Examine Predictors of BMI Classification and Perception of Overweight Status of Caregivers of Preschool Children

Beth H. Chopp
Old Dominion University, bchopp01@gmail.com

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EXAMINE PREDICTORS OF BMI CLASSIFICATION AND PERCEPTION OF
OVERWEIGHT STATUS OF CAREGIVERS OF PRESCHOOL CHILDREN

by

Beth H. Chopp
B.S. June 1984, Drexel University
M.S. May 1987, Saint Joseph’s University

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Approved by:

Muge Akpınar-Elçi (Director)
Praveen Durgampudi (Member)
Hazida Galadima (Member)
ABSTRACT

EXAMINE PREDICTORS OF BMI CLASSIFICATION AND PERCEPTION OF OVERWEIGHT STATUS OF CAREGIVERS OF PRESCHOOL CHILDREN

Beth H. Chopp
Old Dominion University, 2019
Director: Dr. Muge Akpinar-Elci

Since the 1970’s the rate of childhood obesity in the United States has tripled and now one in five school-aged children is obese (Ogden et al., 2016). The childhood obesity epidemic will have medical, social, economic implications for future generations. Risk factors for childhood obesity include genetics, food intake, and physical activity, maternal health during pregnancy, parental weight, maternal employment and sociodemographic influences. This study examined the relationship between caregiver misperception of their preschoolers’ overweight/obese weight status and possible predictors that may assist in future interventions.

The study evaluated NHANES data of 1245 caregivers with a child under age five in their household and 825 children ages two to five in the years 2015 and 2016.

The predictors of body mass index (BMI) categories of overweight and obese in an adult caregiver of children under age five and preschool children age two to five were examined. The analyses included descriptive statistics, correlations and multinomial logistic regressions.

The 61.1% of adults with a child in the household under age five reported “I think I am overweight” are in the obese BMI category and only 30.6% of the overweight adults perceived themselves as “I think I am overweight”. The caregivers who completed a questionnaire about their preschool child, 11.7% reported “think your child weight is about right” when the child’s BMI was in the obese category and 16.0% of the children in the overweight BMI category were incorrectly identified by their caregiver as “about right”. The adult group’s perception of their own weight as well as their child’s weight was miscategorized.
The majority of children who have a BMI in the overweight or obese categories have been told by a healthcare professional (HCP) about their weight. Surprisingly, 12.0% (n=168) of the obese category BMI and 14.5% (n=203) of the overweight BMI category children were not told by an HCP that the child is overweight and at risk for lifetime health issues. Based on the findings of this study, a modified SEM model focusing more attention on caregivers of preschool children and may increase the success of future interventions.
This dissertation is dedicated to my husband, Brian, who has been a constant source of support and encouragement over the past seven years through the many challenges of balancing graduate school, work and home. I am truly thankful and happy to have you be my partner in my life.
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CHAPTER I
INTRODUCTION

Obesity is one of the most significant public health challenges in the United States today. The World Health Organization (WHO) reports the incidence of obesity worldwide has almost doubled since 1980 and today there are more than 1.9 billion obese adults and 42 million overweight children under the age of five ("WHO | Childhood overweight and obesity," n.d.). Since the 1970’s the rate of childhood obesity in the United States has tripled and now one in five school-aged children is obese (Ogden et al., 2016). The childhood obesity epidemic will have medical, social, economic implications for future generations.

Studies have shown that obese children are more likely to be obese as adults (Guo & Chumlea, 1999). Data from the Bogalusa Heart Study showed that children who became obese as early as age two are more likely to be obese as adults and have increased risks of cardiovascular disease in adulthood (D. S. Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001). Obese children and adolescents are at higher risk during their lifetime for coronary artery disease, stroke, type 2 diabetes, high cholesterol, hypertension, gallstones, fatty liver disease, sleep apnea, degenerative joint disease, birth defects, miscarriages, asthma and other respiratory conditions, and numerous cancers (Daniels et al., 2005). Skinner and Shelton (2014) found that preschool children who are overweight have a greater risk to become severely obese in later life as compared to adolescents who become overweight in their teens. A 2014 study found “the incidence of obesity between ages 5 and 14 years was 4 times as high among children who had been overweight at age 5 years as among children who had a normal weight at that age” (Cunningham, Kramer, & Narayan, 2014, p. 409).
Childhood obesity is a complex health issue that is rooted in behavior, environment and genetics and is caused by an energy imbalance between the numbers of calories being consumed and number of calories being burned for basal function and exercise (CDC, 2016). Overweight has been defined as an excess of body weight as compared to a set of standards and obesity is having an abnormally high proportion of body fat compared to lean muscle mass.

Children and adolescents have differing levels of control over the types and quantities of food they consume. “During these early years, children are learning what, when, and how much to eat based on the transmission of cultural and familial beliefs, attitudes, and practices surrounding food and eating” (Savage, Fisher, & Birch, 2007, p. 22). Preschool aged children are not able to purchase, prepare or portion their meals and are entirely dependent on their caregiver to make all food choices as well as model eating behaviors.

It is not surprising that children have a greater risk of becoming obese when they have obese parents. Children with two obese parents are 10 to 12 times more likely to be obese in childhood (Reilly et al., 2005). “Weight gain in early childhood (3 to 5 years of age) is significantly greater among children with overweight or obese parents or among those born of overweight or obese mothers” (Fuemmeler, Lovelady, Zucker, & Østbye, 2013, p. 817). The proposed study will examine caregiver perception of their preschool aged child’s body weight as well as the relationship with the adult’s perception of their own body weight in the context of the Social Ecological Model (SEM) utilizing the National Health and Nutrition Survey (NHANES) from 2015-2016.

**PROBLEM STATEMENT**

Children in the Unites States “are the first generation of young Americans to face the prospect of living their entire lives in poorer health and dying younger than previous
generations” due to extraordinary rates of childhood obesity ("We Must All Play a Role in Ending Childhood Obesity," 2015, para. 1). Nearly 30% of all children in the United States are overweight or obese (Y. Wang et al., 2013). Overweight preschool children are more likely to become the next generation of overweight or obese adults (Dietz, 2004).

**BACKGROUND AND PURPOSE OF THE STUDY**

There are numerous risk factors for childhood obesity including genetics, food intake, physical activity, maternal health during pregnancy, comorbid conditions and sociodemographic (CDC, 2016). Weight gain is dependent on consuming more calories from food and beverages than required for healthy growth and activity of children (Benton & Young, 2017). Since energy imbalance is a critical factor contributing to the high rates of childhood obesity many treatments or interventions focus on food/beverage intake or physical activity (Hill, Wyatt, & Peters, 2012).

The complications and comorbid conditions that accompany childhood obesity add to the cost of health care spending in the United States. Childhood obesity has significant economic consequences due to direct cost of care related to obesity and indirect costs due to increased mortality and morbidity (CDC, 2016). Obese children are at higher risk for chronic conditions such as sleep apnea, type 2 diabetes, hypertension and bone and joint problems (David S. Freedman et al., 2007; Han, Lawlor, & Kimm, 2010). The growth in lifetime chronic health conditions has significant implications for the economic solvency of the healthcare system and ability to supply services and care for obese patients as they age.

Researchers have followed the dramatic increase in the prevalence of childhood obesity over the last 30 years and have used national health survey data to monitor changes in the rates of childhood obesity (Skinner & Skelton, 2014). A 1997 study used the NHANES data to compare the prevalence of childhood obesity in preschool children from 1971 through 1994. The
results showed an increase of the prevalence of overweight preschool children in the United States over a twenty-year period (Ogden et al., 1997). A 2018 analysis of the NHANES data from the years 1999-2016 showed continued increases in the overall prevalence of childhood obesity as well as a significant spike in rates of severe obesity in children ages two to five years old (Skinner, Ravanbakht, Skelton, Perrin, & Armstrong, 2018).

The preschool years is the time of life when attitudes, food preferences, eating behavior, and physical activity are created (Hesketh, Waters, Green, Salmon, & Williams, 2005). The caregivers are the primary role models for preschool children and their perceptions of their child’s weight can play a role in obesity prevention and treatment. A meta-analysis of sixty-nine studies that included 15,791 parent and child pairs, found 50.7% of the parents underestimated their child’s weight who were obese or overweight and one out of seven underestimated their child’s normal weight (Lundahl, Kidwell, & Nelson, 2014).

Pediatricians and primary care physicians are on the forefront of diagnosing and counseling children and their caregivers about obesity. Nutrition education surveys of United States medical schools over the past ten years found 63-71% of schools failed to provide the required 25 hours of nutrition education prescribed by the National Academy of Science (Adams, Kohlmeier, Powell, & Zeisel, 2010; Adams, Kohlmeier, & Zeisel, 2010; Adams, Lindell, Kohlmeier, & Zeisel, 2006; Devries, Willett, & Bonow, 2019). Patients consider physicians as a reliable source of nutrition information but physicians and graduate medical students report lacking the adequate nutrition knowledge to counsel patients about nutrition (Adams, Kohlmeier, & Zeisel, 2010; Connor, Cialdella-Kam, & Harris, 2015; Levine et al., 1993). Lack of nutrition knowledge of medical professionals has been shown to be a barrier to the identification and treatment of obesity (Mogre, Stevens, Aryee, Amalba, & Scherpier, 2018).
The staggering increases in childhood obesity rates have prompted researchers to investigate the risk factors for childhood obesity and attempt to develop interventions to prevent weight gain and to foster weight loss. Several approaches have been suggested to combat the childhood obesity epidemic that include programs placed in schools, communities, and primary care settings (Economos et al., 2007; Hollar et al., 2010; Taveras et al., 2015). Schools, home and community settings have impact on the eating and exercise patterns of children, but few studies have been conducted in preschool age children.

A 2014 review of healthy eating interventions around the world to prevent obesity in preschool aged children evaluated 26 interventions that took place in preschools or kindergartens. The review found healthy eating interventions that targeted food choices in preschools could significantly increase fruit and vegetable consumption as well as increase nutrition knowledge among preschool children. Despite increased fruit and vegetable consumption, only two studies reported a decrease in weight of BMI. Most of the studies, 16 of the 26, did not state if the intervention was based on a health behavioral theory. The Social Cognitive Theory (SCT) was the basis for six of the interventions. The authors concluded preschool setting has great potential for influencing healthy eating habits and combatting obesity in preschool aged children (Mikkelsen, Husby, Skov, & Perez-Cueto, 2014).

A 2016 Cochrane review examined seven randomized controlled trials in preschool aged children. The authors found “Multicomponent inventions appear to be effective treatment option for overweight or obese preschool children up to age 6 years” (Colquitt et al., 2016, p. 2). There were improvements noted in the health-related quality of life in several of the studies but not discussed in the other trials. There was limited discussion of the impact of the interventions on parent-child relationship, or influence on parenting; none of the seven interventions utilized
behavior-change framework (Colquitt et al., 2016). However, none of the interventions reviewed were based on a behavioral model given “increasing evidence suggests that public health and health-promotion interventions that are based on social or behavioral science theories are more effective than those lacking a theoretical base” (Glanz & Bishop, 2010, p. 399).

The family is the primary social group prior to a child beginning school. A 2012 meta-analysis of forty-two childhood obesity interventions for two to nineteen year-old children showed that when parents were involved in the intervention there was a greater reduction in BMI than interventions that had little or no parental involvement (Niemeier, Hektner, & Enger, 2012). Parents and caregivers model eating patterns and exercise behaviors for young children. Children who participate in an intervention based in a school or daycare setting have less involvement from parents. It has not been demonstrated how to best involve parents and caregivers into the obesity interventions and improve results.

A 2016 review of preschool childhood obesity examined interventions that were dived into two categories: prevention or management. The authors found that weight management interventions showed greater weight loss as compared to prevention interventions and that programs need to focus on the parents or caregivers since they are the “agents of change” (Ling, Robbins, & Wen, 2016, p. 270). The review found half of the 29 studies reviewed used the SCT and three used SEM. Interestingly, the studies based on theoretical models did not show greater change in BMI than the studies not based on a theory. These authors concluded that future preschool obesity intervention programs should blend the constructs of self-efficacy, observational learning and role modeling from SCT and require the parent’s or caregivers to be actively involved in the interventions.
A 2018 review of twelve preschool obesity interventions based in preschools or childcare settings found programs that were multi-component focused on environmental and individual level determinates of healthy eating behaviors reported better outcomes. The authors recommended a blending of the SCT along with SEM to better include both individual constructs as well as environmental which were move effective than educational programs focused on the child alone. The study pointed out that parents were seldom fully engaged in the interventions and recommended more research exploring how to maximize the interactions between educators and parents (Matwiejczyk, Mehta, Scott, Tonkin, & Coveney, 2018).

THEORETICAL FRAMEWORK

Childhood obesity is a complicated by multiple dynamic relationships, which include parent-child, family, community and school as well as public policies. The Social Ecological Model (SEM) emerged from ecological systems theory which examined the networks between people and their environment (Bronfenbrenner, 1979). SEM is a model designed to understand the factors and barriers that impact health behavior. There are five nested, hierarchical levels of the SEM: Individual, interpersonal, community, organizational, and policy/enabling environment (McLeroy, Bibeau, Steckler, & Glanz, 1988). Since preschool obesity is impacted by the child's relationships in his or her environment the SEM model was chosen examine how the various factors influence health outcomes.

RESEARCH QUESTIONS AND HYPOTHESES

Research Question 1

Is there a relationship between caregiver perception of their preschool aged child weight status and measured BMI of the child?
H0: There is no relationship between caregiver perception of preschooler’s body weight and the preschooler’s body mass index category in the 2015 -2016 NHANES dataset.

H1: There is a relationship between caregivers’ perception of their preschooler’s body weight and the preschooler’s body mass index category in the 2015-2016 NHANES dataset.

Research Question 2

Are health care providers communicating with caregivers of preschool children about their child’s overweight status?

H0: There is no relationship between notification by a medical professional that a preschooler is overweight and the preschoolers body mass index category in the 2015 -2016 NHANES dataset.

H1: There is a relationship between notification by a medical professional that a preschooler is overweight and the preschoolers body mass index category in the 2015 -2016 NHANES dataset.

**SIGNIFICANCE OF STUDY**

The goal of this research is to examine the utility of the Social Ecological Model as the basis for designing obesity interventions for the preschool population in the United States. Little is known as to which of the five levels of the SEM is most impactful to developing and implementing preschool obesity interventions. Davidson and Birch (2001) designed a model of the factors that may play a role in childhood obesity. The two inner levels focus on the child and the guardians or parents exclusively. This model expands the interpersonal level, reduces the community and public policy level, and may be best suited for preschool obesity interventions since the guardians or parents own behaviors and believe model and control the preschooler’s dietary intake. The findings from this study may guide healthy eating educational programs to focus on caregivers of children who participate in programs for low-income households such as Supplemental Nutritional Assistance Program (SNAP), Women, Infants and Children (WIC) and
Head Start as well as initiatives with health care providers such as parents who may receive education from pediatricians or obstetricians.
CHAPTER II
LITERATURE REVIEW PRESCHOOL OBESITY

The purpose of this chapter is to review the literature about the causes and consequences of the shifting rates of preschool obesity in the United States, as well as review obesity interventions and the utility of the SEM to guide interventions. The prevalence of childhood obesity has been increasing over the past four decades and has reached epidemic proportions in the United States and around the world. In the United States, one in five school-aged children is obese (Ogden et al., 2016). The childhood obesity epidemic is far reaching and will have medical, social, economic implications for future generations.

Overweight and obesity are caused by an energy imbalance between the numbers of calories being consumed and number of calories being burned for basal function and exercise. Obesity is a complex health issue that is rooted in behavior, environment and genetics (“Defining Childhood Obesity | Overweight & Obesity | CDC,” n.d.). BMI is most commonly used tool to assess overweight and obesity. BMI is calculated using a person’s weight and height and has been proven to be a reliable indicator of body fatness for most people (“Body Mass Index (BMI) | Healthy Weight | CDC,” 2019). Weight gain is dependent on consuming more calories from food and beverages than required for healthy growth and activity of children. BMI changes with normal growth and development of children and adolescents and it must be adjusted for age and sex in children (Skinner & Skelton, 2014). In 2000, the Centers for Disease Control and Prevention (CDC) published age and gender specific BMI growth curves for children and adolescents ages two to twenty. The growth curves are based on a national representative sample that is ethnically diverse and is age and sex specific (Spruijt-Metz, 2011).
RISK FACTORS OF PRESCHOOL OBESITY

Numerous risk factors for childhood obesity include genetics, food intake, and physical activity, maternal health during pregnancy, parental weight, maternal employment and sociodemographic influences. Since energy imbalance is a critical factor contributing to the high rates of childhood obesity many interventions focus on food/beverage intake or physical activity (Hill et al., 2012).

1. Maternal Health and Intrauterine Exposures

“Maternal health can have a significant impact on the in-utero environment and, thus, on fetal development and the health of the child later in life” (Leddy, Power, & Schulkin, 2008, p. 171). Maternal obesity and excessive weight gain during pregnancy and gestational diabetes have been associated with childhood obesity (Boerschmann, Pflüger, Henneberger, Ziegler, & Hummel, 2010; Gillman, Rifas-Shiman, Berkey, Field, & Colditz, 2003). Maternal smoking, birth by cesarean section and formula feeding have also been associated with childhood obesity (Haire-Joshu & Tabak, 2016). Interestingly, duration of breastfeeding found to be related to a decreased risk of obesity in adolescence and adulthood (Weng, Redsell, Swift, Yang, & Glazebrook, 2012).

2. Food/Beverage Intake and Physical Activity

Obesity is a consequence of an imbalance between the number of calories eaten and number of calories burned has prompted research into children’s diets as well as physical activity levels. In 2015, the American Academy of Pediatrics recommended the following guidelines a healthy diet and activity levels for children; eat five servings of fruits and vegetables per day, limit screen time, strive for at least one hour of physical activity a day and limit consumption of
sugar-sweetened drinks. Childhood obesity prevention programs include guidance on either
dietary intake or physical activity or both (Daniels, Hassink, & Committee on Nutrition, 2015).

3. Genetics/Endocrine

Genetic research of twin sets either raised together or separately showed that genetic
factors account for between 30% and 70% of variation in BMI between the twin sets (Xia &
Grant, 2013). Studies of adopted children show a strong correlation of the child’s BMI and the
biological parent’s BMI but not with adoptive parent’s BMI (Sørensen, Holst, Stunkard, &
Skovgaard, 1992; Xia & Grant, 2013). Obesity prevalence differences have been shown between
different ethnic groups, which can range from less than 35% in European population to greater
than 50% in Pacific Island peoples (Knowler, Pettitt, Saad, & Bennett, 1990). Genes play a role
in obesity but so do behavior and environment.

4. Parental Education/Income

A 2018 study analyzed parental education level and household income in NHANES data
for the years 2011 through 2014. The study found “Obesity prevalence decreased as head of
household education increased in all subgroups examined. The prevalence of obesity was
consistently lowest among children in households headed by college graduates, which differed
from the pattern seen by income level” (Ogden et al., 2018, p. 187). Household income and
education are interrelated since higher levels of education generally translates to higher incomes
increased at all income and education levels (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010).

5. Maternal Employment

Social changes starting in the 1960’s and 1970’s saw more women working outside the
home. Several authors found an association with maternal employment and increased rates of
childhood obesity (Datar, Nicosia, & Shier, 2014). It has been hypothesized that working mothers spend less time cooking and use more prepared high calorie foods. Herbst & Tekin (2009) have reported that children who are cared for in daycare type arrangements compared to being cared for by relatives or nannies are at increased risk of obesity. Working mothers increase the total household income. There is conflicting data on whether increased income is contributor to obesity by providing a more sedentary lifestyle or increases the ability to purchase healthier fresh fruits and vegetables. More research is needed to determine the effect of maternal employment and increased household income (Fitzsimons & Pongiglione, 2019; Morrissey, 2013).

6. Race/Ethnicity and Household Income

Several studies have shown a correlation between higher rates of childhood obesity with race/ethnicity (Caprio et al., 2008; Dixon, Peña, & Taveras, 2012; Ogden et al., 2016). A study in 2009 found preschool obesity to be more prevalent among American Indian and/or Native Alaskan as compared to Non-Hispanic White or Non-Hispanic Asian children. (Anderson & Whitaker, 2009). A 2015 study examined the relationship between childhood obesity, race/ethnicity and household income in a population of children in Massachusetts. When the researchers controlled for family income, the relationship between race/ethnicity and childhood obesity disappeared. The findings suggest that household income may have a greater impact on rates of childhood obesity than racial/ethnicity differences and that children living in households with lower income may be an optimal population for obesity prevention interventions.

7. Psychological Impact

Overweight and obese children not only have physical disorders are also more likely to suffer psychological effects such as social isolation, bullying low self-esteem, higher rates of
anxiety disorders, body image disturbance, and depression (van Geel, Vedder, & Tanilon, 2014; F. Wang, Wild, Kipp, Kuhle, & Veugelers, 2009). Obese children and adolescents reported significantly lower quality of life compared to their normal-weight peers in the areas of emotional well-being, social relations, self-esteem and perceptions regarding body and appearance (Wallander et al., 2013). Obese children and adolescents report higher rates of teasing and bullying than normal-weight children and adolescents (Griffiths, Wolke, Page, Horwood, & ALSPAC Study Team, 2006; Patro-Sztainer et al., 2002). Teasing and bullying can alienate obese children and adolescents can result in unhealthy binge eating or dieting (Tanofsky-Kraff et al., 2006; Tanofsky-Kraff, Faden, Yanovski, Wilfley, & Yanovski, 2005; Tanofsky-Kraff et al., 2009).

8. Relationship to Parental Obesity

Studies have shown that children have a greater risk of becoming obese when they have two obese parents compared to only having one overweight parent. Children with two obese parents are 10 to 12 times more likely to be obese in childhood (Reilly et al., 2005). There is conflicting data, which overweight parent, mother or father, have the greatest impact on the weight of the preschool child. A longitudinal study in Australia found children with an obese father and a normal weight mother were fifteen times more likely to be obese compared to children with normal weight parents (Freeman et al., 2012). Despite which parent is obese, children born to an obese parent or parents are at significant increase risk to become an obese child.

“Parents have a profound influence on their children’s weight status and lifestyle through their own behaviors, parenting practices and, a role in shaping the food and physical activity environment at home” (Morgan et al., 2017, p. 2). Mothers have an influence on infant’s health
and weight while the baby is in the womb. It has been proposed that the intrauterine environment may influence BMI and adiposity later in life (Patro et al., 2013). A systematic review of 23 studies that examined the association between weight gain during pregnancy and offspring’s body weight suggest high rates of gestational weight gain early in pregnancy could be a possible risk factor for childhood obesity (Lau, Liu, Archer, McDonald, & Liu, 2014). Maternal Gestational Diabetes (MGD) can develop during pregnancy. Obstetricians routinely screen all pregnant women for MGD during weeks 24 - 28 of the pregnancy. In most cases, the condition goes away after the baby is delivered but the lifetime risk of Type 2 diabetes for women with gestational diabetes may be as high as 50 percent (Rani & Begum, 2016).

Intergenerational transmission of obesity risk has been studied across six countries using the following data sets: China Health and Nutrition Survey (CHNS), Indonesian Family Life Survey (IFLS), British 1970 Cohort Studies (BC1970), Health Survey for England (HSE), NHANES, Spanish National Health Survey (ENS-2006) and Evaluation of Urban Households in Mexico. The authors found the intergeneration transmission of obesity is comparable in all six countries over time despite the differences in economies and degree of development (Dolton & Xiao, 2017).

A second intergenerational transmission of obesity study evaluated health surveys for England for the years 2001 to 2006 that included 4432 families and 7078 children ages two to fifteen years old. The study found families with parents whose BMI’s were within the normal range, only 2.3% of their children were obese or had a BMI greater or equal to 30. The group with two overweight parents found 21.7% of their children were obese. The authors also found a stronger association for maternal weight for risk for childhood obesity and discussed the
possibility of targeting obese parents for preschool obesity prevention programs (Whitaker, Jarvis, Beeken, Boniface, & Wardle, 2010).

A cross sectional study conducted in Scotland between 2008 and 2009, surveyed 1651 households with children aged two to fifteen years old. The study found the prevalence child obesity increased with parental BMI. The prevalence of childhood obesity, BMI equal or greater than 30 was 17.2% with normal or overweight parents (BMI 25-30) but increased to prevalence of 57% in children with one parent with a BMI greater than 40. The author suggests targeting household that have one or more parent with a BMI greater than 40 since that would theoretically reduce the overall prevalence of child obesity by nine percent (McLoone & Morrison, 2014).

A 2017 systematic review studied the association between parental and child obesity around the world. The authors examined twenty-two cross sectional studies and ten cohort studies that included school aged children. The authors found two-thirds of the 32 studies showed a moderate association and ten percent showed a strong association between parent and child obesity status. Stronger associations were shown in older children than younger children and the authors suggested that this may be due to more time spent living in the shared obesogenic environment (Y. Wang, Min, Khuri, & Li, 2017).

All the studies reviewed previously were cross sectional or cohort design. There was one longitudinal study, British study of 12,747 children from a 1958 birth cohort were assessed for height and weight at birth to age 33. The authors found that “children of obese parents are at increased risk of obesity throughout childhood and early adult life, particularly if both parents are obese” (Lake, Power, & Cole, 1997, p. 380).

Parents have significant influence on the health of their children. The previous review of literature does point to the fact there is an increased risk of parental transmission of obesity
between parent and child but is not clear which factors, genetics, fetal exposure or common family living lifestyle and eating patterns add most significantly to obesity risk.

9. Lack of Medical Professionals Education on Childhood Obesity

The American Medical Association (AMA) did not officially recognize obesity as a disease until 2013. The AMA called for substantial changes in medical interventions and urged physicians to address obesity concerns with their patients (Pollock, 2013). Pediatricians are the primary medical professionals who are identifying, treating and counseling children, adolescents and their parents. Nutrition education surveys of United States medical schools over the past ten years found the majority of schools, 63-71% of schools failed to provide the required 25 hours of nutrition education prescribed by the National Academy of Sciences (Adams, Lindell, Kohlmeier & Zeisel, 2006; Adams, Kohlmeier, & Zeisel, 2010).

Patients consider physicians a reliable source of nutrition information but physicians and graduate medical students report lacking the adequate nutrition knowledge to counsel patients about nutrition (Levine et al., 1993, Adams, K. M., Kohlmeier, M., & Zeisel, S. H. (2010), Connor, Cialdella-Kam, & Harris, 2015). Healthcare providers report hesitancy to discuss weight status in children and teens due to fear of causing eating disorders later in life or promoting a poor self-concept (Goodman, Hinden, & Khandelwal, 2000). Lack of nutrition knowledge among physicians has been shown as a barrier to the identification and treatment of obesity but there have been no policies enacted by the professional societies or organizations to require medical schools or resident training programs to include expanded nutrition education programs.
ECONOMIC FACTORS INFLUENCING PRESCHOOL OBESITY

The complications and comorbid conditions that accompany childhood obesity add to health care spending in the United States. Finkelstein et al., (2009) estimated medical treatment costs of child obesity in the United States at 14.1 billion dollars in direct costs in 2009. The cost of hospitalizations for obese children and adolescents nearly doubled from $125.9 million in 2001 or $237.6 million in 2005. The average annual Medicaid health costs for an obese child is $6,730 compared to a normal weight child is $2,446 (Trasande, Liu, Fryer, & Weitzman, 2009). Finkelstein, Graham & Malhotra (2014) estimated that the incremental lifetime medical cost of an obese child compared to a normal weight child is $19,000.00 per child.

The factors such as food prices, agricultural support policies and technological advancements have been suggested to have an economic influence the prevalence of childhood obesity. The cost and availability of food eaten at home and in restaurants has been a focus of recent research. Christian, T., & Rashad, I. (2009) has shown that the real price of food (adjusted for inflation) has decreased over the past twenty years. Several other studies have focused on the changes in food prices both increased and decreased as a primary factor in the rise in rates of obesity in the United States (Morrissey, Jacknowitz, & Vinopal, 2014; Powell & Chaloupka, 2009).
The real price for fruits and vegetables has risen over the past 50 years and the consumption of fruits and vegetables by children has decreased. Powell, Zhao & Wang (2009) found that the consumption of fruits and vegetable in young adults is significantly associated with fruit and vegetable prices. When the cost for fruit and vegetable decreases then the consumption of fruits and vegetable by children is increased. Consumption of fruits and vegetables has been found to be associated with lower body weight among low-income children suggesting that lowering the cost of fruits and vegetables for lower-socioeconomic populations may be effective method of reducing childhood obesity among lower socioeconomic groups (Powell, Chriqui, Khan, Wada, & Chaloupka, 2013).

In the 1990’s the term “obesogenic” and “food dessert” began appearing in the literature. Both terms focus on the abundance of high calorie convenience food and the unavailability of healthy whole foods especially in low-income neighborhoods. The media began blaming the consumption of high calorie fast food meals and soda for the childhood obesity crisis. Soda and fast food sales grew exponentially through the 1980’s and 1990’s (Powell & Chaloupka, 2009).
Increases in the cost of sugar led to the increased use of less expensive high fructose corn sugar and resulted in a drop in the cost of two-liter bottle of soda by 35 percent over the past twenty years (Christian & Rashad, 2009). An interesting economic finding by Beydoun, Powell & Wang (2008) is that higher fast-food prices were associated with lower weight outcomes particularly among adolescents suggesting that raising prices of fast food would potentially influence rates of child and adolescent obesity. Real food price and fast food price decreases coupled with fruit and vegetable price increases may be factors that contributed to childhood obesity over the last three decades.

A second possible economic factor contributing to the increase in childhood obesity in the United States is governmental agricultural supports. Current agricultural polices drive the price of sugar up by limiting importation and promote the growing and production of corn with subsidies. The two policies in combination pushed food manufacturers to substitute high fructose corn syrup for sugar in snacks and beverages to increase profits (Cawley, 2010). There is controversial research immersing that fructose does not stimulate gut peptides and insulin like glucose. These proteins play a role in satiety and without them; a person may be more likely to overeat and may be a contributor to obesity (Beghin & Jensen, 2008).

Another proposed factor that may be associated with childhood obesity is the recent advances in technology. Over the past thirty years, technology has changed our lives. Food can be produced in mass quantity and preserved so Americans can make a quick meal with prepared foods (Cawley, 2010). Advances in medical technology and medications have improved the clinical control of diabetes, high blood pressure and high cholesterol so a person can take a medication does not need to exercise or lose weight (Finkelstein & Strombotne, 2010).
Technology has increased our leisure time and has replaced our physical activities with handheld game devices, DVD’s, video games and streaming iPhone (Jackson et al, 2009).

**MONITORING CHILDHOOD OBESITY PREVALENCE**

The prevalence of childhood obesity has been closely monitored since dramatic increases were identified starting in the 1980’s. The first national surveys of children’s BMI began in 1963 and found the BMI of children and adolescents stable until the 1980’s (Lobstein & Jackson-leach, 2007; Strauss &Pollack, 2001; Von hippel, & Nahhas, 2013). Over the next two decades’ rates of childhood, obesity have increased at an alarming pace and are continually monitored. Childhood obesity prevention and intervention programs have been implemented in the United States and around the world to attempt to reverse the weight gain epidemic but there is debate among researchers as to the success of interventions and current trends in prevalence.

The NHANES began in the 1960’s and is a cross sectional health survey collecting data from varied populations and health issues in the United States. In 1999, the NHANES became a yearly survey, compiling health and nutrition data for a representative population of about 5000 Americans. A unique aspect to this survey is the data is not self-reported; instead the data is collected with physical examination and lab testing (“NHANES - National Health and Nutrition Examination Survey Homepage,” n.d.). Many health surveys do not use direct measurement of height and weight instead use parental self-report. Face to face interviews with measured height and weights is cumbersome, time consuming and extremely expensive. The benefit of using standardized measurements is that it limits parental bias or misinformation such as underestimating the child’s weight and overestimating the child’s height (Brettschneider, Ellert, & Schaffrath Rosario, 2012; Dubois & Girad, 2007; Goodman et al., 2000; Huybrechts et al., 2011).
A 1997 study used the NHANES data to compare the prevalence of childhood obesity in preschool children from 1971 through 1994. The results showed an increase in the prevalence of overweight preschool children in the United States over a twenty-year period. This study confirmed the magnitude of the public health problem of childhood obesity (Ogden et al., 1997).

Figure 2. Graph of Childhood Obesity Trends 1963 to 2008.


A second publication of the NHANES data from 1999 - 2000 also showed an increase in childhood obesity prevalence (Ogden, Flegal, Carroll, & Johnson, 2002). Wang (2011) analyzed the 1999-2000 NHANES data for disparities in rates of obesity among different racial and ethnic groups as well as gender and found that some groups are affected more seriously than others.

Native American children have the highest prevalence of obesity, whereas Asians have the lowest rate among all ethnic groups. This early study found preschool age children had lower obesity prevalence than older children. Young people in some states and cities are twice
more likely to be overweight or obese than those living in other regions. Low-socioeconomic status is associated with obesity only among some population groups, e.g. white children and adolescents. (Y. Wang, 2011, p. 30)

In 2014, Ogden et al. analyzed the trends in childhood obesity between 2003 and 2012 using the NHANES data and found no significant changes in obesity prevalence in adolescent or adults between 2003-2004 and 2011-2012 but found a decrease in obesity rates in preschool age children aged two to five years. This was the first time a decrease in prevalence of obesity had been seen in any subgroup of children in the NHANES surveys. This study received considerable attention by the media but skepticism by numerous researchers since all other age groups five to nineteen years old showed continued weight gain and there was a marked rise in percentage of children who are severely overweight or BMI’s greater than 30 in all groups.

Skinner & Skelton (2014) examined a larger number of NHANES, from 1999 to 2012, totaling fourteen years and looked at the prevalence of obesity and severe obesity among children. The authors also saw stabilization in obesity prevalence in some groups of children and adolescents but unlike the Ogden group, the authors did not see a decrease in rates of obesity in preschool children ages two to five years. The researchers also found the number of severely obese Hispanic girls and Non-Hispanic Black boys had increased. The publication questioned if rates of obesity were stabilizing in some populations but increases in severe obesity was rapidly increasing. It did not appear that the interventions across the United States to slow or reduce the prevalence of childhood obesity were having the same impact among varied populations, especially minority populations.

Skinner & Skelton (2014) recommend four accepted classifications of childhood obesity; underweight (BMI-for age < 5th percentile, healthy weight (5th to <85th percentile), overweight (85th to <95th percentile, obese class 1 (95th percentile to < 120% of the 95th percentile) be
expanded to include severe obesity class 2 (120% to 140% of the 95th percentile or BMI of 35.0 to <40.0 kg/m²) and severe obesity class 3 (BMI >140 of the 95th percentile or BMI >40 kg/m²). The expansion of the childhood obesity classifications allows researchers to track changes in levels of severity not just prevalence of childhood obesity to better understand the populations that need to be targeted in interventions.

The most recent analysis of the NHANES data from the years 1999-2016 showed continued increases in the overall prevalence of childhood obesity as well as a significant spike in rates of severe obesity in children ages two to five years old. The study also found increasing rates of severe obesity (Skinner, Ravanbakht, Skelton, Perrin, & Armstrong, 2018). Despite implementation of countless child obesity prevention and intervention programs, obesity in preschoolers continues to be a significant public health problem in the United States and the numbers of preschoolers with severe class 1, 2 or 3 is increasing.

CAREGIVER’S PERCEPTION OF CHILD’S WEIGHT STATUS

The caregivers are the primary role models for preschool children and have the utmost influence on food preferences, eating behaviors and physical activity. The American Academy of Pediatrics recommendations for the prevention of childhood obesity emphasize the central role caregivers play in preventing childhood obesity and in successful interventions (Barlow, 2007). Frequently, parents and caregivers of young children do not correctly recognize that their child is overweight or obese (Wake, Kerr, & Jansen, 2018).

As childhood obesity rates were rising in the early 2000’s, several publications highlighted the inability or unwillingness of parents and caregivers to recognize their child or adolescent is overweight or obese (Baughcum, Chamberlin, Deeks, Powers, & Whitaker, 2000; Carnell, Edwards, Croker, Boniface, & Wardle, 2005; Eckstein et al., 2006; Jackson, Strauss, Lee, & Hunter, 1990). A cross-sectional telephone survey conducted in Mississippi found 86.2%
of the parents misidentified the child’s weight as normal when he or she was obese or overweight. The study also found 97.6% of children under age five were misidentified the child’s weight as normal when he or she was obese or overweight (McKee, Long, Southward, Walker, & McCown, 2016). Several additional studies have shown underestimation of children’s overweight or obesity status particularly in children ages two to five years of age (Lundahl et al., 2014; Queally et al., 2018; Rietmeijer-Mentink, Paulis, van Middelkoop, Bindels, & van der Wouden, 2013).

A 2009 review of 17 studies examined the disparity between parents’ perceptions of their child and actual weight status and showed that parents were more likely to underestimate the weight of younger children than older children. The study designs varied greatly so the authors could not measure a percentage of parents who misjudged their child’s weight status (Towns & D’Auria, 2009).

A second review article of 15 international publications about disparities in parental perception child weight and actual weight status found parents who were overweight themselves were more likely to misperceive their child’s weight. The authors found no underlying factors why parents misperceive their child’s weight but did find that parental perception differed by gender. Parents were more likely to overestimate their daughters’ weight than their sons’ weight (Doolen, Alpert, & Miller, 2009).

A meta-analysis of 69 studies that included 15,791 parent and child pairs, found 50.7% of the parents underestimated their child’s weight who were obese or overweight and one out of seven underestimated their child’s normal weight (Lundahl et al., 2014). A recent longitudinal study of three to five-year-old children in Ireland found 20 percent of mothers failed to classify their child as overweight or obese at age three. In addition, a significant number of mothers
misclassified their child’s weight category at age three as well as at age five (Queally et al., 2018). Misclassification or perception of obesity or overweight in children by their parents and caregivers creates a significant risk for continued higher rates of childhood obesity.

THEORETICAL FRAMEWORK

In 2005, the Institute of Medicine released “Preventing Childhood Obesity: Health in Balance” and spotlighted the SEM to outline the possible causitive factors and suggestions for future interventions (Medicine, 2004). The SEM emerged from ecological systems theory (Bronfenbrenner, 1979), which examined the networks between people and their environment. “Social Ecological Models are visual depictions of dynamic relationships among individuals, groups and their environment” (Golden, McLeroy, Green, Earp, & Lieberman, 2015, p. 95). SEM is a model designed to understand the factors and barriers that impact health behavior. There are five nested, hierarchical levels of the SEM: Individual, interpersonal, community, organizational, and policy/enabling environment (McLeroy et al., 1988).

Little is known as to which of the five levels of the SEM is most impactful to developing and implementing preschool obesity interventions. Davidson and Birch (2001) designed a model of the factors that may play a role in childhood obesity. The two inner levels focus on the child and the guardians or parents exclusively.
Figure 4. Adapted Social Ecological Model with Expanded Interpersonal Level.


This model expands the interpersonal level, reduces the community and public policy level, and may be best suited for preschool obesity interventions since the guardians or parents own behaviors and believe model and control the preschooler’s dietary intake. Although this revised model of SEM increases the contribution of the individual child and parent it still includes the need for community involvement and public policy. Several of the studies reviewed in the literature review commented on the need to not just include the parents or caregivers but also make them an active participant of the intervention to achieve greater success.

SUMMARY

Childhood obesity continues to be a public health problem in the United States. Rates of overweight and obesity continue to rise in populations of preschool children. Studies have shown
parental misperception of personal weight status as well as their child’s weight status. The study examined caregiver misperception of preschool obesity in the 2016-2016 NHANES data set to determine if misperception of weight, education, household income/poverty status, ethnicity, marital status or age are predictors of BMI category and could be incorporated into future childhood obesity education and interventions.
CHAPTER III
METHODS

Goal of the Study

This study examined the relationship between caregiver misperception of their preschoolers’ overweight/obese weight status and possible predictors that may assist in future interventions.

Rationale of the Study

Preschool aged children are not able to purchase, prepare or portion their meals and are entirely dependent on their caregiver to make all food choices as well as model eating behaviors. It is not surprising that children have a greater risk of becoming obese when they have obese parents. Children with two obese parents are 10 to 12 times more likely to be obese in childhood (Reilly et. al., 2005). “Weight gain in early childhood (3 to 5 years of age) is significantly greater among children with overweight or obese parents or among those born of overweight or obese mothers” (Fuemmeler et al., 2013, p. 817).

A 2018 study of the NHANES data from 1999-2016 showed a continued increase in rates of obesity in children ages two to five years but did not examine the relationship between parental impression of child’s weight status, caregiver’s personal weight perception, caregiver education level, marital status, ethnicity/race or household income. (Skinner et al., 2018). Many variables individually have been shown to impact child obesity rates in different studies. Determining the combination of variables may predict those children and caregivers at risk for obesity and help guide future preschool childhood obesity interventions.
Study Population

This study evaluated NHANES data collected on 1245 caregivers with a child under age five in the household and 825 children ages two to five in the years 2015 and 2016. Caregivers that had missing height and weight measurements as well as interview data were excluded.

Data Source

The data source for this study is the NHANES data for years 2015–2016. In the 2015-2016 NHANES study, 15,327 persons were chosen from 30 different survey locations and 9,971 people completed the interview and 9,544 were examined (“NHANES - 2015-2016 Overview,” n.d.). The study is not a random sample but instead uses a complex design to select subjects (“Continuous NHANES Web Tutorial: Specifying Sampling Parameters: Key Concepts about NHANES Survey Design,” n.d.).

The NHANES interview includes demographic, socioeconomic, dietary, and health-related questions. The examination section consists of medical, dental, and physiological measurements, as well as laboratory tests administered by highly trained medical personnel. NHANES is a cross sectional health survey collecting data from varied populations and health issues in the United States. A unique aspect to this survey is the data is not self-reported; instead the data is collected with physical examination and lab testing (“NHANES - National Health and Nutrition Examination Survey Homepage,” 2018).

Protection of Human Subjects

This dissertation used publicly available existing data from the NHANES years 2015-2016. These secondary data are recorded in a manner that subjects cannot be identified, directly
or through identifiers linked to the subjects. The study was approved by the College of Health Sciences Human Subjects Committee of Old Dominion University and was exempt from review by the Old Dominion University Institutional Research Board (IRB).

**Data Analysis Plan**

The analyses included descriptive statistics, correlations and multinomial logistic regression. Descriptive statistics summarize the numbers and percent of all categorical variables and the mean and standard deviations of continuous variables in each weight classifications. The dependent variable is a categorical variable with multiple levels so the appropriate statistical test for multiple categories of a categorical dependent variable.

The first multinomial logistic regression examined the relationship between the caregivers BMI category and the caregiver’s gender, education, perception of own weight status, household income, diabetes diagnosis, ethnicity/race and marital status. A second multinomial logistic regression explored the relationship between the children’s BMI categories, poverty level and two early childhood questions. The two questions asked about the caregiver’s perception of their child’s weight and if a health care professional has told the parent, the child is overweight.

The multinomial logistic regression combined poverty level to have two levels: Household income below 185% and above 185% variable to limit the numbers of cells with no data or limited data. The underweight BMI category was not included in the regression models since the research is examining overweight. Underweight may signal other health concerns as well as malnutrition. The data analyses were performed using the statistical software package IBM SPSS Statistics Grad Pack 24.0 PREMIUM that includes SPSS Complex Samples (SPSS, 2013).
Multinomial Logistic Regression

Multinomial logistic regression is used to construct models from independent variables that have better predictive value when considered together. This statistical tool was selected because it allows for a categorical dependent variable with two or more categories (Mohamad, Ali, Noor, & Baharum, 2016). The goal of a multiple logistic regression is to examine the relationship between the nominal independent variables and the dependent variable and determine possible effects of the independent variables on the dependent variable (McDonald, 2014). The multiple regression model equations is $Y_1 = b_0 + b_1X_1 + b_2X_2 + \ldots b_nX_n + \epsilon_i$. There several key assumptions underlying a multiple regression analysis and they include having a linear relationship, multivariate normality, no multicollinearity and homoscedasticity (Stoltzfus, 2011).

- **Linear Relationship** - There must be a linear relationship between the outcome variable and the independent variables.
- **Multivariate Normality** - Multiple regression assumes that the residuals are normally distributed.
- **No Multicollinearity** - Assumes that the independent variables are not highly correlated with each other.
- **Homoscedasticity** - Assumes the variance of error terms is similar across the values of the independent variables.

Correlation

Correlation is a commonly used statistical analysis used to measure and describe the strength and direction of the relationship between two continuous variables. A correlation is measured using a correlation coefficient and is represented by the symbol ($r$) and is expressed as
a single number that describes the degree of relationship between the two variables (Bewick, Cheek, & Ball, 2003). The correlation coefficient ranges from positive 1 to negative 1. A negative correlation coefficient has a value less than zero and indicates a negative relationship between the variables. This means that the variables move in opposite directions, when one increases the other decreases. A positive correlation coefficient with a value above zero indicates a positive relationship between the variables. This means that both variables move in tandem. A correlation coefficient equal to zero indicates there is no relationship between the variables and one variable can remain constant while the other increases or decreases (Statistics, n.d.).

**Description of Measurement Variables**

Demographic information will be obtained from demographics questionnaires that were administered, in the home, by trained interviewers using the Computer-Assisted Personal Interviewing (CAPI) system (“NHANES - National Health and Nutrition Examination Survey Homepage,” n.d.). Parents/caregivers data will evaluate education level, assess household income/poverty level, race/ethnicity, marital status and diabetes diagnosis.

Body mass index (BMI) was calculated using the height and weight measurements gathered from the physical exam during the survey. The most commonly used tool to assess overweight and obesity is the body mass index (BMI). The formula for BMI calculation is weight (kg) / [height (m)]^2 (Troiano et al., 2008). The standing height of participants was measured in meters using a stadiometer with a fixed vertical backboard and an adjustable headpiece. The weight of participants was measured in kilograms using a digital weight scale (“NHANES - National Health and Nutrition Examination Survey Homepage,” 2018). A child’s weight status is determined using an age- and sex-specific percentile for BMI rather than the BMI categories.
used for adults. A child’s body composition varies according to gender and age (“Defining Childhood Obesity | Overweight & Obesity | CDC,” n.d.).

The BMI statistics for the children were converted into body mass index z-scores, also called BMI standard deviation scores. These are measures of relative weight adjusted for child age and gender. BMI z-score is also defined as BMI-for-age percentile (Must & Anderson, 2006). This study did not use recently accepted six classifications of childhood obesity that include underweight, normal weight, overweight, obese class 1, severe obesity class 2 and severe class 3 but instead will use the four classifications used the NHANES protocol (Skinner & Skelton, 2014).

**Dependent Variables**

- Caregiver’s BMI Category
- Children’s BMI Category

**Independent Variables**

- Caregiver’s Age (16-80)
- Caregiver’s Gender (Male, Female)
- Marital Status (Married, Widowed, Divorced, Separated, Never Married)
- Caregivers Education (Up to 8th Grade, 9-11 Grade, High School, Some College, College Graduate)
- Household Income (Less than $20,000, $20,00- $34,999, $35,000-$54,999, $55,000-$74,999, $75,000 and over)
- Ratio of household income to poverty level (<130%, 130%-185%, >185%)
- Caregiver’s Race (Mexican American, Other Hispanic, Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Asian, Other/Multiracial)
• Have you been told you are Diabetic/Prediabetic? (Yes, No)
• How do you consider your weight? (Overweight, Underweight, About Right, Refused, Don’t know)
• Weight Change (Like to weigh more, Like to weigh less, Stay about the same)
• Child’s Age (2-5)
• Child’s Gender (Male, Female)
• Child’s Ethnicity (Mexican American, Other Hispanic, Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Asian, Other/Multiracial)
• Ratio of household income to poverty level (<130%, 130%-185%, >185%)
• You think your child is … (overweight, underweight, about right)
• Has a doctor or other healthcare professional told you your child is overweight (Yes, No)

Limitations

A limitation to the use of the NHANES data set is that there is no direct linkage between family members. It is not possible to show a relationship between caregiver BMI category and child BMI category. It is also not possible to determine if the caregiver is the primary person in the household who grocery shops, prepares and portions the child’s meals. Ideally, a study would use the BMI for the primary care giver of the child to ensure the relationship between parent and child BMI is true. Although the total number of caregivers and children ages two to five is large, generalizability is limited due to the inability to link the children to the caregivers directly to determine caregiver impact on their own child. The small sample size also limits subgroup analyses that look at differences between gender, race/ethnicity and between age years comparisons. Finally, the 2015-2016 NHANES survey has not released the food insecurity questionnaire that was available in previous years. The original plan was to examine if WIC or
SNAP participation were predictors of preschool obesity but study could only evaluate household income as a predictor.
CHAPTER IV

RESULTS

Descriptive

The study sample consisted of \( n = 1245 \) parents or caregivers living in households with a child under age five. Table 1 provides the descriptive statistics of the parent/caregiver’s baseline characteristics categorized by their BMI grouping. In this sample, 65.8\% of the adults were overweight or obese. The mean age of the population was \( 36 \pm 13.6 \) and participants ranged in age from 16-80 years. Older caregivers were statistically significantly more likely to be overweight or obese (\( p = 0.008 \)). The study included 533 men (42.8\%) and 712 women (57.2 \%). There was no relationship between gender and adult BMI category (\( p = 0.066 \)). About two thirds (67.3\%) of the caregivers had support of a spouse or partner and there is a relationship between marital status and adult BMI category (\( p = 0.001 \)). Caregivers in non-supported relationship had similar percentages of obese BMI categorizations (38.3\%) as compared to supported participants (39.7\%).

The majority (69.3\%) of participants had completed high school or additional education but there were 111 (8.9\%) parents/caregivers who were still enrolled in high school. Almost half (48.7\%) of the participants had some college attendance or had a college degree. The bivariate analysis also shows a significant relationship between BMI category and education (\( p = 0.001 \)). More specifically, those with some college education had the greatest percentage of participants who were in the obese BMI category (48.3\%).

Parents/caregivers who have household income below 185\% of the poverty level qualify for some level of national food supplementary programs such as free and reduced school lunch, WIC or SNAP. In this population, 65.6\% of the caregivers have household income below 185
percent of the poverty level. There was no relationship (p = 0.345) between income or poverty ratio (p =0.106) and BMI category in this group.

The bivariate analysis also shows a significant relationship between BMI category and race and ethnicity (p = 0.001). Non-Hispanic Asians had the lowest number of overweight or obese BMI adults at 42.3% and the highest number of normal BMI category participants (52.3%). Mexican Americans had the largest portion of obese and overweight participants at 76.4%.

There was a statistically significant relationship between BMI category and diagnosis of diabetes or prediabetes (p =0.001). The comorbid illness of diabetes was examined in this dataset. Only 9.9% of the participants reported being diagnosed with diabetes or prediabetes but 85.7% of those with the diagnosis are in the overweight or obese BMI category.

Participants were asked two questions about their perception of their weight status. Overall, the distribution of their perceptions across the BMI categories varied significantly (p =0.001). The first question asked, “do you think you are overweight, underweight or about right?” (WHQ030, Table 1). Most of the respondents in who answered they think they are overweight were in the overweight and obese BMI categories (91.7%). However, 14% of the obese BMI category and 29% of the overweight participants still think they are about the right weight. A second question asked if “you would like to weigh more, weigh less or stay about the same” (WHQ040, Table 1). Many obese and overweight respondents (51.9% and 31.9%) would like to weigh less.
<table>
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<th>Characteristics</th>
<th>Overall (n=1245)</th>
<th>Underweight (n=23, 1.8%)</th>
<th>Normal Weight (n=402, 32.3%)</th>
<th>Overweight (n=354, 28.4%)</th>
<th>Obese (n=466, 37.4%)</th>
<th>p-value</th>
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<td>Mean Age (SD)</td>
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<td>31.0 (12.4)</td>
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<td>7 (0.01)</td>
<td>154 (28.9)</td>
<td>164 (30.1)</td>
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<td>248 (34.8)</td>
<td>190 (26.7)</td>
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<td>74 (21.3)</td>
<td>168 (48.3)</td>
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<td>73 (28.3)</td>
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<td>70 (31.2)</td>
<td>84 (37.5)</td>
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<td>89 (36.9)</td>
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<td>113 (36.6)</td>
<td>88 (28.5)</td>
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Table 1. Adult BMI Category and Characteristics (continued)

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<th>Normal Weight</th>
<th>Overweight</th>
<th>Obese</th>
<th>p-value</th>
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<tr>
<td>&lt;130%</td>
<td>548 (44.0)</td>
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<td>160 (29.2)</td>
<td>163 (29.7)</td>
<td>218 (39.8)</td>
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<td>201 (16.1)</td>
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<td>60 (29.9)</td>
<td>52 (25.9)</td>
<td>84 (41.8)</td>
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<tr>
<td>&gt;185%</td>
<td>393 (31.6)</td>
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<td>142 (36.1)</td>
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<td>137 (34.9)</td>
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<td>77 (43.7)</td>
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<td>282 (22.7)</td>
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<td>97 (34.4)</td>
<td>80 (28.4)</td>
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<td>82 (52.3)</td>
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<td>20 (12.8)</td>
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<tr>
<td>Other /Multiracial</td>
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<tr>
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<td>Yes</td>
<td>112 (9.9)</td>
<td>1 (0.9)</td>
<td>15 (13.4)</td>
<td>30 (26.8)</td>
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<td>287 (27.8)</td>
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<td>Question WHQ030</td>
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<td>Think I am overweight</td>
<td>625 (50.2)</td>
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<td>51 (8.2)</td>
<td>191 (30.6)</td>
<td>382 (61.1)</td>
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<td>8 (12.1)</td>
<td>47 (71.2)</td>
<td>4 (6.0)</td>
<td>7 (10.6)</td>
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</tr>
<tr>
<td>About Right</td>
<td>549 (44.4)</td>
<td>14 (2.6)</td>
<td>304 (55.4)</td>
<td>159 (29.0)</td>
<td>77 (14.0)</td>
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<td>119 (9.6)</td>
<td>12 (10.1)</td>
<td>84 (70.6)</td>
<td>16 (13.4)</td>
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<td></td>
</tr>
<tr>
<td>Like to weigh less</td>
<td>791 (63.5)</td>
<td>0 (0.0)</td>
<td>128 (16.2)</td>
<td>252 (31.9)</td>
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<td>Stay about the same</td>
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<td>190 (56.7)</td>
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<td>48 (14.3)</td>
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A multinomial logistic regression was modelled to predict the overweight BMI category while adjusting for the following variables: diabetes diagnosis, poverty ratio, caregiver’s perception of their own weight, education, gender, ethnicity/race. Table 2a presents the odds ratios for predicting the overweight BMI category of caregivers. The analysis revealed several significant predictors of the overweight BMI category of caregivers. The risk of overweight caregivers is 2.5 times more likely to have a diagnosis of diabetes/prediabetes (p = 0.01) as well 1.6 times more likely to have a household income below 185% of the poverty level (p = 0.02).
Education at any level was not found to be a statically significant predictor of overweight BMI category in this study. Participants who perceived themselves to be overweight were 11.6 times more likely be in the overweight BMI category (0.001) compared to those who perceived their weight to be about right. Mexican American caregivers were 3.9 times more likely have a BMI greater than 25 (p = 0.01) and Non-Hispanic Blacks were 3.8 times more likely to be in the overweight BMI category (p = 0.01) as compared to the reference group (Other/Multiracial). Interestingly, male caregivers in this dataset were 2.7 times more likely to in the overweight BMI category (p = 0.001) as compared to the female caregivers.
Table 2a. Results of Multinomial Regression for Predicting Overweight Among Caregivers

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>SE</th>
<th>P- value</th>
<th>Lower</th>
<th>Odds Ratio</th>
<th>Upper</th>
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<td></td>
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<td></td>
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<tr>
<td><strong>Diabetes/Prediabetes</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>0.93</td>
<td>0.37</td>
<td>0.01</td>
<td>1.23</td>
<td>2.54</td>
<td>5.26</td>
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<td></td>
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</tr>
<tr>
<td>&lt;185%</td>
<td>0.50</td>
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<td>0.02</td>
<td>1.09</td>
<td>1.64</td>
<td>2.47</td>
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<td></td>
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<tr>
<td>Less than 9th</td>
<td>0.56</td>
<td>0.37</td>
<td>0.13</td>
<td>0.85</td>
<td>1.76</td>
<td>3.60</td>
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<td>9th-11th no diploma</td>
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<td>0.7</td>
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<td>0.27</td>
<td>0.43</td>
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<tr>
<td>Think I am overweight</td>
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<td>0.001</td>
<td>7.55</td>
<td>11.57</td>
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<td>0.001</td>
<td>0.05</td>
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<td>0.89</td>
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<td>0.01</td>
<td>1.37</td>
<td>3.78</td>
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<td>1.38</td>
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</table>

Table 2b presents the odds ratios for predicting the obese BMI category of caregivers.

The analysis revealed several significant predictors of the obese BMI category of caregivers.

This analysis also revealed several significant predictors of BMI categories of caregivers. The risk of obese caregivers is 5.3 time more likely have a diagnosis of diabetes/prediabetes as well
as 1.85 times more likely to have a household income below 185% of the poverty level (p = 0.001). Education was not a significant predictor of the obese BMI category as compared to normal BMI category caregivers but was trending for caregivers with less than a ninth-grade education (p = 0.10) and some college (p = 0.10).

Study participants who answered, “I think I am overweight” were 64 times more likely to have a BMI greater than 30 and was statistically significant (p = 0.001) than caregivers in the normal BMI weight category. Male caregivers were 4.2 times more likely to be obese (p = 0.001) than female caregivers. Non-Hispanic Black caregivers were 3.3 more likely to be in the obese BMI category as compared to the reference group (Other/Multiracial) (p = 0.02) in contrast to Non-Hispanic Asian American caregivers who were significantly less likely to obese (p = 0.03) than the reference group.
Table 2b. Results of Multinomial Regression for Predicting Obese Among Caregivers

<table>
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<tr>
<th>BMI Category - Obese</th>
<th>Category</th>
<th>B</th>
<th>SE</th>
<th>P-value</th>
<th>Lower</th>
<th>Odds Ratio</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes/Prediabetes</td>
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<td>1.66</td>
<td>0.38</td>
<td>0.001</td>
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<td>5.28</td>
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</tr>
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<td>0.23</td>
<td>0.007</td>
<td>1.18</td>
<td>1.85</td>
<td>2.89</td>
</tr>
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<td>ref</td>
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<td>0.001</td>
<td>39.33</td>
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<td>103.63</td>
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<td></td>
<td>Think I am underweight</td>
<td>-0.82</td>
<td>0.47</td>
<td>0.08</td>
<td>0.17</td>
<td>0.44</td>
<td>1.11</td>
</tr>
<tr>
<td></td>
<td>About Right</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>Mexican American</td>
<td>0.80</td>
<td>0.50</td>
<td>0.11</td>
<td>0.84</td>
<td>2.24</td>
<td>5.99</td>
</tr>
<tr>
<td></td>
<td>Other Hispanic</td>
<td>0.61</td>
<td>0.52</td>
<td>0.24</td>
<td>0.67</td>
<td>1.85</td>
<td>5.11</td>
</tr>
<tr>
<td></td>
<td>Non-Hispanic White</td>
<td>0.20</td>
<td>0.49</td>
<td>0.70</td>
<td>0.46</td>
<td>1.21</td>
<td>3.17</td>
</tr>
<tr>
<td></td>
<td>Non-Hispanic Black</td>
<td>1.20</td>
<td>0.50</td>
<td>0.02</td>
<td>1.26</td>
<td>3.32</td>
<td>8.78</td>
</tr>
<tr>
<td></td>
<td>Non-Hispanic Asian</td>
<td>-1.23</td>
<td>0.56</td>
<td>0.03</td>
<td>0.10</td>
<td>0.29</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>Other/Multiracial</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>1.43</td>
<td>0.21</td>
<td>0.001</td>
<td>2.79</td>
<td>4.19</td>
<td>6.31</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
<td>ref</td>
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<td>ref</td>
</tr>
</tbody>
</table>

The second sample in this study consisted of n = 825 a of group preschool children ages two to five. Table 3 provides the descriptive statistics of the children’s baseline characteristics categorized by their BMI grouping. In this sample, 27.8% of the preschoolers were in the overweight or obese BMI category. There was no relationship between BMI category and age. (p = 0.461).
There was no relationship between gender and child BMI category (p = 0.49). The study included 426 boys (51.6%) and 399 girls (48.4%). There was no relationship between income or poverty ratio and BMI category in this sample (p = 0.183). Children living in households with incomes below 185% of the poverty level qualify for some level of national food supplementary programs such as free and reduced school lunch, WIC or SNAP. In this population, 64.0% of the children live in households with income below 185 percent of the poverty level.

The caregivers of the 825 preschoolers in this sample were asked a question about their perception of their child’s weight (WHQ030E, Table 3) and if they had ever been told by a health care provider if their child was overweight (MCQ080E, Table 3). The caregivers of children with a BMI category of obese correctly identified their child as overweight 78.6% of the time but 11.7% of caregivers with obese category BMI child thought their child’s weight was “about right”. The relationship between caregiver perception and child BMI category was significant (p = 0.001). Caregivers of an overweight BMI category child had been told their child is overweight by an HCP only 18.1% of the time and those with obese category children 68% of the time. HCP’s did not alert 65.3% of caregivers with an obese category child that their child is overweight. There was a statistically significant relationship between BMI category and having been told your child is overweight by an HCP (p=0.001).
Table 3. Child BMI Categories, Characteristics and Caregivers Perception of Child’s Weight Category

<table>
<thead>
<tr>
<th>Child BMI Category</th>
<th>Overall</th>
<th>Underweight</th>
<th>Normal Weight</th>
<th>Overweight</th>
<th>Obese</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age in Years</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.461</td>
</tr>
<tr>
<td>2</td>
<td>249 (30.2)</td>
<td>4 (1.6)</td>
<td>186 (74.7)</td>
<td>33 (13.2)</td>
<td>26 (10.4)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>178 (21.6)</td>
<td>6 (3.4)</td>
<td>122 (68.5)</td>
<td>26 (14.6)</td>
<td>24 (13.5)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>209 (25.3)</td>
<td>6 (33.3)</td>
<td>139 (24.0)</td>
<td>28 (24.8)</td>
<td>36 (31.0)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>189 (22.9)</td>
<td>2 (11.1)</td>
<td>131 (22.7)</td>
<td>26 (23.0)</td>
<td>30 (25.9)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.489</td>
</tr>
<tr>
<td>Male</td>
<td>426 (51.6)</td>
<td>10 (2.3)</td>
<td>297 (69.7)</td>
<td>53 (12.4)</td>
<td>66 (15.5)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>399 (48.4)</td>
<td>8 (2.0)</td>
<td>281 (70.4)</td>
<td>60 (15.0)</td>
<td>50 (12.5)</td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity/Race</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>Mexican American</td>
<td>159 (19.3)</td>
<td>3 (1.9)</td>
<td>102 (64.1)</td>
<td>29 (18.2)</td>
<td>25 (15.7)</td>
<td></td>
</tr>
<tr>
<td>Other Hispanic</td>
<td>87 (10.5)</td>
<td>0 (0.0)</td>
<td>56 (64.4)</td>
<td>11 (12.6)</td>
<td>20 (23.0)</td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>242 (29.3)</td>
<td>4 (1.6)</td>
<td>185 (76.4)</td>
<td>23 (9.5)</td>
<td>30 (12.3)</td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>208 (5.2)</td>
<td>4 (1.9)</td>
<td>140 (67.3)</td>
<td>36 (17.3)</td>
<td>28 (13.5)</td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic Asian</td>
<td>60 (7.3)</td>
<td>7 (11.7)</td>
<td>41 (68.3)</td>
<td>6 (10)</td>
<td>6 (10)</td>
<td></td>
</tr>
<tr>
<td>Other /Multiracial</td>
<td>69 (8.4)</td>
<td>0 (0.0)</td>
<td>54 (78.3)</td>
<td>8 (11.6)</td>
<td>7 (10.1)</td>
<td></td>
</tr>
<tr>
<td><strong>Poverty Category</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.183</td>
</tr>
<tr>
<td>Less than 135%</td>
<td>376 (48.8)</td>
<td>9 (2.4)</td>
<td>249 (66.2)</td>
<td>57 (15.1)</td>
<td>61 (16.2)</td>
<td></td>
</tr>
<tr>
<td>135-185%</td>
<td>117 (15.2)</td>
<td>1 (0.8)</td>
<td>90 (76.9)</td>
<td>14 (12.0)</td>
<td>12 (10.2)</td>
<td></td>
</tr>
<tr>
<td>Greater than 185%</td>
<td>277 (36.0)</td>
<td>7 (2.5)</td>
<td>205 (74.0)</td>
<td>35 (12.6)</td>
<td>30 (10.8)</td>
<td></td>
</tr>
<tr>
<td><strong>Do you think your child is?</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>Overweight</td>
<td>131 (8.5)</td>
<td>0 (0.0)</td>
<td>6 (0.4)</td>
<td>22 (16.8)</td>
<td>103 (78.6)</td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>96 (6.3)</td>
<td>18 (18.7)</td>
<td>74 (77.0)</td>
<td>1 (1.0)</td>
<td>3 (3.1)</td>
<td></td>
</tr>
<tr>
<td>About right</td>
<td>1309 (85.2)</td>
<td>16 (1.2)</td>
<td>931 (71.1)</td>
<td>209 (16.0)</td>
<td>153 (11.7)</td>
<td></td>
</tr>
<tr>
<td><strong>Have you been told by HCP child overweight</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>132 (8.6)</td>
<td>0 (0.0)</td>
<td>18 (13.6)</td>
<td>24 (18.1)</td>
<td>90 (68.1)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1398 (91.4)</td>
<td>34 (2.4)</td>
<td>993 (71.0)</td>
<td>203 (14.5)</td>
<td>168 (12.0)</td>
<td></td>
</tr>
</tbody>
</table>

A multinomial logistic regression was modelled to predict the overweight and obese BMI categories while adjusting for poverty ratio, caregiver’s perception of child’s weight question and question about being told by an HCP that your child is overweight. Table 4 presents the odds ratios for predicting the overweight and obese BMI categories in the group of children.
Subjects in the overweight BMI category who had been told they were overweight by an HCP are 6.7 times more likely to be overweight \( (p = 0.001) \) and obese BMI category children were 7 times more likely to be overweight \( (p = 0.001) \) as compared to the normal BMI category children. If a caregiver reported that they perceived their child as overweight, the child was 48 times more likely to be in the obese BMI category \( (p = 0.001) \) as compared to normal BMI category children. Household income below 185% of the poverty level was not a significant predictor of a child being in the overweight or obese BMI category \( (p = 0.58) \)

Table 4. Results of Multinomial Regression for Predicting Overweight and Obesity Among Preschoolers

<table>
<thead>
<tr>
<th>BMI Category-Overweight</th>
<th>B</th>
<th>SE</th>
<th>P-Value</th>
<th>Lower</th>
<th>Odds Ratio</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty Index Category</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 185%</td>
<td>0.14</td>
<td>0.23</td>
<td>0.55</td>
<td>0.73</td>
<td>1.15</td>
<td>1.79</td>
</tr>
<tr>
<td>Greater than 185%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think your child is?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>1.593</td>
<td>0.915</td>
<td>0.08</td>
<td>0.82</td>
<td>4.92</td>
<td>29.55</td>
</tr>
<tr>
<td>Underweight</td>
<td>-2.159</td>
<td>1.026</td>
<td>0.04</td>
<td>1.50E-02</td>
<td>0.115</td>
<td>0.86</td>
</tr>
<tr>
<td>About right</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have been told by HCP child overweight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.91</td>
<td>0.54</td>
<td>0.001</td>
<td>2.36</td>
<td>6.74</td>
<td>19.26</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BMI Category-Obese</th>
<th>B</th>
<th>SE</th>
<th>P-Value</th>
<th>Lower</th>
<th>Odds Ratio</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty Index Category</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 185%</td>
<td>0.07</td>
<td>0.26</td>
<td>0.80</td>
<td>0.64</td>
<td>1.07</td>
<td>1.77</td>
</tr>
<tr>
<td>Greater than 185%</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you think your child is?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>3.87</td>
<td>0.77</td>
<td>0.001</td>
<td>10.62</td>
<td>47.69</td>
<td>214.2</td>
</tr>
<tr>
<td>Underweight</td>
<td>-20.36</td>
<td>1.44E-09</td>
<td>1.44E-09</td>
<td>1.44E-09</td>
<td>1.44E-09</td>
<td></td>
</tr>
<tr>
<td>About right</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have been told by HCP child overweight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2.00</td>
<td>0.56</td>
<td>0.001</td>
<td>2.46</td>
<td>7.32</td>
<td>21.75</td>
</tr>
<tr>
<td>No</td>
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</tr>
</tbody>
</table>
CHAPTER V

DISCUSSION AND CONCLUSION

This study examined the predictors of BMI categories of overweight and obese in an adult caregiver of children under age five and preschool children age two to five. This chapter discusses the findings from the study and how the results relate to the current literature as well as its impact on public policy and recommendations for future research.

Main Findings and Interpretations

The overall model of predictors for the adult caregiver BMI category was significant (p = 0.001) and included diabetes/prediabetes diagnosis, poverty category, ethnicity/race, education, gender and question, “how do you consider your weight?”. The 61.1% of adults with a child in the household under age five reported “I think I am overweight” are in the obese BMI category and only 30.6% of the overweight adults perceived themselves as “I think I am overweight”. Caregivers misidentified their own weight as “about right” with 29% of adults in the overweight BMI category and 14% in the obese BMI category. Interestingly, in the group of caregivers who completed questionnaire about their preschool child, 11.7% reported “think your child weight is about right” when the child’s BMI was in the obese BMI category and 16.6% of the children in the overweight BMI category were incorrectly identified by their caregiver as “about right”. The adult group’s perception of their own weight as well as their child’s weight was miscategorized. These findings are similar to the results from many studies that found parents have difficulty recognizing the body weight of their children as well as themselves. (Tompkins, Seablom, & Brock, 2015; Towns & D’Auria, 2009).

The most significant finding from the childhood logistic regression was that the only predictor significant (p =0.001) in both the overweight and obese BMI categories compared to
normal weight BMI was “Has a doctor or health professional ever told you that your child was overweight?” The majority of children who have a BMI in the overweight or obese categories have been told by an HCP about their weight. Surprisingly, 12.0% (n=168) of the obese category BMI and 14.5% (n=203) of the overweight BMI category children were not told by an HCP that the child is overweight and at risk for lifetime health issues. Children who were told they were overweight by an HCP were 6.7 times more likely to be in the overweight BMI category and 7 times more likely to be in the obese BMI category compared to normal/underweight preschoolers.

This study demonstrates the importance of communication between medical professionals and caregivers of preschool aged children in the vulnerable population of obese and overweight preschoolers. Parents and caregivers are powerless to change their misperceptions about their child’s weight without receiving accurate ongoing information and education from health care providers.

There were extremely small numbers of underweight caregivers and children, so the underweight category was not included in the multinomial logistic regressions. This study’s goal was to examine the categories of overweight not underweight. Underweight adults and children may have other health conditions that could have influenced their BMI category. However, due to the small size of age groups, it was impossible to break down analysis by ages two through five or compare between groups.

**Measurement Variables Results**

Excessive weight is a recognized risk factor for diabetes (Eckel et al., 2011). Caregivers in this study who were in the overweight BMI category caregivers were 2.5 times more likely have a diagnosis of diabetes. The results from this study population shows lower risk to develop
type 2 diabetes mellitus than has been reported in the literature of 3.5 times greater risk in overweight adults and this could be due to the fact the population had an extremely large age range as well as over 111 of the caregivers were teenagers (Field et al., 2001). A complete maternal medical history is necessary for pediatricians and HCP to better access possible risk factors for preschool obesity and give special attention to those parents and caregivers who have diabetes or who have had gestational diabetes.

This study showed a relationship between education and BMI category. Parental education level was included as a predictor in the model but education at any level was not found to be a statically significant predictor of overweight and obese BMI category in this study. This study’s findings are contrary to what has been found in previously since usually as parental education increases than rates of childhood obesity decreases. A possible explanation for this outcome could have been that the caregiver who was interviewed was not the primary care giver for the child as well as the 111 teenagers who were not high school graduates were supported by a parent or guardian who may have had a higher level of education.

The current study did show if the household income is less than 185% of the poverty level adults are 1.6 times more likely to overweight and 1.8 times more likely to obese as compared to adults in household above the 185% of the poverty level. The analysis of preschoolers overweight and obese BMI categories and less than 185% of the poverty level did not show significance in either category compared to households with incomes above 185% of the poverty level (p = 0.55, p = 0.80). Despite not having an increase risk in the preschool population, the increased risk in the caregiver population underscores the need to include parents and caregivers in all obesity interventions especially with populations below the poverty level.
Race and ethnicity were significant in the model (p = 0.001). Non-Hispanic Blacks and Mexican Americans were 3.8 times more likely to be in the overweight BMI category than the reference group of Other/Multiracial. Non-Hispanic Asians were less likely to be in the obese category and Non-Hispanic Blacks were three times more likely to be in the obese category than multiracial/other group. The prevalence of obesity in adults in the United States based on data from the 2015-2016 NHANES study was 39.8%. The study saw similar results to the current study with lower prevalence of obesity in Non-Hispanic Asians and higher rates in Non-Hispanic Blacks (Ogden et al., 2018). Identifying populations at higher risk such as Non-Hispanic Blacks and Mexican Americans can help tailor nutrition intervention programs in at risk neighborhoods and schools. Finally, there were limited numbers multiracial participants. This population is growing in the United States but there is no data available and is an area for future research.

This study did not include marital status or supported relationship in the model since it did not improve the model’s predictive power. Marital status or supported relationships has been associated with lower rates of childhood obesity in some studies, but other studies have seen no relationship with parental marital status (Gibson et al., 2007; Gray et al., 2007; Yannakoulia et al., 2008). Emotional support might be difficult to determine since it is so variable for example, a person can have support from a grandparent living with a single parent or a parent living with one of the 111 teenage parents in this study population.

There was no relationship between the gender of the adult sample and the child sample and BMI category (p = 0.07, p = 0.49). When gender was introduced to the model for the adult population it was significant (p = 0.001). Unexpectedly, the regression showed a 2.7 times increased risk for males being in the overweight BMI category and 4.2 times increased risk for males being in the obese BMI category as compared to women. The literature is mixed as to
which parent may have greater influence on a child’s risk for obesity. There is conflicting data, which overweight parent, mother or father, have the greatest impact on the weight of the preschool child. Due to the lack of information in this data set, it is impossible to determine any impact of gender on the BMI category of the preschool children in the study.

**Theoretical Framework Development**

The literature review as well as the results from this study highlight the importance of inclusion of caregivers in preschool obesity intervention programs. Caregivers’ perception of their child’s BMI category is essential to making changes to a child’s diet to prevent excessive weight gain. SEM is a model designed to understand the factors and barriers that impact health behavior. There are five nested, hierarchical levels of the SEM: Individual, interpersonal, community, organizational, and policy/enabling environment. (McLeroy et al., 1988). The Davidson and Birch (2001) model of childhood obesity has two inner levels focus on the child and the guardians or parents exclusively (Davison & Birch, 2001).

Based on the findings of this study, the modified SEM model appears to be an excellent model to use in the future when designing preschool obesity interventions that focus on the caregivers of preschool children and may increase the success of future interventions. The model reduces the community and public policy level and may be best suited for preschool obesity interventions since the guardians or parents own behaviors, believe model, and control the preschooler’s dietary intake. Several of the studies reviewed in the literature review commented on the need to not just include the parents or caregivers but also make them an active participant of the intervention to achieve greater success.
Strengths and Limitations

The greatest strength of this study is identifying a new predictor for preschool obesity. Parental misperception of their child's weight is a well-studied topic in childhood obesity literature but lack of communication between health care providers and parents and caregivers about a child’s BMI category coupled with parental misperception about their child’s weight is a new area for future research and interventions. This study demonstrates that parental misperception of their child’s BMI category coupled with HCP’s who do not take the initiative to open a dialog with parents are increasing the chances that a generation of preschoolers will become obese teens and adults.

The greatest limitation to this study is the use of secondary data. There was a change to the NHANES survey in 1999 and since then there is no way to identify whether one or more survey participants are related or live in the same household based on publicly released data. The use of the NHANES data made it impossible to link between child and caregivers or add additional questions. It is not possible to determine if the caregiver is the primary person in the household who grocery shops, prepares and portions the child’s meals. Ideally, a study would use the BMI for the primary care giver of the child to ensure the relationship between parent and child BMI is true.

Although the total number of caregivers and children ages two to five is large, generalizability is limited due to the inability to link the children to the caregivers directly to determine caregiver impact on their own child. The small sample size also limits subgroup analyses that look at differences between gender, race/ethnicity and between age years comparisons. Weights are created in NHANES to account for oversampling under represented populations, survey non-response and post survey stratification. NHANES is designed to sample
larger numbers of certain subgroups of public health interest. A limitation to the results of this study was that the weights were not applied to this sample since the numbers of each subgroup was so small.

Diabetes or prediabetes is a significant predictor of overweight or obese weight category in adults. The data set did not collect history of gestational diabetes that is also a risk factor for later life diabetes and is linked to epigenetic changes in offspring. If the mother’s data were linked to their child’s, it would be possible to look at childbirth weight and maternal gestational diabetes or diabetes diagnosis.

**Public Health and Policy Implications**

Several local or statewide preschool obesity interventions have been conducted and shown to be successful in reducing rates of overweight and obese in children under the age of five. The programs targeted at risk preschool and parents through both public programs such as WIC and Head Start as well as private practice pediatricians.

Two Massachusetts communities implemented practice-changes in the Women’s Infants and Children program to prevent obesity among low-income children. The intervention used education of parents and daycare providers to eliminate of sugar-sweetened beverage intake, limit of 100% juice intake, replacement of non-nutritious foods with fruit and vegetable, limit of screen time to no more than two hours daily, incorporate one hour of moderate to vigorous physical activity daily and average eleven hours of sleep. The results of the intervention reduced the prevalence of obesity risk factors and a slight improvement in BMI z-scores one of two intervention communities (Woo Baidal et al., 2017).

The changes instituted by these two WIC centers could be replicated across the 50 states and the District of Columbia to reduce obesity risk factors and include parents of low-income
children at risk for obesity. One approach to expanding the parental education and change eating behaviors among WIC participants is to work with National WIC Association. “The National WIC Association (NWA) is the non-profit education arm and advocacy voice of the Special Supplemental Nutrition Program for WIC, the over 7 million mothers and young children served by WIC and the 12,000 service provider agencies who are the front lines of WIC’s public health nutrition services for the nation’s nutritionally at-risk mothers and young children” (“About NWA,” n.d., para. 1). NWA has been successful working with other child advocacy groups to lobby congress for changes to improve breastfeeding support and nutritional education of parents.

In 2009, the North Carolina Child Care Law and Rules required licensing requirements for all Head Start, Pre-K and licensed childcare centers. State and local health department conducted training on preparing healthy foods for the centers as well as educational training of all teachers and parents. This program as seen rates of obesity for children ages two to four from 22.7% to 15.7% over a three-year period (Dooyema et al., 2018). This program showed how to target preschool children not just in low-income families at the state and local level of government. Similar state and local preschool and daycare programs can be implemented if directed by regulations from the Office of Childcare that is under the auspices of the United States Department of Health and Human Services. Updated guidelines for childcare providers to provide healthier foods and additional education to providers and parents.

The Healthy Homes/Healthy Kids Preschool program is an obesity prevention intervention combining pediatrician counseling and a phone-based education component to prevent weight gain in children ages two to four in Minneapolis Minnesota (Sherwood et al., 2015). This intervention utilizes pediatric medical clinics around the state to educate
preschoolers and their parent on decreasing obesity risk factors. This an example how to incorporate parental education and involvement in a population who is dependent on their parent for providing meals and role modeling. Health insurers could initiate similar programs by implementing quality measures for obesity in preschooler that would influence current pediatric practice. All two to five-year old children would be screened for obesity at every visit and children with a BMI greater than the 85% percentile age and gender adjusted would receive a phone-based education program for the parent. Healthcare quality measures are governed by HealthIT.gov which is part of the National Coordinator of Health Information Technology (“Clinical Quality and Safety | HealthIT.gov,” n.d.).

Future public health policy needs to focus on actively engaging young children’s caregivers in education and obesity interventions. HCP’s need expanded education about adult and child obesity to increase self-efficacy to engage families in conversations about healthy eating and weight. States and national organizations need to think outside the box to find novel ways to involve parents of preschoolers in settings in the home and outside the home. Finally, programs need to focus on prevention of obesity and this may mean counseling pre-pregnant women and future fathers on weight loss, so the next generation has a better chance of living a long and healthy life.
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VITA
Beth H. Chopp
College of Health Sciences
2114 HEALTH SCIENCES BLDG
NORFOLK, VA 23529

Education
M.S. Saint Joseph’s University Philadelphia, PA Major in Health Education
B.S. Drexel University, Philadelphia, PA Major Clinical Dietetics

Professional Summary
Novartis Neuroscience Medical Science Liaison 2018 – Present
Member of the Neuroscience Medical Science Liaison (MSL) team covering for the therapeutic areas of Migraine and Chronic Pain. Responsible for developing, maintaining deep therapeutic expertise, dissemination of scientific information externally and internally and building key relationships with Headache and Pain Experts in Maryland, DC, Virginia, North Carolina.

Professional Experience
Lilly USA Neuroscience Medical Liaison 2001-2017.
Lilly USA Hospital Sales Representative 1998-2001
University of PA Hospital OB/Neonatal Nutritionist 1986-1989.

Presentations
Developed and facilitated 8-hour Alzheimer’s/ Solanezumab onboarding workshop for new Pain/Neurodegeneration Medical Liaisons in expectation for launch of the drug. (2016)
Created custom slide presentation on the pathophysiology of Alzheimer’s disease and US compound and PET tracer pipeline and presented to Inova Nuclear Medicine Department. (2016)
Created and presented custom presentation on the pathophysiology and pharmacotherapy of Schizophrenia to case managers from AmeriHealth Caritas in Philadelphia. (2015)
Adjunct Professor at Neuman College Aston PA. Created and taught Normal Nutrition Couse for 2nd year nursing students. (1991- 1993)