lower social capital for the adults, the impact on children was more complex (Pettit & McLanahan, 2003). Children who moved did not reduce their participation in activities outside of school and were generally connected to their new neighborhoods and schools to the same degree as their old neighborhoods and schools (Pettit & McLanahan, 2003). Additionally, many people move *to* places where they have more social capital in the form of extended family (J. Field, 2008). Field also posits that those who move develop even more social support through the development of new and varied friendships. As Portes noted, there is a dark side to social capital when people have large reserves of homogenous social relationships (Portes, 1998). Moving has been shown to negatively impact educational achievements in Coleman's and other studies, but it appears that for childhood obesity (and possibly other health risks) that moving may have favorable associations with social capital for health and/or weight status (Coleman, 1988). Also, moving may be a proxy for upward social mobility. For example, families may relocate to a neighborhood with better schools, grocery stores, recreational facilities and a safer environment.

Family Size (Family Social Capital). Family size, like moving, was conceptualized based on Coleman's original work on social capital with the prediction that smaller family size would be associated with lower BMI or decreased likelihood of obesity. However, smaller family size was associated with *higher* BMI and *increased* likelihood of obesity. Coleman and others have suggested that the greater the number of siblings for children, that parental/family resources are diluted (Coleman, 1988). However, one challenge to this notion is that parental resources are not necessarily diluted if the number of children is not too great, but that parents simply allocate more of their overall resources to child-rearing (Steelman, et al., 2002). Also, there is an argument that having at least one sibling might increase social capital because having a sibling necessarily increases one's ability to manage social relationships, especially with peers (Kitzmann, Cohen, & Lockwood, 2002). Also, having one or more siblings may give children access to even more social relationships than if they were an only child and more opportunities for exercise (pick-up basketball, touch football, running around, etc.).

The immediately preceding explanations describe how having more one or more siblings might increase social capital, but that still begs the question of how a greater number of siblings might be associated with a lower likelihood of obesity? First, is the idea presented earlier in the paper that having siblings increases the amount of physical activity for children and this idea is especially plausible for the age group of the study (Duncan, Duncan, Strycker, & Chaumeton, 2004). Second, it may be that as the number of children increases in a family, more child oriented activities take place and these may involve more physical activity. As with residential moving, Coleman's conception of family size while relevant for educational measures or achievements may function differently for children's risk of obesity.

Parents knowing friends (Family Social Capital). This variable was measured as the parent's response to how many of the child's friends the parents knew with responses on a four point scale including "all," "most," "some" or "none." This variable was included to gauge a dimension of family connectedness. Past research has identified associations between family connectedness and breakfast eating, less emotional distress, higher rates of fruit and vegetable consumption. These factors are all associated with weight status in adolescents (Mellin, Neumark-Sztainer, Story, Ireland, & Resnick, 2002). This variable might also be a proxy for family communication. Higher levels of family communication have been associated with healthier behaviors (Mellin, et al., 2002).

Single Parent Family Structure (Family Social Capital). Three forms of family structure were considered (2 parent biological/adoptive, 2 parent stepfamily and single parent/other). Single parent family structure was associated with both a greater likelihood of obesity and a higher BMI after adjusting for demographic/SES measures. It may be that children have access to overall less social capital simply because the social capital of one person is generally lower than the combined social capital of two people (Ravanera & Rajulton, 2009). The analysis did not consider additional details regarding the child's contact with the non-resident parent, living situation, etc., therefore other observations about this association are unwarranted.

MSA Type (Neighborhood Social Capital). Finally, MSA type, urban/suburban versus rural was a significant factor for the likelihood of obesity and BMI. The social capital of rural areas is more family-based and weaker in the type of social ties that connect people to communities and neighborhoods (Hofferth & Iceland, 1998). Thus, the exposure to and support from non-family members would be weaker for children in rural areas. This limits their opportunities to experience different models, mores or attitudes of behavior which impact obesity and BMI. While it is not unexpected to find rural residence a risk factor for obesity in children, thinking about social capital as one of the mediating paths between rural residence and obesity provides greater insight. This is especially true in this model as it was adjusted for other well known demographic/SES influences.

Safety (Neighborhood Social Capital). Perception of neighborhood or community safety is often used to understand an area's level of social capital. Generally areas perceived as "more safe" are associated with other measures of higher neighborhood social capital (Cohen, et al., 2006). Pettit and McLanahan noted in their research that children who move to neighborhoods that are perceived as safer realize a net gain in social capital (Pettit & McLanahan, 2003). Thus, the idea that social capital is higher in "safer" communities and was associated with BMI and a lower likelihood of obesity adds contextual evidence to the growing body of research that has found associations between neighborhood safety and obesity in children (Franzini, et al., 2009)

Summary. In the research involving key indicators of social capital in a group of 10,018 American 10 and 11 year olds, the likelihood of obesity and BMI were associated with social capital. The previous discussion suggests ways that these indicators of social capital provide pathways to resources that children are accruing and/or accessing from these relationships. Family social capital was more powerful than personal social capital or neighborhood social capital when analyzed separately. This is not surprising in the age group of the study.

One particularly interesting artifact of the study was the fact that while the neighborhood social capital index/measure was significant in the model when used alone, it was not significant in the Full Model when the measures of personal social capital and family social capital were also included. In the literature review, neighborhood social capital was the form of social capital most researched and cited. The novelty of this study was that it incorporated multiple dimensions of social capital – personal, family and neighborhood. This suggests at least two possible explanations. First, the children in the age group of the study, 10 and 11 year olds, are young enough to be relatively "protected" from any depravity in their neighborhoods/communities. Second, it may be that personal social capital and family social capital are more powerful than neighborhood effects in providing social resources to individuals, particularly children.

The purpose of the study was to expand the understanding of childhood obesity in American children. The research was successful in achieving that aim.

Limitations of the Study

There are limitations to the study. First, the height and weight data were reported by the responding parent for the child and were not measured independently by a trained person. However, while independent measures are generally preferred to reduce errors in the database and subsequent analysis, expert researchers from the CDC believe that the age group used from the NSCH dataset for this type of research is acceptable and appropriate (Blumberg, et al., 2005; Singh, Kogan, Van Dyck, et al., 2008). Second, the indicators used to assess personal social capital and family social capital were selected from the National Survey of Children's Health and are thus based on the convenience of their inclusion versus a purposeful measure of personal social capital or family social capital.

Other limitations are based on the specification of some of the variables by the National Survey of Children's Health. The parent education variable was probably too crude. It only included three categories – less than high school (<12 years), high school (12 years) and more than high school (13+). The 13+ category could have been more finely segregated. Including anything beyond high school did not acknowledge the benefits of completing a college degree, even a two or four year degree. Also, for 10 and 11 year olds, the frequency of family outings was not collected[46]. This variable had the potential to be a useful indicator of family social capital.

Furthermore, the regression analyses, OLS and logistic regression, produced weak predictive models, with r^2/pseudo r^2 results of about 7%. This implies that about 7% of the variation in BMI and the likelihood of obesity can be predicted with the models that included age, sex, race/ethnicity, parent education, household income and 11 measures of social capital. This is not surprising given the lack of inclusion of many other types of well-known variables generally associated with childhood obesity such as diet quality, physical activity, television viewing, parental weight (Agras, Hammer, McNicholas, & Kraemer, 2004; Benton, 2004; Booth, et al., 2001). Thus, a limitation of the research is that the models would not be appropriate for predicting BMI and/or the likelihood of obesity. That said, the consistent significant relationships with multiple individual measures of social capital suggest that social capital may be a crucial piece of a larger model of childhood obesity.

[46] Frequency of family outings was collected for children ages 6 years and younger in the 2003 National Survey of Children's Health.

Finally, another critical limitation involves the use of cross sectional data. The analysis only produced associations between BMI or the likelihood of obesity and measures of social capital. Causation can not be assumed and/or inferred. There can be no assumption that lower levels of social capital cause a higher likelihood of obesity and/or higher BMI. Also, obesity itself may lead to lower social capital. For example, obese children may be reluctant to participate in after school activities or introduce their friends to their parents.

Implications for Future Research

Multiple individual measures of social capital were significantly associated with the likelihood of obesity and BMI in a study population of American 10 and 11 year old children. It would be interesting to analyze and compare measures of social capital across groups of varying risks for childhood obesity. For example, does the significance and/or strength of the indicators change for children based on race/ethnicity, parent education and/or household income? Alternatively, would the same results be obtained if the analysis was extended beyond 10 and 11 year olds to consider children of different ages, younger and/or older? Considering the acquisition and use of social capital, in different demographic/SES groups may help to illuminate the pathways to health (or ill health) as described by Link and Phelan (Link and Phelan, 2008).

Family social capital, while a broad construct, has the ability to bring a wide-angle view of the impact of social factors on the experience of health risk factors in the pediatric population. The work of Coleman in the area of family social capital has been used extensively to understand educational achievements. The measures of family social capital in this study were limited to family size, parents knowing friends, family structure and eating meals together. Other measures of family social capital such as parents/family social networks, embeddedness in informal networks, parent/family trust of others, religiosity, diversity of informal relationships, family communication, within family levels of trust, frequency of family activities and other measures could be used as measures. An even more in-depth understanding of a child's family social capital has the potential to provide greater insight into childhood obesity. Additionally, this work could be extended to understand other important areas of children's lives, especially health risks.

The identification and analysis of children's personal social capital is a reasonable research endeavor, especially with children who are old enough to be in school and have regular interactions with peers and adults outside of their immediate family. Personal social capital, compared to family social capital and neighborhood social capital, is the area most lacking in the research. Children's personal social capital may be associated with health risks and conditions other than obesity and social capital could be modeled for those risks. For example, do measures of personal social capital have any associations with the likelihood of substance abuse, cigarette smoking, emotional well-being, teen pregnancy, high risk sexual behavior, depression, suicide ideation, disordered eating, violence or other health risks particularly high for children and adolescents?

The public use dataset of the 2007 National Survey of Children's Health was released after the start of the research. This study could be replicated using the new dataset for comparison and additional insights.

Policy Implications of the Research

The research supports the hypothesis that social capital is associated with childhood obesity. This suggests that enhancing social capital at the personal, family and/or neighborhood level has the potential to lower the likelihood of childhood obesity.

Personal social capital for children can be enhanced by providing them greater access to people (peers and adults) that expand their social networks. One of the strongest associations between the likelihood of childhood obesity and personal social capital was measured as participation in sports or activities outside of school. For example, providing all children and especially those in high-risk groups with more opportunities to be involved in sports, clubs, music lessons and other civic activities allows them to engage in leisure time activities that could substitute for time spent in things that increase the likelihood of obesity. This may be particularly important for children approaching adolescence, such as the study population of 10 and 11 year olds, because previous research documents that this is approximately the age where physical activity begins to decline in children (S. E. Anderson, Economos, & Must, 2008). Providing facilitative social structures for all types of extracurricular activities for children should be a goal not only for public policymakers but private community associations as well.

Family social capital is a function of the social capital parents bring to the family and within family social capital so that children may benefit from their parent's social relationships and networks. Policies which help parents enhance their own social capital may in turn enhance families' social capital. It may be that facilitative social structures in for extracurricular activities outside of employment, parenting and other responsibilities could increase social networks for parents which may then in turn expand their children's social networks. Putnam suggests that family friendly employment structures are needed so that individuals may "replenish" both their personal and family's social capital (Putnam, 2000). Additionally, there may be other social resources in community organizations, outside the employment sector, that if expanded/strengthened could foster family social capital.

Opportunities to expand neighborhood/community social capital can address small scale areas such as individual city all the way up to State level policies. This study showed an association between place of residence (MSA or non-MSA) and weight status. Putnam makes the argument that the physical use of space in communities directly impacts neighborhood social capital (Putnam, 2000). Government zoning laws, building permits and land use plans have the potential to either augment or decrease social capital for residential neighborhoods. The prevalence of childhood obesity in the United States and its clear association with demographic/SES and measures of social capital suggest that social policies are one of the keys needed to address this health issue.

Putnam stated "*Of all the domains in which I have traced the consequences of social capital, in none is the importance of social connectedness so well established as in the case of health and well-being*" (Putnam, 2000, p. 326). There are many other facets related to the problem of childhood obesity: food pricing, diet, school lunches, physical activity, school physical education opportunities, family support systems, individual responsibility and behavior, etc. However, this research supports the argument that social capital is significant and considerable regarding children's likelihood of obesity and thus their overall health and long term well-being.

APPENDIX A – Human Subjects Form

WAYNE STATE UNIVERSITY

HUMAN INVESTIGATION COMMITTEE
101 East Alexandrine Building
Detroit, Michigan 48201
Phone: (313) 577-1628
FAX: (313) 993-7122
http://hic.wayne.edu

Association for the Accreditation of Human Research Protection Programs, Inc. Full AAHRPP Accreditation

CONCURRENCE OF EXEMPTION

To: Cynthia BalaBrusilow
Sociology

From: Ellen Barton, Ph.D. F. Affatato for
Chairperson, Behavioral Institutional Review Board (B3)

Date: July 23, 2009

RE: HIC #: 079109B3X

Protocol Title: A Study of the Associations Between Childhood Obesity and Three Forms of Social Capital

Sponsor:

Protocol #: 0907007373

The above-referenced protocol has been reviewed and found to qualify for **Exemption** according to paragraph #4 of the Department of Health and Human Services Code of Federal Regulations [45 CFR 46.101(b)].

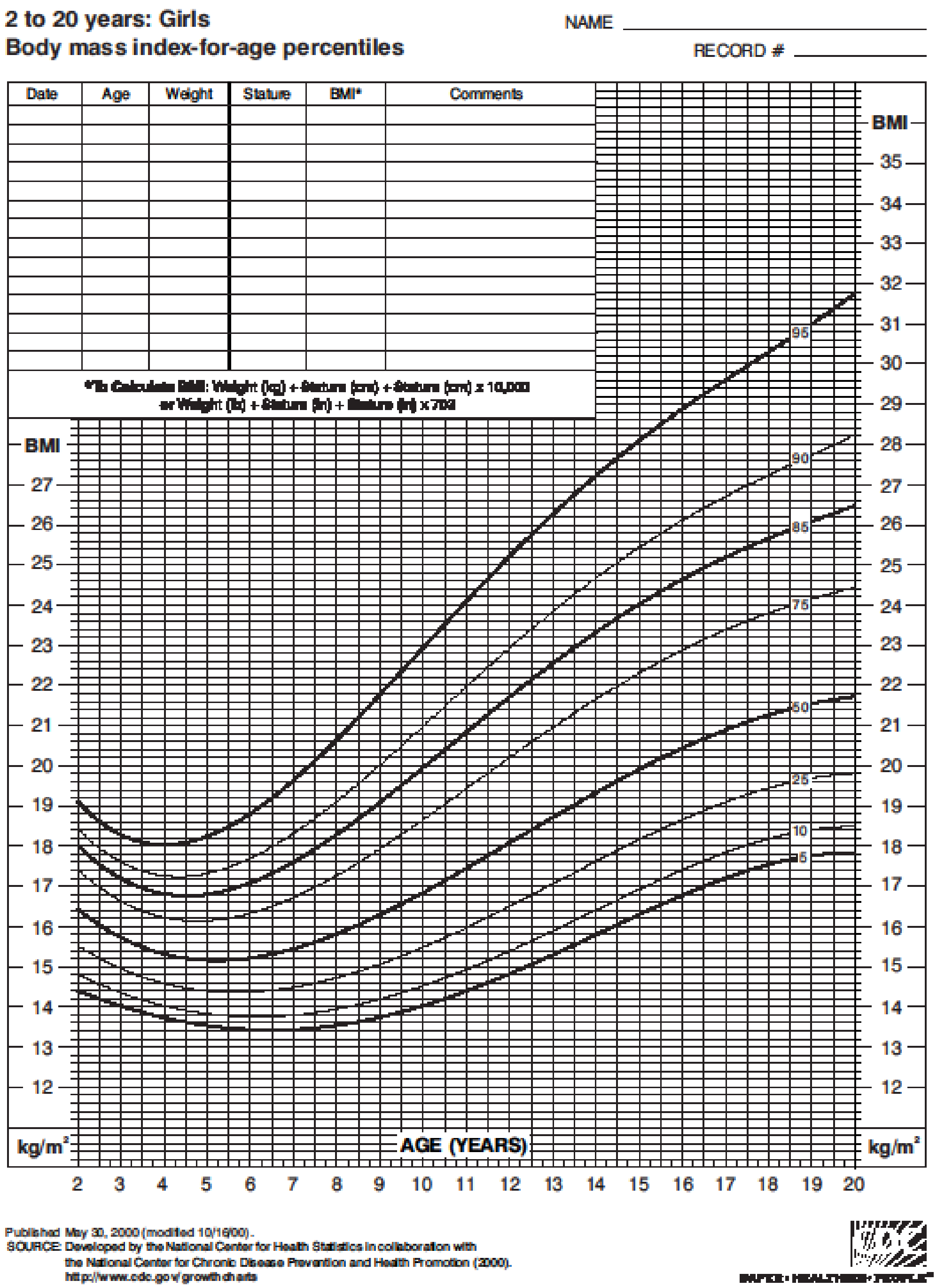
This proposal has not been evaluated for scientific merit, except to weight the risk to the human subjects in relation to the potential benefits.

- Exempt protocols do not require annual review by the IRB.
- All changes or amendments to the above-referenced protocol require review and approval by the HIC **BEFORE** implementation.
- Adverse Reactions/Unexpected Events (AR/UE) must be submitted on the appropriate form within the timeframe specified in the HIC Policy (http://www.hic.wayne.edu/hicpol.html).

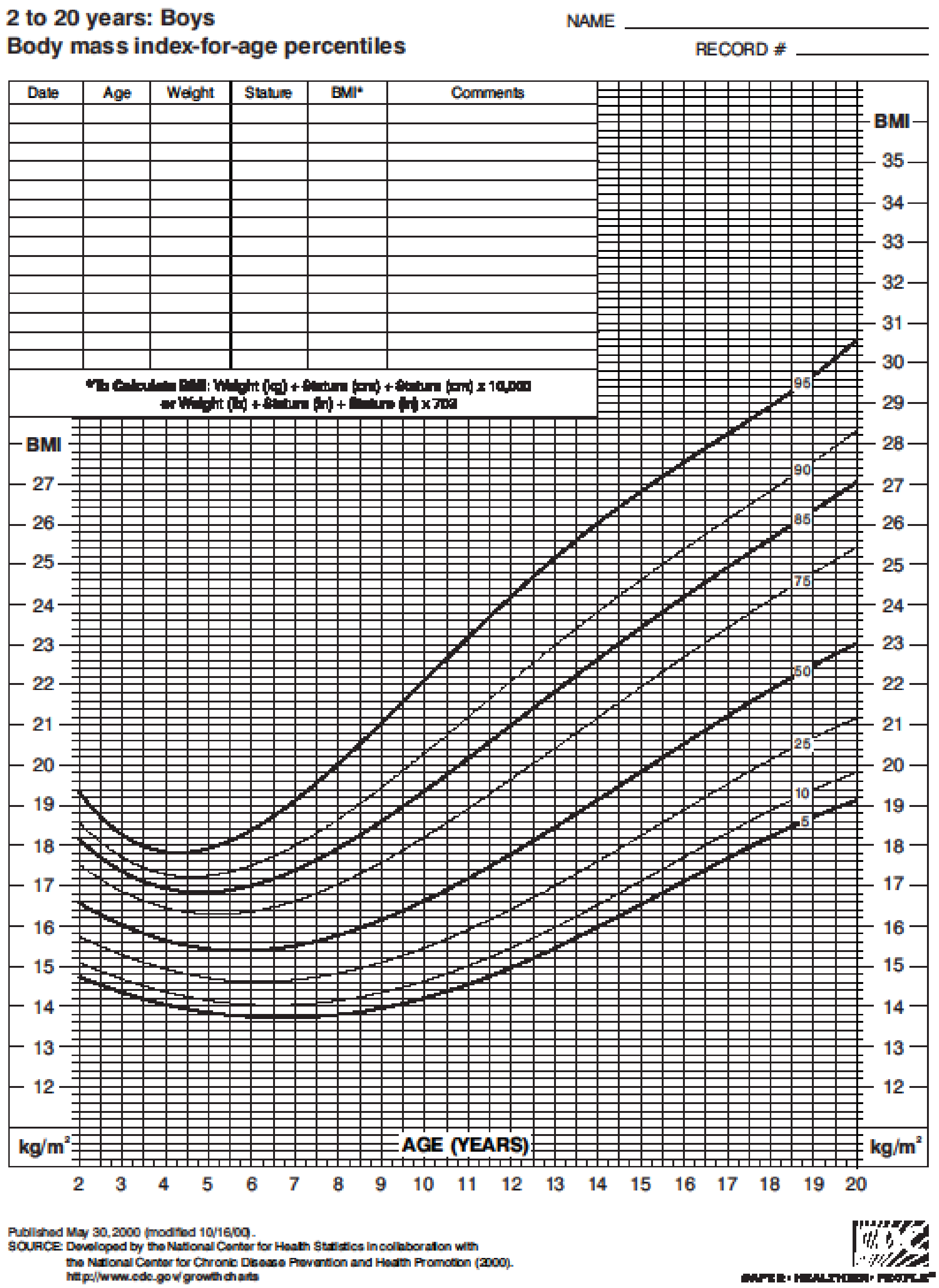
NOTE:

1. Forms should be downloaded from the HIC website at each use.
2. Submit a Closure Form to the HIC Office upon completion of the study.

APPENDIX B – BMI Growth Chart for Girls



APPENDIX B – BMI Growth Chart for Boys



APPENDIX C

Appendix C provides the results of ANOVA procedures conducted to test the difference between mean BMI for each age/sex cohort on race/ethnicity, parent education and household income.

Appendix C-Table 1. Results from one-way ANOVA procedure on mean BMI score for each age/sex cohort in the study for Race/Ethnicity[a], Parent Education[b] and Household Income[c].

Age/Sex Cohort	Variable	Degrees of Freedom	F statistic	p-value
10 year old girl	Race/Ethnicity	3	23.570	.000
10 year old girl	Parent Education	2	40.326	.000
10 year old girl	Household Income	2	35.076	.000
11 year old girl	Race/Ethnicity	3	24.542	.000
11 year old girl	Parent Education	2	30.213	.000
11 year old girl	Household Income	2	34.360	.000
10 year old boy	Race/Ethnicity	3	26.649	.000
10 year old boy	Parent Education	2	33.643	.000
10 year old boy	Household Income	2	28.802	.000
11 year old boy	Race/Ethnicity	3	28.851	.000
11 year old boy	Parent Education	2	31.155	.000
11 year old boy	Household Income	2	33.612	.000

[a] Four categories of race/ethnicity including non-Hispanic white, non-Hispanic black, non-Hispanic multiracial/other and Hispanic.
[b] Three categories of parent education including <12 years, 12 years, 13+ years.
[c] Three categories of household including <200% of poverty level, 200 to 399% of poverty level, 3 ≥ 400% of poverty level.

APPENDIX D

Appendix D contains the results of collinearity diagnostics for the independent variables utilized in the OLS and logistic regressions. The results were obtained from the OLS regression procedure but are also valid in assessing multicollinearity among variables used in logistic regressions (Benson & Saguy, 2005; A. Field, 2005, p. 261). Field suggests that when VIF values are <10 and tolerance statistics are >.2, that multicollinearity is not a problem in the model (A. Field, 2005, p. 174)

Appendix D – Table 1. Collinearity statistics for Control Model – demographics and measures of SES

Variable	Tolerance	VIF
Age in years	.999	1.001
Sex	.999	1.001
Parental Education	.848	1.179
Household Income	.837	1.194
NH White vs. NH Black	.946	1.057
NH White vs. NH Other	.974	1.027
NH White vs. Hispanic	.933	1.072

Appendix D – Table 2. Collinearity statistics for Model 1 – measures of personal social capital

Variable	Tolerance	VIF
Age in years	.998	1.002
Sex	.994	1.006
Parental Education	.823	1.215
Household Income	.790	1.265
NH White vs. NH Black	.939	1.065
NH White vs. NH Other	.969	1.032
NH White vs. Hispanic	.922	1.084
Type of School	.964	1.037
Gets along well with peers	.984	1.016
Participates in activities outside of school	.898	1.113
# of times child has moved	.954	1.049

Appendix D – Table 3. Collinearity statistics for Model 2 – measures of family social capital

Variable	Tolerance	VIF
Age in years	.998	1.002
Sex	.998	1.002
Parental Education	.842	1.188
Household Income	.750	1.334
NH White vs. NH Black	.909	1.100
NH White vs. NH Other	.970	1.031
NH White vs. Hispanic	.923	1.084
Family Size	.937	1.067
Parents know friends	.952	1.051
2 parent bio/adopt vs. 2 parent step	.922	1.085
2 parent bio/adopt vs. single parent	.799	1.251
Eat meals together	.992	1.008

Appendix D – Table 4. Collinearity statistics for Model 3 – measures of neighborhood social capital

Variable	Tolerance	VIF
Age in years	.999	1.001
Sex	.997	1.003
Parental Education	.840	1.191
Household Income	.781	1.280
NH White vs. NH Black	.891	1.123
NH White vs. NH Other	.964	1.037
NH White vs. Hispanic	.906	1.104
MSA Type	.919	1.088
Neighbors help each other	.872	1.147
Safety	.853	1.173

Appendix D – Table 5. Collinearity statistics for the Full Model – measures of personal, family and neighborhood social capital

Variable	Tolerance	VIF
Age in years	.997	1.003
Sex	.993	1.007
Parental Education	.818	1.223
Household Income	.687	1.455
NH White vs. NH Black	.862	1.160
NH White vs. NH Other	.958	1.043
NH White vs. Hispanic	.892	1.121
School Type	.938	1.066
Gets along well with peers	.952	1.051
Activities outside of school	.909	1.100
# of times child has moved	.863	1.158
Family Size	.926	1.080
Parents know friends	.892	1.121
2 parent bio/adopt vs. 2 parent step	.846	1.182
2 parent bio/adopt vs. single parent	.767	1.303
Eat meals together	.984	1.016
MSA Type	.909	1.101
Neighbors help each other	.846	1.183
Safety	.850	1.176

APPENDIX E

Appendix E summarizes the regression models produced. The logistic regression models were built with Obese as the dependent variable. The OLS regression models were built with BMI as the dependent variable. The predictor/independent variables from each model are not included in this section. All relevant factors related to the independent variables were reported in the body of the study.

Appendix E – Table 1. Summary of logistic regression models[a] in the study with Obese modeled as the dependent variable.

	Basic Model	Model 1 Personal	Model 2 Family	Model 3 Neighborhood	Full Model
N	9163	9114	8963	8851	8625
Model Ch-square	453.122	494.358	533.678	455.697	548.456
Model p value	.000	.000	.000	.000	.000
Model -2LL	8787.238	8679.959	8459.777	8443.098	8044.527
Cox & Snell R^2	.048	.053	.058	.050	.062
Nagelkerke R^2	.076	.083	.091	.079	.098
Hosmer & Lemeshow	.764	.287	.600	.466	.104
Initial -2LL	9240.360	8727.822	8550.608	8443.098	8175.245
Pseudo R^2 (calculated)	.049	.057	.062	.054	.067
% Not Obese Identified	99.2	99.1	99.1	99.4	99.1
% Obese Identified	2.7	2.8	2.8	2.9	4.4
Total Percentage Correct	79.7	79.6	79.6	80.0	80.3

[a] Control model includes demographics/SES variables only. Model 1- Measures of personal social capital controlled for demographic/SES influence. Model 2 – Measures of family social capital controlled for demographic/SES influence. Model 3 – Measures of Neighborhood social capital controlled for demographic/SES influence. Full Model – Measures of personal social capital, family social capital and neighborhood social capital controlled for demographic/SES influence.

Appendix E – Table 2. Summary of OLS regression models[a] in the study with BMI modeled as the dependent variable.

	Basic Model	Model 1 Personal	Model 2 Family	Model 3 Neighborhood	Full Model
N	9156	9132	8957	9005	8790
Adjusted R^2	.057	.063	.067	.057	.069
Durbin-Watson	1.987	1.986	1.975	1.996	1.989
ANOVA sig.	.000	.000	.000	.000	.000
Adj R^2 demographics	.057	.057	.057	.055	.054
R^2 change*		.006	.011	.002	.016
Sig. of change*		.000	.000	.000	.000

[a] Control model includes demographics/SES variables only. Model 1- Measures of personal social capital controlled for demographic/SES influence. Model 2 – Measures of family social capital controlled for demographic/SES influence. Model 3 – Measures of Neighborhood social capital controlled for demographic/SES influence. Full Model – Measures of personal social capital, family social capital and neighborhood social capital controlled for demographic/SES influence.

APPENDIX F

Appendix F provides a summary of the logistic regression models produced for the supplementary analyses of age differences, sex differences and weight status differences. These models included all the independent measures of personal social capital, family social capital and neighborhood social capital controlling for demographic/SES influence (known as the "Full Model"). For the supplementary analyses, only the model identified as the Full Model was employed.

Appendix F – Table 1. Summary of supplementary logistic regression models[a] in the study with Obese modeled as the dependent variable except where noted.

	All 10 year olds	All 11 year olds	All Girls	All Boys	Overweight & Obese[b]	Obese Only
N	4249	4376	4196	4429	8625	8625
Model Ch-square	254.581	295.733	213.993	297.324	494.516	548.456
Model p value	.000	.000	.000	.000	.000	.000
Model -2LL	4223.640	3794.268	3543.420	4480.383	10944.301	8044.527
Cox & Snell R^2	.058	.065	.050	.065	.056	.062
Nagelkerke R^2	.089	.108	.084	.098	.076	.098
Hosmer & Lemeshow	.322	.173	.314	.434	.334	.104
Initial -2LL	4294.188	3870.264	3586.366	4579.555	11438.817	8175.245
Pseudo R^2 (calculated)	.059	.076	.061	.065	.043	.067
% Not Obese Identified	98.9	99.3	99.7	98.1	89.4	99.1
% Obese Identified	5.9	4.6	1.3	7.5	24.2	4.4
Total Percentage Correct	78.5	82.5	83.5	77.2	64.7	80.3

[a] All analyses conducted using the Full Model which included measures of personal social capital, family social capital and neighborhood social capital controlling for demographic/SES influence.
[b] In this model only, the dependent variable was modeled as all children with a BMI at the 85th percentile or above for age and sex.

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ABSTRACT

A STUDY OF THE ASSOCIATIONS BETWEEN CHILDHOOD OBESITY AND THREE FORMS OF SOCIAL CAPITAL

by

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Major: Sociology (Medical Sociology)

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The purpose of the study was to expand the understanding of childhood obesity in American children by examining the associations between obesity in children and measures of social capital. Persons between 2 and 20 years of age are categorized as "obese" if their BMI is in 95th percentile or above for their age and sex using the Center for Disease Control and Prevention (CDC) BMI-for-age growth charts.

Obesity prevalence has more than quadrupled in the last 40 years in the United States for children. The prevalence rate is 17.0% for children ages 6-11 years. Social capital, in the study of health, can be defined as *resources* accrued and/or accessed from social relationships/social bonds at multiple levels including the individual, family, neighborhood, community or nation. The research quantitatively analyzed the associations between the likelihood of childhood obesity and BMI with personal social capital, family social capital and neighborhood social capital.

The research was conducted with a public use dataset from the 2003 National Survey of Children's Health. This survey is part of the State and Local Area Integrated Telephone Survey Program (SLAITS) conducted by the CDC's National Center for Health Statistics (NCHS) and was funded by the Maternal and Child Health Bureau (MCHB). A dataset for the study was created for the 10,018 10 and 11 year olds for whom height and weight was available. The study population had an obesity prevalence of 20.4. Logistic and OLS multiple regression models were employed for hypotheses testing. Eleven indicators were categorized as measures of personal social capital, family social capital or neighborhood social capital. The regression models clearly identified many individually significant measures of social capital but their (the regression models) were weak in their predictive power.

Five individual indicators of social capital were particularly noteworthy for having consistently significant associations with the likelihood of obesity and BMI throughout the research. These include type of school (private or public), moving, number of siblings, parents knowing friends and participating in activities outside of school. The research supports the idea that the study of children's social capital (personal, family and neighborhood) is a viable way to expand the understanding of the pathways behind the social patterning of childhood obesity in the United States.

AUTOBIOGRAPHICAL STATEMENT

Cynthia Bala-Brusilow was born in Detroit, Michigan. She received a Bachelor of Business Administration and a Master of Science in Organizational Development from Eastern Michigan University School of Business. Additionally, she has a Master of Public Health from the University of Michigan School of Public Health. She began working as the nurse recruiter for Henry Ford Wyandotte Hospital in 1986. She stayed in the Henry Ford Health System (HFHS) for the next 13 years. In addition to positions at Henry Ford Wyandotte Hospital, she also worked at Henry Ford Hospital and for the Henry Ford Medical Group. She has management and staff experience working with in planning, development, operations, quality assessment, clinical operations and research support. She left Henry Ford in 1999 to begin work on her doctorate in Medical Sociology. Her areas of interest are health risk factors and diseases that are socially patterned, health disparities, health care financing, social capital in the study of health and social factors associated with nutrition and physical activity. She is also interested in the sociology of rock and popular music. Recently, she was elected to the Health Alliance Plan Board of Directors. She resides in suburban Detroit with her husband and three children.