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MATERNAL PERCEPTION OF CHILD BODY WEIGHT AND PHYSICAL
ACTIVITY BEHAVIOR PATTERNS: INTERACTIONS WITH GENDER AND
ETHNIC MINORITY STATUS OF PRESCHOOL CHILDREN

A Thesis

Presented to

the Faculty of the Morgridge College of Education

University of Denver

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Kayla F. Brooks

November 2014

Advisor: Kathy E. Green

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Abstract

Childhood overweight and obesity is a complex disease that requires early identification and intervention. Little research has investigated the influence of maternal perception of child body weight on reported child physical activity behaviors and importance to change these behaviors. Using parent survey and child body mass index (BMI) data, the current study evaluated the difference between maternal perception of child weight status and reported physical activity and sedentary behavior levels amongst preschool-aged children. Reported child physical activity and sedentary behavior levels were not significantly different depending on maternal misperception. A significant interaction, however, between maternal perception of child body weight and child gender, $F(1, 469) = 4.70, p = 0.031$ and maternal perception of child body weight and child ethnicity was revealed, $F(1, 470) = 3.74, p = 0.05$. Furthermore, the degree of importance mothers placed on changing child physical activity behavior was not significantly different depending on maternal misperception. The inability of mothers to accurately perceive the weight status of their child(ren) and report their child's physical activity behaviors has the potential to disrupt prevention intervention efforts. Thus, interventions should incorporate parental education, along with multi-faceted activities, to raise awareness and initiate change to increase physical activity and reduce pediatric overweight and obesity.

Acknowledgements

I would like to take this opportunity to thank the individuals who were instrumental in the completion of this thesis. First, I would like to thank my committee chair, Dr. Kathy Green for her guidance and continuous support throughout this project. Without her leadership I would not have been able to complete my thesis with such critical thinking and precision. Second, I would also like to thank my second committee member, Dr. Nicholas Cutforth, for his encouragement and critical perspective during the development of this project.

Third, I would like to thank Dr. Jini Puma and the Culture of Wellness in Preschools program team, for allowing me access to the parent surveys and child health data. Without their assistance, I would not be able to complete my project. I would like to specifically thank Dr. Puma for her consistent support, encouragement, and critical revisions during the development and data analysis processes. Fourth, I would like to thank my mentor Dr. Kalynn Schulz for her dedication to me as a student and her encouragement to pursue my graduate degree; it was her never-ending belief in my ability as a young researcher that provided me with confidence to complete this project.

Last, but certainly not least, I would like to thank those who had to endure all of the challenges I experienced during this project. I would like to acknowledge the reinforcement my parents and husband provided me during this project; they provided me with a safe space to discuss my insecurities and doubts toward this project and I provided me with sincere words of motivation.

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Chapter One: Introduction

Childhood overweight and obesity is a complex disease that requires early identification and intervention. It is convenient to blame the childhood obesity epidemic on increasing rates of poor dietary and sedentary behaviors and decreasing rates of physical activity; however, childhood obesity is a multi-faceted disease and is influenced by individual, familial, and environmental factors (Davison & Birch, 2001). Parents, especially mothers, have great influence over health behaviors of young children, thus the recognition of increased body mass and health-related risk factors is vital to the success of health and wellness efforts in reducing rates of obesity. Not only should health and wellness programs for children target behavioral risks factors, such as physical activity and sedentary behavior, but maternal perception of body weight status as well. The current study sought to 1) investigate the difference between reported physical activity and sedentary behavior based on maternal misperception of child body weight amongst preschool-aged children; and 2) to investigate the difference of reported importance mothers place on changing physical activity behaviors depending on maternal misperception of child body weight status.

Prevalence of Childhood Overweight

Child and adolescent (2-19 years) weight status is defined based on Body Mass Index (BMI). Overweight amongst children and adolescents is defined as a BMI score at or above the 85th percentile, but less than the 95th percentile and obesity is defined as a

BMI score at or above the 95th percentile on the CDC's 2000 BMI-for-age growth charts (Ogden, Carroll, Kit, & Flegal, 2012). Over the past three decades, a threefold increase in the rates of obesity among children and adolescents has been noted (Davison & Birch, 2001; Hedley & Ogden, 2004). In 2003-2004, 26.2% of children 2-5 years old, 37.2% of children 6-11 years old, and 34.3% of adolescents aged 12-19 were at risk for overweight or obesity according to the National Health and Nutrition Examination Survey (NHANES) (Mendoza, Zimmerman, & Christakis, 2007). More recent reports, however, have demonstrated a slight decline and plateau in the rates of children at risk of overweight or obesity. The prevalence of obesity was approximately 12.1% for preschool-aged children (2-5 years), 18.0% for school-aged children (6-11 years), and 18.4% for adolescents (12-19 years) as reported on the 2007-2010 NHANES (Ogden, Carroll, Kit, & Flegal, 2012). Despite the plateauing rates of overweight and obesity amongst preschool-aged youth, obesity is still considered the most prevalent nutritional disease and modifiable disease among children in the United States and requires further investigation into the characteristics influencing the development and maintenance of pediatric overweight and obesity (Crawford, Story, & Wang, 2001; Davison & Birch, 2001).

Elevated rates of obesity have been noted in both genders and across all racial groups; however, girls and ethnic minority groups have been disproportionately affected (Deckelbaum & Williams, 2001). Among the entire pediatric population, girls have been more affected than boys by the increasing rates of obesity. Within the 20 years between the first and the third National Health Examination Surveys, the prevalence of obesity in

girls nearly doubled, while the prevalence of obesity in boys increased by only 25% (Deckelbaum & Williams, 2001). Moreover, rates of pediatric obesity are found to be highest among Mexican American (18.8% for children 6-11 years; 14.8 % of adolescents 12-17 years) and Native American (39% of children 5-17 years were overweight) children of both sexes and intermediate among African American boys and girls compared to their Caucasian peers (Crawford et al., 2001; Deckelbaum & Williams, 2001). Pediatric overweight and obesity disproportionately affects females and racial-ethnic populations; thus, prevention interventions should tailor their efforts to support populations with greater risks of overweight and obesity.

Obesity among our nation's youth has become a major focus of public health research and prevention efforts given the elevated prevalence and the enduring negative health consequences associated with the disease. Childhood obesity threatens immediate and long-term physical and mental health (Davison & Birch, 2001; Hodges, Smith, Tidwell, & Berry, 2013). Children who are obese are more likely to experience immediate health consequences such as cardiovascular dysfunction, podiatric problems, and sleep disturbances as well as mental health consequences such as low self-esteem and disturbed body image (Biro & Wien, 2010; Davison & Birch, 2001; Deckelbaum & Williams, 2001; Han, Lawlor, & Kimm, 2011; Hodges et al., 2013). Obesity among children has also been linked with negative long-term health consequences that persist into adulthood, such as elevated blood pressure, cardiovascular disease, and Type II Diabetes (Deckelbaum & Williams, 2001; Hodges et al., 2013). The health risks associated with overweight and obesity begin well-before children have reached the

threshold defined by the CDC 2000 BMI-for-age growth charts, however (Lake, 2012). Thus, given the high rates of overweight and obesity in school-age children and adolescents, public health professionals are beginning to focus their intervention efforts on the preschool-age population.

Prevalence of Early Childhood Overweight

Rates of obesity are high among preschool-age children (Davison & Birch, 2001). Between 1976-1980 and 2007-2008, the rate of overweight among preschool children increased from 5.0% to 10.4% (Ogden & Carroll, 2010). Most recently, 21.2% of preschool children aged 2 through 5 in the United States are overweight and 12.1% of preschool children are obese (Hodges et al., 2013; Ogden & Carroll, 2012). Similar to obesity trends seen in school-age children and adolescents, rates of at risk for obesity among 2-5 year olds disproportionately affect girls and ethnic minority populations. In 2005, a study of 8,000 4-year-olds showed increased rates of obesity among children of different ethnic backgrounds: 31.2% of Native American, 22% of Hispanic, and 20.8% of non-Hispanic black children were obese (Anderson & Whitaker, 2009; Lake, 2012). Obesity is a disease that not only affects adults, adolescents, and school-age children, recently, high rates of obesity among preschool-age children have been reported.

Even the healthiest states in the nation, such as Colorado, are seeing high risk rates for obesity among preschool-age children. While Colorado remains the leanest state for adults in the nation, it is considered to have one of the fastest growing rates of childhood overweight and obesity. Recent reports have indicated that nearly 25% of

Colorado children are considered to be overweight or obese; specifically, among children age 2-5, 14.1% are overweight and 9.1% are obese (*Childhood Obesity Statistics*, 2012; Christopher, Harris, Spencer, Harris, & Gates, 2013; National Disease Promotion Nutrition & Activity, 2012). Given that Colorado is considered one of the leanest and most active states for adults, the elevated prevalence in early childhood overweight and obesity suggests a gene-environment and demographic shift interaction influencing body weight gain and health behavior patterns.

In all states, including Colorado, interventions to reduce overweight and obesity should be implemented in children aged 2-5 years. Studies have demonstrated that younger children respond better than adolescents and adults to prevention efforts and obesity treatments. Greater family influence on behavior change, greater motivation to change, and the ability to monitor longitudinal growth contribute to the improved responses in younger children to obesity care (McCambridge, 2006). Successful activity-related interventions include increasing energy expenditure and decreasing sedentary behavior; for instance, BMI among children improved when TV viewing was restricted and physical activity was promoted (McCambridge, 2006). Thus, obesity prevention interventions should be introduced to preschool-aged children both at school and at home that involve structured and unstructured activities focusing on increasing age-appropriate energy expenditure and reducing sedentary behavior.

Factors Associated with the Development of Early Childhood Overweight

The etiology of obesity is complex, complicating prevention intervention efforts with multiple layers that need to be addressed. The Ecological Systems Theory (EST)

hypothesizes human behavior is influenced from interactive individual, community, and societal factors (Davison & Birch, 2001). Contextual consideration is necessary to effectively modify behavioral characteristics of an individual, which includes not only the immediate context, but the context in which that individual is situated. Therefore, a child's ecological context includes their family and school, which are contexts influenced by larger the community and environment (Davison & Birch, 2001).

According to the Ecological Systems Theory (EST), the development of childhood overweight involves interactions between individual child characteristics, family and school processes, and community and societal functioning (Davison & Birch, 2001). Although successful prevention efforts should account for all three ecological niches, this study will examine only two of the niches identified: 1) child characteristics and 2) family/parent characteristics. Parental factors, especially maternal factors, heavily influence the development and prevention of overweight among preschool-age children. Thus, identifying maternal characteristics influencing the development and prevention of overweight will strengthen community-based health and wellness intervention efforts.

The EST framework identifies three behavioral patterns that place children at risk of overweight: dietary intake, physical activity, and sedentary behavior. These child risk factors can be moderated by age and gender (Davison & Birch, 2001). It is postulated that child behavioral patterns contribute to the development of overweight because they disrupt the body's natural energy regulation system. Obesity is a consequence of an imbalance in energy intake and energy expenditure, resulting in positive energy balance (Moore et al., 2003). Positive energy balance, meaning more energy intake than energy

expenditure, has attributed to the increasing rates of obesity since the 1980s (Hill, 2006; Meece, Hamm, & Number, 2008). It has been postulated that establishing optimum energy balance via increasing energy expenditure rather than restricting caloric intake is more effective because it is more difficult to maintain the level of food restriction necessary to regulate normal body weight for extended periods of time (Hill, 2006). Although dietary intake is an important risk factor to address in the attempt to reduce and reverse the obesity epidemic, this thesis will focus on improving energy expenditure and discussing the contributions of physical activity and sedentary behavior on the elevated rates of at risk for overweight and overweight among preschool children.

Physical Activity.

High levels of physical activity could compensate for increased dietary intake and sedentary behaviors and protect against the risk of early childhood overweight. The Centers for Disease Control and Prevention recommends that children accumulate at least 60 minutes of enjoyable physical activity daily both individually and in a group (McCambridge, 2006). Physical activity is imperative in weight reduction and improving obesity-related diseases, such as Type II diabetes and insulin resistance. A randomized controlled study of 9-11 year olds with hypertension demonstrated that aerobic exercise reduced their systolic and diastolic blood pressure, which was maintained 8 month after the intervention ended (McCambridge, 2006). Moreover, physical activity improves self-esteem, and self-concept, which are associated with depression and anxiety in adolescents and adults (McCambridge, 2006). Therefore, regular physical activity has many positive benefits above and beyond weight loss.

Despite the known health and developmental benefits of physical activity, a study published in 2000 reported only 36% of children met the daily physical activity recommendations. The decrease in physical activity could partially explain the increasing rates of obesity among preschool children, given the decrease in free-time physical activity in the past decade (Davison & Birch, 2001). Therefore, establishing the importance of physical activity among children 2-5 years old could help reduce the rates of overweight and obesity in childhood, adolescence, and adulthood.

Physical activity is important to introduce early in life to establish long-lasting health habits throughout development and adulthood. Not only has physical activity been linked to various health benefits, but physical activity patterns in early childhood have been found to predict later physical activity levels, body mass index (BMI), and obesity status in middle-to-late childhood. Habitual exercise and physical activity among preschool children are associated with decreased body fat and BMI, suggesting the importance of establishing early health behavior has lasting benefits (Davison & Birch, 2001; Tucker, 2008). The most active preschool-aged children tend to have less body fat in early adolescence compared to their less active peers (Moore et al., 2003). Furthermore, a positive relationship between minutes of physical activity and BMI was discovered in the first year of a longitudinal study; however, this trend reversed during the second and third years of the study to demonstrate an inverse relationship existed between physical activity and BMI suggesting the relationship between physical activity and body mass varies during developmental periods (Jago, Baranowski, Baranowski, Thompson, & Greaves, 2005). Given the importance of developmental changes in risk

and rates of obesity, prevention interventions should be introduced early in life to support healthy habits during childhood, adolescents, and adulthood.

Physical activity patterns are shaped by various child demographics, such as age, gender, and ethnicity, which influence optimal physical development (Davison & Birch, 2001). Early childhood overweight interferes with physical development, the ability to perform movements requiring gross motor skills, and reduces the amount of physical activity children choose to engage in during late childhood and adolescence (Castetbon & Andreyeva, 2012). Given that a normative decline in physical activity occurs at the onset of puberty when physical changes take place, low physical activity levels in early childhood may exacerbate the adolescent decline in physical fitness ability (Castetbon & Andreyeva, 2012). Physical changes, especially among females, also contribute to adolescents reluctance to participate in physically active situations where developmental changes could be noticed (Castetbon & Andreyeva, 2012; Davison & Birch, 2001; Tucker, 2008).

Gender-related differences have been reported in physical activity levels and gross motor skill ability among preschool-age children of both normal and overweight. In general, boys are more likely to be active than girls and to be more physically fit. Boys also tend to remain more physically active as adolescents compared to girls who become more physically inactive (Davison & Birch, 2001). A recent study of nearly 10,000 preschool and kindergarten age children found that gross motor skill development was inversely associated with high BMI scores and that these differences were affected by gender and required movement (Castetbon & Andreyeva, 2012). Moreover, obese boys

and girls were 17-20% less likely to pass a hop test compared to their normal weight peers at age 4 and 7-11% less likely to pass a hop test at age 5-6. Of the children who participated in this study, obese girls jumped shorter distances relative to their non-obese peers (Castetbon & Andreyeva, 2012). Increased difficulty in these movements could be due to increased body mass and impaired musculoskeletal development. The inability to perform these tasks may in turn reduce participation in organized physical activities and sports that require jumping or running, further contributing to excessive weight gain with age, especially among females.

In addition to age- and gender-related disparities in physical activity, different physical activity patterns appear to exist among ethnic-minority populations. Even though literature investigating ethnic disparities of physical activity among children, especially, preschool-age children is limited, differences have been discovered Caucasian children were more likely to participate in individual activities than African-American or Mexican-American children; however, African-American children were more likely to participate in group activities, such as an organized sport (Kohl & Hobbs, 1998). Age, gender, and ethnicity have the potential to influence physical activity patterns in childhood; thus, prevention intervention programs should identify and address these areas before health habits are established.

Sedentary Behavior.

In contrast to physical activity that might protect against the development of overweight, sedentary behavior places children at risk of developing overweight and obesity (Davison & Birch, 2001). Sedentary behavior is an emerging research focus in

public health due to its increasing rates and health implications. A majority of the research conducted in this area has been in school-aged children; nonetheless, the relationship between patterns of sedentary behavior appears to be consistent (Lumeng, Rahnama, Appugliese, Kaciroti, & Bradley, 2006). According to pediatric health organizations, children between the ages of 2 and 5 should watch no more than 1-2 hours of television daily; but, children and adolescents in the United States watch almost 3 hours of television each day (Carson & Janssen, 2012; Davison & Birch, 2001; Lumeng, Rahnama, Appugliese, Kaciroti, & Bradley, 2006). The increasing rates of sedentary behavior have been linked with children's weight status. It has been postulated that sedentary contributes to overweight and obesity by competing against physically active behaviors; moreover, sedentary behaviors are reinforcing to children, particularly for obese children (Epstein, Paluch, Gordy & Dorn, 2000). As such, higher levels of sedentary behavior are linked with greater prevalence of overweight, greater increases in BMI over a year, and higher BMI, indicating the need to target sedentary behaviors in prevention intervention efforts (Davison & Birch, 2001).

Interventions targeting overweight and obese school-aged children have revealed positive results by promoting reduced sedentary behaviors. A treatment study demonstrated that a reduction in the amount of sedentary behavior a child engaged in was associated with decreased body fat and overweight (Davison & Birch, 2001). Leonard Epstein, Rocco Paluch, Constance Gordy, and Joan Dorn (2000) found that reducing sedentary behaviors among obese children aged 8-12 years was related to increases in physically active behavior and decreases in percent of overweight.

Much like physical activity, sex-differences, age-related, and ethnic-related associations have been noted in sedentary behavior. Girls tend to watch more television than boys, and both boy and girls are more likely to watch greater amounts of television as they age; however, it is unknown if there are sex differences in the degree to which sedentary behavior is associated with overweight (Davison & Birch, 2001). It has been speculated that girls might be more affected because they are less likely to compensate for their sedentary behavior with exercise. For instance, a school-based intervention found that reductions in television viewing were associated with a decrease in the incidence of overweight in girls, but not boys, suggesting girls are more affected by sedentary behavior (Davison & Birch, 2001; Gortmaker, Peterson, Wiecha, Sobol, Dixit, Fox, & Laird, 1999). Moreover, a cross-sectional study of preschool-aged children found children who are older are more likely to exceed the recommended AAP suggestions for television viewing (Mendoza et al., 2007). Mendoza, Zimmerman, and Christakis (2007) also found that television viewing was highest among non-Hispanic black children. Sedentary behavior is associated with rates of overweight and obesity among children age 2 through 5, independent of physical activity, and should be incorporated in future prevention efforts. Thus, intervening early to encourage adequate daily physical activity during this sensitive developmental period of early childhood is imperative to establish the importance of physical activity, promote optimal physical development, and reduce the prevalence of obesity.

Maternal Perception of Childhood Overweight

Maternal Influence on Obesity and Health Behavior.

Identification of children who are overweight and display child risk factors of overweight is important so that prevention efforts can be implemented early in life. Preventions are likely to be unsuccessful if mothers fail to perceive their child as having excess adiposity or fail to recognize the health risks related to excess body weight (Baughcum & Chamberlin, 2000; Maynard, Galuska, Blanck & Serdula, 2003). Studies have demonstrated mothers tend to misclassify their overweight child as typical (Baughcum & Chamberlin, 2000; Maynard et al., 2003). Maynard and colleagues found that 32.1% of mothers with overweight children misclassified them as “about the right weight”; similarly, Baughcum and Chamberlin (2000) found that 79% of mothers with overweight children failed to recognize their child’s actual weight status. In particular, of the 99 mothers with overweight children, only 21% of the mothers accurately perceived their child as overweight; furthermore, of the 66 mothers of children with BMI exceeding the 95th percentile, only 29% believed their child was overweight (Baughcum & Chamberlin, 2000). To expand the limited literature, a large-scale study in California found that 93.6% of mothers of overweight children perceived them as normal weight, and 77.5% of mothers of obese children thought their child was of normal weight. Conversely, nearly all mothers of normal weight children (92.6%) classified their child as being of about the right weight (Chaparro, Langellier, Kim, & Whaley, 2011). The literature has consistently demonstrated the misclassification of child weight status among mothers of overweight children; hence, mothers need to be educated about childhood overweight and the associated long-term risks for early life interventions to be successful (Baughcum & Chamberlin, 2000; Chaparro et al., 2011; Maynard et al., 2003).

Child gender has also been found to predict maternal misclassification of child weight status; however the findings have been inconsistent. Maynard and colleagues (2003) demonstrated that mothers were nearly 3 times more likely to classify “at-risk” daughters as overweight compared to “at-risk” sons; suggesting mothers may be more concerned about their daughters’ weight status and tend to overestimate their bodyweight. Contrary to the results from Maynard et al. (2005), a cross-sectional study of 5-12 year olds found that boys’ weight status was more likely to be misclassified (29%) relative to girls (21%) (De La O et al., 2009). The implications of gender differences of maternal misperception of child body weight are also inconsistent.

It has been hypothesized that maternal misperceptions of girls might serve as a protective factor against obesity. The misclassification of obesity, such as mothers overestimating their daughter’s bodyweight, might encourage mothers to focus on altering the food environment in the household or inspire increased levels of physical activity. In contrast, the failure to perceive “at-risk” or overweight among boys might place them at greater risk to gain more weight and abstain from developing healthy lifestyle behaviors because health behaviors are not encouraged by mothers. Therefore, overweight interventions should involve educating both the mother and the child about recognizing risk factors or signs of overweight and appropriate physical activity and sedentary behavior patterns.

Relationship with Physical Activity and Sedentary Behavior.

Maternal misperception of child weight status has a profound influence on the effectiveness of obesity interventions aimed at the preschool-age population. Mothers

play a primary role in shaping their child's dietary and physical activity patterns (Baughcum & Chamberlin, 2000; Cottrell et al., 2012). Mothers control the food choices of their children and the availability of safe opportunities for physical activity; therefore, prevention efforts should focus on improving maternal perception of weight status and health behaviors and maternal involvement in order to reduce the increasing incidence of overweight among 2-5 year olds.

While studies have recognized the relationship between maternal misperception of overweight and feeding practices of children (Hackie & Bowles, 2007), there are few studies investigating the relationship between maternal misclassification of child's body weight status and physical activity and sedentary behavior patterns (Eckstein et al., 2006a; Jaballas, Clark-Ott, Clasen, Stolfi, & Urban, 2011). Consequently, it is difficult to draw conclusions about how maternal misperception of their child's weight status predicts physical activity levels and sedentary behavior among overweight obese preschool children. Thus, the purpose of this study was to better understand the relationship between maternal perceptions of child weight status and weekly physical activity levels and daily sedentary behaviors; furthermore, the current study sought to uncover the moderating effect gender and race has on the relationship among perception of child body weight status and physical activity and sedentary behaviors in preschool children.

The current study sought to answer five primary research questions:

1. Does child gender and ethnicity predict maternal misperception of body weight status?

2. Does maternal language and level of education predict maternal misperception of their child's weight status?
3. Do reported child weekly physical activity levels differ for mothers who accurately perceive their child's body weight and those who misperceive their child's body weight?
 - a. Does maternal misperception of their child's weight status interact with child's gender?
 - b. Does maternal misperception of their child's weight status interact with child's ethnicity?
4. Is the reported level of importance placed on changing a child's physical activity levels different among mothers who accurately estimate their child's body weight compared to mothers who misperceive their child's body weight?
5. Do reported child daily sedentary behavior amounts differ for mothers who accurately perceive their child's body weight and those who misperceive their child's body weight?
 - a. Does maternal misperception of their child's weight status interact with child's gender?
 - b. Does maternal misperception of their child's weight status interact with child's ethnicity?

Chapter Two

Method

Study Location

Culture of Wellness in Preschools Intervention and Evaluation.

A 3-year grant from the Colorado Health Foundation was awarded to the Rocky Mountain Prevention Research Center at the University of Colorado Denver in 2011 to work with Denver's Great Kids Head Start (DGKHS) to implement a collaborative obesity prevention intervention aimed at promoting a "*culture of wellness*" in Head Start preschools in the Denver Metropolitan area. This program includes the implementation of a range of programs and activities, such as nutrition education classes and structured physical activity opportunities, aimed at increasing daily healthy eating and physical activity for preschool students, staff, and parents in 21 Head Start centers. This program is being evaluated using a mixed methods evaluation approach. Evaluation instruments include a teacher survey, parent survey, playground observations, classroom observations, child BMI data collected by Head Start nurses, teacher and staff focus groups, and parent focus groups. This thesis project used secondary data from the Culture of Wellness in Preschools (COWP) program evaluation. Specifically, data from the parent surveys and child BMI data were used.

Measures

Parent.

Survey development.

Survey data obtained from parents or guardians of children enrolled in Denver Head Start centers were used for the current study. The survey was developed by the Principal Investigator (PI), Dr. Jini Puma and her program steering committee. The survey assessed parental perceptions of their personal and their child's body weight status and health behaviors. Some questions were adapted from existing questionnaires and others were developed by the PI and the steering committee. The PI attempted to align the existing behavioral questionnaire items with the COWP intervention components; questions measuring physical activity, sedentary behavior, and maternal perception of change were extracted from the 2009 Youth, Risk Behavior Survey Questionnaire (YRBS, 2009). Questions not adapted from the YRBS were created by the PI and discussed and refined with the steering committee members.

The final survey elicited responses to four content areas: 1) maternal perception of child body weight status, 2) maternal perception of child health behavior, 3) maternal perception of their own body weight status, and 4) maternal and child demographic factors. The survey comprised 36 multiple-choice and open-ended questions. Maternal perception of child weight status was assessed using one question: "How do you describe your child's weight? (Very underweight, slightly underweight, about the right weight, slightly overweight, very overweight)". Child weekly physical activity was measured using one question, "During the past 7 days, on how many days was your child physically active for a total of at least 60 minutes per day? (0 days to 7 days)" and daily sedentary behavior was measured using one question, "On an average day, how many hours does

your child watch TV or play video or computer games? (none, less than 1, 1 hour per day, 2 hours per day, 3 hours per day, 4 hours per day, 5 or more hours per day)”.

Survey administration procedure.

Participants were recruited by health promoters during drop-off and pick-up hours at each Head Start site in Denver and during parent events. Parents were given information about the project and how the information collected would be used in order to assist with their decision process. Parents who decided to participate were verbally consented into the study. Once consented, one parent or guardian completed the pre-survey and returned it to the health promoter at the Head Start site. Participants were instructed to contact the health promoters if they were having difficulty completing the survey. Surveys were self-administered in both English and Spanish and were verbally administered by the health promoter for participants who were unable to complete the form independently because of reading difficulties. The survey took approximately 10 to 15 minutes to complete. Post-surveys were administered in a similar fashion in the spring of 2014 and parents received a \$10 gift card at completion. For this thesis, only pre-survey data were analyzed.

Student.

Anthropometric.

Height and weight data were collected in fall of 2013 by Head Start nurses for all children. These data were uploaded into the HeartSmartKids database for all children that had a completed parent survey. The height and weight data were converted in to a BMI percentile score by the HeartSmartKids program.

Study Population

Denver's Great Kids Head Start (DGKHS), the largest Head Start preschool agency in Denver, primarily serves economically disadvantaged ethnic minority children (Hispanic/Latino = 64%; Black/African = 22%). One in every 6 (15%) of the preschool children enrolled at Head Start are overweight or obese (DGKHS, 2009). A total of 711 pre-surveys were collected, giving the study an 81% response rate. BMI scores were computed for 562 of the preschool children whose parent/guardian completed a survey; the remaining 149 cases were left blank and no imputation was conducted. Mean imputation refers to replacing the variables with missing values using the variable mean; this method would not be desirable for replacing BMI data because it creates strong bias and could categorize children incorrectly, therefore the findings of the study would be biased. Additional cases were intentionally deleted from the analysis if mothers overestimated their child's weight status ($n = 18$). The demographic, behavioral, and anthropometric characteristics for parents/guardians and children are presented in tables 1 and 2.

Table 1.

Sample Characteristics of Key Demographic Variables

Demographic Variable	%, M(SD)	N
Child Characteristics		
<i>Gender</i>		
Male	49.5	305
Female	50.5	311
<i>Ethnicity</i>		
Hispanic/Latino	68.7	419
Black/African American	23.9	146
White/Caucasian	4.8	29
Asian	1.3	8
Native Hawaiian/Other	0.3	2

Pacific Islander		
American Indian/Alaska Native	1.0	6
Maternal Characteristics		
<i>Level of Education</i>		
Grades 1 through 8	11.9	70
Grades 9 through 11	23.7	139
Grade 12	32.3	189
College 1 year to 3 years	24.7	145
College 4 years or more	7.3	43
<i>Language of Survey</i>		
Spanish	47.0	291
English	53.0	328
<i>Age</i>	31.4(7.7)	576

Table 2.

Sample Characteristics of Main Effect Behavioral and Anthropometric Variables

Main Effect Variable	%, M(SD)	N
Child		
<i>Body Mass Index</i>		
Underweight	1.2	6
Normal Weight	70.7	347
Overweight	12.8	63
Obese	15.3	75
Days child was active for at least 60 minutes	5.2(2.1)	598
Hours child engaged in sedentary behavior	2.4(1.2)	617
Maternal		
<i>Perception of child body weight</i>		
Accurate Perception	64.6	314
Misperception	35.4	172
Importance to change physical activity	7.9(3.4)	617

Statistical Methods

Maternal perception was defined as a dichotomous independent variable: accurate perception vs. misperception. The process to create the maternal perception variable

began with the creation of the child BMI variable. For the purpose of this study, child BMI was categorized as “underweight” (BMI 1 – 4.99 percentile), “normal weight” (BMI 5-84.99 percentile), “overweight” (BMI 85 – 94.99 percentile) and “obese” (BMI \geq 95th percentile). Child BMI was then matched to the responses from the question measuring perception of child body weight. Lastly, accurate perception was defined as mothers who responded with the response option that matched child BMI (for instance, child BMI was in the 83rd percentile and mom answered “slightly overweight”). Misperception was defined as a mother who response option did not match with their child’s BMI (for example, child BMI was in the 95th percentile and mom answered “slightly overweight” or “normal weight”). Descriptive statistics about the distribution of maternal perception by child BMI category, before the groups were collapsed into a binary variable, is presented in table 3.

Table 3

Distribution of Maternal Perception by Child Body Weight

	Maternal Misperception	Maternal Accurate Perception
Normal Weight	45 (13% of Normal Weight)	303 (87% of Normal Weight)
Overweight/Obese	127 (92% of Overweight/Obese)	11 (8% of Overweight/Obese)
Underweight	0 (0% of Underweight)	5 (100% of Underweight)

A chi-square test for association was performed between child weight status and maternal perception of child body weight. Expected cell frequencies for normal weight and overweight/obese children exceeded five; however, the cell frequencies for underweight children did not exceed 5; thus, the underweight group was combined with the normal weight group for the final analysis, resulting in a 2x2 matrix. Results revealed a statistically significant association between child weight status and maternal misperception of child body weight, $\chi^2(1) = 286.88, p < .001$. The analysis suggests that

mothers of overweight or obese children are more likely to misperceive their child's body weight compared to mothers of normal weight and underweight children.

Research questions 1 and 2 were analyzed using binary logistic regression. The dependent variable for each question was maternal perception of child weight (accurate perception vs. inaccurate perception). The predictor variables were child gender, child ethnicity, maternal language, and maternal education level respectively. All assumptions for logistic regression were checked and upheld before performing the analyses.

Research questions 3, 4, and 5 were analyzed using independent sample t-tests. The outcome variable for all research questions was maternal perception of child body weight. The dependent variables were physical activity levels, parental importance to change physical activity behavior, and sedentary behavior, respectively. All assumptions for independent samples t-test were checked prior to final analysis.

Separate two-way analyses of variance (ANOVA) were conducted to analyze the sub-questions for RQs 3 and 5. The dependent variable for research question 3 was child weekly physical activity levels and for research question 5 was daily sedentary behavior patterns. The independent variable for research questions 3 and 5 was maternal perception of child body weight status. The second factor for questions 3a and 5a was child gender and the second factor for question 3b and 5b was child ethnic minority status. Child ethnicity was dichotomized before analysis: Hispanic/Latino and not Hispanic/Latino. All assumptions for two-way ANOVA were checked prior to analysis. SPSS version 22.0 was used for all analyses.

Chapter Three

Results

Prior to analysis, all key variables were examined through various IBM SPSS programs to assess missing values. Less than 5% of the values for all demographic factors included in the analysis were missing; thus, the percent of missing data was too small to warrant any further investigation. However, the “missingness” for the child BMI and the maternal perception variables exceeded 20% (21.0% and 21.7% respectively), which required further investigation. Attrition accounted for 3.6% of the missing cases in the data set; therefore, to explore possible explanations for the remaining missing data, binary logistic regressions analyses were performed using various child and maternal demographic factors as predictor variables and missing/non-missing as the categorical dependent variable. There was a poor model fit on the basis of the five demographic variables tested against child BMI category (Cox & Snell $R^2 = .003$), indicating the variability in the model was not predicted by child and maternal demographic factors (Tabachnick & Fidell, 2013). Furthermore, there was a poor model fit on the basis of the five demographic factors tested against maternal perception of child body weight (Cox & Snell $R^2 = .006$), indicating the variability in the model was not predicted by the child and maternal demographic factors (Tabachnick & Fidell, 2013). The missing values for child BMI and maternal perception were determined to be missing at random; thus, cases were deleted from the analyses using listwise deletion methods.

Of the 492 mother-child dyads included in the analysis, 6 were underweight, 346 were normal weight, 63 were overweight, and 75 were obese. Of the overweight and obese children, 27 males and 36 females were overweight and 36 males and 39 females were obese. The proportion of mothers who accurately identified their child's weight status did not differ by child gender. The distribution of maternal perception of body weight by child gender is shown in figure 4.

Table 4.

Maternal Perception of Child Bodyweight by Child Gender and BMI Category

	Male		Female	
	Normal ¹ Weight	Overweight /Obese	Normal Weight	Overweight /Obese
Accurate Perception	153 (44% of normal weight)	4 (3% of overweight/obese)	149 (43 % of normal weight)	7 (5% of overweight/obese)
Misperception	27 (8% of normal weight)	59 (43% of overweight obese)	18 (5% of normal weight)	68 (49% of overweight/obese)

Research Question 1: Does child gender and ethnicity predict maternal misperception of body weight status?

A binary logistic regression was performed to determine whether maternal perception can be predicted based on child gender and ethnicity. All assumptions for binary logistic regression were examined prior to final analysis and were determined satisfactory.

The logistic regression resulted in adequate model fit, $\chi^2(2) = 9.9, p = .007$, indicating the predictors were able to explain a proportion of the variance in maternal

¹ The normal weight category included the 6 underweight children identified; thus, resulting in a 2X2 matrix.

perception of child body weight; the final model including the predictor variables explained 2.8% (Nagelkerke R^2) of the variance in maternal perception of child body weight, indicating a small effect size. Overall, child gender and ethnicity were able to correctly classify 64.5% of cases of maternal perception. Of the two predictor variables, only one was statistically significant: child ethnicity (as shown in table 5). Non-Hispanic/Latino mothers were 1.9 times more likely to accurately perceive their child's body weight than Hispanic/Latino mothers.

Table 5.

Logistic Regression Analysis of Maternal Perception of Child's Body Weight on Child Gender and Ethnicity

Variables	B	Wald	Odds Ratio	<i>p</i>
Child Gender	-.003	.00	.997	.986
Child Ethnicity	.664	9.54	1.943	.002

Research Question 2: Does maternal spoken language and education level predict maternal perception of their child's weight status?

A binary logistic regression was performed to determine whether maternal perception could be predicted based on language and education level. All assumptions for binary logistic regression were examined prior to final analysis and were determined satisfactory.

The results of the logistic regression did not reveal adequate model fit, $\chi^2(5) = 3.47$, $p = .627$, indicating the predictors were not able to explain additional variance in maternal perception of child body weight; the final model including the predictor variables explained only 1.0% (Nagelkerke R^2) of the variance in maternal perception of child body weight, representing a small effect size. Overall, maternal language and

education level were able to correctly classify 65.7% of cases of maternal perception. This analysis revealed that maternal language ($Wald(1) = 2.85, p = 0.092$) and level of education ($Wald(4) = .894, p = .925$) were not able to predict maternal misperception of child body weight.

Research Question 3: Do child weekly physical activity levels differ for mothers who accurately perceive their child's body weight and those who inaccurately perceive their child's body weight?

There were 167 mothers who misperceived their child's body weight and 304 who accurately perceived their child's body weight. An independent samples t-test was run to determine if there were differences in the reported levels child weekly physical activity between children from mothers who accurately perceived their body weight compared to children from mothers who misperceived their body weight. Reported physical activity scores were normally distributed, as assessed by level of skewness and there was homogeneity of variance, as assessed by Levene's test for equality of variances ($p = .573$). The level of physical activity was not different for children with mothers who accurately perceived weight ($M = 5.23, SD = 2.069$) and those with mothers who misperceived weight ($M = 5.04, SD = 2.198$) ($M = -0.191, 95\% CI [-0.591, 0.209], t(469) = -0.938, p = 0.349$). These results indicate that mothers report their child engages in the recommended level of physical activity regardless of maternal perception of child body weight.

Research Question 3a: Does maternal misperception of their child's weight status interact with child's gender?

A two-way ANOVA was performed to determine the interaction between perception of child body weight and gender. All assumptions for a two-way ANOVA were assessed prior to final analysis. Physical activity level, as self-reported by mothers, was not normally distributed for all group combinations of maternal perception and child gender as assessed by the level of skewness. A square root transformation with reflection was applied to correct the moderately negatively skewed distribution in physical activity.

The analysis yielded a statistically significant interaction between gender and maternal perception of body weight on child physical activity levels, $F(1,469) = 4.70$, $p = 0.031$, partial $\eta^2 = 0.01$ (see Figure 1). The main effect of gender was not statistically significant, $F(1,466) = 3.68$, $p = 0.056$ and the main effect of maternal perception was not statistically significant, $F(1,466) = 0.85$, $p = 0.36$; post-hoc analysis revealed a statistically significant difference in physical activity level between males and females of mothers who misperceived their child's weight status, $F(1,466) = 6.47$, $p < 0.011$, partial $\eta^2 = 0.014$. Female children of mothers who misperceived their body weight engaged in the least amount of weekly PA whereas, male children of mothers who misperceived their body weight engaged in the highest amount of weekly PA. Furthermore, female and male children of mothers who accurately perceived their child's body weight engaged in similar amounts of PA, as reported by mothers (as shown in table 6).

Figure 1.

Interaction Effect of Child Gender and Maternal Perception of Child Body Weight on Child Weekly Physical Activity Levels

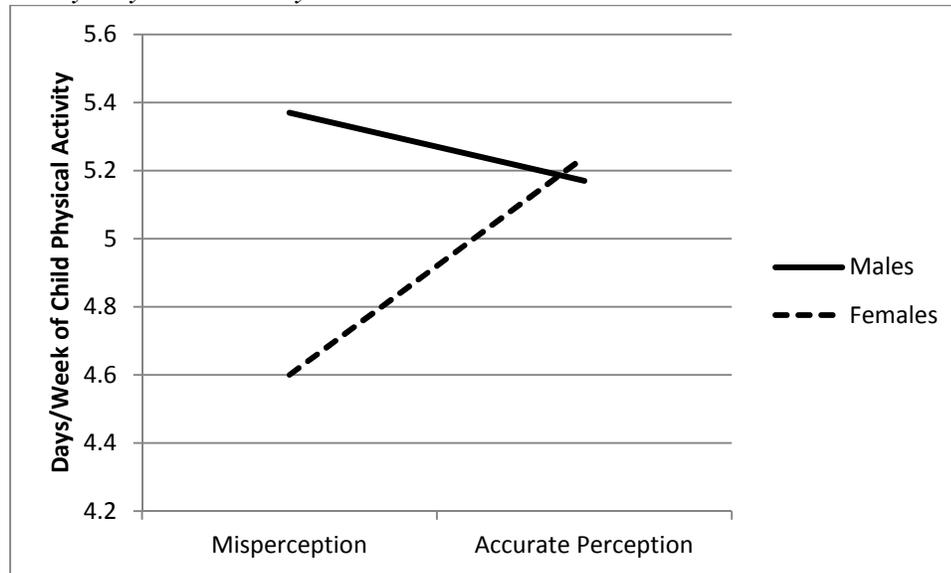


Table 6.

Mean and Standard Deviations of Child Physical Activity Levels as a function of Child Gender and Maternal Perception

Maternal Perception	Gender	
	Male	Female
Accurate	1.56 (0.61)	1.55 (0.59)
Inaccurate	1.49 (0.61)	1.72 (0.61)

Research Question 3b: Does maternal misperception of their child’s weight status interact with child’s ethnicity?

A two-way ANOVA was performed to determine the interaction between ethnicity and child body weight perception for reported child weekly PA levels. All assumptions for a two-way ANOVA were assessed prior to final analysis. Physical activity level, as self-reported by mothers, was not normally distributed for all group combinations of maternal perception and child ethnicity as assessed by Shapiro-Wilk’s

test ($p < .05$). A square root transformation with reflection was applied to correct the moderately negatively skewed distribution of physical activity.

There was a statistically significant interaction between child ethnicity and maternal perception of body weight for child physical activity levels, $F(1,470) = 3.74$, $p = 0.05$, partial $\eta^2 = 0.008$ (as shown in Figure 2). The main effects of child ethnicity was statistically significant, $F(1,470) = 5.01$, $p = 0.03$ and the main effect of maternal perception not statistically significant, $F(1,470) = 1.60$, $p = 0.21$; post hoc analysis revealed a statistically significant mean difference in physical activity level between the Hispanic/Latino and Not Hispanic/Latino children of mothers who accurately perceived their child's bodyweight, $F(1,467) = 14.65$, $p < 0.001$, partial $\eta^2 = 0.03$. For children of mothers who accurately perceived their child's body weight, Hispanic/Latino children had statistically significant greater levels of weekly physical activity than non-Hispanic/Latino children (as shown in table 7).

Figure 2.

Interaction Effect of Child Ethnicity and Maternal Perception on Child Body Weight on Child Daily Sedentary Behavior

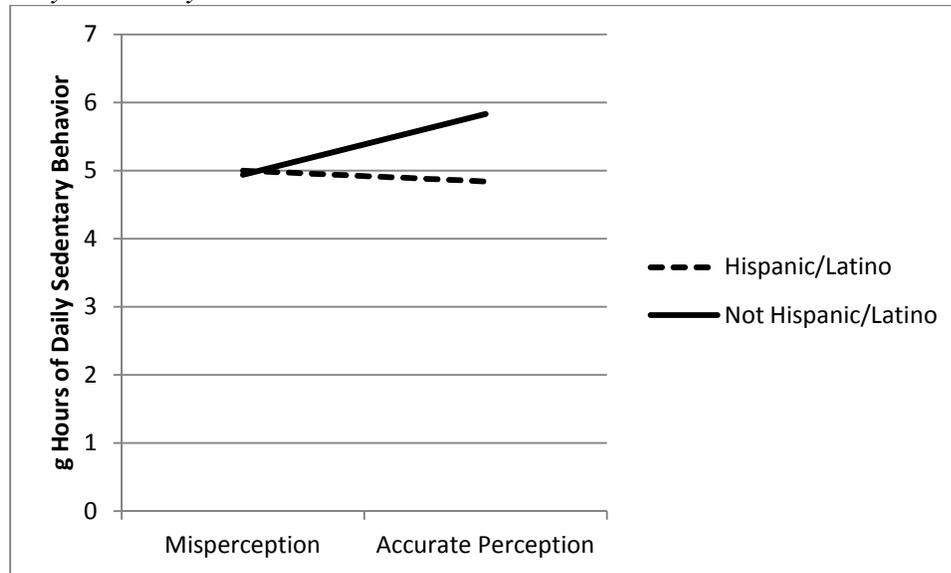


Table 7.

Means and Standard Deviations of Child Physical Activity Levels as a function of Child Ethnicity and Maternal Perception

Maternal Perception	Ethnicity	
	Hispanic/Latino	Not Hispanic/Latino
Accurate	1.65 (0.61)	1.38 (0.54)
Misperception	1.61 (0.61)	1.59 (0.67)

Research Question 4: Is the level of importance placed on changing child’s physical activity levels different among mothers who accurately estimate their child’s body weight compared to mothers who inaccurately estimate their child’s body weight?

There were 172 mothers who misperceived their child’s body weight and 312 who accurately perceived their child’s body weight. An independent samples t-test was performed to determine the difference between the degree of importance to change

physical activity behavior and maternal perception of body weight. Scores for degree of importance to change were normally distributed, as assessed by the degree of skewness; however, homogeneity of variances was violated, as assessed by Levene’s test for equality of variances ($p = .001$). The degree of importance to change child physical activity behavior was not significantly different between mothers who accurately perceived weight ($M = 7.65, SD = 3.538$) and those mothers who misperceived weight ($M = 8.23, SD = 2.982$) ($M = .579, 95\% CI [-0.017, 1.174], t(405.183) = 1.910, p = 0.057$). While the difference was not significantly different, mothers who inaccurately perceived their child’s body weight reported a slightly higher degree of importance to change their child’s physical activity behaviors. To further explore this trend, an auxiliary analysis was performed exploring the difference of the sample of normal weight children and overweight/obese children separately. The supplementary analysis revealed no statistically significant differences between the scores of importance to change of the mothers with normal weight children or the mothers with overweight or obese children (as shown in table 8 and table 9). The group sizes for both populations were unbalanced, which could have affected the power to identify significant differences.

Table 8.

Results of t-tests and Descriptive Statistics Degree of Importance to Change Physical Activity Behavior by Maternal Perception of Normal Weight Children

Outcome	Group						95% CI for Mean Difference	t	df
	Accurate			Inaccurate					
	M	SD	n	M	SD	n			
Importance to Change PA	7.61	3.56	301	8.44	2.56	45	-0.03, 1.70	1.93	72.01

Table 9.

Results of t-tests and Descriptive Statistics Degree of Importance to Change Physical Activity Behavior by Maternal Perception of Overweight and Obese Children

Outcome	Group						95% CI for Mean Difference	t	df
	Accurate			Inaccurate					
	M	SD	n	M	SD	n			
Importance to Change PA	8.91	2.88	11	8.16	3.12	127	-2.68, 1.18	-0.77	136

Research Question 5: Do child daily sedentary behavior amounts differ for mothers who accurately perceive their child’s body weight and those who inaccurately estimate their child’s body weight?

There were 171 mothers who misperceived their child’s body weight and 314 who accurately perceived their child’s body weight. An independent samples t-test was performed to determine the difference between the average daily sedentary behaviors (hours) and maternal perception of body weight. Child sedentary behavior scores were normally distributed and there was homogeneity of variance, as assessed by Levene’s test for equality of variances ($p = .538$). The average hours of daily child sedentary behavior was not significantly different among mothers who accurately perceived weight ($M = 2.38$, $SD = 1.21$) and those mothers who inaccurately perceived weight ($M = 2.42$, $SD = 1.17$) ($M = .039$, 95% CI [-0.184, 0.263], $t(359.407) = .350$, $p = 0.727$).

Research Question 5a: Is there an interaction between maternal misperception of their child’s weight status and child’s gender?

A two-way ANOVA was performed to determine the interaction between child gender and maternal accuracy of child body weight perception for child daily sedentary

behavior level. All assumptions for a two-way ANOVA were assessed prior to final analysis. Child sedentary behavior, as self-reported by mothers, was normally distributed for all group combinations of maternal perception and child gender as assessed by Shapiro-Wilk's test ($p > .05$) and the homogeneity of variance assumption was met.

There was no statistically significant interaction between child gender and maternal perception of body weight on child physical activity levels, $F(1,483) = 1.49$, $p = 0.223$ partial $\eta^2 = 0.003$. No main effects were statistically significant, signifying children of mothers with accurate and inaccurate perception do not engage in different amounts of sedentary behavior regardless of gender (as shown in table 10).

Table 10.

Results from Post-hoc Analysis Investigating Differences of Child Sedentary Behavior by Child Gender.

Maternal Perception	Gender		<i>F</i>	<i>p</i>
	Male	Female		
Accurate	2.38 (1.19)	2.37 (1.24)	2.232	.136
Misperception	2.28 (1.21)	2.55 (1.12)	.001	.976

Research Question 5b: Does maternal misperception of their child's weight status interact with child's ethnicity?

A two-way ANOVA was performed to determine the interaction between child ethnicity and maternal accuracy of child body weight perception for child daily sedentary behavior. All assumptions for a two-way ANOVA were assessed prior to final analysis. Child sedentary behavior, as self-reported by mothers, was normally distributed for all group combinations of maternal perception and child gender as assessed by Shapiro-Wilk's test ($p > .05$); the homogeneity of variance assumption was also met.

There was no statistically significant interaction between child gender and maternal perception of body weight on child physical activity levels, $F(1,451) = .305$, $p = 0.581$, partial $\eta^2 = 0.001$. Neither main effect was statistically significant. The findings from this analysis demonstrated that children of mothers with accurate and inaccurate perception do not engage in different amounts of sedentary behavior regardless of ethnicity (as shown in table 11).

Table 11.

Results from Post-hoc Analysis Investigating Differences of Child Sedentary Behavior by Child Ethnicity.

Maternal Perception	Ethnicity		<i>F</i>	<i>P</i>
	Hispanic/Latino	Not Hispanic Latino		
Accurate	2.30 (1.16)	2.50 (1.30)	1.98	.160
Misperception	2.36 (1.12)	2.62 (1.33)	1.42	.235

Chapter Four

Discussion

Rates of overweight and obesity among preschool-aged children remain high in the United States despite prevention and intervention efforts. In this age group, mothers are less likely to identify their child as overweight or obese compared to mothers of older children, suggesting the ability to recognize the symptoms and risk factors of overweight and obesity in preschool-aged children is lower than those of older children (Eckstein et al., 2006). Lack of acknowledgement of appropriate body weight could affect several behaviors that often attribute to the onset of early childhood obesity, such as lower-than-recommended physical activity (PA) and higher-than recommended sedentary behaviors. Furthermore, the inability to accurately recognize a child's body weight could impede the level of importance mothers place on changing behaviors imperative for reducing overweight and obesity or even recognize the behaviors that need to be modified. Maternal inability to accurately perceive their child's body weight and the risk factors of overweight and obesity contribute to the elevated rates of overweight and obesity in preschool-age children despite intervention efforts.

One of the primary steps in overweight and obesity treatment among preschool-aged children should incorporate maternal recognition of child body weight to influence maternal willingness to make behavior modifications (Eckstein et al., 2006). Educating mothers about age-appropriate bodyweight and risk factors for overweight and obesity

will help establish sustainable health behaviors that could protect young children from gaining unhealthy amounts of body mass during development. The current study investigated maternal perception of child body weight and the influence misperception has on parent reported child health behaviors in an attempt to improve prevention intervention strategies to reduce early childhood obesity. Of the 492 mothers and children included in the current analysis, about 92% of all mothers perceived their child's body weight as appropriate. Moreover, of the mothers with overweight and obese children, only 8% of mothers accurately perceived their child as overweight or obese. These results corroborate previous studies in that mothers of overweight and obese children have a difficult time identifying appropriate weight status (Baughcum & Chamberlin, 2000; Chaparro et al., 2011; Hudson, Cherry, Ratcliffe, & McClellan, 2009; Maynard et al., 2003).

The primary goal of the current study was to assess the difference in levels of parent-reported child physical activity behaviors (e.g., physical activity and sedentary behavior) between mothers that accurately perceived their child's body weight and mothers that misperceived their child's body weight. To support the primary goal, supplemental analyses were conducted to determine whether maternal perception of child bodyweight interacted with child gender and ethnicity to determine a difference in parent-reported physical activity levels. Lastly, the current study assessed the different levels of parent-reported importance placed on changing child physical activity between mothers that accurately perceived their child's body weight and mothers that misperceived their child's body weight.

Maternal and child demographic characteristics have been identified to influence maternal misperception of child body weight, such as child gender and ethnicity and maternal level of education and ethnicity (De La O et al., 2009; Maynard et al., 2003). The current study investigated the predictive ability of child gender and ethnicity and maternal language and education level on maternal perception of child bodyweight. The only factor to significantly predict maternal perception of body weight was child ethnicity, which substantiated findings from previous studies. The current study, however, dichotomized child ethnicity, to represent Hispanic and not Hispanic populations; thus, to uncover more detailed relationships, future analyses should disaggregate child ethnicity to represent more than two categories of ethnicity. Maternal language, which was used as a proxy from maternal ethnicity, was not a significant predictor of maternal perception of child bodyweight in the current study, which also validated findings of previous studies (De La O et al., 2009; Hudson et al., 2009; Maynard et al., 2003). Therefore, child ethnicity appears to have greater ability to predict maternal perception of child bodyweight, but this same relationship does not extend to maternal ethnic-minority status.

Moreover, maternal education level was not a significant predictor of misperception of child body weight, which is inconsistent with findings from previous studies. Baughcum et al. (2000) found that mothers with lower education were more likely to underestimate their overweight or obese child's body weight than those with higher education. Binkin, Spinelli, and Lamberti (2013) also found that maternal education was a significant predictor of inaccurate perception; however, they also found

that while mothers with lower levels of education were more likely to incorrectly perceive their child's weight, high levels of misperception were also found among mothers of high education, especially if they lived in a region with high overweight and obesity rates. Unexpectedly, results of the present study showed no effects of educational level on perception of child's body weight. Although our sample was normally distributed, a majority of the parents in the final example possessed less than or equal to a high school diploma; therefore, it is possible that a restriction of range in education may have resulted in lack of significance for education. Moreover, maternal education might not have significantly predicted maternal misperception of child body weight because of the culture of the community where the Head Start parents lived. Thus, predictors of maternal misperception are multifaceted and should be further investigated to incorporate the contribution of cultural influence.

Maternal perception of child bodyweight has the ability to influence parent-reported child physical activity, however, results have been inconsistent and not significant (Eckstein et al., 2006; Hudson et al., 2009; Jaballas et al., 2011). For example, Eckstein et al. (2006) found that mothers of overweight and obese children did not perceive their child was more physically limited in terms of days/week they engaged in moderate to vigorous physical activity compared to normal weight peers, especially among 2-5 year olds. Therefore, the second aim of the current study was to determine the differences in the level of parent-reported child physical activity of mothers who accurately perceived their child's body weight and mothers who misperceived their child's body weight. Results from the current study revealed no group differences in

parent-reported child physical activity levels between mothers who accurately perceived their child's body weight and mothers who misperceived their child's body weight. Surprisingly, all mothers reported that their child engaged in the recommended amount of physical activity regardless of the accuracy of maternal perception of child bodyweight, which is inconsistent with recent research arguing that nearly half of preschool students do not receive the recommended amount of physical activity (Tucker, 2008). The finding that all mothers reported adequate child weekly physical activity levels suggests an objective measure of child physical activity should be implemented during the intervention. Also, mothers might believe their child is receiving adequate physical activity levels at school during the day, which culminates to the recommended amount of weekly PA. Conversely, this finding supports a previous study involving school-age children where mothers reported their children engaged in adequate levels of physical activity, whether through riding or biking to school, organized sports, or engagement in physical education classes at school, and that their children received adequate physical activity during school-related efforts multiple days a week, regardless of maternal perception of bodyweight (Jaballas et al., 2011). Even though maternal perception of child bodyweight did not significantly affect parent-reported levels of child physical activity differently in the present study, the finding that mothers reported adequate amounts of child physical activity suggests independent and objective measures of child physical activity outside of school should be implemented to validate reported PA.

Maternal perception of body weight and parent-reported physical activity levels disproportionately affect male and female children. As such, child gender might interact

with maternal perception of child body weight to help explain the relationship with parent-reported physical activity levels. Previous studies suggest, male children are more likely to engage in moderate to vigorous physical activity (MVPA) than female children and mothers are more likely to misperceive their daughter's body weight, specifically over-estimating their body weight (Davison & Birch, 2001, De La O et al., 2009, Maynard et al., 2005). Few studies, however, have investigated how maternal perception of child body weight and gender interact to explain maternal report of physical activity levels.

To further investigate the relationship between maternal perception of child body weight and parent-reported child physical activity levels in the current study, gender was included to assess the interaction it might have with maternal perception of child body weight. The findings from this study revealed a significant interaction between gender and maternal perception of child physical activity levels. Although all mothers reported higher than expected levels of physical activity, mothers who misperceived their son's body weight also reported the greatest amount of physical activity during the week. This interaction with male children may exist for a couple of reasons. First, mothers who misperceive their son's body weight might also over-report the amount of physical activity their child engage in. Second, sons of mothers who misperceive their body weight could actually engage in the recommended amount of physical activity, but over eat to compensate for increased energy expenditure that contributes to increase bodyweight. Thus, additional exploration into the relationship between maternal perception of child bodyweight and reported levels of physical activity should be conducted to uncover

confounding factors affecting the accuracy of maternal report of child physical activity levels.

Conversely, mothers who misperceived their daughter's body weight reported the least amount of physical activity during the week. This difference could be due to the fact that mothers of female children underestimate how often their daughter engages in physical activity; or do not recognize their child's ability to be physically active (De La O et al., 2009, Maynard et al., 2005). Moreover, female children may choose to engage in stereotypical activities, such as pretend play, which tends to be less physically activity; indicating that in addition to educating mothers about appropriate body weight for their preschool-age daughter, strategies to encourage MVPA of their daughters should be emphasized during prevention interventions. The statistically significant difference in reported physical activity among boys and girls of mothers who misperceive their weight could exist due to Type I error, suggesting these limited practical significance to the treatment of childhood overweight and obesity. Overall, this is one of the only studies to examine the interaction between maternal perception of child's weight and gender, however, given the known gender-related differences in parent-reported physical activity and maternal perception of child body weight, an interaction was likely.

Research also suggests that self-reported physical activity and maternal perception of child body weight varies among children of different ethnicities. Children of Caucasian descent are reported to engage in greater levels of physical activity than African-American and Mexican-American children (Kohl & Hobbs, 1998). Furthermore, mothers of children from African-American and Mexican-American populations are

more likely to misperceive their child's body weight compared to a Caucasian population, signifying a potential cultural difference in perception of appropriate body weight (Kohl & Hobbs, 1998). Results from the current study revealed non-significant results; however, Hispanic/Latino children from mothers that misperceived their body weight were reported to engage in slightly *greater* amounts of physical activity compared to non-Hispanic/Latino children of mothers who also misperceived their child's body weight. Parent-reported physical activity levels of Hispanic/Latino and non-Hispanic/Latino child populations from mothers that accurately perceived their child's bodyweight were similar. Comparable to the parent-reported physical activity levels for male and female children, reported levels of child physical activity were at the recommended amounts, this was also unexpected. In conclusion, children from different ethnic backgrounds appear to engage in different reported levels of physical activity amongst mothers who misperceive their child's bodyweight, however, various factors could influence and even confound this relationship, such as access to safe physical activity areas, family leisure time activity, and maternal preference for physical activity (Davison & Birch, 2001). Thus, further investigation into this relationship needs to be explored.

The third aim of the current study was to determine whether there were differences in the levels of parent-reported importance of changing child physical activity behavior among mothers who accurately perceived and mothers who misperceived their child's body weight. Once more, the average level of self-reported physical activity among normal weight and overweight/obese children were all reported to be at the

recommended levels. As such, all mothers in the study may not have placed much importance on changing their child's physical activity levels because they were already perceived as engaging in adequate levels of PA. However, mothers who misperceived their child's body weight might not have recognized the importance of increasing their child's physical activity to reduce body mass. Mothers receive information about the recommended physical activity requirements for their children from society through mass media and periodic trips to the pediatrician; however, if the physical activity recommendations are not reinforced to mothers by professionals and peers in their community, it could impede a mother's motivation to change their child's physical activity. Even so, if mothers believe their child is of appropriate weight and engages in the recommended levels of physical activity, they might not realize the need to increase physical activity levels.

Reducing sedentary behavior is a novel strategy in obesity intervention research, thus, very little literature has investigated the relationship between maternal perception of child body weight and parent-reported child sedentary behavior. Hence, the fourth and final aim of the study was to determine whether there were differences in the level of parent-reported child sedentary behavior of parents who accurately perceived and misperceived their child's body weight. In this study, no group differences existed in parent-reported child sedentary behaviors between parents who accurately perceived their child's body weight and parents who misperceived their child's body weight. Sedentary behavior in this study was defined as the average number of hours a child spend watching television during the day; however, additional activities are also identified as sedentary

behavior such as playing video and computer games (Carlson et al., 2010; Carson & Janssen, 2012b). These activities were not explored in the current study, thus differences in parent-reported might have been skewed because parents might have under-reported their child's daily sedentary behavior. For example, mothers in the current study may have monitored the amount of television their child watches because they recognize the consequences of viewing too much television, but they may not monitor how much time they spend playing video or computer games as stringently due to lack of awareness. Investigation into the relationship between reported sedentary behavior and maternal perception of child body weight is new; therefore, additional research into the unique contribution of sedentary behaviors is needed in order to emphasize decreasing this behavior in prevention interventions.

Given the results from this study, a potential cultural shift in the United States could contribute to the lack of difference in maternal perception of child body weight and reported physical activity levels. According to ecological systems theory, community and societal factors contribute to the development of poor health choices and overweight and obesity among children (Davison & Birch, 2006). In the current study, 35.4% of mothers were unable to recognize their child's appropriate weight status. This inability to recognize appropriate weight among preschool-aged children could be due to the increase in overall overweight and obesity the United States has experienced over the past three decades; thus, altering the cultural norm surrounding appropriate body weight. Simply investigating individual differences among groups to identify areas to improve physical activity behaviors may not uncover relationships existing within communities that

contribute to elevated childhood obesity, maternal inability to identify appropriate weight status, and patterns of child physical activity behaviors.

It has been postulated that an individual's social network influences their perception of obesity and even their health behavior. Having overweight or obese connections could alter an individual's tolerance of overweight or obesity and influence them to adopt or accept risk behaviors leading to obesity (Christakis & Fowler, 2007). Furthermore, self-perception of overweight and obesity among adults varies greatly among sub-groups of the population that possess differently normative evaluations of appropriate body weight (Chang & Christakis, 2003). The idea of social network influence on self-perception of adult body weight could be expanded to maternal perception of child body weight to explore the relationships that have stronger influence on the ability to identify appropriate body weight status. Social network analysis of maternal connections could help inform community-based prevention interventions aimed at reducing childhood obesity.

As with the etiology of obesity, the prevention and treatment of obesity is multi-faceted. Great responsibility is placed on mothers to change their child's health behavior, including their physical activity and their eating habits. Unfortunately, the treatment of obesity is not simple. While improving maternal perception and acceptance of their child's weight status could strengthen interventions, it appears that family-involvement should work in combination with community-based interventions to educate the children, the mothers, and the communities involved. Future research is needed that focuses on lessening the gender- and ethnicity-related differences among maternal perception of

body weights and physical activity. In addition, promoting multi-faceted obesity prevention interventions such as the Culture of Wellness in Preschools program will help to place more responsibility on communities.

Limitations and Recommendations for Future Research

There were limitations to the current study. First, the original proposal aimed to assess the differences in maternal perception of physical activity behaviors among the overweight and obese population to bolster the existing prevention interventions. However, the sample size for accurate perception and misperception of child body weight were disproportionate and yielded too small a sample size to analyze misperception data for overweight and obese children alone. Future research should focus on overweight and obese populations to understand the relationships with maternal perception and child physical activity behavior at a refined level for these groups alone. Recruiting a larger sample size of overweight and obese children and their mothers could yield greater power and allow stronger analyses of relationships with maternal perception.

Second, the gender of the mother/guardian was not reported on the survey; therefore, maternal gender could not be determined to isolate the analysis to only the surveys completed by mothers as proposed in the research proposal. Third, child physical activity behavior and sedentary behavior were self-reported by the mothers; thus, there should be an additional objective measure that assesses child physical activity in order to validate reported physical activity levels. The addition of an independent measure of physical activity behaviors will strengthen prevention intervention efforts because

practitioners and researchers will be able to implement and develop activity-specific interventions to targeted populations.

Lastly, maternal weight during pregnancy and postpartum has been linked to child overweight and obesity (Oken, Taveras, & Gilman, 2007; Wrontniak, Shults, Butts, & Stettler, 2008). Therefore, future studies and interventions should incorporate maternal weight and weight gain during pregnancy and postpartum to determine if a genetic predisposition to obesity exists.

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