

PREVALENCE OF WEIGHT MISPERCEPTIONS & TRYING TO LOSE WEIGHT IN 5TH
GRADERS: COMPARING GENDER, WEIGHT STATUS, BODY FATNESS, ETHNICITY,
& DIETARY BEHAVIOR

By

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ABSTRACT

PREVALENCE OF WEIGHT MISPERCEPTIONS & TRYING TO LOSE WEIGHT IN 5TH GRADERS: COMPARING GENDER, WEIGHT STATUS, BODY FATNESS, ETHNICITY, & DIETARY BEHAVIOR

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Objective: In a sample of fifth grade students, evaluate the prevalence of: 1) trying to lose weight, 2) perception of weight status, and compare by gender, weight status, body fatness, ethnicity, and dietary intake. Methods: A total of 519 students completed anthropometric measurements and surveys, including the questions: 1) Are you now trying to lose weight? 2) How do you feel about your body weight? Students were classified as normal weight (NW), overweight (OW), or obese (OB) and as overfat (OF) or normal fat (NF). Daily calorie intake, and a Healthy Eating Index (HEI) and fiber index (FI) (fiber g/1,000 calories) score were derived from a food frequency questionnaire. Statistics included chi-square and ANOVA, with significance set at $p \leq 0.05$. Results: Overall, 22% viewed themselves as too heavy. A majority of OW/OB (64%), and OF males (59%) underestimated their body size. Forty-nine percent reported trying to lose weight, of which 86% were OW or OB. Among NW children, 28% were trying to lose weight. Caucasians had the lowest prevalence of trying to lose weight and perceiving themselves as too heavy. FI was significantly higher ($p=0.007$) in those trying to lose weight versus those who were not. There were no significant relationships with the HEI score or calorie intake. Conclusions: Nearly half of the sample was trying to lose weight, and of concern, 16% were NW, while about 2/3 of OW/OB and OF males underestimated their size. These two questions can identify children who may be pursuing unnecessary weight loss or misperceiving their weight status, which may affect dietary and other lifestyle behaviors, and overall health.

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KEY TO ABBREVIATIONS

%BF	Percent body fat
ADA	American Dietetics Association
AHA	American Heart Association
ANOVA	Analysis of variance
BIA	Bioelectrical impedance
BMI	Body mass index
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control
ChEAT	Children's Eating Attitude Test
Crim	Crim Fit Youth Program
CVD	Cardiovascular disease
ED	Eating disorder
EDNOS	Eating disorders not otherwise specified
FFQ	Food frequency questionnaire
FI	Fiber index
FIT	Project FIT
HEI	Healthy Eating Index
MVPA	Moderate to vigorous physical activity
NF	Normal fatness
NHANES	National Health and Nutrition Examination Survey
NW	Normal weight
OB	Obese

OF	Overfat
OW	Overweight
QOL	Quality of life
SES	Socioeconomic status
(S)Partners	(S)Partners for Heart Health
USDA	United States Department of Agriculture
YRBSS	Youth Risk Behavior Surveillance System

CHAPTER 1

INTRODUCTION

Background & Rationale

The rise in childhood and adult obesity has driven weight issues into the national and global spotlight [1-4]. This focus on body weight has the potential to negatively self esteem related to body size in normal weight (NW) and overweight (OW) or obese (OB) children, including how they perceive their body weight and weight related behaviors. According to Brown and Cantor 2000, all types of media are becoming increasingly interactive and pervasive in children's lives. Media role modeling may negatively affect the development of body image [5], the discrepancy between a person's actual and ideal size [6]. Recent studies indicate that sources influencing body image and lifestyle choices for children are multifactorial, and that the "ideal size" is continually decreasing [1]. Key influences include parents and family dynamics, health interventions, schools, sports, and peers [7-9]. Additionally, low self-esteem and body dissatisfaction are particularly common in OW and OB children [10], and are risk factors for the development of eating disorders in children of all sizes. It appears that as the number of OW and OB youth increases, so do the numbers of clinically diagnosable and sub-clinical eating disorders, as obesity and eating disorders share risk factors and can present concurrently [6, 8].

Perception of body weight is complex and dynamic, and is influenced by a number of factors including growth and environmental factors, and is related to self-esteem [1, 11]. It also influences eating and exercise attitudes and behaviors [9] and health status [12]. Overweight children as young as five years old have reported an overall negative self-identity and perceive themselves to have lower cognitive and physical abilities than their normal weight peers [13]. Additionally, the National Health and Nutrition Examination Survey (NHANES) III [14] and

Youth Risk Behavior Survey [15] data indicate a particularly high prevalence of children that perceive themselves as OW, including those who are classified as NW, and in particular, females.

Studies by Gusella 2008 [16], Zaborskis et al 2008 [17], and Cook et al 2007 [18] indicated that 12.5-60% of children and adolescents are trying to lose weight. Surprisingly, those who report trying to lose weight or are dissatisfied with their size are not just OW and OB children. Between 14-71% of youths classified as NW have reported weight loss desires and/or attempts in recent literature [14, 16, 17, 19]. Those who are unhappy with their weight may engage in unhealthy weight loss behaviors that may progress into more serious conditions, such as anorexia or bulimia nervosa [8]. Likewise, those who are content with their weight when they are actually OW or OB are at risk for obesity-related comorbidities [6]. Identification of inaccurate weight perceptions and subsequent weight related behaviors in children is crucial for prevention or treatment of these conditions and comorbidities. To date, a majority of the literature has focused on females, failed to include children from low socioeconomic status (SES) environments, neglected to stratify by ethnicity, and/or did not evaluate lifestyle behaviors. Our overall objective is to evaluate weight perceptions and trying to lose weight in a sample of fifth grade children, and to evaluate differences by gender, weight status, body fatness, ethnicity, and dietary intake. Our sample includes children from three regions in Michigan with varying SES levels.

Statement of Purpose/Aims

The first primary aim (PA1) was to assess body weight perception and to determine if it varied by gender, weight status, and body fatness. A second primary aim (PA2) was to determine the prevalence of children in our sample who reported trying to lose weight, and determine if it

varied by gender, weight status, and body fatness. A secondary aim (SA1) was to evaluate if ethnic differences existed between those trying to lose weight and those who were not, and by weight perception groups. Another secondary aim (SA2) was to assess daily calorie intake and dietary intake quality [using a fiber index (FI) score and the Healthy Eating Index (HEI) score] to determine if there were differences between those children trying to lose weight and those who were not, and between weight perception categories.

Significance of Study

The present study is unique in that it includes a fairly large sample of fifth grade children (N=519, mean age 10.7 years) from different geographical and socioeconomic status (SES) areas of Michigan. In particular, this sample includes children from three major US ethnic groups (Caucasians, Hispanics, and African Americans), males, and those from low SES areas. This diverse sample would be a unique contribution to current literature, which appears to be limited in assessing young children and those from low SES areas and overwhelmingly focuses on females. Also, we have chosen to assess both body weight status and body composition, using both body mass index (BMI) percentiles as defined by the Centers for Disease Control (CDC) and body fatness measurements using bioelectrical impedance analysis, respectively. Though BMI percentiles are fairly well correlated with body fatness in children, stratifying results based on body composition may eliminate students wrongly categorized as overweight or obese as a result of excess lean body mass. Furthermore, this study assesses dietary intake in order to determine if differences exist between those who report trying to lose weight and those who are not, and among those with differing weight perceptions, which may provide important insight into weight loss practices. Assessing dietary intake in those who report trying to lose weight may

expose those using dangerous or extreme practices who are in need of follow up nutritional and/or psychological care, and has rarely been assessed in current literature.

Aims & Hypotheses

Aim1: To determine the prevalence of children who perceive themselves as “too heavy/too fat” (too heavy) and to evaluate if the reporting result varied by those trying to lose weight, gender, weight status, and body fatness.

Ho1: Children who perceive themselves as “too heavy” will be more likely to answer “yes” than those who answer “about right” or “too skinny.”

Ho2: OW ($\geq 85 - < 95^{\text{th}}$ BMI percentile) or OB ($\geq 95^{\text{th}}$ BMI percentile) children will be more likely to perceive themselves as “too heavy” than NW ($5 - < 85^{\text{th}}$ BMI percentile) children.

Ho3: Overfat (OF) ($\geq 25\%$ males, $\geq 32\%$ females) children will be more likely to answer “too heavy” than normal fatness (NF) ($< 25\%$ males, $< 32\%$ females) children.

Ho4: Females in all weight categories will be more likely to answer “too heavy” than males in all weight categories.

Aim2: To determine the prevalence of children who report they are trying to lose weight, and to evaluate if the reporting result varied by gender, weight status, and body fatness.

Ho1: OW or OB children will be more likely to answer “yes” that they are trying to lose weight than NW children.

Ho2: OF children will be more likely to answer “yes” than NF children.

Ho3: Females will be more likely to answer “yes” than males.

Aim3: To determine if ethnic differences exist between those who report they are trying to lose weight and those who do not; to determine if ethnic differences exist between those who

perceived themselves as “too heavy” and those who perceive themselves as “about right” or “too skinny”.

Ho1: Caucasians in all weight categories will have the highest prevalence of children who answer “yes” that they are trying to lose weight, followed by Hispanics and African Americans in all weight categories, respectively.

Ho2: Caucasians will have the highest prevalence of children who perceive themselves as “too heavy” in all weight categories, followed by Hispanics and African Americans in all weight categories, respectively.

Aim4: To determine if calorie intake and diet quality, as determined by the HEI and FI, differ among those who report they are trying to lose weight and those who are not, and between weight perception groups.

Ho1: Those who answered “yes” that they are trying to lose weight will have a lower calorie intake and lower diet quality than those who answered “no.”

Ho2: Those who perceived themselves as “too heavy” will have a lower calorie intake and lower diet quality scores than those who answered “about right.”

CHAPTER 2

LITERATURE REVIEW

The following review of the literature will address the current understanding of body weight perceptions and trying to lose weight in children and adolescents. To fully understand this topic, the following will also be discussed: Current childhood obesity statistics, comorbidities, and environmental effects; psychological health and self-esteem of children and adolescents related to body weight and etiology and risk factors of eating disorders and disordered eating behaviors; current research studies of weight perception and weight control behaviors in children and their relation to weight status, gender, ethnicity, and socioeconomic status (SES).

Obesity and the Environment

Prevalence and Comorbidities

Healthy People 2010 listed obesity as one of the Leading Health Indicators [4], and public health initiatives relating to this topic have been initiated by First Lady Michelle Obama and former President Bill Clinton, the Let's Move [3] and the Alliance for a Healthier Generation programs [2], respectively. Furthermore, health-related messages in the United States media related to obesity and body image have increased dramatically over the past three decades [20, 21], which may have negative effects on health [12]. In a similar time period, childhood obesity prevalence has roughly tripled in children aged 6-11 and in adolescents aged 12-19 [22], and is associated with physical comorbidities such as cardiovascular disease (CVD), type 2 diabetes, metabolic syndrome, bone and joint problems, sleep apnea, and many others [22-24]. In children and adolescents aged 2-19, weight status is usually assessed using Body Mass Index (BMI) percentiles. BMI is calculated as a ratio of weight to height (kg/m^2), and is then plotted on BMI-for-age growth charts as defined by the Centers for Disease Control (CDC) to determine age-

specific percentiles. According to the CDC, overweight and obesity are defined as $\geq 85^{\text{th}}$ percentile and $\geq 95^{\text{th}}$ percentile for kids of the same age and sex, respectively [25].

In addition to the physical comorbidities of childhood obesity, the psychological manifestations of the disease are also significant [13, 23, 24, 26]. Research shows that social stigmas associated with body size, teasing and bullying from peers, stereotyping, parental concern with weight, cultural beauty ideals, and media influences mediate a relationship between obesity and low self-esteem [1, 6, 13, 17, 24, 27], stress [12], and decreased quality of life [28]. Both the physical and psychological effects of obesity tend to track from childhood into adulthood [24], and as the prevalence of obesity continues to rise, so have societal pressures for thinness, and the ever-shrinking “ideal size” [1]. As a result, though the numbers of overweight and obese youths have risen, so has the prevalence of clinical eating disorders, including anorexia nervosa, bulimia nervosa, and binge eating disorder, subclinical disordered eating behaviors, and body size dissatisfaction [1, 28, 29]. An environment that fosters obesity while valuing thinness may be damaging to children’s psyche, even those who are not overweight.

Researchers in Croatia studied the effect of obesity prevalence rates on body image and weight control behaviors among adolescents. They found that US children in all weight categories and sexes reported significantly higher rates of negative weight perceptions (viewing themselves as larger than their actual size) and weight control behaviors, compared to children from European countries with lower obesity prevalence rates. Additionally, children from countries with moderate and high obesity prevalence were more likely to know their height and weight measurements than those from low prevalence countries. Boys from Lithuania, the country with the lowest obesity prevalence in the study, appeared to be most satisfied with their weight, regardless of weight status. Though they did not assess or control for ethnicity or

socioeconomic status (SES), the authors concluded that sociocultural influences play a significant role in the development of body perceptions. This study suggests that a high prevalence of obesity and societal focus on weight control may increase body size awareness and/or body dissatisfaction [17].

Gender and Obesity

The prevalence of childhood obesity as defined by BMI percentiles has risen in both sexes, though most population studies have shown a slightly higher incidence in males than females [10, 22, 30, 31]. Data from the National Health and Nutrition Examination Survey (NHANES) III showed that rates of severe obesity (defined as BMI $\geq 99^{\text{th}}$ percentile) were also higher in males [32]. Reasons for small differences are likely due to both biological and sociocultural factors. Biologically speaking, there seem to be clear differences in body composition between males and females, with females having more body fat, especially during puberty [24]. On the other hand, males tend to gain more lean muscle mass during puberty, which can skew BMI as an indicator for body fatness [33]. From a cultural standpoint, one study showed males are more likely to be physically active and engage in sports than girls [30].

Obesity also may exhibit different psychological effects on males versus females. A study from Germany showed sex-specific differences in quality of life related to obesity in several different domains of life: physical well-being, emotional well-being, self-esteem, family, friends, and everyday functioning. The authors showed that, compared to boys, girls had decreased physical well-being and significantly lower self-esteem. Compared to girls, boys were impaired in the friend domain. Both boys and girls, however, had significant impairment in quality of life in the school domain [28]. Among adults, females appear to exhibit greater psychological stress associated with being obese than males [34].

Ethnicity & Obesity

Though the numbers of obese youths are rising across all racial and ethnic groups [35], the prevalence and severity is higher in non-white populations based on national and regional data from the United States [23, 32]. DeLeel et al and Strauss found that children from minority groups have higher average BMIs than whites [10, 35]. In particular, the occurrence of childhood obesity is greater among African Americans, Hispanics, and Native Americans than in any other ethnic groups, with particularly sharp increases over the past three decades in African American and Hispanic adolescents [23]. Recent research has shown that differences in obesity prevalence among ethnic groups are already established by adolescence [36], and minority children, particularly Hispanics, are at a disproportionate risk for development of childhood and adult obesity [37]. A 2005 study by Anderson and Whitaker showed that differences in obesity prevalence rates were seen in children as young as four years of age across several ethnic groups: Caucasians (16%), African Americans (21%) and Hispanics (22%) [38]. Reasons for these discrepancies are numerous, including genetics, culture and environment, SES, and interactions between these variables. The influence of these variables may also influence the perceptions of weight status and risk of inappropriate weight control methods.

Socioeconomic Status & Obesity

Socioeconomic status may influence the prevalence and progression of obesity. Differences in SES may be difficult to measure, however, given that indicators of SES, such as education and income levels, may not represent equal access to wealth and resources across all members of a particular SES group [23]. Low SES is associated with higher and more severe rates of obesity [23, 39], and associated with a significantly greater likelihood of being overweight among both male and female children and adolescents [39]. Johnson et al showed

that females living in poverty were nearly six times more likely to be obese than their higher SES counterparts. In males, low parental education was significantly associated with a nearly four times greater risk for obesity [40]. Health disparities related to low SES may begin early in life [41].

According to a Journal of Obesity position statement, three major SES-related factors affect obesity status in kids: money, place, and time. Inability to afford low energy dense, high nutrient dense foods, health care, and health insurance, living in high poverty areas, and lack of time for food preparation and family meals are directly related to SES and highly associated with obesity risk [23]. Interestingly, the Public Health Disparities Geocoding Project showed that geographical location was a more powerful predictor of health outcomes than ethnicity. The study also demonstrated that African Americans and Hispanics were more likely to live in areas with high poverty rates [42]. In addition, stress induced by ethnic discrimination, low SES, the mothers' psychological state [41] and/or obesity itself [34] may have negative effects on health. Furthermore, the extent to which each population group perceives obesity as a disease, understands its causes and comorbidities, and values healthy behaviors influences the progression and treatment of obesity [23]. It is clear that the interactions between ethnic, biological, and cultural factors have significant influences on the development, progression, severity, and prevalence of obesity in population subgroups [23, 38].

Dietary Behaviors in Childhood and Adolescence

Concurrent with the increased prevalence of childhood and adolescent obesity has been a decrease in diet quality, contrary to public health recommendations. Position statements from the American Dietetic Association (ADA) [43] and the American Heart Association (AHA) [44] summarized trends in undesirable eating behavior in children's diets over the last several

decades. The ADA reports an overall increase in energy intake from the 1970s to the late 1990s due to larger portion sizes, related to more meals being consumed outside the home. Changes in macronutrient proportions have also been observed, with total and saturated fat percentages decreasing, carbohydrate intake increasing, and protein intake remaining relatively stable. The increased percentage of calories from carbohydrates is largely related to increased intake of grain mixtures (pizza, pasta, and other dough-based dishes) and sweetened beverages among 2-17 year olds. Percentage of total calories from beverages for this age group is upwards of 24% [43]. Additionally, the AHA noted the following increases: percentage of calories from snacks, consumption of fried and nutrient-poor foods, portion sizes, consumption of sweetened beverages, overall sugar consumption, and sodium intake. Decreases have been observed in the following: breakfast, dairy, fruit, and vegetable (except potatoes) consumption [44]. Wang, et al analyzed data from the 1988-1994 and 1999-2004 NHANES, and reported significant decreases in milk consumption among children 2-5 years and significant increases in fruit juice consumption among adolescents. Overall, 64-88% of children aged 2-9 had diets that scored “need improvement” or “poor,” according to the Healthy Eating Index [45]. Forshee and Storey 2006 also showed decreased diet quality with age [46]. Poor diets have resulted in children and adolescents under-consuming vitamin E, calcium, magnesium, potassium, and fiber [43].

Measuring Dietary Intake in Children & Adolescents

Many methods have been developed to measure and assess dietary intake and quality in children. Age, cognitive ability, knowledge of food, attention span, memory, motivation, and body image affect children’s ability to provide accurate assessments of their intake. Typically, after the age of 8, children become rapidly more able to self-report food intake, with cognitive abilities fully developed by adolescence. However, adolescents may be less willing to participate

in such measures. Underreporting intake has repeatedly been shown in validation studies, though it varies with method used and may be influenced by the child's weight status [47]. For example, a child who is overweight may feel they should be eating less or healthier foods, and thus may not accurately portray their dietary behaviors [6]. Additionally, in studies of repeated measures, high variability in energy and nutrient intake have been shown, indicating that it may be necessary to track children over time to get an accurate picture of their overall intake [47]. Given that research outcomes and nutritional guidance are often based on a child's self-reported intake, valid and reliable data is crucial.

For young children (<7 years of age), parental dietary recalls have been used. This involves parents completing a 24 hour recall of their child's food intake and portion sizes [47]. Treiber et al [48] and Klesges et al [49] showed that parents can accurately report their child's intake in the home environment. However, they were much less accurate at recalling intake outside the home and estimating portion sizes [49]. In older children (>8 years), 24 recall interviews have been shown to be fairly accurate. Lytle et al compared 8 year old children's 24 hour recalls to direct observation and found a 77.9% agreement between the food items recalled and the direct observation report [50]. The food frequency questionnaire (FFQ) is another commonly used method of dietary assessment in children. The FFQ is a list of commonly eaten foods, and asks children to estimate how often they eat these foods in a given amount of time (ie, week or month), and in what amount. FFQs have been shown to be a more desirable tool for older children and adolescents (>12 years) [51, 52], as they require good memory and high level cognitive skills. However in large population studies, more valid and reliable tools, like the 24 hour recall or direct observation, may not be feasible.

Dietary intake scoring systems have been developed to utilize dietary data from the methods described above to rate the quality of intake. Scores may assess certain markers of intake, such as saturated fat or cholesterol, or may assess the diet as a whole. The Healthy Eating Index (HEI) is a calculated diet quality score that is based on compliance to the 2005 federal dietary guidelines, with food group standards based on the United States Department of Agriculture (USDA) MyPyramid [53], and has been evaluated for both validity and reliability [54]. A higher score is indicative of a higher quality diet, with a maximum score of 100. The HEI is calculated using 12 components, which together assess whole fruit and fruit juice, vegetable, grain, whole grain, meat and bean, milk, saturated fat, sodium, oil, added sugar, and solid fat intake [53]. Fiber content of the diet has been shown to be a surrogate marker of overall nutrient density in adults and children [55, 56]. A fiber index (FI) score (grams of dietary fiber per 1,000 kcal) has been used in adult studies by Ludwig et al 1999 [55] and Carlson et al [57], along with indices of saturated fat and cholesterol. Higher intakes of dietary fiber were shown to be associated with a lower prevalence of certain cardiovascular disease risk factors including blood lipids, obesity, and markers of insulin resistance and diabetes. More recently, Carlson et al 2011 demonstrated that higher fiber intakes are inversely related to a metabolic syndrome score in adolescents aged 12-19, whereas saturated fat and cholesterol intakes were not related [56].

Demographics & Dietary Intake

Several studies have shown differences in dietary habits exist based on demographics. Forshee and Storey 2006 [46] and Wang et al 2008 [45] demonstrated gender differences in diet quality. Forshee and Storey demonstrated that males 13-19 had lower diet quality scores, according to the HEI, than females [46]. Wang used data from NHANES III (1988-1994) and NHANES 1999-2004 and found that calories from sugar-sweetened beverages significantly

increased for all youth aged 2-19 in the time period between studies, but only significantly for boys. In 1999-2004, boys 12-19 had higher mean calorie and percent of total calories intake per day for fruit juice (202 kcal, 8%) and sugar-sweetened beverages (409 kcal, 16%) than girls in all age groups and boys in younger age groups [45].

Some ethnic differences in dietary intake in children have also been demonstrated. A 2000 study by Lindquist et al showed that African American and Caucasian children had largely similar diets, with a few exceptions. African American children consumed 40% less dairy, twice as many fruits servings, and 25% more vegetable servings than white children after adjusting for energy intake and social class background (parental education and occupational prestige for the working parents) [58]. In the more recent Wang 2008 study previously mentioned, the largest increases in calories from fruit juice were among black and Hispanic adolescents [45]. Furthermore, Forshee and Storey showed that African Americans had lower diet quality compared to all other ethnic groups [46]. More research is necessary to investigate ethnic differences in children's dietary intake.

The relationship between diet quality and SES seems to be more widely studied. Many such studies have indicated that low SES correlates with poor diet quality. In the Wang 2008 study, the greatest increase in sugar-sweetened beverage intake was among children 2-11 that were from lower income families [45]. Cutler, et al 2001 showed that in both prospective and cross-sectional analyses, socioeconomic status, family meal frequency, and home availability of healthy foods had a positive association with vegetable, fruit, and starchy food intake patterns, and an inverse association with fast food intake patterns [59]. Jackson et al 2009 studied 733 public school children and showed differences in diet and physical activity behaviors between schoolchildren from two different SES areas. The lower SES children consumed significantly

more fried meats, French fries and chips, punch, sports drinks, and soda, and less milk and vegetables than the higher SES children. The high SES town (Ann Arbor, MI) had a higher proportion of Caucasians and Asians, versus the low SES town (Ypsilanti, MI), which had a higher proportion of African Americans. The two towns had similar levels of Hispanic children. The authors suggest that access to healthy foods are possibly limited in “resource poor communities,” and point out that Ypsilanti has four grocery stores, while Ann Arbor has 31 [60]. Furthermore, the American Dietetic Association cites food insecurity as a major issues that impacts undernutrition in low SES populations. As of 2008, there were an estimated 12.4 million food insecure children in the United States [43].

Eating Disorder Risk in Childhood and Adolescence

The American Psychiatric Association established criteria for the diagnosis of four specific types of eating disorders: anorexia nervosa, bulimia nervosa, binge eating disorder, and eating disorders not otherwise specified (EDNOS). Diagnosis of these conditions requires the practice of particular behaviors at certain frequencies, and in the case of anorexia nervosa, specific weight criteria. A person who exhibits behaviors symptomatic of an eating disorder, but does not fit the specific criteria for diagnosis, is said to practice “disordered eating,” or have a “subclinical” eating disorder. Symptoms can include (but are not limited to) restricting food intake, binge eating, self-induced vomiting, use of laxatives or diuretics, excessive exercise, embarrassment, guilt or shame with regard to eating, body image disturbance, and lack of control over eating [61]. Other methods of weight control include skipping meals, particularly breakfast, fasting, and excessive exercise [62]. Consequences of eating disorders are also numerous and can be severe, including protein-energy malnutrition and nutrient deficiencies, cardiovascular

arrhythmias, impaired gastrointestinal function, interruption of pubertal development, osteoporosis, and even death [61].

Recent research has shown that symptoms of disordered eating are highly prevalent in children and adolescents and are occurring at progressively younger ages, often before the onset of puberty [35]. O'Dea and Caputi found that body image and weight concerns are apparent in children as young as 6 years, and increase with age [39], while Davison and Birch showed weight-related stress in five-year-old girls [13]. DeLeel et al studied 9 and 10 year old girls and found that 11% and 7%, respectively, scored eating attitude scores in the anorexic range [35]. Results in a study of youths in sixth, seventh, and eighth grades showed that 8.5% of the sample was classified as high risk for disordered eating and attitudes, reporting significantly higher levels of desire to be thin, fear of being overweight, binge eating, and self-induced vomiting than their peers. Of those in the high-risk group, 24% reported engaging in self-induced vomiting and 38% approved of binge eating. Additionally, simply knowing the participant was currently trying to lose weight increased their chances of being in the high-risk group by 10-fold [16]. Cook et al showed that 16% of adolescents girls with a mean age of 17 years exhibited disordered eating behaviors, including fasting for > 24 hours, using diet medications, vomiting, or using laxatives. Those who viewed themselves as either underweight or overweight were more likely to engage in these behaviors than those who viewed themselves as the “right” weight [18]. These findings highlight the importance of assessing weight perceptions and weight loss behaviors.

Low self-esteem is related to body size and is associated with sadness, loneliness, nervousness [10], lower perceived physical and mental abilities [13], and is also affected by the subjective assessment of one's weight, or weight perception [28]. Obese children have demonstrated decreasing levels of self-esteem over time and a greater likelihood to engage in

smoking and alcohol consumption [10]. Those at high-risk for eating disorders have also demonstrated lower self esteem, and current weight loss attempts and self-esteem scores may be predictive of behaviors and attitudes that put youths at high risk for disordered eating. Data from individuals with eating disorders has shown that dieting usually precedes the development of more serious disordered eating and eating disorders, highlighting the need for recognizing these behaviors at their onset [8]. Additionally, Neumark-Sztainer et al showed that adolescents practicing unhealthy weight control behaviors had were at an increased risk for binge eating, as well as self-induced vomiting and use of diet pills, laxatives, and diuretics in a five year longitudinal study [63]. A 2000 longitudinal study by Strauss showed that obese Caucasian and Hispanic females had significantly decreasing self-esteem over a four-year period compared to their non-obese counterparts, and that obese Caucasian female adolescents had the lowest levels of overall self-esteem [10]. Childhood and adolescence are recognized as critical periods for the development of self-worth, and low self-esteem in childhood seems to worsen with age [17] and predict mental health problems in adulthood [27]. It is important to note, however, that children are affected differently by their weight status, and environmental factors can enhance or protect against negative attitudes towards obese youths [13].

Obesity is now widely recognized as a risk factor for disordered eating and eating disorders [6, 13, 16, 27, 29]. The correlation between disordered eating attitudes and behaviors with depression, low self-esteem, anxiety, and substance abuse may be elevated in overweight youth who are particularly concerned with their body size [6]. A longitudinal study by Wang et al found that excess body weight precedes the development of low self-esteem [27]. A study by Babio et al showed that being overweight for 14 year old boys and girls increased risk for eating disorders according to two eating disorder screening questionnaires compared to a control group.

Furthermore, they found that a high waist-hip ratio, indicative of a preadolescent body shape, is a protective factor against eating disorder risk, thus the development of body curves due to puberty increases this risk. Additionally, higher fat mass (as measured by bioelectrical impedance) increased risk when generalized anxiety disorder, dysthymia (a type of chronic depression), and smoking were present. The authors suggest that body shape affects eating disorder risk when psychological factors are present [29].

Many recent studies have demonstrated low self-esteem [16], negative weight perceptions [17, 19, 28], weight loss desires [16, 17, 19], and eating disorder risk [19] affect a significant number of normal weight children as well. In a Canadian study of 10-14 year olds, of which 92.7% were classified as within or below normal weight, over 10% had scores on an eating attitudes and assessment above the clinical threshold for disordered eating [19]. Gusella et al conducted eating attitude and behavior and self-esteem assessments on sixth, seventh, and eighth graders and found that weight category was not a significant predictor of being in the high-risk group for eating disorders [16]. These findings show that risk for disordered eating and dieting behaviors is not limited to overweight children.

Several studies have suggested that dieting among youth may lead to long-term weight gain and even obesity risk [6, 8, 64], is associated with poorer diet quality and disordered eating behaviors[64], and positively correlates with BMI [8]. Though the mechanisms remain largely unclear, one hypothesis is that dieting increases the risk of subsequent binge eating and therefore, weight gain over time [64], particularly in overweight youths. The Dietary Restraint Model gives one explanation as to how dieting may lead to binge eating and subsequent weight gain. Polivy and Herman explained the model, theorizing that dieting requires a person to eat with a “cognitive style” rather than responding to physiological hunger and fullness cues. “Loss of

cognitive control” results in lapses in dietary restraint, and thus binge eating behaviors [6, 8].

Other factors influencing binge eating include replacement of negative emotions with food and using eating as coping mechanism for psychosocial stressors associated with being overweight, such as teasing and isolation from peers [6]. Dieting may also affect weight gain by altering the metabolism in a way that allows the body to function on fewer calories [8]. A five-year longitudinal study by Neumark-Sztainer et al showed associations between dieting, binge eating, and weight gain. The study showed that dieting at baseline was strongly predictive of binge eating at follow up, in both male and female adolescents. Binge eating was shown to be significantly associated with increases in BMI, and male and female dieters gained an average of 0.8 and 0.7 BMI units more than nondieters, respectively. In addition to binge eating, dieting in females also predicted decreased breakfast consumption and, though not significant, lower fruit and vegetable intake. In males, dieting predicted lower levels of moderate to vigorous physical activity (MVPA). Interestingly, for both males and females, the behaviors most strongly associated with weight gain were the same as those most strongly predicted by dieting [64]. Wang et al found very similar results in low-income non-Hispanic black adolescents [27].

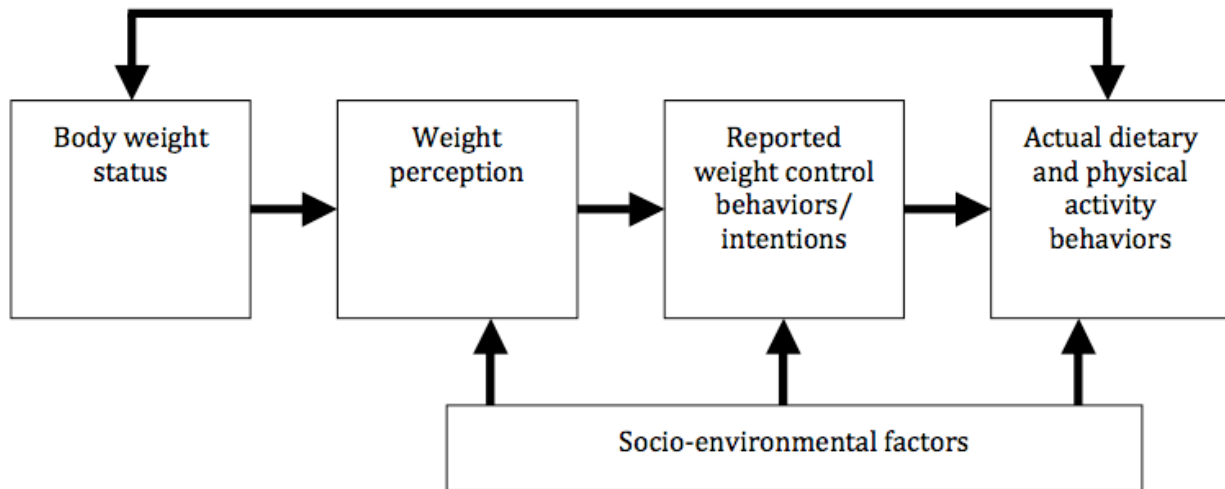
Weight Perception & Weight Loss in Children & Adolescents

Body image is a complex and integrative concept that changes with physical growth, is affected by life experiences and external influences, and incorporates overall self-esteem [1, 11]. The terms “body image” and “self-concept” are comprehensive representations of oneself, of which body weight perception is one facet [11]. Body image is sensitive to media images, parental role modeling, parental weight status, cultural influences, sports, identity evolution, developmental changes, and peer pressure, among many other factors [1, 13, 14, 65]. Another important factor contributing to the development of body image is a concept called the “thin

ideal,” particularly in females. The thin ideal refers to the ideal body size set by personal beliefs and/or cultural and societal standards, and can be unnaturally thin. The thin ideal internalization refers to the degree in which a person believes the ideal size is, “attractive and attainable,” and is a key part of his/her self-worth [66]. New research has demonstrated that the thin ideal internalization differs among ethnic groups and genders, may be responsible for differences in BMI and dieting behaviors [67], and is an emerging risk factor for eating disorders [66, 68]. Those whose self worth is based on the quality of their appearance tend to be more likely to internalize the thin ideal and feel dissatisfied with their body size [6].

Inaccurate body weight perceptions, namely perceiving oneself as heavier than one’s actual weight status, can relate to weight loss desires and have behavioral implications, such as weight control practices and disordered eating [14, 16, 18], and other risky behaviors such as sexual activity or even suicide attempts [18]. Strauss analyzed a subset of NHANES III data and demonstrated that, “dieting behavior is most closely related to whether adolescents view themselves as overweight, independent of whether they are actually overweight” [14]. Similarly, Muennig found that the differences between desired and perceived weight were stronger predictors of mental and physical health than BMI [34]. Figure 1 shows the conceptual framework relating body weight status, weight perception, reported weight control behaviors, and actual behavior, adapted by Wang et al [27].

Figure 1: Conceptual framework relating weight status, weight perception, and weight-related behavior, adapted from Wang, et al [27].



Distorted weight perceptions may also influence quality of life in children. A German study of children aged 11-17 who participated in a self-esteem and psychological quality of life (QOL) assessments showed that QOL was significantly lower for those who rated themselves as “far too fat” than those who were actually classified as obese. This effect was even more pronounced in females. The authors of this study suggest that, in terms of mental health QOL, perceived obesity may be more detrimental than actual obesity [28]. However, not all research has shown that body weight dissatisfaction is harmful. In fact, a review by Goldschmidt et al stated that a moderate degree of body dissatisfaction can actually promote a healthy lifestyle; however, the amount of value placed on body size determines whether dissatisfaction is harmful or beneficial [6].

Risk for changes in body weight perception are particularly high after the onset of puberty, given that it is a time of dynamic physical, physiological, and behavioral changes, and

increased BMI and fat mass, particularly in females [11, 35, 40]. Young athletes during this time are even more likely to be negatively affected by body changes and may practice calorie restriction and other disordered eating behaviors more frequently than non-athletes [11]. Body image and weight perception are topics that are relevant to all racial, ethnic, and SES groups [35]. Assessing body image and body perception during early childhood and adolescence is fundamental to understanding and promoting healthy biological growth and development, as well as identifying those at risk for potentially dangerous weight control behaviors and ultimately, eating disorders.

Recent studies have asked youths about their desire or attempts to lose weight, and found a high prevalence of children and adolescents in all weight categories, ethnicities, and SES categories reporting that they are trying to lose weight [14, 16, 19, 64]. O'Dea and Caputi showed that SES, weight, age, and gender interact with eating behaviors and weight perceptions [39]. However as stated above, weight perceptions appear to be the strongest predictor of weight-related behaviors [14]. Inappropriate weight control behaviors can be of concern for children of all sizes including those who are normal weight and are attempting to lose weight, as well as those who are overweight and not practicing healthy lifestyle behaviors [69]. Weight control behaviors are typically associated with females, both because they are more prevalent in females across ages and ethnicities [14, 27, 31, 39] and because less research exists in male subjects.

Many studies assessing weight perception show that children's views of their body size are inaccurate. A subset of NHANES III data showed poor correlations between children's weight perceptions and medical definitions of weight status, with only 28% of those who considered themselves overweight actually medically defined as such [14]. In a German study of children and adolescents aged 11-17 years, 49% and 26% of normal weight girls and boys,

respectively, considered themselves overweight [28]. A Canadian study showed that 40% of eighth grade females reported a desire to lose weight. Of those who were trying to lose weight, 71.4% were in the normal range for height and weight [16]. Overweight and obese children have also been shown to identify themselves as normal weight. In a study of adolescents in grades 9-12, 6.3% of normal weight children viewed themselves as overweight, while 53.7% of overweight and 20% of obese viewed themselves as normal weight [69]. O'Dea and Caputi's assessment of children and adolescents showed that about half of overweight 6-12 year olds and one third of 12-19 year olds perceived themselves as "about right," and 3% of overweight children perceived themselves as "too thin." The authors hypothesize that some children and adolescents are not aware of their body weight and may be immune to body weight stereotypes [39]. Interestingly, adult data from NHANES 1999-2006 showed weight under estimation among 46% of the overweight and obese participants, particularly in men, minorities, and those with low education levels [70]. Still, despite weight misperceptions being common, Goldschmidt et al argue that concern with weight and body size dissatisfaction are greater in overweight children and adolescents compared to their non-overweight counterparts [6].

Weight Perception, Weight Loss, & Gender

Olvera et al 2005 state that although the prevalence of obesity has risen dramatically, "the pursuit of being thin is common," especially among females [71]. Zaborskis et al suggest that, although prevalence rates of body dissatisfaction differ between countries, concern with body size exists among girls across cultures [17]. This tendency may be exaggerated by changing cultural ideals, unrealistic standards of beauty, fashion, media influences, parental role modeling, and historical traditions [1, 29, 39]. A consensus of many studies has identified that gender differences in body satisfaction appear around approximately 8-10 years of age [24]. Regardless

of actual weight status, numerous studies have shown that females are more likely to identify themselves as overweight and have a negative weight perception than males [14-17, 24, 27-29, 35, 39]. O’Dea and Caputi also showed that overweight females across age groups were more likely than overweight males to be trying to lose weight, and were more likely to skip breakfast [39]. Females may also be more sensitive to media images and peer influences. A 2008 study by Tucci and Peters demonstrated that body dissatisfaction and drive for thinness in undergraduate college females was negatively affected immediately following exposure to magazine images showing models representing the thin-ideal physique [72]. Similarly, Dohnt and Tiggermann found that watching appearance-focused television programs affected appearance satisfaction in a sample of girls 5-8 years old. They also found that perceptions of peers desire for thinness affected the girls’ desire for thinness, appearance satisfaction, and self-esteem [73]. These studies show that females of all ages may be negatively affected by sociocultural influences. However, few studies of this sort have been conducted solely on males [35], and thus the seemingly large differences in weight perception and weight control between girls and boys may be due to the fact that more research has been conducted with female subjects.

Many studies have shown that boys and adult men are more likely than girls and adult women to underestimate weight status [27, 28, 39, 70]. O’Dea and Caputi demonstrated that overweight males were more apt to view themselves as “about right” and be trying to gain weight, presumably lean body mass, than their overweight female counterparts [39]. Similarly, Kuth and Ellert showed that obese males aged 11-17 were much less likely to view themselves as “far too fat” than girls, and that they frequently underestimated their body weight [28]. Overweight boys may also be less likely than girls to receive dietary and weight control advice from others, and report high physical self-esteem. These results were particularly apparent in low

SES boys [39]. O'Dea and Caputi and Wang et al suggested there may be less interest in the weight issues in boys [27, 39], and boys themselves are less concerned with weight status [39]. While O'Dea and Caputi believe that lack of advice on weight control may have a protective effect on body image [39], Wang et al suggested that boys need to be more informed about body weight recommendations and weight perception [27].

Weight Perception, Weight Loss, & Ethnicity

Ethnic differences may be attributed to cultural context and environment, which has a heavy influence on the development of body perception [23], and it seems that ethnic groups have varying notions of the ideal body size. A 1995 study by Powell and Kahn showed that Caucasian females preferred a significantly thinner body, expressed greater concern with body weight and dieting, and felt greater societal pressure to be thin than African American women. Caucasian men in the study reported less desire to date heavier women and more likely to experience backlash for dating a heavier woman than African American men [74]. NHANES III data showed that African American females and males prefer to weigh more compared to Caucasians [14]. Similarly, Goldschmidt et al reported African American children to be less dissatisfied with their body size compared to other ethnic groups [6].

Other associated factors are cultural differences in women's perceptions of their own bodies and eating behaviors, as they are often the primary care takers and pass along cultural values as well as feeding practices [23]. Birch and Fisher showed that Caucasian mothers who dieted attempted to exert more control over their daughter's eating behaviors than those who did not, which resulted in girls who had less self-control over their energy intake (i.e., snacking when not hungry). This "intergenerational transfer of eating and weight problems" may begin as early as preschool [75]. Hispanic mothers seem to prefer a smaller size for themselves and a

fuller figure for their children [76]. Similarly, Olvera et al showed that Hispanic mothers viewed their overweight daughters as the ideal body size, and preferred an average body size for their sons [71].

Many recent studies have found that inaccurate weight perceptions exist in all ethnic groups, both overestimating and underestimating weight status in children [14, 27] and adults [34]. In terms of overestimation, 2009 Youth Risk Behavior Surveillance System (YRBSS) data showed that 33% of Mexican Americans, 26% of Caucasians, and 23% of African American middle school children perceived themselves as overweight [15]. Other studies have shown Caucasians to have the highest number of children and adolescents perceiving themselves as too fat and/or attempting weight control methods [14, 67]. Similarly, Muennig used Behavioral Risk Factor Surveillance System (BRFSS) data on adults and found that Caucasians were most likely to want to lose weight [34]. Vaughan et al theorize that Caucasian females, compared to African American females, possess greater thin-ideal internalization, which accounts for differences in dieting prevalence between the two groups [67]. In terms of underestimating weight status, Wang et al showed that low income African Americans, particularly those who were overweight, perceived their weight as lower than it actually was [27]. NHANES 1999-2006 data showed that, among normal weight adults, African American men and women were more likely to report themselves as “underweight” compared to Caucasians and Mexican Americans. Additionally, overweight and obese African Americans and Mexican Americans were more likely to view themselves as the “right weight” or underweight than their Caucasian counterparts, and overall had a higher prevalence of weight perception that underestimated their actual weight status [70].

Some researchers are conflicted as to whether differences in perceptions and weight loss desires are attributable to ethnicity and not other factors. Not all studies have demonstrated clear

ethnic differences when weight status, gender, and SES were taken into account [14, 35]. It is apparent that culture helps to shape the development of body image, value of the ideal body size, and self-esteem [23]. Additionally, a strong cultural identity may have a protective effect against eating disorders [1]. Overall, weight perceptions appear to influence weight control behaviors, regardless of ethnicity [14]. Most likely, ethnicity, SES, gender, acculturation, family practices, peer influences, and sport participation, among other factors, are interrelated, and their effects on weight perception and weight loss behaviors cannot be assessed in isolation.

Weight Perception, Weight Loss, & Socioeconomic Status

Results from the studies available were conflicted as to whether or not differences in weight perceptions and weight control behaviors could be attributed to SES related factors. Several have shown that low SES is associated with underestimations of weight status. In adults, Dorsey et al showed that low education levels, used as low SES indicator, were associated with perceiving body size as less than actual weight status among those who were normal weight, overweight, and obese of both sexes [70]. In children and adolescents, O'Dea and Caputi found that overweight males and females from low SES areas were more likely to perceive themselves as "too thin" than their middle/high SES counterparts. Additionally, low SES females were more likely than middle/upper SES to be trying to gain weight [39].

Contrastingly, the DeLeel study showed that SES did no account for body weight dissatisfaction [35]. Kurth and Ellert came to similar conclusions with regard to weight perception among normal weight and obese participants [28]. NHANES III data also showed no influence of family education or family income on weight perceptions, weight loss desires, or dieting behavior [14]. These data suggest that eating disturbance and body dissatisfaction are issues that affect those at all SES levels, not just children of high SES as was previously thought.

However, more research related to SES is necessary, as low SES children have been underrepresented in past studies [35]. It should be noted that SES and ethnicity are often closely linked. As stated above, African Americans and Hispanics are more likely to live in areas with high poverty rates [42], which may exacerbate health disparities between low and high SES groups. It is conceivable to assume that studies based on ethnicity will show similar results as those examining SES.

Implications of the Literature Review

This review of the literature discussed the relationships between body weight, gender, ethnicity, and SES on obesity and eating disorder risk, self-esteem, body weight perception and weight control behaviors in children and adolescents. There appears to be limited data on young children, low SES children, and males. Assessing attitudes and behaviors related to weight early in childhood that identify negative perceptions and/or unhealthy weight loss behaviors early in life can lead to earlier interventions that may prevent disordered eating and/or eating disorders. Also, tracking changes in perceptions over time may also be beneficial in determining the etiology of weight-related disorders. More in-depth analysis on the influence of ethnicity on weight perceptions and weight-related behaviors is also necessary. Researchers should attempt to include Native American, Asian, and Middle Eastern children into their samples, ethnicities often underrepresented in weight perception and weight loss studies, to keep pace with the changing US population and obesity rates. Also, nearly all studies used BMI or BMI percentiles to classify children into weight categories. Though BMI percentiles are fairly well correlated with body fatness in children, stratifying results based body composition may eliminate students wrongly categorized as overweight or obese as a result of excess lean body mass. This study

offers new insights using a measure of body fatness to assess children's weight perceptions and if they are trying to lose weight.

Most notably, few studies have assessed the dietary intake of children who report trying to lose weight. Measuring calorie intake and dietary composition and quality may provide further insight into weight loss practices. It is possible that children may answer "yes" because they feel they should lose weight or think it is socially desirable to weigh less, though they are not actually attempting to lose weight. Furthermore, "trying to lose weight" encompasses both safe and effective dieting strategies, as well as dangerous or extreme practices. Assessing dietary intake in those who report trying to lose weight may expose those using dangerous or extreme practices who are in need of follow up nutritional and/or psychological care. This study attempts to evaluate dieting behaviors by comparing three different markers of dietary intake between children with varying perceptions of their body weight and between those who are trying to lose weight and those who are not.

Lastly, very little literature was found that qualitatively assessed how children interpret questions related to weight loss and weight perception questions. Knowing how well children understand these questions directly relates to the validity and usefulness of the data. Depending on their age and comprehension level, children may not fully understand what it means to "lose weight." Future studies could help determine what type of questions and at what age children can provide the most valid and reliable answers. Furthermore, they could determine how questions can be used to identify those children most at risk for inappropriate dieting behaviors, as well as those children who are OB and are not practicing healthy lifestyle behaviors.

CHAPTER 3

MANUSCRIPT

INTRODUCTION

The rise in childhood and adult obesity has driven weight issues into the national and global spotlight [1-4]. This focus on body weight has the potential to negatively self esteem related to body size in normal weight and overweight children, including how they perceive their body weight and weight related behaviors. According to Brown and Cantor 2000, all types of media are becoming increasingly interactive and pervasive in children's lives. Media role modeling may negatively affect the development of body image [5], the discrepancy between a person's actual and ideal size [6]. Recent studies indicate that sources influencing body image and lifestyle choices for children are multifactorial, and that the "ideal size" is continually decreasing [1]. Key influences include parents and family dynamics, health interventions, schools, sports, and peers [7-9]. Additionally, low self-esteem and body dissatisfaction are particularly common in overweight (OW) and obese (OB) children [10], and are risk factors for the development of eating disorders in children of all sizes. It appears that as the number of OW and OB youth increases, so do the numbers of clinically diagnosable and sub-clinical eating disorders, as obesity and eating disorders share risk factors and can present concurrently [6, 8].

Perception of body weight is complex and dynamic, and is influenced by a number of factors including growth and environmental factors, and is related to self-esteem [1, 11]. It also influences eating and exercise attitudes and behaviors [9] and health status [12]. Overweight children as young as five years old have reported an overall negative self-identity and perceive themselves to have lower cognitive and physical abilities than their normal weight peers [13]. Additionally, the National Health and Nutrition Examination Survey (NHANES) III [14] and

Youth Risk Behavior Survey [15] data indicate a particularly high prevalence of children that perceive themselves as OW, including those who are classified as normal weight (NW), and in particular, females.

Studies by Gusella 2008 [16], Zaborskis et al 2008 [17], and Cook et al 2007 [18] indicated that 12.5-60% of children and adolescents are trying to lose weight. Surprisingly, those who report trying to lose weight or are dissatisfied with their size are not just OW and OB children. Between 14-71% of youths classified as NW have reported weight loss desires and/or attempts in recent literature [14, 16, 17, 19]. Those who are unhappy with their weight may engage in unhealthy weight loss behaviors that may progress into more serious conditions, such as anorexia or bulimia nervosa [8]. Likewise, those who are content with their weight when they are actually OW or OB are at risk for obesity-related comorbidities [6]. Identification of inaccurate weight perceptions and subsequent weight related behaviors in children is crucial for prevention or treatment of these conditions and comorbidities. To date, a majority of the literature has focused on females, failed to include children from low socioeconomic status (SES) environments, neglected to stratify by ethnicity, and/or did not evaluate lifestyle behaviors. Our overall objective is to evaluate weight perceptions and trying to lose weight in a sample of fifth grade children, and to evaluate differences by gender, weight status, body fatness, ethnicity, and dietary intake. Our sample includes children from three regions in Michigan with varying SES levels.

The first primary aim (PA1) was to assess body weight perception and to determine if it varied by gender, weight status, and body fatness. We hypothesized that 1) females would be more likely to view themselves as “too heavy/too fat,” (too heavy) than “too skinny” or “about right” than males; 2) children who were classified as OW or OB will be more likely to view

themselves as “too heavy” than “too skinny” or “about right” than those classified as NW; 3) children who were classified as overfat (OF) will be more likely to view themselves as “too heavy” than “too skinny” or “about right” than those classified as having normal fatness (NF). A second primary aim (PA2) was to determine the prevalence of children in our sample who reported trying to lose weight, and determine if it varied by gender, weight status, and body fatness. We hypothesized that 1) more females and would be trying to lose weight than males; 2) children who were classified as OW or OB would be trying to lose weight more often than those classified as NW; 3) children who were classified as OF would be trying to lose weight more often than those classified as NF. A secondary aim (SA1) was to evaluate if ethnic differences existed between those trying to lose weight and those who were not, and by weight perception groups. We hypothesized that Caucasians would be more likely to be trying to lose weight and perceive themselves as “too heavy” than African Americans, Hispanics, and other ethnicities. Another secondary aim (SA2) was to assess daily calorie intake and dietary intake quality to determine if there were differences between those children trying to lose weight and those who were not, and between weight perception categories. We hypothesized that those who reported trying to lose weight and/or perceive themselves as “too heavy” would have a lower calorie intake and lower dietary quality based on a fiber index (fiber g/1,000 kcal) and Healthy Eating Index (HEI) scores.

SUBJECTS & METHODS

The present study is a cross-sectional evaluation of baseline data from fifth grade children from Michigan enrolled in three school-based nutrition and physical activity interventions designed to sustain or improve cardiovascular disease risk factor status. Figure 4 summarizes the inclusion criteria, data collection dates, and demographic overview of the three interventions, which are

(S)Partners for Heart Health [(S)Partners], Project FIT (FIT), and the Crim Fit Youth Program (Crim). All three programs were reviewed and approved by the Michigan State University Institutional Review Board and by the school boards of participating schools. All participating children and their parent/guardians were required to assent and consent, respectively.

MEASUREMENTS

Measurements included anthropometric measures including standing height, body weight, and percent body fat (%BF), and surveys that included the weight perception and weight loss questions and a food frequency questionnaire (FFQ).

Weight status classification:

BMI percentile was used as an indicator of weight status. BMI was calculated as:

$$\text{Weight (kg)} / [\text{Height(m)}]^2$$

Percentiles were estimated using BMI-for-age growth charts according to the Centers for Disease Control. Weight status was categorized as follows: underweight ($\leq 5^{\text{th}}$ percentile), normal weight (5^{th} - 85^{th} percentile), overweight ($\geq 85^{\text{th}}$ percentile), and obese ($\geq 95^{\text{th}}$ percentile).

Height was measured using a portable Shorr Board (Seca Road Rod, Issaquah, WA). Students removed shoes and stood flat with feet together and backs, buttocks, and heels flush to the rod. The measurer held the head in the Frankfort plane. The student was instructed to take and hold a deep breath and the headboard was lowered firmly down onto the head, pressing the hair as much as possible. Measurements were recorded at the end of the student's deep breath inwards. Repeated measurements were taken until two were within 0.3 cm (two measurements minimum). The two measurements within 0.3 cm were averaged.

Weight was measured using a digital scale that also has the option to estimate body fat percentage (Tanita Corporation, Tokyo, Japan, Tanita InnerScan BC534). The scale was calibrated and each measurement was conducted per manufacturer's instructions. Each student was instructed to remove shoes and heavy outer garments and empty their pockets. Student height and age were entered into the scale per manufacturer instructions. When the scale read zero, students stepped on the center of the scale with weight evenly distributed, and were instructed to look straight ahead and hold still until weight appeared on the screen. The student stepped off and repeated the measurement. Repeated measurements were taken until two measures were within 0.1 kg.

Percent body fat

Percent body fat was assessed via bioelectrical impedance (BIA) using the same scale and procedure described above used to measure weight. %BF appeared on the scale screen immediately following the appearance of body weight. Repeated weight measurements were taken as described above, and thus repeated %BF were taken and then averaged. BIA using Tanita scales have been shown to have a high correlation with skinfold measurements (0.73-0.79 for boys and 0.77-0.81 for girls) in normal, overweight, and obese male and female children [77]. According to FITNESSGRAM Standards for the Healthy Fitness Zone, body fatness recommendations used for this analysis were <25% for males and <32% for females, values above which are correlated with increased disease risk in children [78]. These recommendations were used to classify children into two categories: those meeting recommendations (normal fatness) and those exceeding recommendations (overfat).

Ethnicity

Ethnicity categories were Caucasian, African American, Hispanic, Asian, Native American, Multi-racial, and “other.” For (S)Partners, ethnicity was reported by parents on the study consent form. For FIT, ethnicity data was obtained from the elementary schools, whose information was obtained from the parent. For Crim, ethnicity was self-reported by the students on a Lifestyle Survey. Due to small sample sizes that reported they were Asian, Native American, Multi-racial, and “other,” these groups were combined into a single “other” category for analyses.

Dietary Intake

Dietary intake was assessed using the Block FFQ for Kids (NutritionQuest, Berkeley, CA, <http://www.nutritionquest.com/>). Block is a 77-item questionnaire designed for children ages eight to 17 years. It was developed using 1999-2002 NHANES dietary recall data, and provides pictures to enhance accuracy of portion size estimation [79]. The FFQ estimates daily servings of various foods and calorie, micronutrient, and macronutrient intakes. The Block FFQ for Kids has been tested for reliability and validity, with Pearson’s correlation coefficients ≥ 0.4 for 9 of 13 variables examined, compared to 24 hour recalls in children ≤ 12 years old [51]. The measurement team was trained to administer surveys per company instructions in a standardized manner, and administration of the FFQ took place in a classroom group setting. Finished questionnaires were mailed to NutritionQuest for analysis and to flag surveys that may be invalid based on too few or too many foods selected and too few or excess calories. Two registered dietitians reviewed the flagged FFQs to deem them invalid or valid, based on the child’s gender, height, weight, %BF, BMI percentile, and whether or not they reported trying to lose weight. FFQs determined to be invalid were eliminated from the analysis. The FFQ data was used to

derive the three dietary variables in this study: daily calorie intake, the fiber index (FI) score, and the Healthy Eating Index (HEI) score, which are described below.

The mean \pm SD of total daily calorie intake was obtained from the FFQ calorie analysis. The HEI is a calculated diet quality score that is based on compliance to the 2005 federal Dietary Guidelines, with food group standards based on the United States Department of Agriculture (USDA) MyPyramid [53], and has been evaluated for both validity and reliability [54]. A higher score is indicative of a higher quality diet, with a maximum score of 100. The HEI is calculated using the 12 components and scoring standards as described in Figure 5, which were derived from the FFQ. Individual HEI components were also analyzed.

The FI was derived from the FFQ and included grams of dietary fiber per 1,000 calories (mean \pm SD). Fiber content of the diet has been shown to be a surrogate marker of overall nutrient density in adults and children [55, 56]. A fiber index (FI) score (grams of dietary fiber per 1,000 kcal) has been used in adult studies by Ludwig et al 1999 [55] and Carlson et al [57], along with indices of saturated fat and cholesterol. Higher intakes of dietary fiber were shown to be associated with a lower prevalence of certain cardiovascular disease risk factors including blood lipids, obesity, and markers of insulin resistance and diabetes. More recently, Carlson et al 2011 demonstrated that higher fiber intakes are inversely related to a metabolic syndrome score in adolescents aged 12-19, whereas saturated fat and cholesterol intakes were not related [56].

Weight Perception & Trying to Lose Weight

Students participated in a lifestyle behavior survey that included one question each to assess weight perception and current weight loss aims. The weight perception and weight loss questions were originally selected from Stevens, et al 1999, who previously reviewed existing questionnaires with an expert committee, who selected specific questions focused on weight-

related attitudes and behaviors and modified them to be age appropriate for third to fifth grade children. The questions were qualitatively assessed with child focus groups and were shown to have high test-retest reliability ($r > 0.6$) [80]. Furthermore, these questions have been used in numerous other published studies cited above, including Gusella et al 2008 [16], Brener et al 2004 [69], O'Dea and Caputi 2001 [39], and Strauss 1999 [14]. The lifestyle questionnaire was administered after the completion of the FFQ. Weight loss and weight perception questions and response choices were as follows: 1) Are you now trying to lose weight? Response choices: a) Yes; b) No; 2) How do you feel about your weight? Response choices: a) Too skinny; b) About right; c) Too heavy, too fat.

STATISTICAL ANALYSIS

Data analysis was conducted using SPSS version 19.0, with significance set at $p \leq 0.05$.

Descriptive statistics were used to determine sample characteristics. For PA1, PA2, and SA1, Chi-square and analysis of variance (ANOVA) were used to assess the significance of difference between categorical and continuous variables, respectively. Prevalence ratios were calculated by dividing the conditional probability of a positive test result if the condition is present for a reference group, divided by the conditional probability of positive test result if the condition was absent. Prevalence ratios were considered significant if 1.0 was not included in the confidence interval. For SA2, the General Linear Model univariate analysis was used to determine if significant differences existed between groups.

RESULTS

Descriptive characteristics of the sample are described in Table 1. A total of 570 children from the three cohorts completed baseline measurements. After eliminating those who did not answer either the trying to lose weight or weight perception questions, 519 were included in the

final analyses. Additionally, due to the small number of subjects in the underweight category (n=6), the group was eliminated from analyses. There were no significant gender differences in age, height, weight, BMI and BMI percentile, and the percentages in each weight status. Females had a significantly higher %BF but significantly more males were classified as OF. Of the total sample, 42.4% were classified as OW (18.7%) or OB (23.7%).

Ethnicity was reported for 454 children: 57.3% were Caucasian, 18.1% were African American, 15.2% were Hispanic, and 9.5% were other ethnicity. Caucasian children had a significantly lower body weight and BMI than all other ethnic groups, the lowest BMI percentile, percent body fat, and percent of children classified as overfat (significantly lower than Hispanics and other category), the lowest percentage of children classified as obese (significantly lower than Hispanics), and the highest percentage of children classified as normal weight (significantly higher than Hispanics and other category).

Weight Perception

Of the total sample, 506 children answered the weight perception question. Of those, 7.1% viewed themselves as too skinny, 70.6% about right, and 22.3% too heavy. Table 3 lists weight perceptions by gender, weight status, and body fatness. Associated prevalence ratios are listed in Table 4. There was a significant graded relationship between weight perception and weight status, with 6.2% of NW, 32.6% of OW, and 52.9% of OB children perceiving themselves as too heavy. Overweight and OB children were 5.3 and 8.5 times more likely to perceive themselves as too heavy, respectively, than NW children. About 90% of children who perceived themselves as too heavy reported trying to lose weight (Figure 7). No significant differences by gender were observed in the total sample or in any weight status category. However, 25.1% of females versus 18.5% of males perceived themselves as too heavy ($p=0.08$),

54.5% of OB males versus 36.4% of OB females perceived themselves as about right ($p=0.07$), and 60.6% of OB females versus 43.6% of OB males perceived themselves as too heavy ($p=0.07$). There were significant differences between males and females in both the NF and OF groups. In the NF group, females (12.9%) were 2.2 times more likely to perceive themselves as too heavy compared to males (5.9%) ($p=0.03$). In OF children, males perceived themselves as about right ($p=0.03$) more often and too heavy ($p=0.04$) less often than females, making OF females 1.4 times as likely to perceive themselves as too heavy than males. Additionally, 77.1% of OW, 56.3% OB, and 58.7% of OF males perceived themselves as too skinny or about right.

Prevalence of Trying to Lose Weight

Of those who answered the weight loss question ($n=507$), 48.5% reported trying to lose weight. Table 2 lists percentages of those who reported trying to lose weight by gender, weight status, and body fatness, and the associated prevalence ratios. There was no significant difference between females and males (50.2% versus 46.2%, respectively). A large percentage of NW (28.4%) and NF (33.2%) children were trying to lose weight. There was a significant graded relationship between trying to lose weight and weight status (Figure 6) and body fatness. Overweight, OB, and OF children were 2.1, 3.1, and 2.4 times more like than normal weight children to be trying to lose weight, respectively. This pattern was observed in both males and females, but differences were only significant between normal fat males and females ($p=0.05$), with 27.4% and 37.8% of males and females, respectively, reporting trying to lose weight.

Ethnic Differences

The same pattern existed in terms of weight perception, although not all differences were significant (Table 3). Caucasians (20.3%) had the lowest prevalence of children perceiving themselves as too heavy, followed by African Americans (23.2%), Hispanics (26.5%), and other

ethnicities (28.6%). However, the only significant differences were Hispanics having a significantly higher proportion (14.7%) of children perceiving themselves as too skinny ($p=0.04$) and significantly lower percentage perceiving themselves as about right (58.5%) ($p=0.016$) than Caucasians. Caucasians had the lowest percentage of children reporting they were trying to lose weight (41.3%), which was significantly lower than African Americans (53.7%, $p=0.041$), Hispanics (61.8%, $p=0.002$), and other ethnicities (69.0%, $p=0.001$) (Table 2)

Dietary Intake Variables

A total of 452 children completed a FFQ, of which 362 were deemed to be valid (80.3%, 25.8%, 75.3% of participants from (S)Partners, FIT, and Crim, respectively). Dietary variables overall and broken down by gender and ethnicity are summarized in Table 5. Table 6 summarizes dietary variables for the weight perception and weight loss questions. There were no significant differences in calorie intake or HEI score between those who reported trying to lose weight and those who did not. However, looking at individual components of the HEI, those trying to lose weight had significantly higher total fruit ($p=0.011$), whole fruit ($p=0.015$), and total vegetable ($p=0.055$), and lower saturated fat ($p=0.009$) and sodium ($p=0.032$) intakes than those who were not. Similarly, the FI score was significantly higher ($p=0.007$) in those who reported trying to lose weight (9.0 ± 2.9 g) than those who did not (8.3 ± 2.3 g). No significant differences were observed for any of the dietary variables between groups with respect to weight perception. However, a non-significant trend existed in total mean calorie intake, with those who perceived themselves as too heavy having the lowest calorie intake (1572 ± 773), followed by those who answered about right (1699 ± 852), and too skinny (1871 ± 1006).

DISCUSSION

The present study assessed fifth grade males and females of varying ethnicities, body sizes, and body compositions from three areas of Michigan on their weight perceptions and if they were trying to lose weight. Nearly half (48.1%) of the children in our sample and nearly one third of NW children were trying to lose weight. About three-quarters and one-half of OW and OB males, respectively, described their weight as about right. Compared to a majority of the current literature on this topic, the present study included samples of three major US ethnic groups, Caucasian, Hispanic, and African Americans, assessed body composition in addition to BMI percentile, and assessed dietary intake.

Cook et al 2007 [18], Gusella et al 2008 [16], Strauss 1999 [14], and Wang et al 2009 [27] reported a similarly overall prevalence of children or adolescents trying to lose weight in their samples. In our sample, 31.5% and 24% of females and males, respectively classified as NW were trying to lose weight, and additionally, 32% of those classified as NF were trying to lose weight (Table 3). Gusella et al 2008, reported 71% of children trying to lose weight were NW [16]. Similarly, McVey et al 2004, reported 29% of 10-14 year old females were trying to lose weight, while 93% of the sample was NW or underweight [19]. NW or NF children who are inappropriately trying to lose weight are at an increased risk for practicing unhealthy weight control behaviors that can precede the development of an eating disorder. Gusella et al 2008 stated that simply knowing if a child is trying to lose weight gives caregivers the opportunity to prevent serious weight-related conditions. Their data on middle school children showed that current attempts to lose weight and having lower self-esteem were the best predictors of high risk disordered eating behaviors [16].

Previous research has overwhelmingly shown that higher rates of children, adolescent, and adult females report trying to lose weight or diet [16, 27, 31] and overestimate their body

weight [14, 27, 70, 81] than males. In our study, females tended to be trying to lose weight and perceive themselves as too heavy more often than males, though differences were not always statistically significant. Specifically, significantly more NF females were trying to lose weight than males, and significantly more OF and NF females perceived themselves as too heavy than males. Additionally, more OB and OF males perceived themselves as about right than too heavy, while the opposite occurred in females. Of interest is the fact that significant differences were only observed between genders based on %BF, not BMI percentile-based categories. Very few studies to date have measured body composition in this context, which may be more valid than BMI classification.

In the present study, we anticipated that OW and OB children would perceive themselves as too heavy more often than about right or too skinny. However, weight perceptions of OW and OB children did not correspond well with their actual weight status, as 42% of the sample was classified as OW or OB while only 22% viewed themselves as too heavy. Additionally, 67% of OW and 45% of OB children viewed themselves as about right. Brener et al 2004 [69] assessed adolescents in grades 9-12 and O'Dea and Caputi 2001 [39] assessed children and adolescents aged 6-19, and both demonstrated OW and OB subjects frequently underestimating their weight status. While having a negative weight perception is certainly not desirable in children, accurately perceiving body size may lead to the practicing of healthy lifestyle behaviors for OW and OB children. This theory has yet to be confirmed.

In NW children in our study, weight perceptions and trying to lose weight seemed to be poorly matched, with 28% reporting trying to lose weight, but only 6% perceiving themselves as too heavy. This contradicts the Wang, et al 2009 theory that perceived weight status directly influences intended/reported weight control behaviors [27]. Additionally, Strauss 1999 argued

that weight perception is the best predictor of weight loss attempts, not necessarily weight status [14]. Our results do not support Wang et al and Strauss's statements for NW children, but do for the overall sample, given that over 90% of those who perceived themselves as too heavy were trying to lose weight

Current literature suggests that children of all ethnicities have some degree of weight misperception and are reporting weight loss behaviors or intentions. Our study supports this finding, with 41-69% of children in all ethnic groups trying to lose weight. DeLeel et al 2009 similarly reported that body weight concerns are not limited to Caucasian females, as was previously assumed. In a study of 9 and 10 year old females, they compared a group of minority children (African American, Asian, Hispanic/Latina, and mixed or other race) to Caucasian children. The two groups scored equally on a body dissatisfaction measure, and the minority group, had significantly higher eating disturbance scores than the Caucasian group [35]. In contrast, studies by Sira and Pawlak 2010 [31] in college students and Dorsey et al 2009 [70] in adults found that weight overestimation and/or dieting behaviors were more common in Caucasians. As illustrated in Table 3, in our study Caucasian children in our study had the lowest prevalence of trying to lose weight, which was significantly different compared to all other ethnic groups. The same pattern was observed for children who perceived themselves as too heavy, though differences were not significant. It is important to note, however, that Caucasians, on average, weighed less and had lower %BF than the other groups. Hispanics and children of other ethnicities were, on average, the heaviest with the highest %BF. Controlling for weight status and body composition is necessary to determine whether or not differences are actually attributable to ethnicity. Furthermore, parental influences, opinions, and perceptions of their childrens' weight will provide valuable insight.

To date, only one study has measured dietary intake and compared it in those who reported trying to lose weight with those who did not, as was done in the current study. Wang et al 2009 studied low-income, African American adolescents and estimated energy and nutrient intake, finding no significant differences between groups [27]. With respect to the dietary variables used in the present study (Table 7), significant differences were in the FI and selected HEI variables in those reporting trying to lose weight versus those who were not. It is plausible that those who report trying to lose weight were attempting to lose weight by including healthier fiber-rich foods, given their higher fruit and vegetable HEI scores, which contributed to a higher FI. A confounding factor, however, was that Hispanics had the highest prevalence of children trying to lose weight in our sample (>60%). Hispanics tend to have the highest dry bean intakes as compared to non-Hispanics whites, according to the USDA Continuing Survey of Food Intakes by Individuals [82], which would have an independent effect on fiber intake. In our sample, Hispanics did, in fact, have the highest FI, significantly different than Caucasians and African Americans. With respect to calorie intakes, there was a non-significant trend (Table 7) that indicated children who perceived themselves as too heavy had a lower calorie intake than those who perceived themselves as about right, which was lower than those perceived themselves as too skinny.

Limitations and Strengths

Limitations: The present study is cross-sectional, from which no causal effects can be determined. Using only one question each to assess weight perception and weight loss desires may not fully portray the complexities of children's feelings and actual behaviors. Also, the weight loss question does not identify if healthy and unhealthy practices are being used. Furthermore, it may reveal a child's intentions or desires to lose weight even if they are not

actively pursuing weight loss [6]. In addition, other than Stevens et al 1999 [80], little research has been done on how children of this age interpret weight perception and weight loss questions. It is possible that their answers are guided by what they think is socially desirable. Rolland et al suggested that children often answer in a manner that aims to please their superiors [83]. It is also possible that answers are influenced by weight status. For example, underweight or NW children may underreport weight loss desires while overweight or obese children may overreport them [35]. A more in-depth questionnaire, such as the Children's Eating Attitude Test (ChEAT) (Maloney, McGuire, and Daniels, 1998), would be a more comprehensive tool to gain information on children's eating and weight loss behaviors. The Body Image Measure (Collins, 1991) uses pictorial representations to gauge children's perceptions of their body size and their idea of the right size, which may be more useful for children in this age group. This study also did not assess self-esteem, a key factor that can affect weight perceptions and weight control behaviors [16, 28].

Another limitation of the present study was the fact that Crim participants had self-reported ethnicity, rather than parent or school reported as in (S)Partners and FIT. Furthermore, future studies will be strengthened by including a valid SES indicator across all cohorts. As shown in Figure 4, the percent of students eligible for free and reduced school lunch in each study provides an estimate of SES for the whole sample, but we do not have information on which children were eligible and participated in the study and how they answered the weight-related questions.

Lastly, significantly fewer FIT participants (26%, n=24) completed a valid FFQ versus (S)Partners (80%, n=271) and Crim (76%, n=61). Limited dietary data on FIT children weakens our ability to draw definitive conclusions, given that FIT had the highest prevalence of students

reporting trying to lose weight (62.4%), compared to (S)Partners (41.6%) and Crim (59.3%). However, those who completed a valid FFQ were fairly representative of the whole FIT sample in terms of height, weight, BMI, and trying to lose weight, though they differed somewhat in terms of BMI percentile. FIT children who completed a valid FFQ had a mean BMI percentile of 79 ± 27.3 , compared to 72.7 ± 28.6 in the whole FIT sample. The groups were nearly identical in their percentage trying to lose weight, as 62.5% of those who completed a valid FFQ reported trying to lose weight.

Strengths: The present study pooled data from three school-based cohorts, which included sampling from 10 schools from three regions in Michigan. Therefore, our sample was ethnically diverse, and included children from rural and urban areas, males and those from low-income areas, groups that are typically underrepresented in weight loss and weight perception studies [35]. Additionally, the children sampled were younger than in most studies on this topic, which tend to focus on older children and adolescents. This study was also strengthened by using standardized measurement tools and procedures by a staff that underwent a strict measurement training protocol. Additionally, we used both BMI percentiles and %BF to assess body size and composition.

Very few studies have evaluated diet quality in conjunction with questions to about weight perception and weight loss. Screening for weight perceptions and weight loss attempts in conjunction with dietary practices could provide valuable insight on whether kids are attempting to control weight through calorie or other nutrient restriction, and would identify children who are in need of nutritional and potentially psychological counseling.

SUMMARY & CONCLUSIONS

The present study evaluated the prevalence of weight misperceptions and trying to lose weight in fifth grade children in relation to weight status, body fatness, gender, and ethnicity. Nearly half of the sample was trying to lose weight, and of concern, 16% of them were NW, while about two-thirds of OW/OB and OF males underestimated their size. Additionally, Caucasians were shown to have the lowest prevalence of those trying to lose weight, as well as the lowest prevalence of those who perceived themselves as too heavy, though they were the least overweight and obese of all ethnic groups. Overall, those who were trying to lose weight had a significantly higher FI score than those who were not. No significant relationships were detected between daily calorie intake and HEI scores with trying to lose weight or weight perceptions. This study was limited by not assessing individual markers of SES in our population. Additionally, the two question assessment used in this study does not provide a comprehensive evaluation of weight related attitudes and behaviors, and does not include a marker of self-esteem. However, this study was unique in that it assessed dietary intake to detect possible diet-related weight control behaviors.

Though not comprehensive, the two-question assessment, in conjunction with measured height and weight, can quickly identify children who are misperceiving their weight status and/or pursuing unnecessary weight loss. Data from the present study and others show NW children frequently perceive themselves as too heavy and/or want to lose weight, and OW and OB children not recognizing themselves as such. NW children who perceive themselves as too heavy and/or are trying to lose weight may be practicing disordered eating behaviors. Overweight or OB children who do not view themselves as too heavy may be at risk for practicing unhealthy nutrition and physical activity behaviors, which can fuel further weight gain. Future studies

should similarly assess dietary intake and follow up with students who are misperceiving their size and/or attempting to lose weight.

APPENDICES

APPENDIX A: Chapter 3 Tables

Table 1: Descriptive characteristics of the total sample and by gender. Values are mean \pm standard deviation or percent when noted.

	Total (N=519)	Males (n=217)	Females (n=302)
Age	10.7 \pm 0.7	10.7 \pm 0.6	10.6 \pm 0.8
Height (cm)	144.7 \pm 7.6	144.3 \pm 7.7	144.9 \pm 7.5
Weight (kg)	43.3 \pm 12.3	43.2 \pm 12.5	43.4 \pm 12.2
BMI (kg/m ²)	20.5 \pm 4.5	20.5 \pm 4.5	20.5 \pm 4.5
BMI percentile	69.2 \pm 27.6	71.0 \pm 26.7	68.0 \pm 28.2
Body fat (%)	24.8 \pm 9.0	22.8 \pm 9.2	26.3 \pm 8.6*
Underweight (%)	1.2	1.4	1.0
Normal weight (%)	56.4	56.3	56.5
Overweight (%)	18.7	16.3	20.4
Obese (%)	23.7	26.0	22.1
Overfat (%)	29.7	35.5	25.6*

Sample sizes vary slightly for each variable based on completion of measurements

*Significantly different from males

Table 2: Descriptive characteristics by ethnicity. Values are mean \pm standard deviation or percent when noted.

	Caucasian (n=260)	African American (n=82)	Hispanic (n=69)	Other (n=43)
Age	10.6 \pm 0.5	10.9 \pm 1.3 ⁺	10.6 \pm 0.5	10.9 \pm 0.7 ⁺
Height (cm)	143.7 \pm 7.0	146.8 \pm 8.5 ⁺ &	143.2 \pm 6.7	148.3 \pm 9.3 ⁺ &
Weight (kg)	41.0 \pm 10.9	45.7 \pm 14.3 ⁺ #	45.3 \pm 12.6 ⁺	50.4 \pm 13.6 ⁺ &
BMI (kg/m ²)	19.7 \pm 4.0	20.9 \pm 5.2 ⁺	21.9 \pm 5.0 ⁺	22.5 \pm 4.6 ⁺
BMI percentile	65.8 \pm 27.7	68.8 \pm 28.3 [#]	76.1 \pm 27.3 ⁺	82.7 \pm 21.0 ⁺
Body fat (%)	23.6 \pm 8.4	24.8 \pm 9.7 ^{&#}	27.9 \pm 9.7 ⁺	28.8 \pm 8.4 ⁺
Underweight (%)	2.3	0	0	0
Normal weight (%)	62.0	58.5 [#]	42.6 ⁺	32.6 ⁺
Overweight (%)	16.7	15.9 [#]	20.6	34.9 ⁺
Obese (%)	19.0	25.6	36.8 ⁺	32.6
Overfat (%)	22.6	32.1	47.8 ⁺	39.5 ⁺

Sample sizes vary slightly for each variable based on completion of measurements

⁺ Significantly different from Caucasian

& Significantly different from Hispanic

[#] Significantly different from Other

Table 3: Percentage of children trying to lose weight in the total sample and by sex, weight status, and ethnicity

	Trying to Lose Weight (%)	Prevalence Ratio (95% CI)
Total (n=507)	48.5	
Males (n=212)	46.2	-
Females (n=295)	50.2	1.09 (0.903-1.305)
Normal weight total (n=289)	28.4	
Males (n=121)	24.0	-
Females (n=168)	31.5	1.32 (0.893-1.940)
Overweight total (n=96)	58.3	2.06 (1.602-2.638) [#]
Males (n=35)	54.3	-
Females (n=61)	60.7	1.12 (0.776-1.610)
Obese total (n=122)	88.5	3.12 (2.570-3.788) [#]
Males (n=56)	89.3	-
Females (n=66)	87.9	0.98 (0.866-1.118)
Normal fat total (n=352)	33.8	
Males (n=135)	27.4	-
Females (n=217)	37.8*	1.38 (0.998-1.905)
Overfat total (n=152)	81.6	2.41 (2.047-2.845) ⁺
Males (n=76)	78.9	
Females (n=76)	84.2	1.07 (0.917-1.241)
Ethnicity		
Caucasians (n=252)	41.3	
African American (n=82)	53.7 [^]	0.77 (0.599-0.987) ^{&}
Hispanic (n=68)	61.8 [^]	0.67 (0.527-0.848) ^{&}
Other Ethnicity (n=42)	69.0 [^]	0.47 (0.465-0.768) ^{&}

*Significantly different from males

[#]Normal weight who answered “yes” used as the reference group

⁺Normal fatness who answered “yes” used as the reference group

[^]Significantly different from Caucasian

[&]Caucasians who answered “yes” used as reference group

Table 4: Weight perception of the total sample and by sex, weight status, and ethnicity

	Weight perception (%)		
	Too Skinny	About Right	Too heavy
Total (n=506)	7.1	70.6	22.3
Males (n=211)	8.1	73.5	18.5
Females (n=295)	6.4	68.5	25.1
Normal weight total (n=290)	11.4	82.4	6.2
Males (n=121)	13.2	81.0	5.8
Females (n=169)	10.1	83.4	6.5
Overweight total (n=95)	0	67.4	32.6
Males (n=35)	0	77.1	22.9
Females (n=60)	0	62.7	38.3
Obese total (n=121)	2.5	44.6	52.9
Males (n=55)	1.8	54.5	43.6
Females (n=66)	3.0	36.4	60.6
Normal fat total (n=352)	9.1	80.7	10.2
Males (n=135)	11.1	83.0	5.9
Females (n=217)	7.8	79.3	12.9*
Overfat total (n=151)	2.6	47.0	50.3
Males (n=75)	2.7	56.0	41.3
Females (n=76)	2.6	38.2*	59.2*
Caucasians (n=251)	6.0 [#]	73.7 [#]	20.3
African Americans (n=82)	6.1	70.7	23.2
Hispanics (n=68)	14.7	58.8	26.5
Other Ethnicity (n=42)	4.8	66.7	28.6

*Significantly different from males

[#]Significantly different from Hispanic

Table 5: Prevalence Ratios – “Too heavy” versus “Too skinny” or “About right”

	Prevalence Ratio (95% CI)
Females vs. Males*	
Total sample	1.36 (0.961-1.917)
Normal weight	1.13 (0.449-2.819)
Overweight	1.67 (0.843-3.337)
Obese	1.39 (0.971-1.986)
Normal fatness	2.18 (1.023-4.636)
Overfat	1.43 (1.032-1.988)
Between weight categories [#]	
Overweight	5.26 (3.086-8.955)
Obese	8.52 (5.284-13.743)
Between body fat categories ^{&}	
Overfat	4.92 (3.476-6.968)
Ethnicity [^]	
Caucasian	-
African American	0.88 (0.551-1.395)
Hispanic	0.77 (0.482-1.223)
Other Ethnicity	0.71 (0.416-1.217)

*Females used as the reference group

[#]Normal weight used as the reference group

[&]Normal fatness used as the reference group

[^]Caucasians used as the reference group

Table 6: Dietary intake in the total sample and by gender and ethnicity. Values are mean \pm SD.

	Ethnicity				Gender	
	Caucasian	African American	Hispanic	Other	Male	Female
Calorie intake	1565 \pm 784 ^{^*}	2021 \pm 953 [#]	2042 \pm 990	1630 \pm 760	1746 \pm 872	1624 \pm 820
HEI score	57.2 \pm 8.8	56.1 \pm 6.8	58.5 \pm 7.1	56.8 \pm 9.3	56.5 \pm 8.2	57.6 \pm 8.8
FI	8.5 \pm 2.6 [*]	8.3 \pm 2.8 ^{*#}	9.7 \pm 2.6	9.5 \pm 3.2	8.4 \pm 2.6	8.8 \pm 2.7

^{*}Significantly different from Hispanic

[#]Significantly different from Other

[^]Significantly different from African American

Table 7: Dietary Intake and weight questions. Values are mean \pm SD.

	Trying to Lose Weight		Weight Perception		
	Yes	No	Too skinny	About right	Too heavy
Calorie intake	1677 \pm 851	1672 \pm 840	1871 \pm 1006	1699 \pm 852	1572 \pm 773
HEI score	57.4 \pm 8.6	56.8 \pm 8.5	54.1 \pm 7.3	57.5 \pm 8.5	56.7 \pm 9.0
FI	9.0 \pm 2.9*	8.3 \pm 2.3	8.3 \pm 2.0	8.6 \pm 2.6	8.8 \pm 2.8

*Significantly different from “no”

Table 8: Healthy Eating Index 2005 components for scoring, adapted from the USDA Center for Nutrition Policy and Promotion Fact Sheet [54].

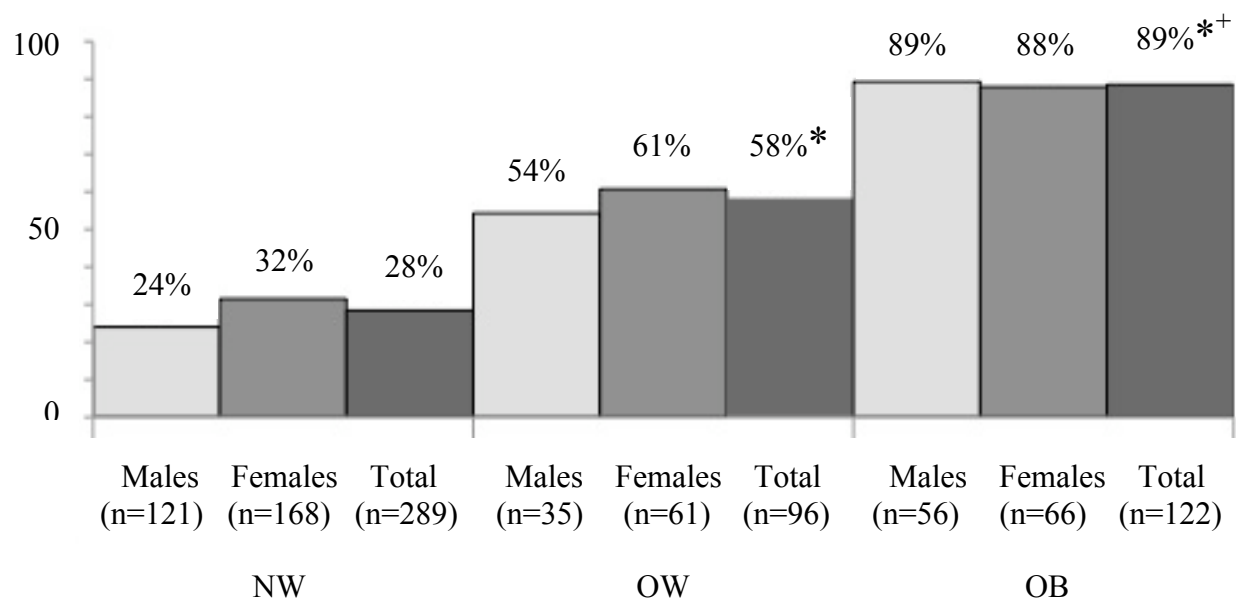
Component	Maximum points	Standard for maximum score	Standard for minimum score of zero
Total fruit (including 100% fruit juice)	5	≤ 0.8 cup equiv. per 1000 kcal	No fruit
Whole fruit (not juice)	5	≥ 0.4 cup equiv. per 1000 kcal	No whole fruit
Total vegetables	5	≥ 1.1 cup equiv. per 1000 kcal	No vegetables
Dark green and orange vegetables and legumes	5	≥ 0.4 cup equiv. per 1000 kcal	No dark green or orange vegetables or legumes
Total grains	5	≥ 3.0 oz equiv. per 1000 kcal	No grains
Whole grains	5	≥ 1.5 oz equiv. per 1000 kcal	No whole grains
Milk	10	≥ 1.3 cup equiv. per 1000 kcal	No milk
Meat and beans	10	≥ 2.5 oz equiv. per 1000 kcal	No meat or beans
Oils	10	≥ 12 grams per 1000 kcal	No oil
Saturated fat	10	$\leq 7\%$ of energy	$\geq 15\%$ of energy
Sodium	10	≤ 0.7 gram per 1000 kcal	≥ 2.0 grams per 1000 kcal
Calories from solid fats, alcoholic beverages, and added sugars	20	$\leq 20\%$ of energy	$\geq 50\%$ of energy

APPENDIX B: Chapter 3 Figures

Figure 2: Study characteristics including inclusion criteria, data collection, ethnicity, and location.

<p><u>(S)Partners</u> (N=351)</p> <p><i>School inclusion criteria:</i> <50 miles from Michigan State University campus > 30% of students qualifying for free/reduced school lunch</p> <p><i>Data collection:</i> Fall 2008 and fall 2009</p> <p><i>Primary ethnicity:</i> Caucasian (>80%)</p> <p><i>Location(s):</i> St. Louis, Holt, Marshall, and Olivet, MI</p>	<p><u>FIT</u> (N=129)</p> <p><i>School inclusion criteria:</i> > 95% of students qualifying for free/reduced school lunch</p> <p><i>Data collection:</i> Fall 2009</p> <p><i>Primary ethnicity:</i> Hispanic (>50%)</p> <p><i>Location(s):</i> Grand Rapids, MI</p>
	<p><u>Crim</u> (N=90)</p> <p><i>School inclusion criteria:</i> Participation in Crim Fitness Foundation program</p> <p><i>Data collection:</i> Spring 2010</p> <p><i>Primary ethnicity:</i> African American (>60%)</p> <p><i>Location(s):</i> Flint, MI</p>

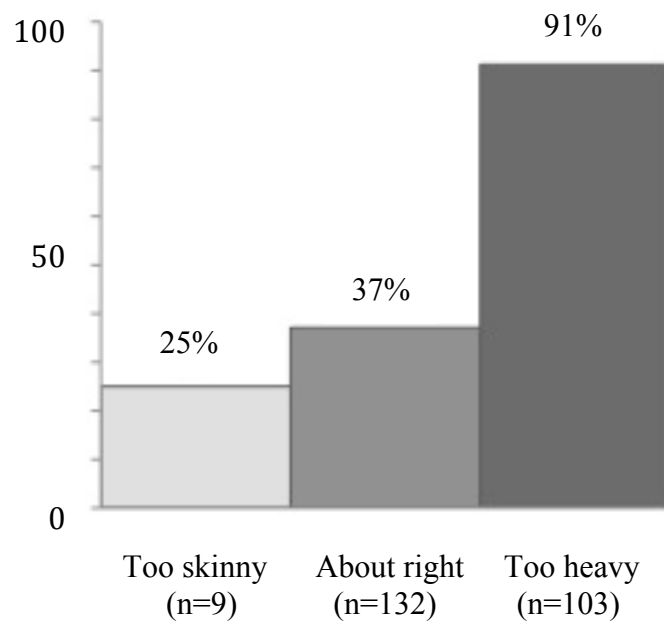
Figure 3: Prevalence of trying to lose weight by weight status category.



*Significantly different from normal weight

⁺Significantly different from overweight

Figure 4: Prevalence of trying to lose weight by weight perception group.



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