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This research examined the following major aims via three separate studies: 1) how body esteem develops in middle childhood, 2) the nature of the relationship between dietary restraint and body weight in middle childhood, and 3) whether and how diet quality may differ according to varying degrees of dietary restraint in young adults.

In study 1, longitudinal trajectories of body esteem were explored in a sample of elementary school-aged children. While previous research suggests that levels of body dissatisfaction begin to decrease in adolescence, the current literature on body dissatisfaction among younger children is scarce. The findings of the current study, utilizing a sample of 1111 children aged 6-9 years indicated that children's body esteem scores generally increased; however, there was great variability in the degree to which scores changed over time. Furthermore, although gender did not appear to have an impact on the body esteem trajectories, differences in the body esteem score patterns were identified by child weight status.

The aim of study 2 was to investigate the direction of the associations between dietary restraint and weight in a sample of elementary school-aged children. While numerous studies have described associations between weight status and dietary restraint in cross-sectional designs, only a few have examined the potential prospective relations between these constructs. The current study is unique in that it considers the bidirectional nature of weight and dietary restraint development over time in a sample of elementary school-aged children (n=263). Findings from the cross-lagged design controlling for sex, race/ethnicity, and weight status in first grade suggest that children's weight status in 3rd grade better predicts levels of dietary restraint in grade 4 rather than the other way around.

Finally, study 3 examined the quality of the diet of young adults by the level of self-reported dietary restraint in a sample of young adults (n=215). Some emerging research has found dietary restraint to be an indicator of self-control in eating, but so far, no studies have examined how dietary restraint influences diet quality scores or other eating-related patterns in young adulthood. Results from this study revealed dietary restraint did predict higher overall diet quality in young adulthood. In particular, young adults in our sample with higher levels of restraint reported higher consumption of total vegetables, greens and beans, total fruit, whole fruit, seafood and plant proteins and lower intakes of added sugars. Future research should consider the different potential dimensions of dietary restraint and the degree of restraint in relation to potential effects on health outcomes in young adults.

Overall, this research contributes to a better understanding of some specific psychological correlates related to obesity and diet quality in childhood and young adulthood, namely body esteem and dietary restraint. Future studies are warranted to extend these findings by including multiple measures of body image and dietary restraint to broaden the investigation of these factors in children and young adults.

# BODY ESTEEM AND DIETARY RESTRAINT IN CHILDREN AND YOUNG ADULTS: ASSOCIATIONS WITH BODY MASS INDEX AND DIET QUALITY

by

Megan Lawless

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Dr. Lenka Shriver
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# CHAPTER I: INTRODUCTION

The prevalence of overweight and obesity in the U.S. remains high, and together with the contemporary cultural obsession with thinness, concerns about body weight and dieting behaviors are common in both youth and adult populations (Bray et al., 2017; Hales et al., 2018). Though obesity and eating disorders have been largely studied separately, empirical evidence suggests these conditions do not occur in isolation of one another (Goldschmidt et al., 2018; Irving & Neumark-Sztainer, 2002; Raynor et al., 2006; Swanson et al., 2011). Analysis of data from a nationally representative sample of adolescents revealed that individuals with overweight or obese classifications are more likely to engage in unhealthy weight-control behaviors, such as meal skipping, fasting, and vomiting, compared to their normal-weight peers (Swanson et al., 2011). These unhealthy behaviors are associated with an increased risk for developing partial syndrome eating disorders, such as binge eating characterized by loss of control (Loth et al., 2014; Ward et al., 2019). Thus, it is important to address modifiable factors that are linked to both obesity as well as disordered eating. Of these modifiable factors described in the existing literature, body esteem and dietary restraint stand out as significant predictors for both childhood obesity and adolescent eating disorder risk, making them important points for intervention (Bornioli et al., 2019; Damiano et al., 2015; Rick M. Gardner et al., 2000; Loth et al., 2014).

Body esteem refers to the self-evaluations of one's body or appearance and is considered the attitudinal component of body image (Beverley K Mendelson et al., 2001). While body esteem has mostly been studied in adolescent samples, increasing evidence suggests that body image concerns begin to develop at a young age (Bun et al., 2012; Nichols et al., 2018; S. J. Paxton & Damiano, 2017; Striegel-Moore, 2001). From early on, children are able to determine their ideal body shape and by the age of 6, body weight and shape become increasingly prominent considerations, oftentimes

leading to negative feelings about one's physical appearance (Smolak, 2004). A review of studies of childhood body image concluded that around 40% of girls between the ages of 10 and 11 report body dissatisfaction (Smolak et al., 1998). This is unsurprising as middle childhood has been identified as the time when self-concept becomes more complex, and when children are better able to make comparisons between themselves and others (Cash, 2017; S. J. Paxton & Damiano, 2017; Smolak, 2004). On the other hand, current literature lacks findings on body image from boys in middle childhood and from children younger than 10 years (Smolak, 2004). Further, most evidence to date has come from cross-sectional research which limits the capacity for detecting patterns in changes over time. A better understanding of the longitudinal changes in body esteem throughout this developmental period is important to determine if/when problematic declines in body esteem begin to occur, and to determine who is most vulnerable to potential negative consequences of low body esteem.

Another line of research points to a high prevalence of dietary restraint that exists even among children (Carper et al., 2000; Damiano et al., 2015; Rodgers et al., 2019a; Shunk & Birch, 2004b). Dietary restraint refers to the cognitive control of food intake for weight management and is often conceptualized interchangeably with dieting. The majority of existing research on dietary restraint has largely focused on examining potential consequences of dietary restraint as an extreme weight control strategy (Neumark-Sztainer et al., 2012; vander Wal, 2012a). However, there has been growing attention in recent literature to the importance of childhood self-regulation skills and their role in the development of eating behaviors and overall future obesity risk (Russell & Russell, 2020). Given the abundance of highly palatable, energy-dense foods in the modern eating environment, an ability to intentionally self-regulate food intake might be a necessary and welcomed adaptive mechanism for improving diet quality and maintaining a healthy weight over time (F. Johnson et al., 2012; Kliemann et al., 2018). In fact, cognitive restraint has been identified as a potential antecedent of self-regulation related to eating among overweight and obese adults (Reed et al., 2016). Furthermore,

it has been suggested that dietary restraint is essential for maintaining a healthy weight in individuals who tend to overeat and gain weight (F. Johnson et al., 2012). So far, however, the nature of the relation between dietary restraint and weight outcomes has not been well examined in child populations.

Individuals engage in a variety of weight loss or weight maintenance strategies and these behaviors may have varying influences on the individuals' health and overall well-being (Keery et al., 2006; N. Larson et al., 2018; N. I. Larson et al., 2009; Neumark-Sztainer et al., 2012). Dieting to attain a body type that is in line with the thin ideal, for example, has often been associated with poorer psychological and physical health outcomes, including greater levels of depression and the use of extreme weight-loss strategies like purging or fasting (Loth et al., 2014; Neumark-Sztainer et al., 2007, 2012). On the other hand, healthy weight control strategies that involve increasing fruit and vegetable intake to meet current dietary and health recommendations appear to have a positive influence on overall nutritional status and health outcomes (Adam et al., 2009; N. Larson et al., 2012; Provencher et al., 2009). This might be especially important for individuals who are determined to be at nutritional risk or who struggle to meet recommendations for a healthy diet. Numerous studies have highlighted the period of young adulthood (ages 20-35) as a time when dietary intakes are especially poor as evidenced by diet quality scores that are lower than any other adult age group (Hiza et al., 2013; Thorpe et al., n.d.; Woglom et al., 2020). Young adulthood is also characterized by high rates of weight gain making this a critical period for weight control (Wane et al., 2010). Additional research on the associations between weight control behaviors and potential benefits to the overall diet quality of young adults is still needed.

Given the current understanding of the associations between body esteem, weight, dietary restraint and diet quality and the gaps identified in the existing research in this area, the specific aims of the present research are:

**Aim 1:** Explore children's trajectories of body esteem during middle childhood (approximate ages 6-9 years) and assess inter-individual differences in these patterns by gender and weight status.

*Hypothesis 1a:* There will be inter- and intra-individual change in levels of body esteem throughout middle childhood.
*Hypothesis 1b*: Trajectories of body esteem will differ by gender and weight status in middle childhood.

**Aim 2:** Determine the degree and nature of the relation between dietary restraint and body mass index (BMI) z-scores over time during middle childhood (approximate ages 9-10 years).

*Hypothesis 2a:* There will be a significant, moderate stability in dietary restraint and BMI z-scores over time.
*Hypothesis 2b:* There will be significant, positive correlations between dietary restraint and BMI z-scores at each time point.
*Hypothesis 2c:* There will be transactional effects over time such that higher BMI z-scores at age 9 will prospectively predict higher dietary restraint at age 10, and the opposing direction (dietary restraint prospectively predicting BMI z-scores) will be weaker.

**Aim 3:** Examine the association between dietary restraint and diet quality and explore differences in diet-quality outcomes between individuals with high and low levels of dietary restraint in a sample of young adults.

*Hypothesis 3:* There will be differences in diet quality and other diet outcomes among young adults according to levels of dietary restraint.

# CHAPTER II: REVIEW OF THE LITERATURE

## Childhood Obesity

Obesity refers to an excess accumulation of body fat. The most common measure for assessing weight status at the population level is the Body Mass Index (BMI) which is derived using a ratio of the body weight and height (*About Adult BMI | Healthy Weight, Nutrition, and Physical Activity | CDC*, n.d.; Bray et al., 2017; Churuangsuk et al., 2018). The World Health Organization (WHO) defines adult obesity as a BMI value of 30 or higher (Bray et al., 2017; Churuangsuk et al., 2018). During childhood, however, normal growth and development results in variability in height and weight and subsequent levels of body fatness. Thus, the norms for the absolute level of BMI in children vary with age and sex (Barlow, 2007). For children between 2 and 20 years of age the Centers for Disease Control (CDC) recommends using BMI reference standards to express BMI relative to other children of the same sex and age (Barlow, 2007; *Defining Adult Overweight and Obesity | Overweight & Obesity | CDC*, n.d.; Skinner et al., 2018). Using these reference standards, obesity in children is defined as values equal to or greater than the 95$^{th}$ percentile and overweight as a BMI at or above the 85$^{th}$ percentile and below the 95$^{th}$ percentile. Although probably not ideal for all segments of the pediatric population, these standards are typically applied to all children regardless of ethnicity or socioeconomic status or geographical location around the world (Chen et al., 2016; Dobashi, n.d.; May et al., 2013; Ward et al., 2017a; Weiss et al., 2004).

The most recent data from the National Health and Examination Survey (NHANES) indicate that an estimated 18.5% of children and adolescents (2-19 years) are obese and another 16.6% are overweight (Hales et al., 2018; Skinner et al., 2018). Children who are obese are at increased risk for remaining obese as adults and for developing other health consequences that are common in adulthood, such as diabetes and coronary heart disease (Simmonds et al., 2016; Ward et al., 2017b). Obesity in

childhood has been also strongly associated with other poor health outcomes and psychological problems such as depression, low self-esteem and physiological problems including sleep apnea and asthma(Quek et al., 2017; vander Wal & Mitchell, 2011; Wardle & Cooke, 2005; Weiss et al., 2004).

Rather than a stable condition, childhood obesity represents a dynamic process in which a set of factors that are related to biology and the environment interact with each other to contribute to positive energy balance over time (Dobashi, n.d.; Kumar & Kelly, 2017; Lee & Yoon, n.d.). Over the past decades, studies have identified a number of risk factors associated with childhood obesity, including increased time spent in sedentary behaviors, less frequent family meals, greater intake of sugar-sweetened beverages, and greater exposure to food-based marketing (Bray et al., 2017; Gordon-Larsen et al., 2004; Mameli et al., 2016; May et al., 2013). Several leading health organizations have developed comprehensive interventions that address these factors. The Expert Committee on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity recommends a staged approach to behavioral interventions that focus on low-energy-dense, balanced diets, structured meals, and increased physical activity and reduced screen time per day (Barlow, 2007; Kumar & Kelly, 2017). However, the effectiveness of these strategies is still in question as a number of studies have revealed only moderate improvements to BMI and overweight/obesity prevalence following the implementation of behavioral interventions (Y. Wang et al., 2015). Given the high prevalence of overweight and the high costs associated with treatments for obesity and related comorbidities, there is a growing need to understand the characteristics of individuals that interact with the environment to either maximize or minimize risks for weight gain and unhealthy eating practices and excessive weight gain over time.

## Psychological Correlates of Obesity

Besides negative physical health consequences, overweight and obesity are often associated with mental health problems and psychosocial difficulties in both adults and children (Puder & Munsch, 2010; vander Wal & Mitchell, 2011; Wardle & Cooke, 2005). A review of the psychological correlates of childhood obesity revealed that externalizing (impulsivity and attention-deficit hyperactivity disorder) and internalizing (depression and anxiety) behavioral problems are some of the most frequently cited factors related to childood obesity (Amaya-Hernández et al., 2019; K. K. Davison et al., 2000; Dion et al., 2016; Puder & Munsch, 2010). In particular, overweight and obese children often report higher levels of weight and shape concerns (Puder & Munsch, 2010). This is problematic because weight and shape concerns have been linked with the adoption of unhealthy eating patterns and reduced participation in regular physical activity, both of which contribute to increase risk for excessive weight gain (Aparicio-Martinez et al., 2019; Bornioli et al., 2019; vander Wal, 2012b). Furthermore, there is also significant co-occurrence of eating disorders in individuals with a higher BMI (Bornioli et al., 2019; Goldschmidt et al., 2018; Haines & Neumark-Sztainer, 2006). For example, a large, nationally representative study of U.S. adults found that the adjusted odds ratio for having been diagnosed with an eating disorder (specifically binge eating disorder (BED)) increases as BMI increases (Udo & Grilo, 2018). Similar associations have also been found in younger samples of adolescents, suggesting maladaptive strategies to cope with overweight begin early in life (Aparicio-Martinez et al., 2019; Goldschmidt et al., 2018; Loth et al., 2014; Rohde et al., 2015).

Excessive adiposity is stigmatized in Western cultures, with larger body shapes regarded as socially undesirable for both adolescent girls and boys (Grogan, 2006). Thus, many adolescents and adults who feel dissatisfied with their own weight often turn to dieting and weight loss (Bornioli et al., 2019; Rodgers et al., n.d.; Stice & Shaw, 2002). The belief that being thin is most attractive and desirable, commonly referred to as the “thin ideal,” also affects how people view the relationship between weight and

health, with thin individuals being considered to be healthy regardless of their actual medical status (Aparicio-Martinez et al., 2019; Fitzsimmons-Craft et al., 2012). A brief review of two key psychological correlates of obesity is provided in detail below.

### Body Image

Body image is a complex and multifaceted construct that can be understood as the "figuration of our body formed in our mind" (Huang et al., 2007). It can be further subdivided into two dimensions: a perceptual component and an attitudinal component (Cash, 2017; Thompson, 2004)The perceptual component of body image refers to the accuracy of judgement in body size, shape and weight (Thompson, 2004). The attitudinal component covers the thoughts, feelings, and behaviors related to the body (Karazsia et al., 2017; Tatangelo et al., 2016; Thompson, 2004). Body dissatisfaction falls into the attitudinal dimension of body image and refers to the negative subjective evaluation of one's body or appearance (Littleton & Ollendick, 2003), Body dissatisfaction has been studied in previous research most frequently for its manifestation across life stages and in relation to negative physical and psychological health outcomes (Bornioli et al., 2019; Dion et al., 2016; Littleton & Ollendick, 2003; Tatangelo et al., 2016; Tiggemann, 2005).

Negative body image and/or body dissatisfaction has been well researched in older youth and is shown to be highly prevalent among adolescents (Bornioli et al., 2019; Bully & Elosua, 2011; Marita P. McCabe & Ricciardelli, 2004; Susan J. Paxton, Eisenberg, et al., 2006). Evidence from epidemiological studies indicate that 24% to 46% of adolescent girls and 12% to 26% of adolescent boys report marked dissatisfaction with their bodies (Bucchianeri et al., 2016; Susan J. Paxton, Eisenberg, et al., 2006; Presnell et al., 2004; Stice & Shaw, 2002). Some studies suggest that for both boys and girls, levels of body esteem may begin to decrease in middle school and throughout adolescence (Fiona Johnson & Wardle, 2005; Rodgers et al., n.d., 2014) as well as from adolescence to young adulthood (mid-20s) (Loth et al., 2015; Sharpe et al.,

2018). Further, among adolescents and young adults negative body image has been shown to be associated with higher levels of self-disgust (von Spreckelsen et al., 2018), lower self-worth (Susan J. Paxton, Neumark-Sztainer, et al., 2006; van den Berg et al., 2010), and higher risk for disordered eating (Aparicio-Martinez et al., 2019; Askew et al., 2020; Loth et al., 2014; Rodgers et al., 2014).

Compared to studies with adolescent and adult samples, however, research on the trends and development of body esteem during childhood is sparse (Tatangelo et al., 2016). Some evidence from cross-sectional research suggests that body image concerns begin to develop during childhood with as many as 40% of late elementary school-aged girls reporting body dissatisfaction (Nichols et al., 2018; S. J. Paxton & Damiano, 2017; Striegel-Moore, 2001). Other findings indicate concerns about weight occur at increasing rates in children as young as 5 (K. K. Davison et al., 2000; Ricciardelli & McCabe, 2001). Data for these studies, however, predominantly come from samples of white female children of middle or high income, so the ability to generalize to a larger population is limited (Smolak, 2004). Furthermore, evidence for individual level changes in body esteem throughout childhood is lacking. Since negative body image represents a risk factor for a number of adverse psychological and physical health outcomes, a greater understanding of body image in younger populations is warranted.

One of the barriers to body image research with child populations is the fact that the assessment of body image concerns and body dissatisfaction in children poses greater challenges than assessments in adolescents and adults. In order for researchers to correctly identify meaningful body image concerns in this population, children must have the capacity to assess his/ her body and compare his/her body to an internalized ideal (Thompson, 2004). Instruments need to be shorter and use simpler language so they can be fully understood (Smolak, 2004). The main types of measures used so far in research include figure preference ratings (Rick M. Gardner et al., 2009; Tatangelo et

al., 2016), video projection techniques (R. M. Gardner et al., 1995), and questionnaires (Evans et al., 2013; Garner et al., 1982; Beverley K Mendelson et al., 2001). Most of these techniques conceptualize body dissatisfaction by examining the discrepancy between the current and the ideal body size (R. M. Gardner et al., 1995; Rick M. Gardner et al., 2009). The other measures, such as The Body Esteem Scale for Children (BES) (B. K. Mendelson & White, 1982) assess children's affective evaluations of their bodies and can be used to assess multiple dimensions of body image simultaneously, which is preferred to capture different dimensions of body image and body esteem. Namely, the BES includes subscales for satisfaction with general appearance, satisfaction with weight, and attribution of positive evaluations to others. Scores for the BES have been shown to be moderately correlated with body dissatisfaction as assessed by figure preferences (B. K. Mendelson et al., 1995).

### Associations of Body Esteem with Weight Status

Current literature shows that body weight represents one of the strongest correlates of low body esteem across age groups (K. K. Davison et al., 2000; Ferreira et al., 2016; Goldfield et al., 2010; Shriver et al., 2013), with studies consistently finding that body esteem is lower in obese children and adolescents comparted to their normal-weight counterparts (Shriver et al., 2013; N. A. Weinberger et al., 2017). For example, in a sample of nine- and ten-year-old girls, overweight/obese individuals had significantly lower levels of body esteem than underweight/ healthy weight individuals (Szamreta et al., 2017). Even still, the level of body image disturbance is shown to vary wildly across samples of overweight adolescents (Lacroix et al., 2020; Ricciardelli & McCabe, 2001) and not all children who are overweight have low body esteem (Frisén & Holmqvist, 2010; Lacroix et al., 2020). Furthermore, low body esteem is present among children with normal weight, indicating that weight is not the only determinant for level of body esteem but there are likely other factors, including parental and peer influences, that shape children's body esteem during childhood (Bernier et al., 2010; Nichols et al., 2018; Striegel-Moore, 2001).

### Associations of Body Esteem with Child's Sex

Along with weight, child's sex is one of the main factors associated with body image concerns (Abell & Richards, 1996; Bully & Elosua, 2011; Shriver et al., 2013). Adolescents and adult women tend to be more dissatisfied with their bodies than men, especially with regard to body fat, and girls show greater investment in their body image compared with boys (Lawler & Nixon, 2011; Presnell et al., 2004; Smolak, 2004). One explanation for this difference is the gendered body ideal which emphasizes thinness in women and muscularity in men (Field et al., 2001; Lawler & Nixon, 2011; Presnell et al., 2004). Previous studies show that girls who are preoccupied with their weight often display a wish to be thinner, whereas boys often desire a body that is lean yet muscular (Bray et al., 2017; Churuangsuk et al., 2018).

The period between ages 8 and 10 has been suggested in earlier research as the time when gender differences in body esteem may begin to appear (Smolak, 2004; Tiggemann, 2005). Beginning in elementary school, girls are more worried about being fat than boys are (Smolak & Levine, 2001). On the other hand, some research suggests young boys (e.g. younger than 11 years) might not yet be concerned with reaching the adult male muscular body ideal, and thus may not experience issues with body image (Lawler & Nixon, 2011; Marita P. McCabe & Ricciardelli, 2004; Smolak, 2004). Given that the transition from early to mid-adolescence is thought to be when gender differences in pubertal development become significant (Tiggemann, 2005; Tremblay & Lariviere, 2009), and pubertal development is tied to body esteem (Tremblay & Lariviere, 2009), it is worthwhile examining the effects of gender on the trajectories of body esteem during middle childhood, prior to early adolescence.

## Unhealthy Weight Control Behaviors

Disordered eating includes a broad range of practices but broadly reflects two categories of behaviors: unhealthy weight control behaviors and disinhibited eating

(Neumark-Sztainer & Hannan, 2000; vander Wal, 2012a). Unhealthy weight control behaviors include a range of cognitive and behavioral strategies aimed at controlling weight or promoting weight loss (Leann L. Birch & Fisher, 1998; Leann Lipps Birch & Davison, 2001). Most health risk behaviors, including the use of unhealthy and extreme weight control behaviors, are believed to begin to arise during adolescence (N. I. Larson et al., 2009; Neumark-Sztainer & Hannan, 2000; STORY et al., 2002). The social pressures to conform to a thin body ideal coupled with the high volume of media messages pushing the latest diet fads lead many individuals to engage in dieting and other weight control behaviors (Field et al., 2001, 2008; Lam et al., 2009). Literature on restrictive dieting suggests these practices lead to periods of disinhibited eating and that preoccupation with food/eating are predictive of weight gain over time (Field et al., 2003, 2007; M. R. Lowe, 2015; Neumark-Sztainer et al., 2007). However, not all studies that examined the long-term effects of dieting found such associations (Senf et al., 2006; Urbanek et al., 2015). A different line of research related to self-regulation suggests that some degree of self-control of food intake is necessary for individuals with obesity or for those at risk of developing weight-related health problems, in order to reduce the negative health consequences of obesity (F. Johnson et al., 2012; Reed et al., 2016). Therefore, it is important to consider the specific types of weight control behavior to determine which behaviors, if any, offer benefits to individuals who struggle with maintaining a healthy and/or a balanced diet.

## Dietary Restraint as an Eating Behavior

Research on dietary restraint emerged in the 1960s and stemmed from psychological theories concerning obesity which characterized differences in eating patterns between obese and nonobese individuals (Nisbett, 1972; Schachter, 1968). These early theories proposed that obese and normal weight individuals differed in their responsiveness toward food rewards and toward environmental cues for eating (Ruderman & Christensen, 1983). Herman and Mack (1975) further developed these food regulation models by proposing that obese individuals are more prone to overeating because they

attempt to suppress their food intake and keep their body weight below a biological “set point” (C Peter Herman & Mack, 1975; Ruderman & Christensen, 1983). This cognitive suppression of food intake, termed restraint, was thought to predict behavior, particularly an overeating response when some environmental trigger undermined self-control (C. P. Herman & Polivy, 1984; C Peter Herman & Mack, 1975). The restraint scale (Polivy et al., 1979) was developed to study this phenomenon and has been used frequently in research (Boyce et al., 2015; Laessle et al., 1989; Stice et al., 2010; van Strien et al., 2007). However, the scale has drawn some criticism for its inability to distinguish between restrained and disinhibited eating (Hagan et al., 2017) and for the differences in associations between normal-weight and overweight/obese samples (Stice et al., 2010; van Strien et al., 2007). Two alternative scales, the Three Factor Eating Questionnaire (TFEQ) (Stunkard & Messick, 1985) and the Dutch Eating Behavior Questionnaire (DEBQ) (Strien, Frijters, Bergers, et al., 1986; Strien, Frijters, Staveren, et al., 1986; van Strien et al., 2007) were since developed that measure different “styles of eating,” and include subscales for dietary restraint in eating.

In line with early theoretical work, dietary restraint has typically been measured and denounced as a “dysregulated behavior” meant to be avoided, particularly among children and adolescents who are at a heightened risk for developing eating disorders (Bauer & Chuisano, 2018; Fiona Johnson & Wardle, 2005). However current literature offers a new perspective on dietary restraint in the light of major changes in our food environment, highlighting the need to re-examine dietary restraint as a construct. Some research also provides evidence for potential positive benefits of long-term moderate dietary restriction, including improvements in various health markers (e.g. blood pressure, glucose, insulin, low-density lipoprotein, and triglycerides) (Fontana et al., 2004; Meyer et al., 2006; Sharafi et al., 2016) and diet quality (Olea López & Johnson, 2016; Rideout et al., 2004). Further, there is emerging evidence that the associations between dietary restraint and physical and mental health outcomes are dependent on the individual and the circumstances under which dietary restraint is employed, such

that some individuals with more flexible-style dietary restraint will have better weight control and less risk of eating pathology compared with individuals with a rigid-style dietary restraint (Bauer & Chuisano, 2018; Westenhoefer et al., 2013).

Though early work on eating responses among adolescents and adults often characterized dietary restraint as a negative trait in relation to disordered eating and long-term weight outcomes, the distinction between dietary restraint and unhealthy dieting is very rarely recognized. Whereas dietary restraint reflects a *cognitive effort* to control food intake, dieting represents the set of practices for restricting food intake specifically for the purpose of weight loss (Michael R. Lowe, 1995; Meule, 2016; Rideout & Barr, 2009). Unlike dieting, dietary restraint is considered a stable or trait-like approach to eating when considered among adult samples (Michael R. Lowe, 1993). Furthermore, existing measures for assessing dietary restraint do not specifically address weight loss or desire to become thin (Strien, Frijters, Bergers, et al., 1986; Strien, Frijters, Staveren, et al., 1986; Stunkard & Messick, 1985), and while most individuals who currently identify as dieters are also restrained eaters, not all restrained eaters identify as currently dieting (Michael R. Lowe & Timko, 2004). This distinction has led some to reconsider the role of dietary restraint in the development of obesity and eating disorders and its potential influences on diet and weight related outcomes in children as well as adults (F. Johnson et al., 2012; Schaumberg et al., 2016).

### *Dietary Restraint and Weight Gain*

Numerous studies with adult and adolescent samples have illustrated a link between dieting and weight gain over time (Field et al., 2003, 2007; Strauss, 1999). It is hypothesized that dieting leads to weight gain because the level of restraint/dieting is unsustainable in nature; engaging in a prescribed, often excessively restrictive diet results in feelings of deprivation which lead to counterregulatory eating, often in excess of one's energy needs (C. P. Herman & Polivy, 1984; Neumark-Sztainer et al., 2007). Findings from a large, longitudinal study of adolescents revealed that those who

reported dieting to lose weight gained more BMI units than non-dieters over a five-year period (Neumark-Sztainer et al., 2007). This is consistent with other research that indicate attempts at dietary restriction among normal-weight individuals predict weight gain rather than weight loss (Goldstein et al., 2013; Stice et al., 2010). On the other hand, it has been suggested that the cognitive effort to restrict food intake, as seen in restrained eaters, may indicate a susceptibility toward future weight gain (Michael R. Lowe & Levine, 2005). Individuals who are overweight or prone to weight gain may increase dietary restraint in order to reduce the amount of weight gain over time (M. R. Lowe, 2015). Moreover, for individuals with obesity, dietary restraint has been shown to be a protective factor against future weight gain (Bellisle et al., 2004; Drapeau et al., 2003; Provencher et al., 2003).

Dietary restraint has been studied in children as young as five, well before the normative weight gain associated with puberty (Shunk & Birch, 2004a). While this remains an understudied topic in current literature, the limited knowledge suggests that children's early weight status and gender play a role in the development of dietary restraint later on, with girls consistently showing higher levels of dietary restraint than boys (Shunk & Birch, 2004a, 2004c). Due to the potential beneficial influence of dietary restraint on body weight control in certain adult samples, further investigation of the longitudinal effects of dietary restraint on body mass in younger populations is warranted.

*Dietary Restraint and Diet Quality*

Multiple factors in the current food environment interact to create circumstances wherein self-control of appetite is difficult, leading to overconsumption of unhealthy foods versus healthy eating patterns, and contributing to the high prevalence of obesity in the U.S. (N. Larson et al., 2012, 2015; Moore et al., n.d.). The ability to control food intake, including both the quantity and quality of the diet, has important implications for

obesity prevention programs and for obesity treatments (Christoph et al., 2019; N. Larson et al., 2012, 2015).

Research in non-clinical settings indicates that restrained eaters may not necessarily be in a negative energy balance (Stice et al., 2010) and do not eat less than unrestrained eaters, suggesting that perceived restraint does not always correspond with the notion of “excessive dieting/fasting” (Goldstein et al., 2013; Michael R. Lowe & Timko, 2004). However, there is evidence that higher levels of dietary restraint are associated with lowered intakes of certain foods and food groups, like ice cream and added sugars (Moreira et al., 2005; Racine, 2018; Rideout et al., 2004). For example, in their research with post-menopausal women, Goulet et al. (2008) found that individuals with high levels of dietary restraint consumed higher levels of vegetables and whole grains and had lower intakes of red meat, processed meat, refined grains, and diet sodas than individuals with lower levels of dietary restraint (Goulet et al., 2008). This data suggests that dietary restraint could reflect a more moderate weight control strategy and play an important role in determining healthy eating patterns. Additional research is needed to see if these findings extend to younger populations.

Research into diet-disease relationships have traditionally focused on the role of a single nutrient or food group without considering possible interactions between foods (Berryman et al., 2018; Churuangsuk et al., 2018; Han et al., 2019; Kim et al., 2016). At the same time, poor quality diets are typically defined as diets high in saturated fat, sodium, refined grains and/or added sugars but low in fruits, vegetables and whole grains (Asghari et al., 2017; Hiza et al., 2013; Leech et al., 2015; Mesas et al., 2012). In order to better capture the complexity of people’s diets, research needs to examine the overall quality of the diet.

Most assessments of overall dietary intake rely on the use of pre-specified dietary indices to determine how closely an individual’s food intake complies with nutrition

recommendations (Asghari et al., 2017; George et al., 2014; Harmon et al., 2015; Hiza et al., 2013). These indices are typically calculated using a composite of scores from individual food components, such as refined grains and added sugars, and studied as a reflection of overall diet quality. One measure for assessing diet quality is the Healthy Eating Index which determines how well dietary intakes align with the key food choice recommendations from the Dietary Guidelines for Americans (DGA) (Kirkpatrick et al., 2018; Krebs-Smith et al., 2018). The DGAs are the evidence-based foundation for nutrition policy of the US government so are a helpful source for guidance of the total diet (Krebs-Smith et al., 2018; Reedy et al., 2018). The HEI-2015 includes 13 components: 9 adequacy components (higher intakes recommended) and 4 moderation components (lower intakes recommended) (Bray et al., 2017; Churuangsuk et al., 2018). Details related to the individual components and scoring conventions can be found in Appendix A.

A recent analysis of data from the National Health and Nutrition Examination Survey (NHANES) revealed that for young adults aged 20-39, the average total HEI-2015 score was 55.0± 0.7, which was significantly lower than scores from older age groups (Reedy et al., 2018). In general, these young adults consumed lowered intakes of fruits, vegetables, whole grains, seafood and plant proteins, and consumed higher intakes of fatty acids, refined grains and added sugars (Reedy et al., 2018). Other studies have similarly reported low scores for diet quality among this age group (Hiza et al., 2013; Lipsky et al., 2017; Thorpe et al., n.d.). Since evidence from previous research suggests dietary restraint could be associated with increased intakes of “healthy” food groups and decreased intakes of foods higher in added sugars and refined grains, the present study considered associations between dietary restraint and diet quality in a sample of young adults.

## Conclusions and Significance of Current Research

Obesity continues to be a national public health issue with both physical and psychological consequences for the individual. Interventions aimed at decreasing obesity prevalence and improving outcomes associated with overweight must consider the complex interactions between physiological, social and psychological factors that contribute to excessive weight gain over time. There is a wealth of research dedicated to describing the role of excessive restraint and/or dieting and body dissatisfaction in the development of eating disorders and excessive adiposity. However, experts have begun to move away from the view of dietary restriction/restraint as a homogeneous construct and have instead started to examine the potential beneficial consequences of self-regulation of food intake or the flexible type of dietary restraint that may be a useful tool for maintaining a healthy weight. More research is needed to understand the complex relationship between dietary restraint and weight and nutritional outcomes across different life stages. In addition, body esteem, particularly low body esteem/body dissatisfaction, has been implicated as a risk factor in pathological eating disorder. While some research posits that body image concerns begin early in life, the trajectories of body esteem development prior to adolescence are not fully understood. Therefore, this research attempts to address the development of body esteem during middle childhood, with a look at the significance of gender and weight status in this relationship, as well as associations between dietary restraint and weight outcomes and dietary variables in middle childhood and young adulthood.

# CHAPTER III: DEVELOPMENTAL CHANGES IN BODY ESTEEM ACROSS MIDDLE CHILDHOOD: A LATENT GROWTH CURVE ANALYSIS


## Abstract

### BACKGROUND

Body image concerns are highly prevalent among adolescents, but some evidence suggests that low body esteem emerges earlier in childhood. The purpose of this study was to examine the development of body esteem throughout middle childhood from ages 6-9 years in a community sample of boys and girls, and to explore differences in trajectories of body esteem by child's sex and weight status.

### METHODS

Data was collected from 1111 children from rural Oklahoma participating in a longitudinal study of the antecedents, correlates and consequences of childhood obesity, the Families and Schools for Health project. Children were interviewed at four timepoints during elementary school beginning in the fall of their first-grade year. Body esteem was assessed using the Body Esteem Scale and child's weight and height were measured by trained researchers. Latent growth curve models were used to investigate individual level changes in body esteem over time and to consider differences in these developmental trajectories across children in the sample.

### RESULTS

On average, levels of body esteem increased from grade 1 through grade 3. There was small but significant variance in baseline levels of body esteem ($b$=0.02, p<0.0001) and change in body esteem over time ($b$=.003, p<0.0001) between individuals. Child's sex

did not significantly predict intercept (*b*=0.004, p=0.672) or slope (*b*=-0.006, p=0.34). Children's weight status in the first grade, however, significantly predicted intercept (*b*=-0.020, p<0.0001) and slope (*b*=-0.009, p=0.002).

## CONCLUSION

These results suggest levels of body esteem moderately increase during middle childhood. Boys and girls in our sample did not differ in their body esteem scores, but children with higher weight status had lower scores for body esteem at baseline and reported less steep increases in body esteem over time. Additional research is needed to understand the effects of these trajectories on later physical and psychosocial health outcomes.

## Introduction

The high prevalence of weight-related problems among youth, including overweight, obesity and disordered eating, presents a major public health priority (Haines & Neumark-Sztainer, 2006; Lobstein et al., 2015; Loth et al., 2014). An often-overlooked concern has been the effect of these weight-related outcomes on psychological health. Children who are overweight or obese are more likely to suffer from psychological comorbidities such as depression, anxiety, and low self-esteem (Quek et al., 2017; Rankin et al., 2016). Body image, in particular, is negatively affected in persons with obesity (Dion et al., 2016; Duncan et al., 2013; Rosenblum & Lewis, 1999). Given that negative body image at early ages is associated with unhealthy eating and disordered eating risk later in life (Stice & Shaw, 2002), a better understanding of the nature of its development in childhood is warranted.

Body image is a multifaceted construct that encompasses a person's perceptions and attitudes toward their own body and appearance (K. K. Davison et al., 2000; Marita P. McCabe & Ricciardelli, 2004; Tatangelo et al., 2016). One facet of body image is body

esteem, which refers to the subjective evaluation of one's physical appearance (B. K. Mendelson & White, 1982; Beverley K Mendelson et al., 2001). Though the bulk of research related to body esteem has been conducted in adolescent and adult samples, some studies have shown children as young as 6 already express dissatisfaction with their bodies and the desire to be thinner (Clark & Tiggemann, 2008; Lowes & Tiggemann, 2003; Ricciardelli & McCabe, 2001). By early adolescence, the prevalence of body image concerns is common with as many as 46% of girls and 26% of boys reporting low body esteem (Neumark-Sztainer et al., 2006; Presnell et al., 2004). Consequently, a large number of studies in recent years have examined risk factors for the onset of body image concerns.

Current literature shows that body weight represents one of the strongest correlates of low body esteem across age groups (Keery et al., 2006; Loth et al., 2014; Neumark-Sztainer et al., 2006), with studies consistently finding that body esteem is lower in children and adolescents with obesity (B. K. Mendelson & White, 1982; Rodgers et al., 2014). Even still, the level of body image disturbance is shown to vary wildly across samples of overweight adolescents (Lacroix et al., 2020; N.-A. Weinberger et al., 2016) and not all children who are overweight have low body esteem (N.-A. Weinberger et al., 2016). Furthermore, low body esteem is present among children with normal weight, indicating that weight is not the only determinant for level of body esteem (Bun et al., 2012).

Along with weight, child's sex is one of the main factors associated with body image concerns (Lacroix et al., 2020; Macneill et al., n.d.; Ricciardelli & McCabe, 2001; Rodgers et al., 2014). Most studies show that girls in general are more dissatisfied with their body weight than boys (Dion et al., 2016; Mäkinen et al., 2012). One explanation for this difference is the gendered body ideal which emphasizes thinness in women and muscularity in men (Fitzsimmons-Craft et al., 2012; Ricciardelli & McCabe, 2001; N.-A. Weinberger et al., 2016). Previous studies show that girls who are preoccupied with

their weight often display a wish to be thinner, whereas boys often desire a body that is lean yet muscular (Dion et al., 2016; Marita P. McCabe & Ricciardelli, 2004). On the other hand, some researchers argue that these differences don't become apparent until children are between the ages of 8 and 10 years, when sociocultural messages about the ideal body size become internalized (M. P. McCabe et al., 2005; S. C. Nelson et al., 2018). In line with this theory, girls tend to show sharper declines in body esteem during adolescence coinciding with normative weight gain associated with puberty (Rosenblum & Lewis, 1999; Smolak, 2004). However, longitudinal investigations of body esteem prior to adolescence have not been well represented in the literature, so differences in developmental trajectories of body esteem during childhood remain largely unknown.

While childhood is identified as a key developmental period for the formation of body image attitudes (S. J. Paxton & Damiano, 2017), few studies have examined whether, and if so how, body esteem changes before the onset of puberty (Bray et al., 2017; Hales et al., 2018). This information could help pinpoint the ideal time for early interventions aimed at preventing negative body esteem in children and young adolescents. Therefore, the aim of the current longitudinal study was to investigate children's change in body esteem over a 3-year timespan and to examine the potential influence of baseline weight status and child's sex on their trajectory of change in body esteem. Latent growth curve models were used to investigate individual level change in child's body esteem over time and to consider differences in these developmental trajectories across children in the sample.

## Methods

### Study Design and Procedures

The current study is a secondary data analysis from a large-scale longitudinal research project titled the Families and Schools for Health (FiSH), a unique, interdisciplinary study of the antecedents, correlates, and consequences of childhood obesity (Harrist et

al., 2016, 2017). A community sample of children and their mothers were recruited from 29 elementary schools in rural Oklahoma when children were entering the first grade and followed through the end of fourth grade (Harrist et al., 2016, 2017). The original study included two cohorts: cohort 1 was recruited beginning in the fall of 2005 and cohort 2 was recruited in the fall of 2006. Prior to the start of data collection, parents provided written consent giving permission for their children to participate in the study. Children were asked for assent to participate in data collection.

The first wave of data collection occurred when children were entering first grade at approximately 6 years of age. Waves 2-4 occurred at the end of first, second, and third grade, respectively. At each wave, all participating parents were mailed a survey and were asked to complete and return questionnaires via mail (only socio-demographic data provided by parents are included in the current study) (Harrist et al., 2017; Topham et al., 2011). Data from children were collected via individual child interviews and assessments conducted by trained researchers. The interviews took place during regular school days and regular class times.

Additional details of the study design and methodology are described in detail elsewhere (Harrist et al., 2017; Shriver et al., 2015; Topham et al., 2011). The study protocol was reviewed and approved by the University Institutional Review Board prior to any data collection.

## STUDY MEASURES

### Socio-Demographic Characteristics

Demographic information on participating children were collected from parent report. All participating parents were mailed a survey and were asked to complete and return questionnaires via mail (only socio-demographic data provided by parents are included

in the current study) (Harrist et al., 2016; Topham et al., 2011). If parents did not respond to the child ethnicity question or did not return questionnaires, a graduate student travelled to each school with a form to obtain the child ethnicity data, bringing information on parent provision of consent for demographic data, and obtained the ethnicity data from the school office (Harrist et al., 2016, 2017). Because 58% of parents did not complete the parent questionnaire packet, information on child sex was recorded by research assistants during the one-on-one child interviews (Harrist et al., 2017).

### Body esteem

Body esteem was assessed during interviews with trained researchers at waves 1 through 4. At each wave, children's body esteem was assessed using the 20-item Revised Body Esteem Scale for Children (BES) (B. K. Mendelson et al., 1995; B. K. Mendelson & White, 1982). The BES is a multidimensional scale that was designed to assess children's global evaluations of their bodies. At the child interviews, participants verbally responded to questions assessing attitudes and feelings toward their body and appearance asked in a "yes" or "no" format. Four items were dropped from the original 24-item measure due to poor item to total score correlations which reduced internal reliability estimates (B. K. Mendelson et al., 1995; B. K. Mendelson & White, 1982). Examples of items included in the measure were: "I really like what I look like in pictures;" "I am proud of my body;" and "My classmates would like to look like me." Responses indicating high body esteem were coded as 1 and responses associated with low body esteem were coded as 0. For the current study, a total score was derived by averaging the responses to the 20-items with mean values closest to 1 reflecting highest overall body esteem. Strong psychometric properties of the 20-item BES have been established in previous research with school-aged children (Kirsten Krahnstoever Davison et al., 2003). The Cronbach's alpha scores for our study sample across the four waves of data collection ranged from 0.74 to .84 indicating good internal consistency at every timepoint.

### Weight Status

During the interview visits at the participating schools, trained researchers assessed children's weight and height using standard anthropometric measurement procedures (Center for Disease Control and Prevention, 2007). Children were asked to remove bulky clothing and shoes prior to assessment (Topham et al., 2011). Weight was measured using a portable digital scale (Tanita Electronic Scale, BWB-800) to the nearest 0.2 pounds. Height measurements were taken twice using a portable height board (Shorr Productions, Olney, MD) and recorded to the nearest 0.2 centimeters; if values were not within $\pm$ 0.3 centimeters, a third measure was taken. The average of the recorded values was used to calculate final height. Weight was converted in kilograms and divided by the height in meters squared to calculate body mass index (BMI). BMI percentiles (BMIp) and z-scores (BMIz) were calculated by expressing a child's BMI relative to children of the same sex and age in the CDC growth charts (Barlow, 2007; Pi-Sunyer et al., 1998). The CDC growth standards were selected as they are meant to reflect optimal growth and are recommended for use in this age group in the United States (Barlow, 2007; Pi-Sunyer et al., 1998). BMIp were used for descriptive purposes to classify children's initial weight status as obese (BMI-for-age percentile $\geq$ 95), overweight (BMI-for-age percentile $\geq$ 85 and < 95) and not overweight or obese (BMI-for-age percentile <85) (Krebs et al., 2007). Continuous level BMIz were used to identify the effect of children's weight status on BES trajectories. BMIz have been recommended for use in research and advantages of the z-score for population-based assessment of child growth have been describes elsewhere (Anderson et al., 2017; Inokuchi et al., 2011). BMIz were calculated for all participating children at each data collection point during the study.

## STATISTICAL ANALYSIS

Latent growth curve modeling (LGCM) was used to analyze changes in body esteem over time. This person-centered analysis approach is flexible and powerful for

understanding change over time in any variable for which multi-wave data are available (Burant, 2016; Rovine & McDermott, 2018; Voelkle, 2007). First, descriptive statistics and correlations were examined among all study variables. Second, an analysis comparing participants with missing data to those without any missing data was run to determine if there were any group differences. Next, a series of unconditional growth models (without covariates) were run to determine the nature of the changes in body esteem over time. Model information criteria were used to compare models. Because different fit measures focus on various components of the fit (Bentler, 1990; Browne et al., 2002; E. R. Grimm & Steinle, 2011), multiple fit indices were considered in evaluating model quality: the chi-square test, the comparative fit index (CFI), the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR) and the Bayesian Information Criteria (BIC) (Bentler, 1990; L. T. Hu & Bentler, 1999). Generally, a value of 0.90 or greater on the CFI (Bentler, 1990), 0.08 or lower on the RMSEA (Browne et al., 2002; L. T. Hu & Bentler, 1999), and 0.06 or lower on the SRMR represents an acceptable model fit.

In models 1 and 2, the path from the slope to the indicator at time 1 was fixed to zero so that the intercept would represent the initial level of body esteem. The subsequent slope pattern coefficients were fixed according to measurement intervals (i.e. 0.5, 1 and 2 to represent waves 2, 3, 4 respectively). Model 2 also included a quadratic component to test for nonlinear trajectories. In the third model, a latent basis growth model tested for nonlinear change patterns. Identification constraints were placed on slope factor loadings (i.e. 0 and 2 for times 1 and 4 respectively) and other loadings were left to be freely estimated. In this model, the rate of change was not constrained to be constant across time and thus was able to capture a variety of nonlinear change patterns (K. J. Grimm et al., 2010, 2011). The estimated loading for waves 2 and 3 can be interpreted as the proportion of change that occurred up to that point (E. R. Grimm & Steinle, 2011; K. J. Grimm et al., 2010). Once the shape of growth was determined in the LGCM, the effects of participants' baseline weight status (i.e. BMIz) and sex were considered as

predictors in the models by regressing the intercept and slope of body esteem on these variables. The latent growth curve modeling analyses for this study were conducted using Mplus software (Muthen & Muthen 1998-2010). For other data analysis, including descriptive statistics and Spearman's correlation analysis, we used SPSS v 26.0 (SPSS Inc., Chicago, IL, 2019). Maximum likelihood estimation was used for the LGCMs and statistical significance was set at $p < 0.05$.

## Results

Of the original 1171 children recruited in first grade, only those children who contributed data for at least 2 timepoints during waves 1-4 were included in the current study. This resulted in a total sample of 1111 children (548 girls and 563 boys) aged 6 years at baseline. Roughly 18% of the children were American Indian and the rest were primarily white. The average proportion of children on free/reduced price lunch (a proxy for adversity at the school level) was 65% (Harrist et al., 2016; Topham et al., 2011). According to BMI-for-age cutoff values recommended by the Centers for Disease Control and Prevention to classify weight status by age and sex, at wave 1 approximately 17% of the children were obese (BMI-for-age percentile $\geq 95$), 17% were overweight (BMI-for-age percentile $\geq 85$ and $< 95$) and 65% were not overweight (BMI-for-age percentile $<85$).

Means for body esteem and BMIz by sex are presented in Table 1. At wave 1, the sample mean for BES was 0.74 [standard error (SE) = 0.18]. There were no differences in BES at wave 1 by sex ($t=-0.55$, $p=0.58$).

Table 1. Descriptive Information for Study Variables

| Wave | n | BES | BMIz |
|---|---|---|---|
| **1** | 1071 | 0.74 (0.03) | 0.61 (1.07) |

| | | | |
|---|---|---|---|
| **2** | 1060 | 0.78 (0.04) | 0.60 (1.03) |
| **3** | 884 | 0.82 (0.04) | 0.68 (1.05) |
| **4** | 746 | 0.83 (0.04) | 0.69 (1.06) |

Model fit information for the unconditional growth models is presented in Table 2. The linear, quadratic and latent basis models showed good fit based on the fit indices (CFI >0.9, SRMR <.06). However, the model fit indices for the quadratic and latent basis models suggest these models fit the data slightly better (CFI 0.99, RMSEA 0.05). Given the flexibility of the latent basis growth model for estimating nonlinearity in the rate of change, model three was selected for interpretation in the analyses with predictors.

Table 2. Model Fit of Unconditional Models

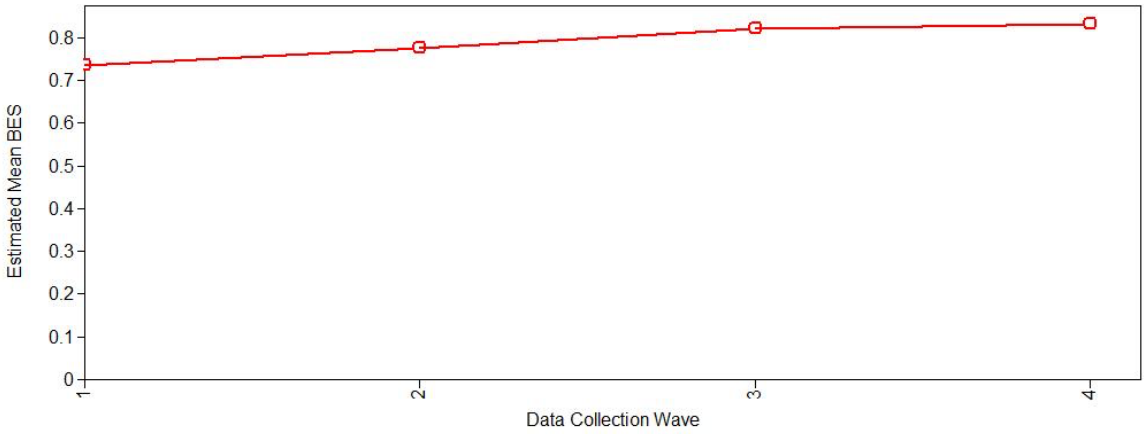
| **Model** | $\chi^2$ | **df** | **CFI** | **RMSEA** | **SRMR** |
|---|---|---|---|---|---|
| **Linear** | 56.05* | 5 | 0.94 | 0.1 | 0.03 |
| **Quadratic** | 4.115 | 1 | 0.99 | 0.05 | 0.01 |
| **Latent Basis** | 11.93 | 3 | 0.99 | 0.05 | 0.04 |

*p<0.001

The intercept (estimated baseline value for sample while correcting for measurement error) for body esteem was 0.75 (p< 0.0001). The slope was estimated at an average rate of change as positive 0.06 units (p<0.0001) representing an 8% increase in body esteem scores over the 3-year period (0.06/0.75 * 100). Visual inspection of the estimated means at each measurement wave (Figure 1) shows a leveling out in growth between waves 3 and 4, indicating that overall body esteem scores aren't changing as much after second grade as they did after first grade. Results from the latent basis model support this observation. The freely estimated parameter for the slope loading at wave 2 was estimated at $\lambda$= 0.80 while the freely estimated parameter for the slope loading at wave 3 was estimated at $\lambda$= 1.75. This suggests that most of the change in

body esteem occurred by wave 3 (the end of 2nd grade) compared with a small proportion of change occurring between waves 3 and 4.

Figure 1. Estimated Means of BES across Measurement Waves




While in general, scores for body esteem increased for the sample, 21% of individuals had lower body esteem scores at wave 4 than they did in wave 1. There was small but significant variance of the intercept (*b*=0.02, p<0.0001) and slope (*b*=.003, p<0.0001), warranting the inclusion of predictors of the slope and intercept to the model. In the model with added predictors, the slope and intercept were not significantly related (r=-0.001, p=0.16). Child's sex did not significantly predict intercept (*b*=0.004, p=0.672) or slope (*b*=-0.006, p=0.34). Weight status, however, significantly predicted intercept (*b*=-0.020, p<0.0001) and slope (*b*=-0.009, p=0.002). These results suggest boys and girls do not differ in their body esteem scores during middle childhood, but children with higher weight status had lower scores for body esteem at baseline and reported less steep increases in body esteem over time.

## Discussion

The purpose of this longitudinal study was to examine the developmental change in children's body esteem over time, specifically between grades 1 and 4, and to investigate the potential influence of child's sex and weight status on these trajectories. Findings indicated that on average, body esteem scores increased from ages 6-9 even after accounting for the effects of child's sex on developmental patterns. While previous research indicates that major changes in body esteem occur during adolescence, our findings suggest that interesting changes in body esteem occur much earlier, during early elementary school years, with variability in body esteem development that might be explained by weight status, but not child's sex.

Though several previous studies of body image in children note that there is an increase in body dissatisfaction from the ages of 9-10 through adolescence (Bully & Elosua, 2011; Dion et al., 2016; Tiggemann, 2005), the variability in the instruments used to assess body image among this age group makes drawing comparisons difficult. Even so, initial levels of body esteem in our sample were comparable with those observed in previous studies that used the Body Esteem Scale with elementary-aged children (K. K. Davison et al., 2000). One earlier study of weight concern in 5-year-old girls used the 24-item version of the Body Esteem Scale and defined cut-off scores based on what "clearly' indicated body dissatisfaction according to average responses (S. C. Nelson et al., 2018; Neumark-Sztainer et al., 2006; Susan J. Paxton, Eisenberg, et al., 2006). In their study, Davison et al. used a mean score of 0.67 (score of 48 out of possible 72) to define body dissatisfaction, with only 9% of girls meeting this criterion (Kirsten Krahnstoever Davison et al., 2003). In the current study, 35% of children had mean scores below 0.67 in the first grade which increased to 44% in third grade, a similar prevalence to that of other studies with pre-adolescents (Marita P. McCabe & Ricciardelli, 2004; Ricciardelli & McCabe, 2001). However, future research should focus on developing and using consistent measures of body esteem and defined cutoffs for body dissatisfaction so results can be compared across studies.

The results demonstrated a general positive change in children's body esteem over time, although there was significant variance in both the rate of change and the degree of change between individuals. These results partially support research among adolescent and adult samples which also show large inter-individual variability in body esteem trajectories (Duncan et al., 2013; Lacroix et al., 2020). However, unlike previous studies which noted declines or no change in body esteem across time (Lacroix et al., 2020; S. C. Nelson et al., 2018), the change in BES over time in our sample was positive, indicating an increase in body esteem through middle childhood. The inconsistency in our results compared with what is observed in older samples could be due to the developmental changes that occur during adolescence, or from differences in the measures used to assess body image between studies. Several studies assess body dissatisfaction using a single item (e.g. "are you satisfied with your weight/body) or using figure preferences (Rick M. Gardner et al., 2009; Ricciardelli & McCabe, 2001; Smolak, 2004). It may be beneficial for future research to use a combination of measures when studying body image in order to determine how these constructs relate to each other in the same samples.

Increases in body esteem seemed to stabilize by grade 2 which was supported by findings from the latent basis model showing most of the change in body esteem happens before second grade. There are several possible explanations for these findings. Middle childhood has been identified as the time when self-concept becomes more complex, and when children are better able to make comparisons between themselves and others (Smolak, 2004). However older children might be more susceptible to peer influence and vulnerable to messaging from media related to ideal body image, which in turn influences their overall body esteem. Additionally, there is good evidence for a decline in body esteem during adolescence (Fiona Johnson & Wardle, 2005; Rodgers et al., n.d.) which is thought to be associated with pubertal maturation and normative changes in body weight. Children at later stages of middle

childhood might be beginning to experience some of those declines in body esteem associated with these factors in adolescence. Additional research into the relation between pubertal timing and body esteem development is needed.

It is recognized that certain biological factors predict the development of body image. In the current study, patterns in BES did not differ between girls and boys. These findings are in line with some prior research among elementary school-aged children where levels of body esteem were similar between young boys and girls (S. C. Nelson et al., 2018; Susan J. Paxton, Eisenberg, et al., 2006; Rodgers et al., 2019b). Studies that have observed supposed sex differences in body dissatisfaction focus on the period of adolescence when differences in pubertal maturation are significant (Lawler & Nixon, 2011; Mäkinen et al., 2012). In these studies, girls show higher levels of body dissatisfaction than boys (Bornioli et al., 2019; Dion et al., 2016), though girls who were underweight expressed the greatest satisfaction with their bodies (Aparicio-Martinez et al., 2019; Fitzsimmons-Craft et al., 2012). Cultural beauty standards emphasize a thin-ideal which surely influences how children perceive their weight and appearance, particularly girls. The lack of difference in BES trajectories between girls and boys in the current study may be explained by the young age of children in the sample or the use of a body esteem measure that does not examine sex-specific domains of body satisfaction (B. K. Mendelson et al., 1995; B. K. Mendelson & White, 1982).

Consistent with the literature providing evidence of an association between body size and body esteem, our model indicated that weight status was not only negatively associated with body esteem at baseline, but it also negatively influenced change in body esteem across childhood. Specifically, a higher weight status at age 6 was associated with smaller increases in body esteem by age 9. This suggests that by middle childhood, body weight is already an important determinant in how individuals perceive their body and appearance. These results support previous evidence that weight bias is already present by the time children reach elementary-school age (S. J.

Paxton & Damiano, 2017; Spiel et al., 2016) and is especially concerning because body dissatisfaction has been shown to predict eating disorder symptomology, including the use of unhealthy weight control practices among adolescents (Loth et al., 2014; Rohde et al., 2015). In light of these findings, there is clearly a need for early interventions focused on improving body image among children, with greater emphasis on reducing weight stigma at earlier ages.

Notable strengths of this study were that it examined body esteem in a large, community-sample of children that included both boys and girls, a rarity in the body esteem research. Furthermore, body esteem was assessed using a well-established 20-item measure that covers multiple domains of children's affective evaluations of their bodies (Cragun et al., n.d.). The longitudinal design and the use of LGCA were also major strengths of the current study as the use of this statistical approach allows for the estimation of inter-individual variability in intra-individual trajectories over time (K. J. Grimm et al., 2011).

This study also has several limitations. First, though the body esteem scale has been used in previous research with children, and has shown reasonable test-retest reliability, this measure has not been subjected to psychometric evaluation among children younger than 8. It is possible that a change in scores on the BES reflects differences in interpretation of the items being used to assess body esteem rather than changes in body esteem itself (Amaya-Hernández et al., 2019; Putnick & Bornstein, 2016). However, the reliability of the BES measure was good at each wave in the current study. Future research should explore measurement invariance of the body esteem scale to determine if this is a valid tool for assessing body esteem across middle childhood. Second, children's BMI was used as the sole indicator of weight status and change in this measure over the course of the study was not considered in the analysis. Though BMI is commonly used as an indirect indicator of adiposity in research, other anthropometric measures can more accurately estimate fat percentage, and this might

be useful for exploring differences in body esteem by gender (Inokuchi et al., 2011). Thirdly, this study did not consider other factors that might contribute to differences in body esteem development in childhood, like parental concern related to weight or peer weight-related teasing (Amaya-Hernández et al., 2019; Lowes & Tiggemann, 2003; Spiel et al., 2016). Future longitudinal studies are recommended to further explore the potential role of such additional correlates to gain more insight into the mechanisms underlying children's individual trajectories of body esteem over time.

## Conclusion

The current study contributes significantly to the current literature by examining body esteem changes over time in young elementary school age children. The results provide valuable information about these trajectories across the entire BMI continuum. While previous research has noted the negative consequences of childhood adiposity on a variety of child health outcomes, our study highlights the negative psychological consequences related to child weight status as early as 1$^{st}$ grade. Our findings thus highlight the importance of exploring individual change in body esteem across middle childhood to develop more effective targeted interventions that promote a healthy body esteem and prevent unhealthy weight control behaviors related to body image disturbances. Interventions to improve body image in children and adolescents should focus on the years prior to grade 3, when body esteem levels are still increasing, and maximize positive feelings related to the physical self. Additional research should focus on factors that predict declines in body esteem at or after grade 3 and subsequent risks for eating disorders.

# CHAPTER IV: BIDIRECTIONAL ASSOCIATIONS BETWEEN RESTRAINED EATING AND BMI IN MIDDLE CHILDHOOD


## Abstract

### BACKGROUND

In the current obesogenic environment, increased access to unhealthy, energy-dense food along with reductions in overall energy expenditure through activity and exercise lead to increased risk for weight gain over time. Identification of effective childhood weight management strategies are needed to improve obesity prevention efforts. Though cross-sectional studies have observed emerging dietary restraint among young children, it is still unclear whether weight gain drives increased restraint or whether restrained eating contributes to weight gain in this age group. The current study builds on previous prospective research by examining the transactional associations among restrained eating behavior and weight among boys and girls in middle childhood.

### METHODS

Data for this study came from 263 children participating in the Families and Schools for Health Project, a longitudinal study of the correlates of childhood obesity. Participants were interviewed in their third- and fourth-grade year by trained researchers where they completed questionnaires and anthropometric assessments. Dietary restraint was assessed using the restrained eating subscale of the Dutch Eating Behavior Questionnaire, and weight was assessed using body mass index z-scores (BMIZ). Bidirectional associations between variables were examined using cross-lagged models controlling for children's sex, ethnicity, and weight status in first grade.

## RESULTS

The cross-lagged model demonstrated good model fit $\chi^2(6)= 12.33$, p=0.74, CFI= 1.00, RMSEA= 0.00, SRMR=0.01. Weight status in grade 3 was related to greater dietary restraint in grade 4 (B=0.20, p=0.001) but dietary restraint in grade 3 was not associated with weight status in grade 4 (B=0.01, p=0.64). Neither child sex nor race/ethnicity were associated with BMIz or dietary restraint at either time point.

## CONCLUSION

The current study contributes to the growing body of literature on the development of eating behaviors in childhood and supports the role of children's weight status in the development of dietary restraint.

### Introduction

Projections estimate that by 2030, over 50% of adults will be obese, a staggering number considering the health and financial burden associated with excess adiposity (Kochanek et al., 2019; Ward et al., 2019). It has been well established that children who are overweight and obese are more likely to remain overweight as adults (Li et al., 2007). Strategies for reversing obesity and associated comorbidities in adulthood have, so far, been limited in their long-term success (Bray et al., 2017; Churuangsuk et al., 2018; Gloy et al., 2013). Thus, prevention of overweight and obesity is integral to current public health efforts to reduce the burden of weight-related diseases on society (May et al., 2013). Identification of effective childhood weight management strategies is needed to improve obesity prevention efforts.

Dietary restraint, or the conscious control of food intake for the purpose of weight management, has been a controversial topic in the literature with regard to its association with weight gain and other negative eating outcomes (Boyce et al., 2015;

Hagan et al., 2017; C Peter Herman & Mack, 1975; F. Johnson et al., 2012). On one hand, there is evidence that excessive dietary restriction may alter metabolic functioning, making it difficult for individuals to maintain long-term weight loss (Greenway, 2015). This notion is supported by findings from some longitudinal studies which indicate that adolescents and adults who reported dieting and weight loss efforts at baseline showed greater weight gain at follow-up and an elevated risk of obesity (Neumark-Sztainer et al., 2007, 2012). The potential mechanism for these findings has been attributed to the fact that individuals who report dieting and weight loss attempts engage in excessive restraint, which is unsustainable and leads to binge eating episodes and weight gain over time (C. P. Herman & Polivy, 1984). Experimental investigations, however, have consistently shown that dietary restrainers are not in negative energy balance (Stice et al., 2010), which suggests that cognitive dietary restraint is not a good indicator of actual restriction of food intake (F. Johnson et al., 2012).

Another line of research has found that increasing dietary restraint can be effective in successfully preventing weight gain in adults, particularly among individuals prone to overeating (Bray et al., 2017; Hales et al., 2018). This ability might be especially important in the current food environment, which is characterized by ready availability to highly palatable, energy dense foods over healthier, nutrient-dense options (Monteiro et al., 2013). Moreover, there is evidence that difficulties with self-control of energy intake is associated with poor dietary intakes and weight status in children (Bauer & Chuisano, 2018; Ha et al., 2019; Russell & Russell, 2020). Thus, it is possible that some degree of dietary restraint is important as an adaptive measure to limit weight gain (F. Johnson et al., 2012; Schaumberg et al., 2016).

To date, dietary restraint in children has been studied for its association with early maternal feeding practices (Leann L. Birch & Fisher, 2000; Leann Lipps Birch & Davison, 2001; Carper et al., 2000; Savage et al., 2007), child self-esteem (Damiano et

al., 2015; Rodgers et al., 2019a), and child body dissatisfaction (Rodgers et al., 2019a; Shunk & Birch, 2004c). Limited research has focused on prospective associations between dietary restraint and weight status in children (Shunk & Birch, 2004c). The most common measure used for assessing dietary restraint in these studies has been the restraint subscale of the Dutch Eating Behavior Questionnaire (van Strien & Oosterveld, 2008). Previous research has indicated its use for children as young as 7 years as this is the age when measures of dietary restraint begin to show acceptable levels of reliability and validity (Shunk & Birch, 2004a). Because weight-related concerns and dieting behaviors have been observed in studies with children as young as 5 years old (Anschutz et al., 2009; Kirsten Krahnstoever Davison et al., 2003), additional evidence for the nature of the relation between dietary restraint and weight in middle childhood is warranted.

Bidirectional influences of weight status and restraint have been conceptualized in the literature on eating behaviors (Snoek et al., 2008), however, empirical research examining these dynamic relations in child and adolescent samples is still very limited (Costa et al., 2020; Hughes et al., 2015; Power et al., 2020). To our knowledge, no study has investigated the direction of the relation between dietary restraint and weight during middle childhood, a time period that has been identified in previous literature as a key developmental period for the onset of eating disorder symptomology and subsequent weight gain (Kirsten Krahnstoever Davison et al., 2003; Haines & Neumark-Sztainer, 2006; Shunk & Birch, 2004c). The current study builds on previous prospective research by examining the transactional associations among restrained eating behavior and weight among boys and girls in middle childhood. Specifically, we consider the longitudinal indirect pathways by which restrained eating behavior and weight influence one another in middle childhood. Given the established link between early weight status and emerging dietary restraint, it is hypothesized that greater weight in grade 3 will predict higher levels of dietary restraint in grade 4, whereas dietary restraint will be unrelated to changing weight within the same time period.

## Methods

### Study Design and Procedures

Data for this study come from participants enrolled in a large-scale longitudinal study examining the social and emotional correlates of childhood obesity titled the Families and Schools for Health (FiSH) project (Harrist et al., 2016, 2017). A complete description of the study design has been described elsewhere (Bray et al., 2017; Hales et al., 2018)(Harrist et al., 2017; Shriver et al., 2015; Topham et al., 2011). Briefly, a community sample of nearly 1200 children and their parents were recruited from 29 elementary schools in rural Oklahoma when children were entering the first grade and followed through the end of fourth grade (Harrist et al., 2017). Recruitment began in 2005 (Cohort 1) and continued in 2006 (Cohort 2). Initial written consent to participate in the study was obtained from school principals, teachers and parents prior to the start of data collection. Children were asked for assent to participate in data collection. Participation in the FiSH project averaged 55.6% per first-grade class (*SD* = 18.7%) (Harrist et al., 2016; Topham et al., 2011). The average proportion of children on free or reduced-price lunch—a proxy for poverty at the school level—was 65% (Harrist et al., 2016). Additional details of the study design and methodology are described in detail elsewhere (Shriver et al., 2013, 2015; Topham et al., 2011). The study protocol was reviewed and approved by the University Institutional Review Board prior to any data collection.

### Procedures

Data from children at the participating schools was collected via individual child interviews and assessments conducted by trained researchers (Topham et al., 2011). The interviews took place during regular school days and regular class times (Topham et al., 2011). Additionally, all participating parents were mailed a survey and were asked to complete and return questionnaires via mail (only socio-demographic data provided

by parents are included in the current study) (Harrist et al., 2016). If parents did not respond to the child ethnicity question or did not return questionnaires, a graduate student travelled to each school with a form to obtain the child ethnicity data, bringing information on parent provision of consent for demographic data, and obtained the ethnicity data from the school office. A total of 58% of parents did not complete the parent questionnaire packet in the beginning of the study. For these children, information on child sex was recorded by research assistants during the one-on-one child interviews at school (Topham et al., 2011). The current study utilizes the following data that were collected during the FiSH study: 1) Socio-demographic data (collection method: parent surveys administered at the beginning of 1st grade for all participating children); 2) child BMI (collection method: anthropometric assessment of height and weight in grades 1, 3 and 4) and 3) dietary restraint (collection method: self-report measure administered to children by trained researchers during individual interviews in grades 3 and 4).

## STUDY MEASURES

### Dietary Restraint

Dietary restraint in the current study was assessed using the Dutch Eating Behavior Questionnaire (DEBQ; English version) (Strien, Frijters, Bergers, et al., 1986). This measure contains 33 items, with three factors: restrained, emotional and external eating. The restrained eating subscale contains 10 items and measures behavioral strategies to control energy intake. Dietary restraint was assessed in a subsample of participants beginning when children were in grade 3 (approximate age 8). Some modifications were made to the original measure to make it more suitable for younger children as demonstrated by previous research in elementary school children (Shunk & Birch, 2004a). For example, the response set was reduced from a 5-point scale (ranging from seldom to very often) to a 3-point scale (yes, sometimes, no) and the language

was simplified (ex. ‘Do you deliberately eat less in order not to become heavier?’ was changed to read ‘Do you try to only eat a little bit on purpose so that you won't get fat?’) (Shunk & Birch, 2004a). The Cronbach’s alphas were 0.82, 0.85 in grades 3 and 4, respectively. Only participants with complete data in grades 3 and 4 were included in this study (pooled data from cohort 1 and 2).

### Weight and Weight Status

Children’s weight and height was assessed during the interview visits at the participating schools. Trained researchers completed the assessments using standard anthropometric measurement procedures (Barlow, 2007). Weight was measured using a portable digital scale (Tanita Electronic Scale, BWB-800) to the nearest 0.2 pounds. Height measurements were taken twice using a portable height board and recorded to the nearest 0.2 centimeters; if values were not within $\pm$ 0.3 centimeters, a third measure was taken. The average of the recorded values was used to calculate final height and weight for each child. Weight was converted into kilograms and divided by the height in meters squared to calculate body mass index (BMI). BMI-for-age percentiles (BMIp) and z-scores (BMIz) were calculated by expressing a child’s BMI relative to children of the same sex and age in the CDC growth charts (Flegal et al., 2002; Krebs et al., 2007). The CDC growth references have been designed to reflect growth of children in the U.S. and are recommended for use in children aged 2-20 years of age. Children’s weight status was classified utilizing the BMIp and established cut offs as follows: obese (BMI-for-age percentile $\geq$ 95), overweight (BMI-for-age percentile $\geq$ 85 and < 95) and not overweight or obese (BMI-for-age percentile <85) (Flegal et al., 2002; Krebs et al., 2007). BMIz were used to assess child’s weight change over time in the bidirectional models. The advantages of utilizing BMI z-scores as a continuous variable of child growth for population-based assessment have been described elsewhere (Anderson et al., 2017; Inokuchi et al., 2011; Youfa Wang & Chen, 2012).

### Statistical Analysis

Preliminary analyses were conducted to examine descriptive variables and correlations among the study variables using IBM SPSS Statistics for Windows (Version 26.0) (see Table 3). Associations between dietary restraint and BMIz were estimated using Mplus (version 8.4 | *Mplus User's Guide*, n.d.). The Mplus software drops cases for which there are no data for all variables at all time points. Thus, full information maximum likelihood (FIML) estimation was used to handle incomplete data (see Table 3 for sample sizes for each variable). FIML estimation uses all available information to account for missing data. Given the well-established associations between dietary restraint and weight with race, sex and early weight status (e.g. (Bohrer et al., 2015; Carper et al., 2000; Meule, 2016; Rodgers et al., 2014)), children's race/ethnicity, sex and weight in grade 1 were examined as covariates in all models.

Following procedures developed by De Jonge et al. (2001), a stability model was compared to the more complex, cross- lagged model (de Jonge et al., 2001). Thus, the following models were estimated: a stability model for dietary restraint and weight with no cross-lag paths, and a full reciprocal model for dietary restraint and weight. Across models, concurrent associations among constructs were estimated. The model fits were evaluated using several fit indices. A Root Mean Square Error of Approximation (RMSEA) of 0.06 or smaller, a comparative Fit Index (CFI) of 0.95 or larger, a Standardized Root Mean Square Residual (SRMR) of 0.08 or smaller indicate adequate model fit (L. T. Hu & Bentler, 1999).

## Results

A total of 266 children provided data at both time points (grade 3 and 4). Three outliers with potential measurement errors for height and/or weight were removed prior to the final analyses. In the final dataset with complete data from grade 3 and 4 (n=263), 56.7% were male, and 18.1% were Native American with the rest primarily of European

American descent. When children were in the third grade, around 62% were normal weight, 17% were overweight, and 21% were in the obese weigh status category.

The means and standard deviations for children's dietary restraint and BMIz at the two time points are presented in Table 1. Sample means for BMIz and dietary restraint showed stability from the 3rd grade to 4th grade. Significant positive associations were found between BMIz and dietary restraint at both time points (Table 4). Neither child sex nor race/ethnicity were associated with BMIz or dietary restraint at either time point.

Table 3. Descriptive Information for Study Variables

| Variable | N | M | SD | Range | Skewness |
|---|---|---|---|---|---|
| **Grade 3 BMIz[a]** | 263 | 0.65 | 1.13 | -2.22-2.7 | -0.23 |
| **Grade 4 BMIz** | 263 | 0.66 | 1.23 | -2.6-2.72 | -0.28 |
| **Grade 3 Restraint** | 263 | 1.52 | 0.24 | 0.88-2.80 | 0.71 |
| **Grade 4 Restraint** | 263 | 1.45 | 0.22 | 0.89-3.00 | 0.96 |

[a]BMIz= Body Mass Index z score

Table 4. Correlations for Study Variables

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| **1. Grade 3 BMIz[a]** | --- | | | | | | |
| **2. Grade 4 BMIz** | 0.95*** | --- | | | | | |
| **3. Grade 3 Restraint** | 0.26*** | 0.25*** | --- | | | | |
| **4. Grade 4 Restraint** | 0.29*** | 0.34*** | 0.43**** | --- | | | |
| **5. Sex** | -0.01 | 0.01 | -0.08 | 0.02 | --- | | |
| **6. Race/ Ethnicity** | -0.04 | -0.03 | 0 | 0 | -0.02 | --- | |
| **7. Grade 1 BMIz** | 0.88*** | 0.85*** | 0.23*** | 0.29*** | 0 | -0.03 | --- |

[a]BMIZ=Body Mass Index z score

*p<0.05

**p<0.01

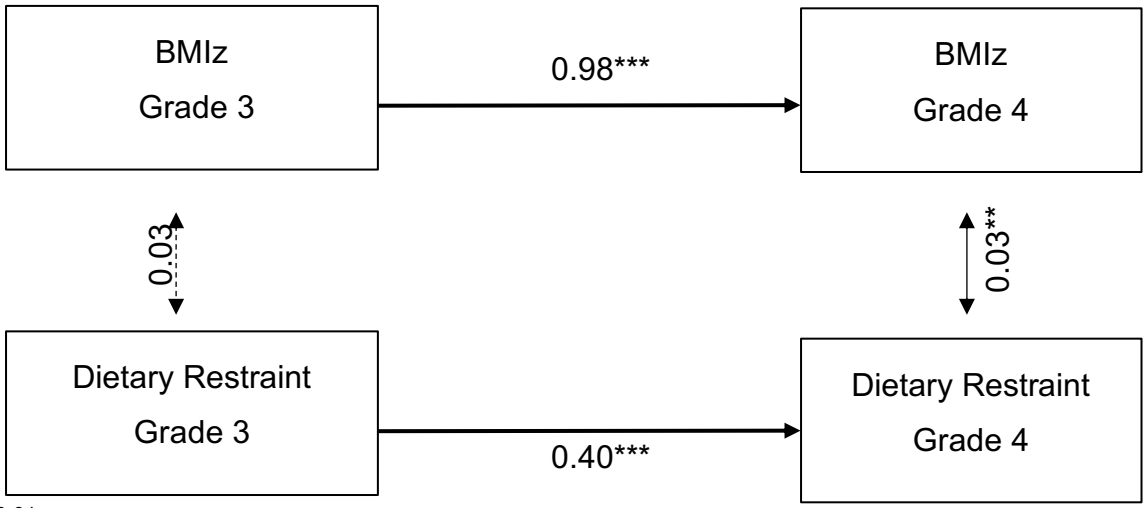
***p<0.001

## STRUCTURAL MODEL COMPARISONS

### Stability Model

The stability model had adequate fit to the data, $\chi^2(8)= 15.84$, P=0.04, comparative fit index (CFI) =0.99, root mean square error of approximation (RMSEA)= 0.06, and a standardized root mean square residual= 0.06 (see Table 4). Autoregressive coefficients were constant over time for the stability model estimating dietary restraint and weight (see Figure 2). The standardized path coefficients for dietary restraint demonstrated moderate stability and were significant (B= 0.40 p<0.001). For weight, the autoregressive paths were significant and demonstrated high stability over time (B=0.98, p<0.001). Within-time correlations revealed that dietary restraint was positively associated with concurrent weight at grade 4 and was trending toward significance at grade 3 (grade 3: B= 0.03, p=.05 grade 4: B=0.03, p=.002). In sum, weight status was highly stable from grade 3 to grade 4 and dietary restraint was moderately stable across this timespan; weight status was concurrently associated with dietary restraint in grade 4 but not grade 3.

Figure 2. Stability Model with BMIz and Dietary Restraint




**p<0.01

Cross-lagged Model

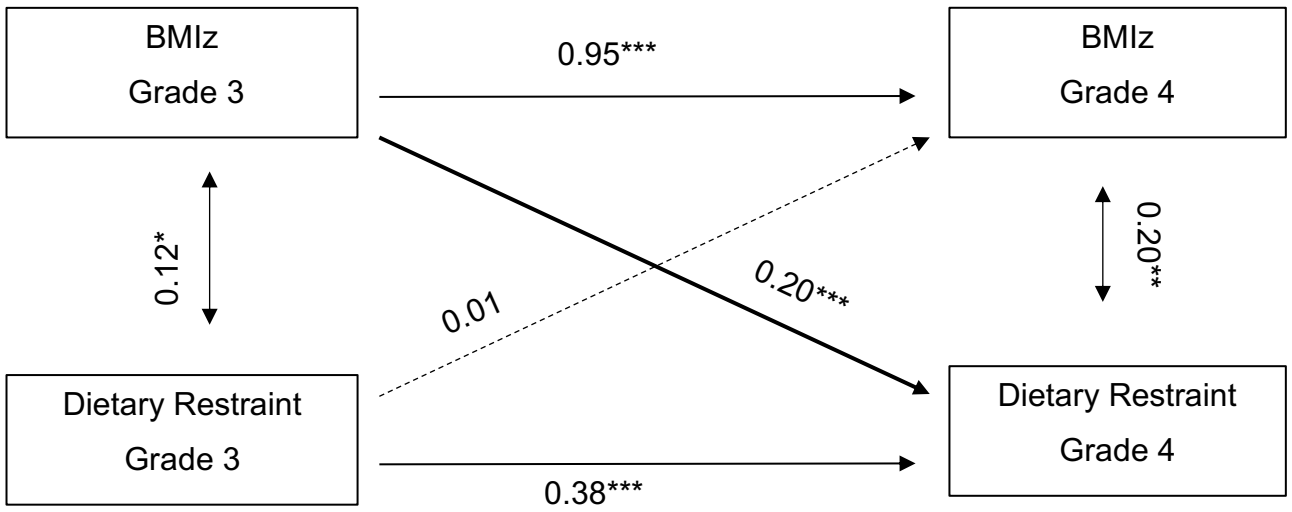
The cross-lagged model demonstrated good model fit and better explained the development of dietary restraint and weight status from 3rd grade to 4th grade. Thus, this model was interpreted. Within the dietary restraint cross-lagged model, all autoregressive paths were positive and significantly different from zero, indicating that both dietary restraint and weight status were stable over time (Figure 3). The cross-lagged paths revealed that dietary restraint in grade 3 was not associated with weight status in grade 4 (B=0.01, p=0.64) but that weight status in grade 3 was related to greater dietary restraint in grade 4 (B=0.20, p=0.001). Therefore, the cross-lagged model supported our hypothesis and revealed a transactional relation between weight status and dietary restraint such that greater BMI in the 3rd grade was associated with greater dietary restraint by 4th grade.

Table 5. Model Fit and Model Comparisons

| Model | $\chi^2$ | df | $\Delta\chi 2/\Delta df$ | CFI | RMSEA | SRMR |
|---|---|---|---|---|---|---|
| **Stability** | 15.84* | 8 | | 0.99 | 0.06 | 0.06 |
| **Cross-lagged** | 3.51 | 6 | 12.33 (2) | 1 | 0 | 0.01 |

* p<0.05

Figure 3. Cross-Lagged Model with BMIz and Dietary Restraint




*p<0.05

**p<0.01

## Discussion

In the current study, a transactional design was used to examine the longitudinal associations between dietary restraint and weight between the 3rd and 4th grade in a sample of elementary school aged children. This design was advantageous in that it allowed for the examination of the direction and nature of the relation between objectively measured weight and self-reported dietary restraint across two time points during middle childhood, a developmental period that has been largely understudied in terms of the emergence of weight control behaviors. Significant longitudinal associations between weight status and dietary restraint emerged in the path model presented in the current study, suggesting an underlying developmental process and highlighting the need for future research to continue to examine these relations longitudinally and move beyond focusing on single time points.

Our findings showed that both BMI and dietary restraint scores were stable between the 3rd and 4th grade. These patterns are consistent with previous longitudinal research with this age group (Jackson & Cunningham, 2017; Shunk & Birch, 2004a). For example, Shunk and Birch (2004) explored the validity of dietary restraint as measured among girls between the ages of 5 and 9 and observed a significant correlation in scores for dietary restraint measured using the DEBQ at ages 7 and 9 (Shunk & Birch, 2004a). It was hypothesized that girls younger than 7 did not yet possess the self-regulatory skills necessary to inhibit the cognitive impulse to obtain immediate gratification in favor of more delayed reward, making it difficult to successfully employ dietary restraint. However, by age 7, children have mostly developed the use of cognitive strategies to resist temptations allowing them the ability to practice dietary restraint (Shunk & Birch, 2004a). In early research of eating behaviors, dietary restraint was believed to emerge during adolescence and represent a consequence of the normative weight gain associated with growth and pubertal development (Striegel-Moore, 2001; Tremblay & Lariviere, 2009). Increased weight and/or weight status among adolescents has been strongly associated with negative body image and body dissatisfaction among adolescents (Mäkinen et al., 2012; van den Berg et al., 2010). In turn, adolescents who are dissatisfied with their weight or appearance are more likely to engage in unhealthy weight loss behaviors, such as fasting, bingeing and purging, which may increase their future risk of eating disorders (Haines & Neumark-Sztainer, 2006; Loth et al., 2014; Susan J. Paxton, Eisenberg, et al., 2006).

As hypothesized, we demonstrated that higher weight in 3rd grade was associated with greater dietary restraint by 4th grade. In contrast, the opposite relation (higher restraint in 3rd grade predicting higher weight in 4th grade) was not supported. This finding remained unchanged even after controlling for child's sex, race/ethnicity, and weight in grade 1, suggesting that child's current weight is likely to trigger the engagement in higher levels of restrained eating and not vice versa. Our findings align with previous longitudinal research among children which suggest that dietary restraint is a

consequence of higher weight or weight status and that the directionality of this relation can be observed as early as elementary school-aged children (Shunk & Birch, 2004c).

In recent years, longitudinal research with adults has shown that increases in restraint over time may be associated with greater weight loss, but this relation has not been reproduced in studies among children or adolescents (F. Johnson et al., 2012; Urbanek et al., 2015). In our study, levels of dietary restraint in grade 3 were not associated with weight in grade 4. Thus, higher levels of restraint did not contribute to subsequent increases or decreases in weight. There are several possible explanations for this finding. Since the restraint scale of the DEBQ is a measure of the intention to control food intake, it is possible that children in this study did not actually reduce energy intake enough to effectively regulate weight. It is also possible that individuals who report higher levels of dietary restraint are more prone to overeating, and thus are at a higher risk for weight gain. Further research is needed to examine different levels of dietary restraint and to better understand the mechanisms behind dietary restraint as a method for regulating for food intake and successful healthy weight management.

### Strengths and Limitations

There were several strengths to the present study including the large sample of boys and girls from elementary schools, with high proportions of children with lower socio-economic backgrounds. The longitudinal design also allowed for examining changes and nature of the relation between restraint and weight over 2 time points during middle childhood. Furthermore, since we used a transactional model, we were able to test for stability in these measures over time and determine the cross-construct relations that emerge over and above the contributions of the stability of these constructs over time. Thus, we can conclude that our result of weight predicting dietary restraint over time was not just attributable to overweight or obese children having higher restraint scores at each time point.

Despite the many strengths of this study, it is not without limitations. First, although dietary restraint was assessed using a measure previously established in research with children of similar age, the measure still relies on self-report and thus may be subject to reporting bias. Furthermore, dietary restraint was not considered in conjunction with actual dietary intake, so interpretation of this measure is limited to perceived restraint and not actual caloric reductions via food intake. Secondly, our sample consisted of children from rural communities in Oklahoma, thus generalizability of the results is limited. Thirdly, the present study assessed restraint and BMI on two occasions during middle childhood, and the time points were relatively close together. Additional time points that span across middle childhood and adolescence should be used in future research because they may better capture changes in eating behaviors and associations with normative weight gain, including later changes that are associated with puberty. Future research should examine these associations across developmental time periods to get a more accurate assessment of the relation between weight status and restraint over time.

## CONCLUSIONS

The current study contributes to the growing body of literature on the development of eating behaviors in childhood and supports the role of children's weight status in the development of dietary restraint. In our model, there was a dominant cross-lagged effect of weight status on future restraint, even after controlling for sex, race and weight status from grade 1. Rather than driving BMI trajectories upward (or downward), dietary restraint was not significantly related to future weight status in children. This has important implications for childhood obesity interventions. Weight-control behaviors, like dietary restraint, may have little impact on weight status by the time children reach middle childhood. Alternatively, dietary restraint may not be a good indicator of weight-control eating in this age group.

# CHAPTER V: DIETARY RESTRAINT IN YOUNG ADULTS: ASSOCIATIONS WITH DIET QUALITY AND DIETARY BEHAVIORS


## Abstract

### BACKGROUND

Establishing a diet that follows the Dietary Guidelines for Americans has been associated with lower risk of mortality from cardiovascular disease and cancer. Young adults, in particular, are vulnerable to food-related behavior associated with poor diet quality, such as meal-skipping and frequent snacking. Some research has shown that individuals' desire for weight control is an important factor in determining daily food choices. The aims of this study were to 1) examine dietary restraint in young adulthood as a predictor of overall diet quality in young adulthood and 2) examine potential differences in sociodemographic characteristics and selected dietary behaviors by levels of restraint.

### METHODS

Data for this study were collected from 215 young adults (mean age 19.2 years) participating in the RIGHT Track Health Study (RTH). Dietary restraint was assessed using the 21-item subscale of the Three Factor Eating Questionnaire. Three 24-hour dietary recalls were collected to estimate dietary intake and Healthy Eating Index 2015 (HEI-2015) scores were calculated to determine diet quality. Self-report questionnaires were used to collect information on participants' sociodemographic information and select dietary behaviors. Multiple linear regression models were utilized to examine the associations between dietary restraint and HEI-2015 total and subcomponent scores. Chi-Square Analysis and one-way ANOVA were used to test for differences in sociodemographic characteristics and selected dietary behaviors between high

(restraint scores >12), medium (restraint scores 5-11), and low restrainers (restraint scores <5). Level of significance was set at $p<0.05$.


RESULTS

Overall, participants consumed a poor-quality diet (HEI-2015 score = 48.3 ± 13.4). Higher restraint was associated with higher total HEI-2015 score ($F (9, 194) = 5.45$, $p < 0.001$, $R^2=0.20$) as well as higher scores for the HEI-2015 components total vegetables, greens and beans, total fruit, whole fruit, seafood and plant protein and lower scores for added sugars. Total energy intake was significantly lower among high restrainers compared with low restrainers, but groups did not differ in the frequency of their consumption of meals or snacks.

CONCLUSIONS

Higher cognitive restraint predicted better overall diet quality in young adulthood. Nevertheless, young adults in our sample failed to meet the federal dietary guidelines. Interventions aimed at improving diet quality should consider an individuals' level of dietary restraint to better tailor nutrition advice.


## Introduction

Estimates from simulated trajectories suggest that over 50% of today's children will be obese by the time they reach adulthood (Hales et al., 2018; Ward et al., 2017b). Young adults, typically referring to individuals between the ages of 18 and 35, experience higher rates of weight gain than any other age group making this a critical period for weight control (Wane et al., 2010). Not only is the presence of obesity and unhealthy lifestyle characteristics at this life stage associated with adverse changes in markers for chronic disease like increases in blood pressure and decreases in fasting insulin (Norman et al., 2003; Truesdale et al., 2006), but this is also a critical time for the

adoption of lasting health behaviors due to increasing autonomy and adult responsibilities (M. C. Nelson et al., 2008).

Moreover, evidence from nationally representative data suggests young adults have the poorest diet quality of any age group (Hiza et al., 2013). Few young adults meet the current recommendations for fruit or vegetable consumption (Christoph et al., 2019; N. I. Larson et al., 2009). Given that poor diet contributes toward increased risk for weight gain (Asghari et al., 2017; E. A. Hu et al., 2020), and that dietary intake is influenced by a variety of personal and behavioral factors (N. Larson et al., 2011, 2012; Laska et al., 2012; Nelson Laska et al., 2010), a better understanding of how weight-related behaviors influence the quality of the diet in young adulthood is warranted.

Dietary restraint, or the conscious control of food intake for the purpose of weight management, has been a controversial topic in the literature in regards to weight and other eating outcomes (Hagan et al., 2017; F. Johnson et al., 2012; Laessle et al., 1989; Michael R. Lowe et al., 2013). For example, some research indicates that dietary restriction among youth may lead to unhealthy dietary habits and elevated risk for eating disorders, which may negatively influence future health status (Field et al., 2003; Hill, 2004; Michael R. Lowe et al., 2013). Longitudinal studies have shown that adolescents and young adults who report dieting and other unhealthy weight control behaviors have poorer dietary intakes (N. I. Larson et al., 2009). However, another line of research suggests that a wide range of cognitive and behavioral strategies that rely on self-regulation skills to control food intake can be employed to maintain or achieve healthy eating- or weight-related goals (F. Johnson et al., 2012; Kliemann et al., 2018; Olea López & Johnson, 2016). With respect to dietary restraint, research among university students has shown that high levels of dietary restraint predicted both weight loss and weight gain in the first year of school (Provencher et al., 2009). There is also evidence that higher eating self-regulatory skills may help students maintain a healthy diet (Kliemann et al., 2018). Thus, it is possible that a degree of deliberate self-imposed

restriction may be necessary as an adaptive measure to limit weight gain and improve dietary intake patterns (Hagan et al., 2017; Moreira et al., 2005; Schaumberg et al., 2016).

Strategies for weight loss that involve dietary modification have traditionally relied on modification to a single nutrient (ex. low-fat) or reduction in overall energy intake (Churuangsuk et al., 2018; Cioffi et al., 2018). However, in the current obesogenic food environment with disproportionate access to palatable foods that are high in energy and low in nutrients, tracking individual nutrients and daily energy intake may be insufficient for understanding how dietary choices influence health-related outcomes (Asghari et al., 2017). Since foods are rarely eaten in isolation, it may be more important to look at the overall diet to identify dietary patterns that predict health status (Asghari et al., 2017; Cunha et al., 2018; Wu et al., 2019). The Dietary Guidelines for Americans (DGA), updated every five years, uses recent evidence to establish recommendations for eating patterns that promote health while reducing risk of chronic disease (*Chapter 1 Introduction - 2015-2020 Dietary Guidelines* | *Health.Gov*, n.d.)). Compliance with these guidelines can be measured and used as a marker of overall diet quality. The Healthy Eating Index 2015 (HEI-2015) specifically measures alignment with the DGA 2015-2020, the most recent iteration of the guidelines (Kirkpatrick et al., 2018; Krebs-Smith et al., 2018). Higher HEI-2015 scores are associated with lower all-cause mortality risk, cardiovascular disease death and cancer death among populations of older adults (George et al., 2014; Hiza et al., 2013; Panizza et al., 2018; Reedy et al., 2014).

To successfully incorporate the positive aspects of dietary restraint into interventions targeting healthy weight maintenance in young adulthood, a nuanced examination of the relation between dietary restraint and resulting eating patterns is necessary. By identifying and better understanding associations between dietary restraint, dietary intake and food-related behaviors motivated by weight control efforts in this population, we can identify specific foci for future programs that will aim to improve diet quality and

promote healthy eating behaviors. Thus, the primary aim of this study was to determine whether self-reported dietary restraint predicts the overall diet quality in a community sample of young adults. The secondary aim of the study was to describe dietary behaviors among young adults and examine whether these behaviors differ by the degree of self-reported dietary restraint.

## Methods

### Participants and Procedures

Data for this study were collected from young adults participating in the RIGHT Track Health Study (RTH), an ongoing, longitudinal study out of Greensboro, North Carolina. Detailed description of the study, screening criteria and data collection procedures are described elsewhere (Wideman et al., 2016). Briefly, beginning in 1994, children (aged 2 years) were recruited in central North Carolina from local child day care centers, the County Health Department, and the Women, Infants, and Children (WIC) program and invited to participate in a study examining social and emotional development. The original study (RT Parent; n=447) over-sampled for children at risk for future externalizing behaviors (Wideman et al., 2016). Approximately half (51.3%) of the original sample were female, and a majority were white (66.4%). The remaining sample identified as African American (27.7%) or other (5.9%), and at the time, were representative of the surrounding area in terms of race and socio-economic status (Wideman et al., 2016). In adolescence, these individuals were re-contacted and asked to participate in RTH, which was designed to examine how factors from early childhood affect cardiometabolic risk later in development, specifically during adolescence and young adulthood. Data presented in this study were collected during the young adult health visit that took place when participants were approximately 19 years old (age range 18-21). Written consent was obtained from all participants prior to beginning data collection. Participants completed online questionnaires on self-reported health measures (e.g. weight- control behaviors and eating behaviors) as well as in-person

assessments to assess various cardiovascular risk factors. All in-person assessments were conducted in the exercise physiology lab at the University of North Carolina Greensboro by trained research assistants. In addition, participants were asked to complete three 24-hour dietary recalls within fourteen days of their young adult health lab visit. Recalls were conducted by trained researchers from the Nutrition Obesity Research Center (NORC) at the University of North Carolina Chapel Hill using Nutrition Data Systems for Research (NDSR; University of Minnesota Nutrition Coordinating Center, Minneapolis, MN). To reflect the marketplace throughout the study, dietary intake data was analyzed using multiple versions of the NDSR software (Schakel, 2001; Schakel et al., 1997). The NDSR time-related database updates only analytic information while maintaining nutrient profiles true to the version used for data collection.

All study procedures were approved by the Institutional Review Boards at the University of North Carolina Greensboro and the University of North Carolina Chapel Hill (Wideman et al., 2016).

## Study Measures

### Socio-demographic Characteristics

Demographic details were collected from each participant, including details on age, sex, race, home environment (e.g. where the individual lived for most of the year), highest level of education attained to date, employment history, and income level. Additional information on socioeconomic status (SES) was determined using the Hollingshead Index which measures social status of a child or adolescent based on the marital status, employment status, educational attainment, and occupational prestige of the parent (*Hollingshead Four-Factor Index of Socioeconomic Status (SES-Child) — Nathan Kline Institute - Rockland Sample Documentation*, n.d.)). The Hollingshead Index was completed when participants were 10, 15 and 17 years of age, and data were pooled

from the RT Parent and RTH data to create an estimate value for SES at young adulthood.

### Dietary Restraint

Dietary restraint was assessed using the restraint subscale of the Three Factor Eating Questionnaire (TFEQ) (Stunkard & Messick, 1985). This measure consists of 21 items that are associated with the intent to control energy intake for weight management (e. g., “I deliberately take small helpings as a means of controlling my weight”). The subscale was modified slightly for the RTH study by omitting one item from the original measure (e.g. “on a scale of 0 to 5, where 0 means no restraint in eating and 5 means total restraint, which number would you give yourself”). Responses to each of the 20 items were scored as 0 or 1 point. Total score for the restraint subscale were calculated by summing the responses, with higher scores indicating a greater level of dietary restraint. Construct validity has been established for the TFEQ restraint subscale among various populations including adults and individuals with obesity (Bohrer et al., 2015; Laessle et al., 1989). The Cronbach’s alpha coefficient of the restraint subscale in our sample was 0.82, indicating good internal consistency.

### Overall Diet Quality

Participants were asked to complete three 24-hour recalls dietary recalls by telephone within two weeks of their young adult laboratory visit. Data from the recalls were averaged to create an estimate of usual intake. As suggested by Poslusna et al. (2009), recalls with an energy value of less than 800 kcal or more than 3,500 kcal went through a consistency analysis, with a review of all content (Poslusna et al., 2009). Food serving counts for select food categories were created in NDSR and used to identify daily servings.

HEI-2015 scores were calculated to assess overall diet quality at the individual level using data from the dietary recalls (Kliemann et al., 2018). The HEI-2015 is a measure of diet quality developed by the Department of Agriculture that assesses conformance to the 2015-2020 Dietary Guidelines for Americans (Krebs-Smith et al., 2018). The index is made up of 13 components (ie. Total Fruit, Whole Fruit, Whole Grains, Total Vegetables, Greens and Beans, Dairy, Total Protein Foods, Seafood and Plant Proteins, Fatty Acids, Refined Grains, Added Sugars, Sodium, and Saturated Fats) scored on either a 0-5 or a 0-10 scale with a maximum score of 100 (Krebs-Smith et al., 2018). 10 adequacy components represent food groups and nutrients that individuals are encouraged to consume so higher scores reflect higher intakes. Three moderation components were calculated for which consumption in moderation is desirable, so higher scores reflect lower intakes. The HEI uses a density approach to scoring which means scores reflect intakes of food groups per 1,000 Calories, with the exception of the Fatty Acids component which is scored based on the ratio of unsaturated fatty acids to saturated fatty acids. A complete description of the scoring method for the HEI-2015 is described elsewhere (Krebs-Smith et al., 2018). The sum of the component scores is used to create a total score, which is a validated indicator of overall diet quality (George et al., 2014; Krebs-Smith et al., 2018). The average HEI-2015 score of American adults is 59 with diet quality generally improving from young adulthood into adulthood (Hiza et al., 2013; Kirkpatrick et al., 2018; Reedy et al., 2018).

### Selected Diet-related Behaviors

Additional diet-related behaviors were assessed using individual items from the Youth Risk Behavior Survey (YRBS) and from 24-hour dietary recalls (Kann et al., 2018). The YRBS measures 6 categories of health-related behaviors including unhealthy dietary behaviors and inadequate physical activity (Kann et al., 2016, 2018). Select items were chosen for consideration based on previously established relations with dietary intake patterns (N. Larson et al., 2011, 2012; Nelson Laska et al., 2010). Dieting to lose weight was assessed using the item “Which of the following are you trying to do about your

weight?" Participants chose one of the following options: 1) gain weight; 2) lose weight; 3) stay the same weight; or 4) I am not trying to do anything about my weight. For the purposes of the current study, the responses were dichotomized into two categories: 1) trying to lose weight was coded as "yes; and 2) all other responses were coded as "no." Participants' efforts to exercise in order to lose weight or keep from gaining weight was assessed using the following item: "In the past 30 days, did you exercise to lose weight or keep from gaining weight?" Possible responses included 1) yes; or 2) no. Ate less food to lose weight or keep from gaining weight was assessed using the item "In the past 30 days, did you eat less food, fewer calories, or foods low in fat to lose weight or keep from gaining weight".

Breakfast consumption and eating frequency were also assessed in the study. Breakfast skipping was assessed using the following item: "In the past 7 days, on how many days did you consume breakfast?" Answers ranged from 0 to 7 days. Participants who reported consuming breakfast on 0 of the past 7 days were considered breakfast skippers. The frequency of meals and snacks was determined from the dietary data collected via the 24-hour dietary recalls. "Eating occasion" was defined as consumption of any food/beverage with a minimum energy content of at least 50 kcal (Leech et al., 2015).

### Weight Status

Height and weight were collected as part of the in-person young adult health laboratory assessments. Height was measured using a wall mounted, calibrated stadiometer (SECA, Chino CA) to the nearest 0.1 cm and weight was measured using a balance-beam scale (Detecto-medic, Brooklyn NY) to the nearest 0.1 kg. Participants were instructed to wear light clothing to their appointment, and to remove any objects from their pockets, as well as shoes, before measurements were taken. Body mass index (BMI) was then calculated using the standard formula [weight(kg)/height ($m^2$)]. Several participants with otherwise complete data had missing height and weight at the

laboratory visit (n=48); thus, missing BMI were imputed using the expectation/maximization likelihood treatment of missing data described by Schafer (Schafer, 1999). The imputation procedure consisted of modeling the available measurements from anthropometric data collected during the participant's laboratory visits at ages 4, 5, 7, 10, 15 and 17. The model's parameters were then used to define the data distribution from which to impute the missing BMI values (Schafer, 1999). To fully account for the data variability, and assuming that data were missing at random, ten sets were created in which all observed data were represented and missing data estimated, and the mean values from the datasets were used in the analyses. For descriptive purposes, participants were classified into weight status categories based on their BMI as 1) not-overweight (BMI < 25.0); 2) overweight (BMI ≥25.0 and <30.0); and 3) obese (BMI≥ 30.0) (*Defining Adult Overweight and Obesity | Overweight & Obesity | CDC*, n.d.).

### Statistical Analysis

Multiple linear regression models were utilized to examine the primary aim of the study. The models included the dietary restraint score as the main predictor, adjusting for sex, race, SES, college-enrollment status, BMI and trying to lose weight, to predict the total HEI-2015 score (overall diet quality) and the 13 HEI-2015 component scores in order to examine specific food/nutrient groups (e.g. added sugars). Covariates for the models were determined based on their hypothesized relation to both independent and dependent variables from previously published research (Bailey et al., 2020; N. Larson et al., 2012; Thorpe et al., n.d.; Tripicchio et al., 2019). The total energy intake (kcal) was not entered in the model as an adjustment variable because the HEI-2015 scores were produced at a density of 1,000 kcal.

To examine the secondary aim of the study, participants were classified into three groups based on their self-reported dietary restraint using cut-off scores from previous research on eating behaviors in young adults (Alexander & Tepper, 1995). The three

groups were defined using the total restraint subscale scores as follows: low restrainers (dietary restraint scores between 0-4), moderate restrainers (dietary restraint scores between 5-11) and high restrainers (dietary restraint scores >12). Chi-Square Analysis and one-way ANOVA were used to test associations between sociodemographic variables and the selected weight control and eating behaviors between the three groups. All statistical analyses were performed in SPSS v 26.0 (SPSS Inc., Chicago, IL, 2019).

## Results

A total of 281 participants (of the 447 individuals who were recruited for the original study at age 2), completed the young adult health visit. Of those, data from 24-hour dietary recalls were available from 215 participants: 191 completed 3 recalls, 14 completed 2 recalls and 14 completed 1 recall. There were no significant differences in the HEI-2015 scores ($F(2, 214) = 0.12$, $p = 0.89$) or scores for dietary restraint ($F(2, 214) = 1.67$, $p = 0.19$) between participants who completed 3 versus 2 versus 1 dietary recall; thus, data from all young adults who provided 1-3 recalls were included in the final analyses. Demographic characteristics of the sample are presented in Table 6. The mean age of the participants was 19.2 years. Over half (56.3%) of the total sample were females, 63.3% were white and 30.7% were black. Most reported that they were currently enrolled in school (80%) and 52.3% reported living at home for a majority of the previous year. The mean BMI of the sample was 26.1, with 48.4% of the participants being in the overweight and obese category. The mean HEI-2015 score was 48.2 (range 0-100) and the mean score for the dietary restraint subscale was 6.9 (range 0-19).

Table 6. Demographic Characteristics for the Sample

| **Young Adult Characteristics** | (n=215) |
|---|---|
| **Age** | 19.2 (10.0) |

| | |
|---|---|
| **Sex** | |
| Male | 94 (43.7) |
| Female | 121 (56.3) |
| **Race/Ethnicity** | |
| Non-Hispanic white | 136 (63.3) |
| Non-Hispanic black | 66 (30.7) |
| Biracial/Other | 12 (6.0) |
| **SES*** | 45.0(12.2) |
| **Currently in school** | |
| Yes | 172 (80) |
| No | 43 (20) |
| **Living at Home** | |
| Yes | 112 (52.3) |
| No | 102 (47.6) |
| **BMI**** | 26.1 (5.9) |
| Not-overwight | 108 (51.7) |
| Overweight | 62 (29.7) |
| Obese | 39 (18.7) |
| **HEI-2015 Total Score** | 48.3 (13.4) |
| **Dietary Restraint Total Score** | 6.9 (4.0) |

Expressed as Mean (SD) or Count (%)
*missing data on SES from n=4
**missing height/weight data from n=6

Results of the models predicting HEI-2015 total and component scores are shown in Table 7. Only participant's sex, SES and scores for dietary restraint predicted significant ($p < .05$) partial effects in the full model predicting HEI-2015 total scores. The model was able to account for 20% of the variance in HEI-2015 scores [$F (9, 194) = 5.45$, $p < 0.001$, $R^2=0.20$]. Of the models predicting each of the 13 component scores, dietary restraint had significant partial effect for predicting higher scores for total vegetables, greens and beans, total fruit, whole fruit, seafood and plant protein, and added sugars.

Table 7. Summary of Multiple Regression Analysis for Variables Predicting Young Adults HEI-2015 Total and Component Scores (N=204)

| | Total HEI-2015 Scores | | | HEI-2015 Total Vegetables | | | HEI-2015 Greens and Beans | | | HEI-2015 Total Fruit | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | ***B*** | ***SE B*** | **β** | ***B*** | ***SE B*** | **β** | ***B*** | ***SE B*** | **β** | ***B*** | ***SE B*** | **β** |
| Sex | 5.27 | 1.86 | 0.20** | 0.8 | 0.2 | 0.28** | 0.762 | 0.3 | 0.18* | 0.53 | 0.24 | 0.16* |
| Race (white) | 1.84 | 1.83 | 0.02 | 0.45 | 0.62 | 0.05 | -1.34 | 0.91 | -0.1 | 1.8 | 0.76 | 0.17* |
| Race (black) | -0.71 | 1.99 | -0.02 | 0.22 | 0.22 | 0.07 | -0.22 | 0.32 | -0.05 | -0.15 | 0.26 | -0.04 |
| Race (biracial/other) | 1.65 | 4.88 | 0.02 | -0.19 | 0.53 | -0.02 | 1.86 | 0.78 | 0.16* | -0.17 | 0.64 | -0.02 |
| SES | 0.23 | 0.08 | 0.21** | 0.03 | 0.01 | 0.24** | 0.03 | 0.01 | 0.15* | 0.02 | 0.01 | 0.13 |
| Currently in school | 0.33 | 2.33 | 0.01 | -0.03 | 0.25 | -0.01 | -0.29 | 0.37 | -0.06 | 0.21 | 0.31 | 0.05 |
| BMI | -0.31 | 1.67 | -0.14 | -0.01 | 0.02 | -0.02 | -0.06 | 0.03 | -0.17* | 0.01 | 0.02 | 0.03 |
| Currently trying to lose weight | 0.6 | 2.22 | 0 | 0.15 | 0.24 | 0.05 | 0.29 | 0.36 | 0.07 | -0.3 | 0.3 | -0.09 |
| Dietary Restraint Total Score | 0.99 | 0.25 | 0.3** | 0.05 | 0.03 | 0.15* | 0.14 | 0.04 | 0.27** | 0.07 | 0.03 | 0.15 |
| Constant | 4.3 | 5.86 | | 1.11 | 0.64 | | 1.89 | 0.94 | | 0.14 | 0.78 | |
| $R^2$ | 0.2 | | | 0.18 | | | 0.19 | | | 0.11 | | |
| F | 5.45** | | | 4.65** | | | 5.20** | | | 2.70** | | |
| SEE | 12.3 | | | 1.34 | | | 1.97 | | | 1.63 | | |

| | HEI-2015 Whole Fruit | | | HEI-2015 Whole Grains | | | HEI-2015 Dairy | | | HEI-2015 Total Protein | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | ***B*** | ***SE B*** | **β** | ***B*** | ***SE B*** | **β** | ***B*** | ***SE B*** | **β** | ***B*** | ***SE B*** | **β** |
| Sex | 0.74 | 0.27 | 0.19** | 0.35 | 0.47 | 0.05 | 0.5 | 0.42 | 0.08 | -0.19 | 0.14 | -0.1 |
| Race (white) | 0.54 | 0.84 | 0.04 | 2.29 | 1.43 | 0.11 | -0.85 | 1.3 | -0.05 | -0.21 | 0.44 | -0.03 |
| Race (black) | -0.15 | 0.29 | -0.04 | -0.85 | 0.5 | -0.12 | -1.7 | 0.45 | -0.26** | 0.3 | 0.15 | 0.15 |
| Race (biracial/other) | -0.13 | 0.72 | -0.01 | 1.12 | 1.22 | 0.07 | 0.91 | 1.11 | 0.06 | -0.35 | 0.37 | -0.07 |
| SES | 0.03 | 0.01 | 0.12* | 0.04 | 0.02 | 0.16* | 0.02 | 0.02 | 0.1 | -0.01 | 0.01 | -0.08 |
| Currently in school | 0.17 | 0.34 | 0.04 | 0.39 | 0.58 | 0.05 | -1.05 | 0.53 | -0.15* | 0.05 | 0.18 | 0.02 |
| BMI | -0.01 | 0.02 | -0.03 | -0.07 | 0.04 | -0.12 | 0.01 | 0.04 | 0.03 | -0.02 | 0.01 | -0.15 |
| Currently trying to lose weight | -0.3 | 0.33 | -0.08 | 0.67 | 0.56 | 0.1 | 0.22 | 0.51 | 0.04 | 0.13 | 0.17 | 0.07 |
| Dietary Restraint Total Score | 0.12 | 0.04 | 0.24** | 0.07 | 0.06 | 0.09 | -0.03 | 0.06 | -0.04 | 0.01 | 0.02 | 0.05 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Constant | 0.13 | 0.86 | | 2.82 | 1.47 | | 5.09 | 1.33 | | 5.32 | 0.45 | |
| $R^2$ | 0.15 | | | 0.12 | | | 0.11 | | | 0.06 | | |
| F | 3.66** | | | 2.86** | | | 2.77** | | | 1.28 | | |
| SEE | 1.81 | | | 3.09 | | | 2.8 | | | 0.94 | | |

| | **HEI-2015 Seafood and Plant Protein** | | | **HEI-2105 Fatty Acid** | | | **HEI-2015 Sodium** | | | **HEI-2015 Added Sugars** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | ***B*** | ***SE B*** | **β** | ***B*** | ***SE B*** | **β** | ***B*** | ***SE B*** | **β** | ***B*** | ***SE B*** | **β** |
| Rex | 0.44 | 0.31 | 0.1 | -0.52 | 0.49 | -0.08 | 1.11 | 0.45 | .18* | -0.24 | 0.42 | -0.04 |
| Race (white) | -0.44 | 0.95 | -0.03 | -0.62 | 1.49 | -0.03 | -1.2 | 1.38 | -0.06 | 1.19 | 1.3 | 0.06 |
| Race (black) | -0.3 | 0.33 | -0.08 | 1.72 | 0.52 | 0.24** | -0.8 | 0.48 | -0.12 | -0.04 | 0.45 | -0.01 |
| Race (biracial/other) | -0.15 | 0.81 | -0.01 | -1.02 | 1.28 | -0.06 | -0.02 | 1.18 | -0.001 | 0.15 | 1.11 | 0.02 |
| SES | 0.01 | 0.01 | 0.07 | 0.004 | 0.02 | 1 | -0.003 | 0.02 | 0.01 | 0.04 | 0.02 | 0.18** |
| Currently in school | -0.17 | 0.39 | -0.03 | 0.56 | 0.61 | 0.07 | 0.02 | 0.56 | 0.003 | -0.28 | 0.53 | -0.04 |
| BMI | -0.08 | 0.03 | -0.26** | -0.05 | 0.04 | -0.09 | 0.02 | 0.04 | 0.05 | -0.02 | 0.04 | -0.04 |
| Currently trying to lose weight | -0.05 | 0.37 | -0.01 | 0.74 | 0.58 | 0.11 | -1.06 | 0.54 | -0.17 | -0.17 | 0.51 | -0.03 |
| Dietary Restraint Total Score | 0.11 | 0.04 | 0.21** | 0.05 | 0.07 | 0.06 | 0.03 | 0.06 | 0.04 | 0.18 | 0.06 | 0.15** |
| Constant | 3.65 | 0.98 | | 5.38 | 1.53 | | 2.86 | 1.42 | | 5.68 | 1.33 | |
| $R^2$ | 0.12 | | | 0.09 | | | 0.06 | | | 0.1 | | |
| F | 2.91** | | | 2.02* | | | 1.22 | | | 2.48* | | |
| SEE | 0.205 | | | 3.22 | | | 2.98 | | | 2.8 | | |

| | **HEI-2015 Saturated Fats** | | | **HEI-2015 Refined Grains** | | |
|---|---|---|---|---|---|---|
| **Variable** | ***B*** | ***SE B*** | **β** | ***B*** | ***SE B*** | **β** |
| Sex | 0.001 | 0.44 | 0 | 1 | 0.49 | 0.15* |
| Race (white) | -0.05 | 1.35 | -0.002 | 0.28 | 1.5 | 0.01 |
| Race (black) | 0.91 | 0.47 | 0.15 | 0.41 | 0.52 | 0.06 |
| Race (biracial/other) | -0.02 | 1.15 | -0.002 | -0.38 | 1.28 | -0.02 |
| SES | 0.01 | 0.02 | 0.04 | 0.002 | 0.02 | 0.01 |
| Currently in school | 0.2 | 0.55 | 0.03 | 0.55 | 0.61 | 0.07 |
| BMI | -0.03 | 0.04 | -0.05 | -0.01 | 0.04 | -0.01 |
| Currently trying to lose weight | 0.59 | 0.52 | 0.1 | -0.86 | 0.58 | -0.13 |
| Dietary Restraint Total Score | 0.04 | 0.06 | 0.06 | 0.14 | 0.07 | 0.17* |

| | | | | |
|---|---|---|---|---|
| Constant | 5.3 | 1.4 | 3.7 | 1.54 |
| $R^2$ | 0.04 | | 0.06 | |
| F | 0.79 | | 1.38 | |
| SEE | 2.9 | | 3.23 | |

* p<0.05
** p<0.01
*** p<0.001

The diet-related characteristics of the participants by levels of self-reported restraint are displayed in Table 8. Approximately 15% of young adults were classified in the high restraint category and 32% were classified as low restrainers. There were significant group differences for several key sociodemographic factors and dietary behaviors. High restrainers were more likely to be females who reported they were trying to lose weight. They also had higher overall diet quality, and consumed fewer calories, and fewer servings of sugar sweetened beverages per day than both low and moderate restrainers. No significant differences were found in the frequency of total eating occasions, frequency of snacking occasions, or tendency to skip breakfast between the high, moderate and low restrainers.

Table 8. Characteristics of Low, Moderate and High Dietary Restrainers

| | **Overall** (n=215) | **Low Restraint** (n=69) | **Moderate Restraint** (n=114) | **High Restraint** (n=32) | **ANOVA or Chi Square** |
|---|---|---|---|---|---|
| **Sex** | | | | | (2, 215) 7.75* |
| Male | 94 (43.7%) | 35 (50.7%) | 52 (45.6%) | 7 (21.9%) | |
| Female | 121 (56.3%) | 34 (49.3%) | 62 (54.4%) | 24 (78.1%) | |
| **Race/ Ethnicity** | | | | | (6,215) 12.34 |
| non-Hispanic white | 136 (63.3%) | 41 (59.4%) | 72 (63.2%) | 23 (71.9%) | |
| non-Hispanic black | 66 (30.7%) | 25 (36.2%) | 36 (31.6%) | 5 (15.6%) | |
| Biracial/ Other | 13 (6.0 %) | 3 (4.3%) | 6 (5.3%) | 4 (12.5%) | |
| **Currently in enrolled in school?** | | | | | (2,215) 1.57 |
| yes | 172 (80%) | 53 (76.8%) | 91 (79.8%) | 28 (87.5%) | |
| no | 43 (20%) | 16 (23.2%) | 23 (20.2%) | 4 (12.5%) | |
| **Currently employed?** | | | | | |
| yes | 112 (52.1%) | 34 (49.3%) | 59 (51.8%) | 19 (59.4%) | (2,215) 0.91 |
| no | 103 (47.9%) | 35 (50.7%) | 55 (48.2%) | 13 (40.6%) | |
| **SES** | | | | | |
| | 45.01 ±12.18 | 43.56± 14.13 | 45.49± 11.73 | 46.48± 8.60 | (2,210) 0.80 |
| **BMI** | | | | | |
| Underweight/normal weight (BMI <25.0 kg/m²) | 108 (51.7%) | 47 (70.1%) | 49 (44.1%) | 12 (38.7%) | (4,209) 18.7** |
| Overweight (BMI ≥ 25.0 kg/m² to < 30.0 kg/m²) | 62 (29.7%) | 17 (25.4%) | 33 (29.7%) | 12 (38.7%) | |
| Obese (BMI > 30.0 kg/m²) | 39 (18.7%) | 3 (4.5%) | 29 ( 26.1%) | 7 (22.6%) | |
| **Diet Quality** | | | | | |
| HEI-2015 Total Score | 48.25 ± 13.4 | 44.17 ± 10.53 | 48.76 ± 14.23 | 55.22 ± 13.09 | (2,212) 8.12*** |
| Total Daily Energy Intake | 1802.84 ± 711.78 | 1993.60 ± 816.18 | 1787.71 ± 621.26 | 1445.49 ± 644.62 | (2,212) 6.90** |
| Total Daily Eating Occasions | 3.41 ± .93 | 3.36 ± .857 | 3.47 ± 1.016 | 3.30 ± .773 | (2,212) 0.57 |
| Total Daily Snack Occasions | 0.88 ± .78 | 0.86 ± 0.66 | 0.91 ± 0.85 | 0.83 ± 0.74 | (2,212) 0.18 |
| Daily Energy From Breakfast**** | 340.4± 196.51 | 369.22 ± 212.89 | 343.55 ± 179.28 | 272.91 ± 210.26 | (2,189) 2.45 |
| Daily Energy from Lunch | 533.38 ± 331. 81 | 587.95 ± 420.11 | 535.39 ± 288.93 | 411.99 ± 221.46 | (2,201) 3.01 |
| Daily Energy from Dinner | 684.19 ± 339.56 | 776.44 ± 362.37 | 666.96 ± 324.57 | 545.86 ± 289.49 | (2,211) 5.58** |
| Daily Energy from Beverages | 60.64 ± 122.79 | 84.59 ± 192.94 | 52.36 ± 71.7 | 45.24 ± 89.01 | (2, 136) 1.14 |
| Total Daily Energy from Snacks | 321.96 ± 267.97 | 341.89 ± 263.94 | 326.48 ± 271.36 | 259.26 ± 265.59 | (2,179) 0.89 |
| **Diet- Related Behaviors** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Skipped breakfast for the past 7 days | 34 (16%) | 15 (21.7%) | 16 (14.2%) | 3 (9.7%) | (2, 215) 2.90 |
| Trying to lose weight | 88 (41.1%) | 6 (8.7%) | 56 (49.6%) | 26 (81.3%) | (2,215) 54.57*** |
| Exercised in the past 30 days to lose weight/keep from gaining weight | 101 (47.2%) | 7 (10.1%) | 66 (58.4%) | 28 (87.5%) | (2,215) 64.57*** |
| Ate less food in the past 30 days to lose weight/ keep from gaining weight | 74 (34.6%) | 2 (2.9%) | 43 (38.1%) | 29 (90.6%) | (2,215) 75.65*** |

Reported as mean ± SD or Count (%)

[a] Low Restrainers= score range (0-4); Moderate Restrainers = (5-11); High Restrainers (12-19)

* p<0.05

** p<0.01

*** p<0.001

## Discussion

The results of this study expose differences in diet quality and other dietary behaviors between young adults with varying levels of dietary restraint. Dietary restraint was associated with higher scores for total overall diet quality, as well as higher scores for the HEI-2015 components total vegetables, greens and beans, total fruit, whole fruit, seafood and plant protein and lower scores for added sugars. These results are consistent with findings from some earlier studies that found dietary restraint scores to be positively associated with intakes of whole grains and vegetables, and negatively associated with intakes of added sugars (Alexander & Tepper, 1995; Moreira et al., 2005; Rideout & Barr, 2009).

Previous cross-sectional studies have reported that adolescents and young adults who engage in unhealthy weight control behaviors are more likely to have lower intakes of fruits and vegetables and higher intakes of high-fat foods (N. I. Larson et al., 2009). On the other hand, higher self-regulation in eating along with healthful weight control behaviors have been associated with higher intakes of fruits and vegetables and lower intakes of sweet or salty snacks (Kliemann et al., 2018). This is in line with findings from the present study that high restrainers had higher overall diet quality than the rest of the sample, and suggests that for young adults, dietary restraint may serve an adaptive function for promoting healthful eating habits.

Although young adults with higher scores for dietary restraint had higher intakes of several key healthful dietary components, the average HEI-2015 total score was classified as “needs improvement” in terms of adherence to the current dietary guidelines (Kirkpatrick et al., 2018; Reedy et al., 2018). It is worthwhile to note that the HEI-2015 uses a density approach to determine the overall quality of the diet, and this does not factor in overall energy intake. Interpretation of scores must consider the suitability of the energy level (Krebs-Smith et al., 2018). In our sample, energy intakes

for the high restraint group were significantly lower than the low restrainers. When energy levels are low, scores can be improved by increasing consumption of foods from the adequacy components since higher consumption of those foods will lead to higher overall scores. For low restrainers with low HEI scores who were already in energy balance, scores would be improved by simultaneously increasing intakes of foods in the adequacy components while decreasing consumption of foods in the moderation components, like refined grains and added sugars.

Previously published studies have highlighted the barriers to consuming a healthy diet among young adults, and ease of access of unhealthy foods coupled with low self-efficacy for preparing healthy meals were both identified as factors preventing healthy eating (Greaney et al., 2009; Munt et al., 2017). Thus, it is possible that the most accessible foods in the current obesogenic environment prohibit individuals from adequately meeting recommendations of nutritional intakes for health, regardless of their desire to control food intake and monitor body weight. Since a poor diet quality is known to contribute to an increased risk for certain chronic diseases, it would be worthwhile to further explore environmental factors that influence eating self-regulatory skills.

We also saw sex and socioeconomic differences in the overall diet quality score, confirming findings from other research on diet quality that females and those from higher socioeconomic status tend to have higher diet quality scores than males and those from lower socioeconomic status (Hiza et al., 2013). While mechanisms for the inequalities in dietary behavior between individuals with differing socioeconomic status have been proposed, including lack of material and psychosocial resources, the reasons for sex differences in healthy eating are not well understood. In focus-group discussions with adolescents, Neumark-Sztainer et al. (1999) found that males report lack of motivation as a barrier to healthy eating (Neumark-Sztainer et al., 1999). However, the adolescents in this focus group were younger than the males and females

in our sample, so factors viewed as most important to influencing food choice may be different. Further exploration of the observed sex differences in diet quality among this population is needed.

Previous research has shown that restrained eaters report overeating more frequently than do unrestrained eaters (van Strien et al., 2007). In the current study, total energy intake was significantly lower among high restrainers compared with low restrainers. However, the level of restraint was not associated with frequency of eating occasions or snacking, or with energy consumed from beverages or at meals besides the dinner occasion. Stice et al. has argued the reason for this discrepancy is due to the inability of dietary restraint scales to accurately assess energy restriction (Stice et al., 2010). These authors argue that dietary restraint scales truly measure a person's desire to eat less than they what they feel they need and possibly identifying individuals with a tendency to overeat (Stice et al., 2010). Since a majority of participants in the high restraint group were also trying to lose weight and reported trying to eat less food, it is possible that these individuals conceptualize appropriate food intake as overeating (Long et al., 2020).

A strength of this study is that dietary behaviors and diet quality were assessed among individuals in young adulthood, which is a group often overlooked in research. This developmental life stage has been identified in previous literature as a key population for targeting interventions due to changes in lifestyle-related behaviors and the associations with future health risks (Ma et al., 2009; Poslusna et al., 2009). Further, dietary intake was assessed using three multi-pass, 24-hour food recalls which has been shown to increase reliability of the data. In addition, these results were based on a diverse sample of young adults that included both males and females and was not limited to students in a university setting which adds to the generalizability of the findings.

This study does have some limitations. The cross-sectional nature of our study prevents the interpretation of associations between variables as resulting from cause and effect. Though dietary data were collected via multi-day 24-hour recalls using a multiple-pass method, under- and over-reporting is still a potential issue (E. A. Hu et al., 2020). This may affect interpretation of the results related to dietary behaviors reported in the study. To assess how restraint predicts specific indices of diet quality, we relied on HEI-2015 total and component scores which uses a density approach to adjust for misreporting in energy intake. These scores have been used in previous research to test associations between dietary patterns and future cardiovascular risk (Hagan et al., 2017; Timko & Perone, 2006; Westenhoefer et al., 2013). Additionally, the scale used to measure dietary restraint was modified in the original study and an item from the original TFEQ-restraint subscale was left out. Thus, responses to the dietary restraint subscale were out of a maximum of 20 rather than 21 items. This may affect the reproducibility of results among other samples of young adults.

Further, though the restraint subscale of the TFEQ was designed to assess the intent to control energy intake for the purpose of controlling weight, it is possible that the current scale does not distinguish between unique factors related to weight regulation, such as those associated with positive dietary behaviors and those associated with dysregulated weight control behaviors. Previous work has differentiated between rigid restraint, characterized by an “all or nothing” approach to dieting, and a more flexible-style restraint (Bond et al., 2001). Other findings on the construct validity of the TFEQ suggest the restraint scale may better represent multiple dimensions of this eating behavior (Bond et al., 2001).The findings from the current study highlight the need for developing a refined measurement tool which can be used to monitor self-regulation of energy intake among individuals for healthy weight maintenance.

## CONCLUSIONS

Overall, our findings provide evidence that higher levels of dietary restraint are associated with higher diet quality among young adults. This may be due to the adoption of specific strategies to control weight, such as consuming more nutrient-dense foods like fruits and vegetables in favor of energy-dense foods like sugar-sweetened beverages. Given the high rates of weight gain among this age group, future research should further investigate the exact mechanism of how dietary restraint may be influencing daily food choices and diet quality of individuals in young adulthood.

# CHAPTER VI: EPILOGUE

Early in the research process, I struggled to narrow my focus. I had an established interest in the construct of dietary restraint that first piqued while completing my Master's thesis, but other research experiences have since broadened my focus to encompass other areas of human development and diet. With access to such large datasets, I became overwhelmed trying to make connections between all the data that were available and the research questions that still needed to be explored. To that end, I have certainly learned more about study design and following the literature in secondary analyses. The specific direction for my dissertation came from an idea I had while completing coursework for my graduate requirements. I realized that what I was really interested in was change in behaviors over time and how different processes can be related in new and unique ways. From there, my project grew into three aims that represent my varied interests in nutrition and behavior.

## Summary of Findings and Implications

This research examined two psychological correlates of obesity, body esteem and dietary restraint, and their associations with other health outcomes during childhood and young adulthood. Together, the results from these studies support the complex nature of the relations between overweight/obesity and key psychological correlates. In study one, I explored trajectories of body esteem development during middle childhood, an overlooked age group in the body esteem literature. In this research, we saw distinct patterns of body esteem change within and between individuals and detected an association with early weight status. Our results were somewhat surprising because previous research with older samples emphasize declines in body esteem as individuals age. So, we would have expected body esteem scores to drop in subsequent waves of the study. One possible explanation is that the rise in body esteem during middle childhood is the result of increases in social support groups that emerge as students

enter elementary school, but additional research is needed to examine those relations. As predicted, we saw that increased early weight status had a negative effect on trajectories of body esteem in middle childhood. Specifically, individuals who were higher weight status at the beginning of first grade showed smaller increases in body esteem over 3 years than their lower weight peers. This is in line with earlier studies with older age groups and highlights the negative psychological consequences of increased weight status.

In study two, I tested the hypothesis that weight status better predicts restrained eating compared with the reverse relation, that restrained eating promoting higher weight status. In support of this hypothesis, we found weight status significantly predicted scores for dietary restraint in middle childhood, whereas the inverse relationship (restraint scores predicting weight status) was not significant in this study. This finding supports growing evidence in the field of nutrition that dietary restraint might emerge as an adaptive response to the current obesogenic food environment among individuals prone to overeating. It would be worthwhile to investigate how increasing dietary restraint may help manage excess weight gain among children, particularly those who are prone to overeating. It is possible that restrained eating can be taught as a skill for self-control of eating in a food environment that seemingly encourages eating in excess, but future studies are needed that 1) determine if/how one can increase positive forms of dietary restraint, and 2) examine the long-term effects of increased dietary restraint in childhood.

In study three, I looked at the dietary profiles of young adults characterized by their level of dietary restraint. In this cross-sectional study, we found higher levels of diet quality among restrained eaters compared with unrestrained eaters which suggests dietary restraint might impact nutritional status among individuals in this life stage. Since young adults are reported to have the poorest diet quality of any age group, this finding is promising. Additional work is needed to understand other factors that contribute to

improved dietary intakes among this age group, and to determine if dietary restraint, in conjunction with these factors, could act as a potential target for intervention studies that seek to increase diet quality in this population.

This research contributes to the literature in several key areas. It is well established that body dissatisfaction and unhealthy weight control behaviors are both key psychological correlates of overweight and obesity among youth. The research presented in this dissertation considers how two related constructs, body esteem and dietary restraint, develop with age and how these associate with weight and nutrition across different life stages. Thus far, research on these factors in middle childhood and young adulthood have lacked critical investigation. There was a lack of longitudinal examinations of body esteem prior to adolescence. Further, in the existing literature, eating has typically been evaluated based on its associations with negative health consequences, and relatively little attention has been paid to the normative development and potential positive associations of restraint with diet outcomes at various stages.

There were some limitations to this research. Data for study aim 1 and 2 came from a community sample of children in rural Oklahoma who were predominantly white and so results may not be generalizable to the greater population. Further, as commonly occurs in longitudinal research, the sample size at later waves was affected by participant attrition which may result in some bias in the results. Future research might also consider the measures used to assess body image and dietary restraint in these age groups. Because body image is a multidimensional construct, some researchers suggest using multiple tools to assess body image, such as figure rating scales and questionnaires, to better contextualize how body dissatisfaction manifests in individuals. It would also be worthwhile to test the measurement invariance of the Body Esteem Scale across time in middle childhood, and between sexes. As for dietary restraint, it is important to note this is a measure of intention to restrict food intake. Though we were able to assess energy intake in our study, we were not able to fully assess individual

energy needs; it is possible that individuals who were highly restrained still consumed energy in excess of their physiological energy needs. Future studies might consider novel ways to conceptualize self-control in eating that incorporate both energy intake and output to identify individuals who are successful restrainers.

## Problems Encountered and Lessons Learned

> "Ignorance more frequently begets confidence than does knowledge"
> - Charles Darwin

This research was not without its challenges. Though I was fortunate to have access to complete datasets for my secondary analyses, there were some limits to using data that were collected for different studies with their own unique designs. Some of my initial plans had to be modified as I ran up against issues with specific measures or instruments, and several times I had to pause to reflect and reassess what I was doing. This taught me about the importance of flexibility and my ability to shift gears. I also came away with a better understanding of research methodology and my limits as a methodologist. While I learned of some strategies for analyzing data related to my specific research questions, my biggest struggle with this dissertation was choosing the methodology and interpreting my study findings. I now better recognize the scope of what I still need to learn related to study design and data analysis. I see development of these skills taking on a bigger focus in my future career as a research scientist.

It was also difficult to deal with the quantity of literature that has already been published in this research area. My research included elements from multiple disciplines, each with their own framework and theories to consider. As such, I struggled to fine-tune my topic based on what were still major gaps in the literature. Ultimately, I developed my project based on the crux of what I wanted to explore. The result is that my dissertation has added to my body of knowledge on development of eating behaviors. Going

forward, I would try to do a better job prioritizing the data related to the research question and understand that it is not possible to analyze all the available data relevant to the topic of interest.

I would also be remiss not to mention the COVID-19 pandemic and its impact on almost every facet of daily life in 2020 and 2021. Beginning in March 2020, the global situation quickly devolved as the coronavirus spread and people were forced to quarantine at home. While academic life quickly transitioned to accommodate online/virtual learning, the ability to conduct research and carry out in-person work was entirely put on hold. Luckily for me and with the help of my advisor and committee members, I was able to shift my proposal format and dissertation meetings to a virtual platform and continue my timeline uninterrupted. Still, this pandemic has had ripple effects that are still making themselves known. I have had family members test positive for the virus, I have had scares with potential exposures, and I have run dangerously low on toilet paper. I no longer can plan gatherings with friends or unwind in public settings without fear that we might be spreading a contagion on to a vulnerable member of society. The stress and uncertainty of this experience compounded an already demanding time, and I expect it will change my outlook on work-life balance and the necessity for self-care for the rest of my career.

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# APPENDIX A: HEI-2015 SCORING METHODOLOGY

**Table 1.** HEI-2015 Total and Component Scoring Standards

| Component | Maximum Score | Standard for Maximum Score (1) | Standard for Minimum Score (0) |
|---|---|---|---|
| **Adequacy*** | | | |
| Total Fruits[2] | 5 | GE 0.8 cup equivalent per 1,000 Kcal | No Fruit |
| Whole Fruits[3] | 5 | GE 0.4 cup equivalent per 1,000 Kcal | No Whole Fruit |
| Total Vegetables[4] | 5 | GE 1.1 cup equivalent per 1,000 Kcal | No Vegetables |
| Greens and Beans[4] | 5 | GE 0.2 cupequivalent per 1,000 Kcal | No Dark-Green Vegetables of Legumes |
| Whole Grains | 10 | GE 1.5 cup equivalent per 1,000 Kcal | No Whole Grains |
| Dairy[5] | 10 | GE 1.3 cup equivalent per 1,000 Kcal | No Dairy |
| Total Protein Foods[6] | 5 | GE 2.5 ounce equivalent per 1,000 Kcal | No Protein Foods |
| Seafood and Plant Proteins[4,6] | 5 | GE 0.8 ounceequivalent per 1,000 Kcal | No Seafood or Plant Proteins |
| Fatty Acids[7] | 10 | (PUFAs + MUFAs)/SFAs GE 2.5 | (PUFAs + MUFAs)/SFAs LE 1.2 |
| **Moderation**** | | | |
| Refined Grains | 10 | LE 1.8 ounce equivalent per 1,000 Kcal | GE 4.3 ounce equvalent per 1,000 Kcal |
| Sodium | 10 | LE 1.1 grams per 1,000 Kcal | GE 2.0 grams per 1,000 Kcal |
| Added Sugars | 10 | LE 6.5% of total Kcal | GE 26% of total Kcal |
| Saturated Fats | 10 | LE 8% of total Kcal | GE 16% of total Kcal |

* represents food groups, subgroups and dietary elements that are encouraged; higher scores reflect higher intakes

** represents foods groups and dietary elements for which there are limits to consumption; higher scores reflect lower intakes

1. Intakes between the minimum and maximum are scored proportionally
2. Includes 100% fruit juice
3. Includes all forms except juice
4. Includes legumes (beans and peas)
5. Includes milk producsts, such as fluid milk, yogurt, cheese, and fortified soy beverages
6. Includes seafood, nuts, soy products (other than beverages), and legumes (beans and peas)
7. Ratio of poly- and mono- unsaturated fatty acids (PUFAs and MUFAs) to saturated fatty acids (SFAs)

## APPENDIX B: REVISED BODY ESTEEM SCALE FOR CHILDREN

Beverley K. Mendelson & Donna R. White
Concordia University
Research Bulletin, 1993-94, Vol. XII No. 02*

| | | | |
|---|---|---|---|
| 1. | I like what I look like in pictures | Yes | No |
| 2. | Kids my own age like my looks | Yes | No |
| 3. | I'm pretty happy about the way I look | Yes | No |
| 4. | Most people have a nicer body than I do | Yes | No |
| 5. | My weight makes me unhappy | Yes | No |
| 6. | I like what I see when I look in the mirror | Yes | No |
| 7. | I wish I were thinner | Yes | No |
| 8. | There are lots of things I'd change about my looks if I could | Yes | No |
| 9. | I'm proud of my body | Yes | No |
| 10. | I really like what I weigh | Yes | No |
| 11. | I wish I looked better | Yes | No |
| 12. | I often feel ashamed of how I look | Yes | No |
| 13. | Other people make fun of the way I look | Yes | No |
| 14. | I think I have a good body | Yes | No |
| 15. | I'm looking as nice as I'd like to | Yes | No |
| 16. | I often wish I looked like someone else | Yes | No |
| 17. | My looks upset me | Yes | No |
| 18. | I'm as nice looking as most people | Yes | No |
| 19. | My parents like my looks | Yes | No |

20. I worry about the way I look Yes No

APPENDIX C: DUTCH EATING BEHAVIOR QUESTIONNAIRE

Van Strien, T., Frijters, J. E., Bergers, G. P., & Defares, P. B. (1986). The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of eating disorders*, *5*(2), 295-315.

**Response options:** never (1); seldom (2); sometimes (3); often (4); very often (5)

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**Restrained Eating**

1. If you have put on weight, do you eat less than you usually do? *
2. Do you try to eat less at mealtimes than you would like to eat?
3. How often do you refuse food or drink offered because you are concerned about your weight?
4. Do you watch exactly what you eat?
5. Do you deliberately eat foods that are slimming?
6. When you have eaten too much, do you eat less than usual the following days?'
7. Do you deliberately eat less in order not to become heavier?
8. How often do you try not to eat between meals because you are watching your weight?
9. How often in the evening do you try not to eat because you are watching your weight?
10. Do you take into account your weight with what you eat?

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*items with a non-relevant response category in addition to the regular responses

## APPENDIX D: THREE FACTOR EATING QUESTIONNAIRE: DIETARY RESTRAINT SUBSCALE

PART 1

4. when I have eaten my quota of calories, I am usually good about not eating any more

6. I deliberately take small helpings as a means of controlling my weight

10. Life is too short to worry about dieting

14. I have a pretty good idea of the number of calories in common food

18. While on a diet, if I eat food that is not allowed, I consciously eat less for a period to make up for it

21. I enjoy eating too much to spoil it by counting calories or watching my weight

23. I often stop eating when I am not really full as a conscious means of limiting the amount that I eat

28. I consciously hold back at meals in order to not gain weight

30. I eat anything I want, any time I want

32. I count calories as a conscious means of controlling my weight

33. I do not eat some foods because they make me fat

35. I pay a great deal of attention to changes in my figure

PART 2

37. how often are you dieting in a conscious effort to control your weight

38. would a weight fluctuation of 5lbs affect the way you live your life

40. Do your feelings of guilt about overeating help you control your food intake

42. How conscious are you of what you are eating

43. How frequently do you avoid ‘stocking up” on tempting foods

44. How likely are you to shop for low calorie foods

46. How likely are you to consciously eat slowly in order to cut down on how much you eat

48. How likely are you to consciously eat less than you want

*(50) left out of survey