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Does Weight Matter? The Role of Actual and Perceived Body Weight in the Trajectories  
of Internalizing Symptoms in Childhood

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## ABSTRACT OF THE DISSERTATION

Does Weight Matter? The Role of Actual and Perceived Body Weight in the Trajectories of Internalizing Symptoms in Childhood

by

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Doctor of Philosophy, Graduate Program in Psychology  
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Dr. Misaki N. Natsuaki, Chairperson

Existing empirical evidence has reported consistent concurrent associations between children's BMI and internalizing behaviors; however, less is known about the possible long-term effects of BMI on those behaviors. Thus, one aim of this dissertation was to assess the concurrent and longitudinal effects of children's BMI on their internalizing behaviors. Moreover, building on the premise that effects of children's BMI are better understood in the context of parents' perceptions of children's weight, this work aimed to assess the role of parental appraisals of their children's weight and its discrepancy from the children's actual weight on the changing trajectory of internalizing behaviors between age 4.5 and 11.

Results from growth curve analysis analyzing the data from 361 families from the Early Growth and Development Study (EGDS) suggested that children's actual BMI was not associated with internalizing behaviors either concurrently or longitudinally. However, parental concerns of child weight were concurrently associated with children's

internalizing behaviors at age 4.5, although no significant long-term effect was observed. Lastly, the assessment of parental misperceptions of child weight revealed that about a quarter of mothers and fathers in the study underestimated their children's overweight status, although these discrepancies from children's actual weight did not have meaningful influences on children's internalizing behaviors. Results are discussed in terms of research and theoretical implications.



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## CHAPTER 1: INTRODUCTION AND THEORETICAL FRAMEWORK

Childhood obesity is one of the most serious public health concerns with approximately 42 million children younger than 5 years of age being considered overweight or obese around the world (Ng et al., 2014). Obesity is based on body mass index (BMI) percentiles using height and weight information adjusted for sex and age. According to the United States Department of Health and Human Services' Center for Disease Control and Prevention (CDC), a child is considered overweight if body mass index (BMI) is above the 85<sup>th</sup> percentile and below the 95<sup>th</sup> percentile and obese if BMI is above the 95<sup>th</sup> percentile for children and of the same age and sex (Center for Disease Control and Prevention [CDC], 2020). In the United States, childhood overweight/obesity remains one of the most concerning health issues for children. Nationally, the proportion of children with a BMI greater than 95<sup>th</sup> percentile has doubled between 1963 and 1991, together with an increase of approximately 50% in the prevalence of children with a BMI of more than 85<sup>th</sup> percentile (Styne, 2001). Similar trends have also been observed in recent years as well, with a significant increase in obesity and severe obesity in children aged 2 to 5 years from 2015 to 2016 (Skinner, Ravanbakht, Skelton, Perrin, & Armstrong, 2018), suggesting that the prevalence rates of obesity among U.S youth was 18.4% in school aged children (6-11 years) and 13.9% in preschool-aged children (2-5 years) in 2015-2016 (NHANES 2015-2016 Overview).

Childhood obesity has far reaching and enduring consequences for health outcomes. Well-documented physical illness associated with childhood obesity include asthma (Lazorick, Peaker, Perrin, Schmid, Pennington, Yow, & DuBard, 2011; Mahut,

Beydon, & Delclaux, 2012), hypertension (Wake et al., 2010), sleep problems (Marcus, 2006), and metabolic syndrome (Must & Strauss, 1999), in addition to long-term outcomes such as adult diabetes (Tirosh et al., 2011), elevated blood pressure (Lloyd, Langley-Evans, & McMullen, 2010), certain types of cancer (e.g., breast cancer, kidney cancer; Fagherazzi, Guillas, Boutron-Ruault, Clavel-Chapelon, & Mesrine, 2013; Samanic, Gridley, Chow, Lubin, Hoover, & Fraumeni, 2004), and overall poor oncological outcomes (Chromecki et al., 2013). In addition to the medical comorbidities associated with childhood obesity, the psychosocial sequelae that accompany child obesity are paramount. Particularly, the association between child obesity/overweight and internalizing problems is well known. Overweight status in childhood seems to be a prominent risk factor for internalizing symptoms, as evidenced by studies reporting heightened depression, anxiety, eating related disorders and overall low quality of life among overweight/obese children (Gibson, Allen, Davis, Blair, Zubrick, & Byrne, 2017; Phillips et al., 2012; Schwimmer, Burwinkle, & Varni, 2003). In this dissertation, I will use the term “overweight” to encompass both obesity and overweight status.

The majority of the studies on overweight and internalizing psychopathology in young children are based on cross-sectional designs, focusing on the concurrent relations between the two. Surprisingly little is known regarding the possible role of overweight status in early childhood in the subsequent trajectory of internalizing psychopathology over time, which is known to take a gradual upward trend between childhood and adolescence (Fanti & Henrich, 2010). Thus, the primary aim of this study is to evaluate

the effect of child weight status at age 4.5 on the trajectory of internalizing behaviors between the ages of 4.5 and 11 years.

While research highlighted above speaks to the importance of childhood overweight status based on actual BMI for internalizing behaviors, it is noteworthy that its effects on psychosocial distress can be understood in the context of self and others' perceptions of weight. For example, it is well known that weight perception and actual weight are distinct in adolescence, and it is weight perception, not the actual weight, that is linked to psychological distress (Brener, Eaton, Lowry, & McManus, 2004).

For children, especially young ones, parents and caregivers are the most proximal and influential socialization agents. Parents play a crucial role in the development of body image and schemas by providing children with pertinent information and models regarding body image and food related issues (Powell & Hendrick, 1999). Whether explicit or implicit, parental attitudes and messages about body weight and shape that are communicated to children, set a powerful foundation for the development of children's understanding of self and body image (Akerman, Williams, & Meunier, 2007; Davison & Birch, 2002). Critical and negative attitudes from parents about child's weight can serve as potent risk-factors for child and adolescent distress.

Unfortunately, parents often make inaccurate judgements regarding their child's weight status (Tompkins, Seablom, & Brock, 2015). For example, in a nationally representative study of 2-to-11-year old children, about one-third of mothers underestimated the weight of their overweight children (Maynard, Galuska, Blanck, & Serdula, 2003). There is reason to believe that parents' misperception of weight may have

important implications for mental and physical health outcomes in children. Parents' overestimation (or exaggeration) of child body weight (e.g., parents perceived the child as 'heavy' when the child is at healthy weight), for instance, may result in unrealistic and unhealthy weight expectations for the child, while the underestimation of child overweight (e.g., parents consider the child to be at normal weight when s/he is overweight) may lead to decreased emphasis on healthy habits and behaviors at home. Thus, it seems essential to closely examine the accuracy of parental assessments of their children's weight, and specifically, as they may be related to children's internalizing behavior outcomes over time.

The next several sections of the Introduction, which provides a detailed background of this study, are organized as follows. In the first section, I discuss the importance of body weight in children's internalizing behaviors and the need for exploring the possible longitudinal effects of body weight on the trajectory of those behaviors. The following section highlights the existing literature on the trajectory of internalizing behaviors in childhood. The subsequent two sections provide a detailed review on the role of parental appraisals and perceptions of children's weight in children's internalizing behaviors and highlight the need to better understand the mismatch between children's actual weight and parental appraisal of the child's weight.

### **Importance of Body Weight: How It Relates to Internalizing Behaviors in Childhood**

Body weight is one of the most socially visible aspects of body appearance, and as such, it is thought to play an important role in the psychological adjustment of children

from an early age. Existing literature examining the role of body weight in one's psychological adjustment has primarily focused on children's own appraisals of weight – a known component of body image. Body image awareness is thought to emerge early in the development, as evidenced by studies suggesting that children as young as 5 years old have absorbed the cultural bias against fat people (Musher-Eizenman et al., 2003) and may be emotionally invested in the thin ideal (Harringer, Calogero, Witherington, & Smith, 2010). Even 3-year-old children may be aware of the anti-fat prejudice and weight stigma (Spiel, Paxton, & Yager, 2012; Tremblay, Lovsin, Zecevic, & Lariviere, 2011). These weight-related stigma and biases are eventually internalized, setting a stage for negative weight-related attitudes about self and others.

Not surprisingly, much of the research assessing the associations between children's weight status and children's psychological well-being has focused on internalizing behaviors in children (McCabe & Marwit, 1993; Schur, Sanders, & Steiner, 2000). The general consensus in the field is that overweight children are more prone to psychological distress and internalizing difficulties (Bradley, Houts, Nader, O'Brien, Belsky, & Crosnoe, 2008; Buddeberg-Fischer, Klaghofer, & Reed, 1999), have a poorer quality of life (Schwimmer, Deutsch, Rauch, Behling, Newbury, & Lavine, 2003), and face numerous social issues, including isolation and bullying (Strauss & Pollack, 2003; Janssen, Craig, Boyce, & Pickett, 2004). In a study of 7-to-12-year-old boys and girls, Bell and colleagues (2011) found that overweight children were more likely to experience anxiety, depression, and bullying, compared to their non-overweight peers. Another study of overweight children across a wide age range (ages 5 to 17) found that more than half



of the overweight children were either borderline or clinically depressed, as gathered through self-report measures (Sheslow, Hassink, Wallace, & DeLancey, 1993). Similarly, significant positive associations between BMI and symptoms of withdrawal, anxiety and somatic complaints in children from age 2 years to 6<sup>th</sup> grade have also been reported (Bradley et al., 2008). A recent meta-analytic review reported a meaningful positive association between weight status and anxiety in children and adolescents younger than 18 years of age (effect size  $r = 0.08$ , Burke & Storch, 2015).

Importantly, sex differences in the aforementioned association have also been reported, such that overweight girls exhibit more adverse psychosocial outcomes than boys (Gibson, Byrne, Blair, Davis, Jacoby, & Zubrick, 2008). For instance, an early investigation by Erickson and colleagues (2005) demonstrated significant association between BMI and depressive symptoms in elementary school-aged girls, but not in boys. These results were later echoed by Steen and colleagues (2006) who compared normal-weight and obese boys and girls, and found that overweight boys generally appeared happier with their looks and perceived themselves to be less overweight, compared to girls who were also overweight (Steen, Wadden, Foster, & Andersen, 2006). Moreover, differences in the association between childhood overweight and anxiety were also found in a meta analytic study, where an effect size between weight status and anxiety was stronger in girls ( $r = 0.12$ ) than in boys ( $r = 0.02$ ; Burke & Storch, 2015). Taken together, these studies paint a compelling picture of body weight as a risk factor for internalizing problems in childhood, especially in girls.

It is noteworthy that most studies in this area have evaluated the psychological outcomes associated with overweight/obesity in older children (7-12 years) and adolescents, whereas limited work has focused on understanding the possible adverse impact of childhood overweight in younger children. This is an unfortunate gap in the literature, given recent work documenting substantial increase in body weight in the group of 2-to-5-year old children (Skinner et al., 2018). Developmentally, ages 4-to- 5 are an important developmental period where children's body evaluations start to form (Menzel, Krawczyk, & Thompson, 2011; Musher-Eizenman, Holub, Edwards-Leeper, Persson, & Goldstein, 2003). Although body evaluations and self-concept do not get fully consolidated are not fully developed until later in the development, understanding the role of children's overweight at as young as 4-5 years of age may be an important addition to existing literature.

### **Trajectories of Internalizing Behaviors from Childhood to Adolescence**

While the majority of prior work on childhood overweight and internalizing psychopathology has focused on concurrent relations (e.g., Lumeng, Gannon, Cabral, Frank, & Zuckerman, 2003; Bradley et al., 2008), less is known regarding the long-term effects of childhood weight on internalizing psychopathology. Existing work in the area, however, offers the possibility of lingering effects exerted by early childhood overweight, as evidenced by a longitudinal study of 7-to-15 year old school students, for whom childhood overweight was associated with an increased risk of mood disorders in adulthood (Sanderson, Patton, & McKercher, Dwyer, & Venn, 2011).

When testing the longitudinal, prospective effects of weight status in early childhood (i.e., preschool age) on subsequent internalizing psychopathology, researchers need to be aware of the patterns of changes in internalizing psychopathology in childhood and adolescence. Research suggests that internalizing behaviors gradually increase between childhood and adolescence (Brendgen, Wanner, Morin, & Vitaro, 2005; Gilliom & Shaw, 2004). To date, these studies have recorded typically small but gradual increases from ages 2 to approximately 11 (Sterba, Prinstein, & Cox, 2007; Gazelle & Ladd, 2003). Similarly, results were reported in a group of 2-to-6-year old children, which revealed a gradual increase in those behaviors between infancy and early childhood (Gilliom & Shaw, 2004). Moreover, an earlier investigation by Achenbach and colleagues (1991) from ages 4 to 16 years provided evidence that even among clinically referred children, internalizing behaviors tend to increase with age (Achenbach, Howell, Quay, & Conners, 1991).

Currently, it is unknown whether the effect of preschool overweight on internalizing psychopathology is long-lasting or short-lived. The possibility of long-term effects of childhood obesity has been recognized in the physical health literature, but not in the mental health literature. For instance, there is evidence that obesity-related metabolic and cardiovascular effects in childhood persist and contribute to adult morbidity (Reilly & Kelly, 2011). To our knowledge, there are limited studies assessing the longitudinal trajectory of internalizing behaviors associated with early childhood overweight. Thus, this study aims to assess the role of early childhood overweight (age

4.5) on the longitudinal trajectory of internalizing problems from childhood to adolescence (from ages 4.5 to 11).

### **Parental Appraisals of Children's Body Weight**

The overweight literature reviewed above has primarily focused on actual, objective BMI. However, in human minds, the concept of body weight is not only about the objective number but also about how self and others perceive, interpret, and evaluate the shape and size of the body. In this dissertation, I focus on how parents perceive the child's weight.

According to Colley's (1902) *Looking Glass Self*, perceptions that we make of ourselves are a product of others' perception of ourselves, which we accept and internalize. Opinions of others are often based on the accepted societal norms and standards of the time, which are often reflected back to us in words or actions of acceptable, liking, dislike or hate (Hayes & Ross, 1986). In the Western world, for instance, these evaluations are heavily based on the socio-cultural standards emphasizing physical attractiveness and certain body types (Stice, Schupak-Neuberg, Shaw, & Stein, 1994). Socio-cultural standards of beauty are delivered and reinforced via exposure to media and social interactions with members of society, especially from those who meet culturally defined ideals of beauty and attractiveness (e.g., Sujoldzic & Lucia, 2007), and close individuals such as peers and families (Davison & Birch, 2002). In fact, recent research amongst adolescents suggested that sociocultural variables are stronger predictors of body image and body change than biological variables of age and BMI (McCabe & Ricciardelli, 2003).

Perhaps not surprising, criticism and feedback from family and peers play a significant role in the development of body image (Kluck, 2010; Smolak, Levine, & Schermer, 1999). Because outward physical appearance is a strong social stimulus (Cash, 1995), it evokes certain reactions from the surrounding environment. Overweight children may suffer from negative body image, low self-esteem, and even high rates of depression compared to other normal-weight children, because their feelings about themselves are often shaped by the attitudes of others (e.g., Ross, 1994). Especially concerning is a finding of a recent increase in the incidents of societal stigmatization and teasing of overweight children from parents, peers and even educators (Kestila, Rahkonen, Martelin, Lahti-Koski, & Koskinen, 2009; Krukowski, West, Siddiqui, Bursac, Phillips, & Raczynski, 2008). Overweight children are often perceived by their normal weight peers as being less healthy, eating less well, and exercising much less (Israel & Ivanov, 2002). Similarly, overweight children and adolescents are often liked less and rejected more by friends and peers (Puhl & Latner, 2007). Moreover, overweight school-aged children often report higher levels of peer weight -related teasing (Pierce & Waddle, 1993) and peer rejection (Strauss, Smith, Frame, & Forehand, 1985), compared to non-overweight children. Similarly, negative weight related feedback from parents may heighten children's risk for development of poor body image and self-esteem (Davison & Birch, 2002).

Parents have been identified as an important source of social feedback in childhood, when parental influence over children's overall adjustment and development of body image is most salient (e.g., Akerman et al., 2007). Particularly in childhood,

parents exercise a significant amount of power on their children's behaviors and habits (including feeding), and by extension, their physical and mental health (Brown & Ogden, 2004; Wong, Chang, & Lin, 2013). Children's body esteem may be deeply rooted in parental reactions to and appraisals of children's body attributes. Children's body image may be shaped by parents' verbal messages and or modeling of appearance-related attitudes and behaviors, as evidenced by studies showing that caregivers' satisfaction with their child's body size was associated with the child's satisfaction with their own body size (Wong et al., 2013). Parental judgements of children's weight that does not meet their expectations of ideal body image that parents hold may affect children's eating and dieting behaviors, foster self-criticism, and influence their self-esteem (Davison & Birch, 2002; Pierce & Wardle, 1993). In an experimental work with preschool, first, and third-and-fifth grade children, for instance, parents were provided three pictures of children (one average-weight child, one obese child, and one physically disabled child) and were asked to tell a story about each child. Out of the three pictures, parents reported the obese child to have the lowest self-esteem and self-concept, and least likely to be successful at the end of the story (Adams, Hicken, & Saleh, 1988). Negative messages and weight-related stigma, in turn, may have important ramifications for children's self-concept and psychological well-being (Smolak et al., 1999).

Available literature has documented that weight/shape-related negative comments from family members were associated with disturbances in children's eating behaviors (Eisenberg, Berge, Fulkerson, & Nuemark-Sztainer, 2010). More often direct verbal criticism and weight-related teasing are more harmful than indirect effects such as seeing

a parent diet (Keery, Eisenberg, Boutelle, Neumark-Sztainer, & Story, 2006). In fact, a study of adolescent girls identified weight-teasing by family members as the strongest and most consistent correlate of problematic weight-related outcomes (Neumark-Sztainer et al., 2010). Girls who reported being teased by family members because of their weight were more likely to report extreme weight control behaviors and binge eating, compared to girls who were not teased (Neumark-Sztainer, Bauer, Friend, Hannah, Story, & Berge, 2010).

Research in younger age groups has detected similar patterns of results, demonstrating associations between parental concerns of child's weight and lower body-esteem in fourth and fifth grade girls (Smolak et al., 1999), in addition to lower self-perception in girls as young as 5-years old (Davison & Birch, 2001). Similarly, parental dissatisfaction with child body size, coupled with children's beliefs about parental dissatisfaction, may have significant implications for self-esteem in 9-to-11-year-old children (Pierce & Wardle, 1993). These findings are especially important because internalization of weight-related stigma in overweight and obese children has been found to be associated with lower self-esteem (Allen, Byrne, Blair & Davis, 2006), depression (Noles, Cash, & Winstead, 1985) and eating disturbances (Brown, Cash & Lewis, 1989).

Parental concern of children's weight status and related control over child-feeding practices also deserve attention. Parental concerns about the child's weight, which could also be expressed in a form of criticism or strict control of dietary behaviors, may in turn send a message to the child about the undesirability of their weight and eating behaviors. Work from eating disorders literature suggests significant associations between parental

food restrictions and childhood overweight (Faith, Scanlon, Birch, & 2004; Fisher & Birch, 1999). One explanation is that parents who exhibit too much control over their child's eating behaviors may inhibit the child's ability to self-regulate his or her own energy intake, and the child may react by overeating the restricted food when they are made available (Fisher & Birch, 1999). And while to my best knowledge, direct associations between parental concerns of child overweight and children's internalizing behaviors have not been studied, there is reason to believe that parents' concern of child weight may also have important implications for psychological adjustment in children.

### **Discrepancy Between Actual Body Weight and Parental Perceptions of Weight: Possible Linkage to Internalizing Symptoms?**

Given the power of parental appraisals of child weight, it is of great importance to understand the accuracy of parental perceptions of child's weight. After all, parents' unrealistic expectations of child body shape that stems from inaccurate perception of child weight may set the stage for further psychological difficulties in children. Overestimation of weight in a child with a lean body can lead to unrealistic body expectations for the child whereas underestimation of weight in an obese child could contribute to decreased emphasis on healthy eating and physical activity (Akerman et al., 2007), which may in turn lead to adverse mental health consequences.

Indeed, available research in the area suggests that parents often fail to accurately identify the weight status of their overweight or at-risk children. Overwhelmingly, research suggests that parents, and especially mothers, tend to underreport the weight of their at-risk-of-overweight or overweight child (Tompkins et al., 2015), with more than



50% of parents being unable to recognize when their child is overweight (West, Raczynski, Phillips, Bursac, Heath Gauss, & Montgomery, 2008). A recent study of a nationally representative sample of 2-to-11-year-old children, for instance, found that about one-third of mothers identified their overweight child as “about the right weight.” Accuracy of weight perceptions also differed by child’s sex. A majority of mothers (about 85%) classified their sons who were at-risk-of-overweight as “about the right weight,” with only 14% of them correctly identifying their weight status. Mothers were slightly more accurate in their perceptions of daughter’s weight, with about 29% of them correctly identifying their at-risk-of-overweight daughters (Maynard et al., 2003), though the majority (71%) rated them inaccurately.

Parents of very young children also seem to underestimate the weight of their at-risk-of-overweight and overweight children (Maynard et al., 2003; Eckstein, Mikhail, Ariza, Thomson, Millard, & Binns, 2006). Evidence shows that a large majority of mothers of toddlers (70-91%) identified their at-risk-of overweight child as being normal weight (Baughcum, Chamberlin, Deeks, Powers, & Whitaker, 2000). Interestingly, even obese mothers who accurately identify their own weight status, tend to underestimate their obese or overweight child’s weight (Baughcum et al., 2000). Similar findings were reported among preschool and elementary school-aged children (4-8-year olds); astonishingly, all parents of overweight children underestimated their child’s weight, with not one parent correctly identifying their child as overweight (Etelson, Brand, Patrick, & Shirali, 2003). Parents in this study significantly underestimated their child’s weight status by classifying them in the normal weight category.

Interestingly, the finding of inaccuracy in parental appraisal of child weight tends to be consistent across studies and across various countries. For instance, in an Australian study of 4-year-old children, an overwhelming majority (i.e., over 70%) of mothers reported their overweight children as normal weight, and only 5% correctly identified them as overweight (Campbell, Williams, Hampton, & Wake, 2006). Similarly, Carnell and colleagues (2005) studied perceptions of child weight in a group of 3-to-5 year old children in the United Kingdom and reported that approximately 94% of parents of at risk or overweight children failed to correctly classify the weight of their children (Carnell, Edwards, Croker, Boniface, & Wardle, 2005).

Additionally, though limited, a different kind of parents' inaccurate perception is also documented: parents' tendency to inaccurately perceive their child of normal weight as an overweight. A study of 4-to-10-year old children from Italy demonstrated that although a substantial number of mothers (28%) underestimated their child's body weight, about 9% of them actually overestimated it (Genovesi et al., 2005). A more recent large-scale multicultural investigation of families with 2-to-9-year-old children reported that 16.9% of respondents across countries classified their normal weight children as "slightly or much too overweight" (Regber et al., 2013). Further support came from a relatively smaller scale study of Chinese parent-child dyads where parents of underweight children were more likely to overestimate their child's weight, at the same time when parents of overweight children largely underestimated children's weight (Chan & Wang, 2012).

It is noteworthy that while previous studies have identified the possible discrepancies between children's actual weight and parents' perceptions of weight, few have taken advantage of the fact that the gap between these two sources of information may provide unique effects on child development above and beyond what they may provide separately. While not empirically tested, it may be presumed that parental overestimation the weight of children who are of normal weight may contribute to increased body dissatisfaction and unrealistic expectation of weight shape, which may set a stage for potential internalizing symptoms in children, whereas parental underestimation of heavy child's weight could lead to children's dismissal of the importance of healthy eating habits and physical activity, thus leading to other forms of health-related outcomes (e.g., Akerman et al., 2007). Given the scarcity of empirical work on parental accuracy of perceptions, this study aims to understand the relation between parent' perception of their children's body weight and children's actual weight.

### **Study Overview: Aims and Hypotheses**

The overarching aim of this project is to understand the effects of children's body weight in early childhood at age 4.5 on the developmental trajectory of internalizing behaviors from childhood to early adolescence (from ages 4.5 to 11), emphasizing the roles of parental appraisal of children's weight and its discrepancy from their actual weight. I chose to study children as young as 4.5 years old for several reasons. First, research has documented significant increases in children's overweight among 4-to-5-year old children (about 14% of 2-to-5-year olds children, CDC, 2017); therefore, better understanding of emotional ramifications of overweight in early childhood is imperative.

Also, given that body image is thought to develop before age 6 (Menzel, et al., 2011), actual weight as well as parental appraisal of child weight in preschool ages may have the potential to set the stage for subsequent adjustment.

This study was designed to address the following research questions: 1) Does child's actual weight influence the developmental trajectory of internalizing behaviors from ages 4.5 to 11 years?; 2) Do parental appraisals of child's weight (i.e., parental perception of child overweight status and their concerns about child weight and feeding) matter for children's internalizing behaviors?; 3) Are there discrepancies between children's actual weight and parental perceptions of weight?; 4) Do discrepancies between children's actual weight and parental perceptions of child weight affect children's internalizing behaviors over time?

Several hypotheses were formulated:

Hypothesis 1: There would be a concurrent and longitudinal association between children's actual body weight at age 4.5 and internalizing symptoms such that overweight children at the age of 4.5 years would be expected to experience a higher increase in the levels of internalizing symptoms across childhood (i.e., between ages 4.5 and 11).

Hypothesis 2: Parental appraisal of child weight (i.e., parental perception of child overweight status and their concerns about child weight and feeding) would predict children's internalizing behaviors concurrently and persistently.

Hypothesis 3: The majority of parents would inaccurately appraise the weight status of the child, with many underestimating the overweight problem in their child.

Hypothesis 4: There would be a disconnect between child's actual weight and parental perceptions would predict the changing trajectory of internalizing behaviors over time, such that a greater mismatch between parental perceptions of weight and child's actual weight will predict a higher increase in levels of internalizing behaviors over time.

Although, no sex specific hypotheses were formulated, I tested the main and interactive effects of child sex in supplemental analyses.

One unique feature of this study is the utility of an adoption design, which is a valuable tool for teasing apart the underlying genetic and environmental origins of behaviors. In particular, the advantage of adoption design is a removal of passive *r*GE. If passive *r*GE is operating, then research in biologically related families cannot determine whether observed associations between how parents perceive child weight and what they do to control it, and children's internalizing outcomes are due to genes shared between parents and children. To clarify whether parental influences on children's internalizing behaviors are via environmental pathways, I adopted an adoption design whereby the adoptive parents and the child do not share common genes.

## CHAPTER 2: METHOD

### **The Early Growth and Development Study (EGDS)**

This study is based on subset of adopted families who participated in the Early Growth and Development Study (EGDS; Leve, et al., 2019). The EGDS is a prospective, longitudinal adoption study of biological parents, adopted children and adoptive parents recruited in two cohorts. In this study, I focus on Cohort I families who participated in the middle childhood data collection (further information provided later). The primary aim of the EGDS is to investigate the influences of genotype-environment interactions and correlations on child development (Leve et al., 2019). Participants were recruited between 2003 and 2006 through 33 adoption agencies located in 10 states spanning the northwest, mid-Atlantic, and southwest regions of the United States. Participating agencies reflected the full range of adoption agencies in the United States: public, private, religious, secular, those favoring open adoptions and those favoring closed adoptions. Eligibility criteria for the study participation included (1) domestic adoption placement; (2) placement occurring within 3 months postpartum; (3) nonrelative placement; (4) no known major medical conditions such as extreme prematurity or extensive medical surgeries; and (5) English proficiency at the 8<sup>th</sup> grade level for birth and adoptive parents.

The complete EGDS assessments included questionnaires, in-person interviews, and standardized testing for birth parents, adoptive parents and children; diagnostic interviews with adoptive and birth parents (about themselves and their children); observational interactions (mother-father, mother-child, father-child and mother-father-child) for adoptive families; food and activity diaries for adoptive parents; birth mothers'

pregnancy-related medical records and medical records from children's pediatricians; DNA and cortisol measures for adopted children, teacher questionnaires; and official arrest records for birth parents.

### **The Current Study Sample**

The current investigation is based on five waves of EGDS when adopted children were 4.5, 6, 7, 8 and 11 years old. The EGDS cohort I, which this study is based on, consists of 361 adoption-linked families each of which include an adoptee, adoptive mothers, adoptive fathers, and birth mothers (and birth fathers, if available). Dataset consists of 311 children at age 4.5, 320 children at age 6), 311 children at age 7, 274 children at age 8, and 290 children at age 11. In this analytical sample 57.3% of children were boys. The ethnicity of the children was 57.7% White, 22.3% multiracial, 10.9% African American, 7.7% Hispanic or Latino and 1.4% other. Adoptive parents were typically college educated and from middle to upper class families, with over 85% of them being married at each of the assessment points. Adoptive mothers and fathers were primarily Caucasian (more than 90%).

### **Measures.**

**Internalizing Problems:** Children's internalizing symptoms were assessed with adoptive mothers' and fathers' reports of the Child Behavioral Checklist (CBCL, Achenbach, 1991). When children were 4.5, 5, 6, 7, 8 and 11 years old, adoptive mothers and fathers individually rated how well each of the items described their child during the last 2 months on a 3-point scale (0 = *not true*, 1 = *sometimes true*, and 2 = *very true*). The CBCL has two versions: one designed for children ages 1.5-5 (Achenbach & Rescorla,

2000) and one for ages 6-18 Achenbach & Rescorla, 2001). The EGDS switched from the version for young children to that for older children when children were 7-years old. Both versions contain items tapping internalizing problems, but the content of some items varies across the two versions in order to better capture the behaviors that are appropriate for a certain developmental period. Given that growth curve modeling requires item equivalence across waves, we followed the method used by prior work (Gilliom & Shaw, 2004 and Fanti & Henrich, 2010), and selected the internalizing items that appeared in both versions of the measure. A total of 10 items were identified (i.e., “Aches or pains without medical cause,” “Nausea, feels sick, without medical cause,” “Nervous, high stung, or tense,” “ Self-conscious or easily embarrassed,” “ Stomach aches or cramps, without medical cause,” “Too fearful or anxious,” “ Too shy or timid,” “Unhappy, sad, or depressed,” “ Withdrawn, doesn’t get involved with others,” and “ Worries.”) A composite internalizing behavior score was created by averaging those items for adoptive mothers and fathers at each wave. Across six waves, internal consistency estimates ranged from  $\alpha = .64 - .82$  for adoptive mothers, and  $\alpha = .63 - .77$  for adoptive fathers. The interrater correlations between adoptive mothers and fathers within each wave ranged from .32 to .43, which are equivalent to the mother-father correlations for child internalizing psychopathology reported in earlier work (e.g., Achenbach, 2006; De Los Reyes & Kazdin, 2005), I created a final internalizing behavior score by averaging adoptive mothers’ and fathers’ reports for each wave.

**Parents’ Appraisals of Child Weight:** Parental appraisals of child weight, which includes two components, i.e., *parental concern about child’s weight* and *parental*



*perception of child weight status*, was ascertained using three subscales from the Birch Child Feeding Questionnaire at the age 4.5 assessment (Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002). First, *parental perception of child's weight* was assessed with a one-item measure. In EGDS, we administered this question when the child was 4.5 years old, asking adoptive mothers and fathers indicate how they would classify their child's weight status on a 5-point scale (1 = *markedly underweight*, 2 = *underweight*, 3 = *average*, 4 = *overweight*, and 5 = *markedly overweight*). This item was then recoded into a 3-point scale (0 = *underweight*, 1 = *normal weight*, and 2 = *overweight*) to accordance to the CDC weight status guideline (CDC, 2020) such that the original responses on "marked underweight" and "underweight" were combined to represent "underweight," whereas original responses on "overweight" and "markedly overweight" were combined to represent "overweight."

*Parental concern about child overweight* was assessed by two subscales. The first subscale, parental concern about child's overweight, which consists of three items, asked adoptive mothers ( $\alpha = .72$ ) and fathers ( $\alpha = .81$ ) the degree of their concern about the child becoming overweight on a three-point scale (1 = *unconcerned*, 2 = *slightly unconcerned*, 3 = *neutral*, 4 = *slightly concerned*, and 5 = *concerned*). Sample items included the following: "How concerned are you about your child eating too much when you are not around him/her?" "How concerned are you about your child becoming overweight?" The second subscale, restriction of children's food, measured parental concern and effort to control children's eating behavior. Using eight items, adoptive mothers ( $\alpha = .76$ ) and fathers ( $\alpha = .76$ ) were asked individually to report on their feeding

concern and behaviors toward their child using a 5-point scale (1 = *disagree*, 1 = *slightly disagree*, 3 = *neutral*, 4 = *slightly agree*, 5 = *agree*). Sample items included “I have to be sure that my child does not eat too many sweets” and “I intentionally keep some foods out of my child’s reach.” The interrater correlation between adoptive mothers and fathers was  $r = .40, p < .001$  for parental concern of child’s overweight, and  $r = .36, p < .001$  for restriction of child’s food, and thus I aggregated the two sources of information. Moreover, the correlation between the concern and feeding restriction subscales was  $r = .24, p < .001$ , and thus, I combined the two subscales and created a final composite score of *parental concerns of child’s overweight*.

**BMI:** Data on children’s height and weight at ages 4.5 and 5 were gathered from their medical records from their pediatricians. Because the timing of medical data varied by individuals’ schedule to visit pediatric offices, some children had multiple records at age 4.5 and 5. In those cases, we compiled the multiple medical records of height and weight gathered around the ages of 4.5 and 5 years, calculated the BMI, and then averaged them. The continuous BMI measure was then recoded into a 3-point scale in order to match the CDC qualifications of children’s BMI status (0 = *underweight*, 1 = *normal weight*, 2 = *overweight*; CDC, 2020), which was then used in the main analyses.

### **Covariates**

**Adoptive Parents’ Anxiety.** First, adoptive parents’ anxiety symptoms were included as covariates in the current study because parental anxiety can influence their concerns of children’s overweight (Epstein, Wisniewski, & Weng, 1994). Parental anxiety was ascertained using the Beck Anxiety Inventory (Beck & Steer, 1993). When

children were 4.5 years old, adoptive mothers and fathers individually rated the degree to which they were bothered by the feeling that were listed on the questionnaire. Their responses were measured on a four-point scale (1 = *Not at all*, 2 = *Slightly*, 3 = *Moderately*, 4 = *Severely*). Sample items included “Nervous” and “Feeling of choking.” Internal consistency estimates were  $\alpha = .82$  for both adoptive mothers and fathers. A composite score of parental anxiety was created by averaging the two reporters (a correlation between adoptive mothers’ and fathers’ anxiety at  $r = .15, p = .01$ ).

**Child Sex:** Child sex (0 = *boys* and 1 = *girls*) was also included as a covariate because prior work has identified sex differences in the association between BMI and internalizing behaviors, such that overweight girls are known to exhibit more adverse psychological outcomes than boys (Gibson et al., 2008). Sex differences in the rates of internalizing behaviors are also known, such that girls have a significantly higher prevalence rates, compared to boys (McLean, Asnaani, Litz, & Hofmann, 2011).

**Child Race/Ethnicity:** I used children’s race/ethnicity as a covariate given work suggesting race/ethnicity disparities in high BMI. For example, a study of nationally representative samples of children in the United Kingdom revealed that Black Caribbean children were more likely to be obese and Black African children to be overweight compared to White children (Zilanawala, Davis-Kean, Nazroo, Sacker, Simonton, & Kelly, 2015). Ethnic disparities were also found in a study of 4-to-6-year old US children, indicating that African American and Latino children displayed higher predicted mean BMI scores compared to White children (Guerrero, Mao, Fuller, Bridged, Franke, & Kuo, 2016). In EGDS, race/ethnicity was measured on an 8-point scale (1=*American*

*Indian/Alaskan, 2 = Asian, 3 = Native Hawaiian/Pacific Islander, 4 = Black/African American, 5 = White, 6 = Multiracial, 7 = Unknown, 8 = Hispanic/ Latino*); however, I recoded race, such that 0 = *White* and 1 = *Nonwhite*.

### **Missing Data Analyses**

The percentage of missingness on any variable in this study ranged from 28% to 54%, with child BMI being the highest number of missingness. To identify a specific pattern of missingness in our data, I conducted Little's  $\chi^2$  test of Missing Completely at Random (MCAR, Little, 1988). Results indicated that the data were missing completely at random ( $\chi^2_{(608)}=1811.36, p = .27$ ). In subsequent analyses, missing values were handled using SAS PROC MI (SAS Institute, 2011), which is based on a multiple imputation method. This procedure consists of three important steps to obtain accurate parameter estimates (Graham, 2009). In the first phase, the imputation model and the number of imputed datasets is specified. In this study, I created 10 datasets to incorporate appropriate variability across the imputations. In the second step, the analytic model of interest (such as SAS Proc Mixed) is run within each of the imputed datasets. Finally, in the last step, all parameter estimates (coefficients and standard errors) across all imputed datasets are combined to create one final output with all parameter estimates for the model of interest (Graham, 2009; SAS Institute, 2015).

### **Analytic Strategy**

**Preliminary Analyses.** Data were cleaned and analyzed with SPSS version 24 (IBM Corp., 2016) and SAS University Edition (SAS Institute Inc., 2011). First, descriptive analyses examined the means, variability and normality statistics (i.e.,

skewness and kurtosis) for each study variable. Correlation analyses evaluated the associations between the child BMI at age 4.5, parental perception and concern of child weight at age 4.5, and child internalizing behaviors at ages 4.5, 6, 7, 8 and 11, along with the aforementioned covariates.

**Growth Curve Analyses.** Main study hypotheses were addressed by conducting a series of growth curve analyses (Singer & Willett, 2003) in SAS PROC MIXED (SAS Institute, 2011). First, to identify the shape of internalizing behavior trajectories, I conducted an unconditional means model (Model A) which used internalizing behaviors as outcomes in the model estimating an intercept only. This unconditional means model separates the variance in the outcome variable (i.e., child internalizing behaviors) into the estimated within-person and between-person variance, in addition to providing a baseline for evaluating the shape of internalizing behavior trajectories from ages 4.5 to 11. Next, an unconditional linear growth model (Model B) was fitted, which included age as a predictor of internalizing behavior trajectories. The fit of this model was subsequently compared to Model A by using fit indices such as the log-likelihood ratio, AIC and BIC (Vrieze, 2012). Next, to determine whether the shape of internalizing behaviors between the ages of 4.5 and 11 would best be described as curvilinear, an unconditional quadratic model (Model C) was conducted by including a quadratic term of age for the rate of change. The fit indices produced from this model were then compared to those from Model B to determine the shape that best described the trajectory of internalizing behaviors.

Once the shape of the trajectories of internalizing behaviors was determined, I tested Hypothesis 1 (i.e. a main effect of child BMI on the trajectory of internalizing behaviors over time) by adding children's BMI and BMI x age interaction in the model (Model D). Then, the next two models addressed the hypothesis regarding the role of parental appraisals for children's internalizing behaviors. Model E (Hypothesis 2) included parental perception and parental perception x age interaction in the model, whereas, Model F included parental concerns of child weight, in addition to parental concern x age interaction. Lastly, to test the hypothesis regarding the role of the mismatch between child's actual weight and parental appraisals of child weight (Hypothesis 4), Model G tested BMI x parental perception of weight x age interaction, whereas Model H tested BMI x parental concern of weight x age interaction. All of these analyses include child sex, race/ethnicity, and parental anxiety as covariates.

## CHAPTER 3: RESULTS

### Preliminary Analyses

*Descriptives:* Table 1 provides the means and standard deviations of internalizing behaviors for ages 4.5, 6, 7, 8 and 11. In general, the examination of the means over time revealed that for both boys and girls, internalizing behaviors during this age span appear to take a slight upward trend.

*Correlations.* The bivariate correlation matrix of the study variables is presented in Table 2. Interestingly, children's BMI at age 4.5 was positively associated with mothers' ( $r = .25, p = .03$ ) and fathers' ( $r = .37, p = .002$ ) perception of child weight status for boys, but not girls ( $r = .21, p = .11$  and  $r = .20, p = .16$ ). The magnitude of correlations suggests the possibility that actual BMI and parents' perceived child weight status did not correspond perfectly. Additionally, parental concern of child overweight (maternal and paternal reports combined) was positively associated with children's internalizing behaviors at ages 4.5 ( $r = .18, p = .05$ ), 6 ( $r = .20, p = .04$ ) and 8 ( $r = .26, p = .006$ ) for boys and age 7 for girls ( $r = .23, p = .03$ ). Lastly, race/ethnicity in girls was positively associated with parental perception of child overweight ( $r = .20, p = .03$ ), such that parents of nonwhite girls expressed higher levels of weight concern, compared to parents of white girls. No such associations were found in boys, however. Given the potential sex and racial/ethnic differences in interrelations among variables, I retained child sex and race/ethnicity as covariates in the following analyses.

Table 1.

*Means and Standard Deviations of Children's Internalizing Behaviors by Sex and Age*

	Boys	Girls
Age 4.5	11.02 (1.40)	11.37 (1.88)
Age 6	11.11 (1.64)	11.41 (1.73)
Age 7	11.48 (1.82)	11.64 (1.67)
Age 8	12.09 (2.40)	12.36 (2.15)
Age 11	12.75 (2.55)	12.62 (2.54)



Table 2. *Correlations of Study Variables by Child Sex*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Child Race/Ethnicity		0.20	0.04	0.22 *	0.08	0.20 *	0.06	0.06	-0.16	-0.03	-0.05	-0.06	-0.15	0.08	-0.16	0.01
2 Child's Actual BMI	0.13		-0.05	0.21	0.20	0.24	0.30 *	0.14	0.09	-0.11	0.19	0.07	-0.08	-0.01	-0.08	-0.01
3 Parental Anxiety	0.01	0.00		-0.11	-0.03	-0.12	-0.01	0.04	-0.01	0.12	-0.02	0.30 **	0.16	0.22 *	0.22 *	0.16
4 Mothers' Perception of Child's Weight	-0.08	0.25 *	0.11		0.56 **	0.86 **	0.26 **	-0.05	0.12	0.20	0.20 *	-0.04	0.03	0.11	-0.07	0.19
5 Fathers' Perception of Child's Weight	0.12	0.37 **	-0.04	0.57 **		0.84 **	0.25	0.11	0.16	0.03	0.20 *	0.14	0.17	0.19	0.09	0.12
6 Parental Perception of Child's Weight-Composite <sup>a</sup>	0.04	0.36 **	0.02	0.83 **	0.91 **		0.29 **	0.26 **	0.10	0.16	0.20 *	0.02	0.05	0.14	0.00	0.17
7 Mothers' Concern of Child's Weight	-0.16	0.32 **	0.04	0.21 *	0.33 **	0.30 **		0.44 **	0.20 *	0.13	0.70 **	0.04	0.16	0.21	0.07	0.05
8 Fathers' Concern of Child's Weight	0.07	0.15	-0.01	0.28 **	0.21 *	0.07	0.40 **		0.03	0.09	0.62 **	0.02	-0.07	0.12	0.00	-0.04
9 Mothers' Restriction of Child's Food	-0.13	-0.14	0.18 *	0.18 *	0.06	0.12	0.31 **	0.20 *		0.43 **	0.67 **	0.05	0.17	0.14	0.20	0.17
10 Fathers' Restriction of Child's Food	0.02	-0.01	0.10	0.25 **	0.12	0.08	0.23 *	0.33 **	0.32 **		0.63 **	0.15	0.34 **	0.26 *	0.24 *	0.29 **
11 Parental Concern of Child's Weight-Composite <sup>b</sup>	-0.11	0.14	0.13	0.32 **	0.25 **	0.28 **	0.71 **	0.74 **	0.66 **	0.67 **		0.07	0.19	0.23 *	0.18	0.16
12 Internalizing Behaviors at Age 4.5	-0.05	-0.16	0.04	-0.09	0.03	-0.04	0.01	0.12	0.25 **	0.09	0.18 *		0.60 **	0.50 **	0.62 **	0.49 **
13 Internalizing Behaviors at Age 6	-0.07	-0.03	-0.03	-0.09	-0.08	-0.11	0.13	0.14	0.16	0.15	0.20 *	0.28 **		0.55 **	0.63 **	0.54 **
14 Internalizing Behaviors at Age 7	-0.03	-0.01	0.12	-0.06	-0.14	-0.10	-0.07	0.05	0.23 *	0.07	0.10	0.30 **	0.20 *		0.64 **	0.63 **
15 Internalizing Behaviors at Age 8	-0.16	-0.06	0.08	-0.03	-0.02	-0.04	0.10	0.12	0.33 **	0.11	0.26 **	0.39 **	0.32 **	0.56 **		0.64 **
16 Internalizing Behaviors at Age 11	-0.06	-0.06	0.07	0.09	0.03	0.05	0.00	0.13	0.25 *	0.10	0.16	0.32 **	0.33 **	0.55 **	0.78 **	

Note: <sup>a</sup> Parental Perception of Child's Weight-Composite = the average of mothers' and fathers' perceptions of children's weight; <sup>b</sup> Parental Concern of Child's Weight-Composite = the average of mothers' and fathers' concern about child overweight and food restriction. Boys' correlations are below the diagonal.

Table 3. Mothers' and Fathers' Perception of Child Weight Status

Actual Weight Status	Perceived Weight Status of Children					
	Underweight		Normal Weight		Overweight	
	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers
Underweight <sup>a</sup>	0.7	0.8	8.1	10.8	0	0
Normal Weight <sup>b</sup>	0.7	0.8	65.2	62.5	24.4	23.3
Overweight <sup>c</sup>	0	0	0	0	0.7	1.7

Note: <sup>a</sup> ≤5th percentile; <sup>b</sup> normal weight ≤5th percentile and ≤85th percentile; <sup>c</sup> ≥85th percentile. Values are in percentages.

*Discrepancy Between Children's Actual BMI and Parental Perception of Child Weight.* Table 3 presents the rates of mismatch between child's actual BMI (medical record data recorded into a 3-point scale by the CDC guideline) and mothers' and fathers' perception of child's weight. About 65% of mothers and 62% of fathers accurately perceived their normal-weight children as being at normal weight; however, 24% of mothers and 23% of fathers overestimated the weight of their child, such that they perceived their normal-weight child to be overweight. The intraclass correlation coefficient between mothers and fathers was high ( $ICC = .73, p < .001$ ); therefore, given the high rates of overall between the reporters, an overall score of parental perception of child weight was created by averaging mothers' and fathers' reports for subsequent analyses.

### **Longitudinal Trajectory of Internalizing Behaviors as Function of Age, Children's BMI and Parental Perceptions of Child Weight**

I performed a series of multilevel models using SAS PROC MIXED (Singer, 1988; Singer & Willett, 2003) to model the trajectory of child internalizing behaviors. Table 4 present the parameter estimates of all the models described in the data analytic plan. In these analyses, parameter estimates are interpreted similarly to unstandardized regression coefficients in multiple regression analyses, which indicate an increase or decrease in the outcome variable with a unit change of independent variables. I used fit indices such as log-likelihood ratio, AIC and BIC to determine which model fit the data best for each of the outcomes. Obtained coefficients represent coefficients estimates with the maximum likelihood (ML) estimation procedure with unstructured covariance matrix.

### **Unconditional models.**

The descriptive statistics (Table 1) suggested that internalizing behaviors appeared to increase linearly, but gradually, from ages 4.5 to 11. Then I formally tested the shape of trajectories using PROC MIXED. First, I tested Model A, which describes the variation in internalizing behaviors (Singer & Willett, 2003). As shown in Table 4, both estimated within and between-person variances from unconditional mean model (Model A) were significant ( $\sigma_{\epsilon}^2 = 3.34$ ,  $\sigma_{\theta}^2 = 1.19$ ,  $p < .001$ ). This model indicated that approximately 25% of the total variance in internalizing behaviors was due to differences among children ( $\hat{\rho} = 0.256$ ).

A subsequent unconditional linear growth model (Model B) included children's age as a predictor. To avoid the possible issues with collinearity between the true intercept and slope in the unconditional models (McElreath, 2020; Singer & Willett, 2003), age was centered at age 5 for the unconditional models. As shown in Table 4, the linear term for internalizing behaviors was positive ( $\gamma = 0.26$ ,  $p < .001$ ), indicating an increase in the rates of internalizing behaviors between the ages of 4.5 and 11 years. Estimated within and between person variances were also significant ( $\sigma_{\epsilon}^2 = 2.62$ ,  $\sigma_{\theta}^2 = 0.75$ ,  $\sigma_{\tau}^2 = 0.05$  all  $p < .001$ ). This model was then compared to Model A with a chi-square difference test, indicating that Model B fit better than Model A ( $\chi^2_{(3)} = 251$ ,  $p < .01$ ). The Pseudo  $R^2$  suggests that model B explained about 21% of the within-person variation in internalizing behaviors that is associated with the linear term.

In the next model, I added a quadratic term for the rate of change (Model C). This unconditional model retained the significant coefficient for the linear term of age, ( $\gamma =$

.24,  $p = .002$ ), but the quadratic term was not significant ( $\gamma = .003, p = .74$ ). Moreover, estimated within and between-person variances were significant in this model as well ( $\sigma_{\epsilon}^2 = 2.63, \sigma_0^2 = 0.75, \sigma_1^2 = 0.05$ , all  $p < .001$ ). The chi-square difference test suggested that Model B displayed significantly lower indexes of -2 residual log likelihood ( $p < .05$ ), suggesting that Model B fit better than Model C ( $\chi^2_{(2)} = 7.25, p < .05$ ). Thus, as expected from the descriptive statistics, the changes in child internalizing behaviors between ages 4.5 and 11 appeared to take a linear, gradual trend. I tested the potential sex differences in the rate of change (not shown), but the age x sex interaction was not significant.

#### **Conditional models.**

To examine the effect of children's actual BMI and parental appraisal (i.e., concern and perception) of child weight status, I performed a series of conditional models with covariates (i.e., parental anxiety, child race/ethnicity and child sex). To facilitate the interpretability of the findings, I structured these conditional models to have age 4.5, or the initial data point of the study, as a intercept.

*The role of children's actual BMI.* In the next model (Model D), I tested the concurrent and persistent effects of children's actual BMI on child internalizing behaviors. Children's actual BMI at age 4.5 was not a significant predictor of internalizing behaviors at age 4.5 ( $\gamma = -0.13, p = .58$ ). Moreover, the BMI x age interaction did not reveal a significant association with the change in internalizing behaviors ( $\gamma = -0.002, p = .96$ ).

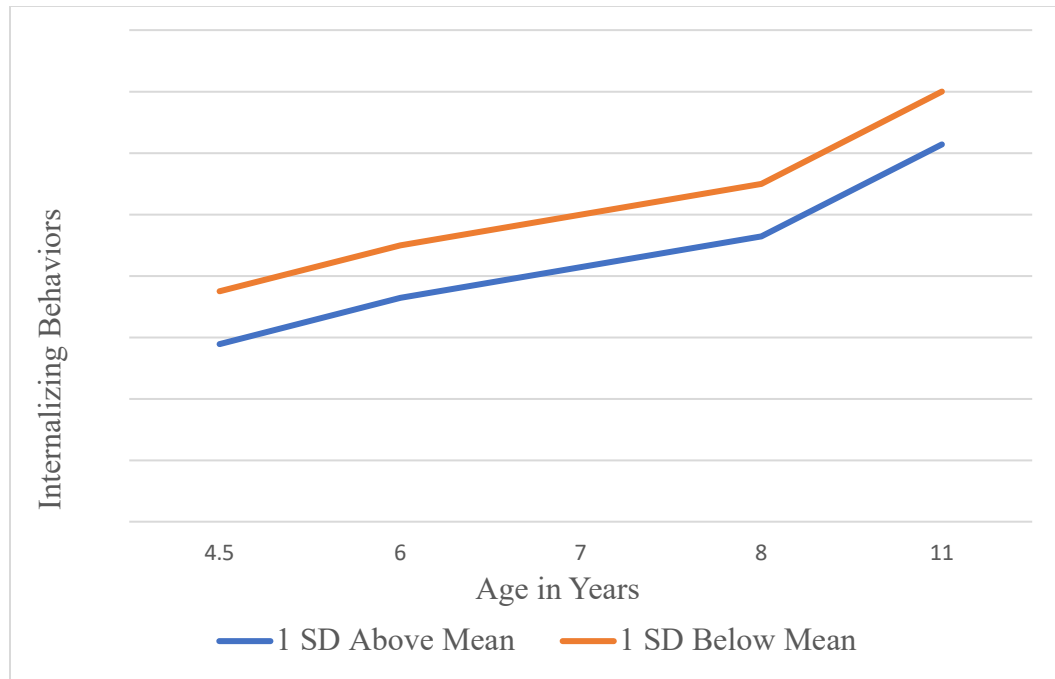
*The role of parental appraisal of child weight: Perceived Weight Status and Weight Concern.* Subsequent two models were designed to test the concurrent and

lingering effects of parental appraisals in children's internalizing behaviors. Model E included parental perception of child weight status and its with age. Neither parental perception of child weight status ( $\gamma = -0.15, p = .58$ ) nor its interaction with age ( $\gamma = 0.08, p = .37$ ) was significant predictor of internalizing behaviors. Model F showed that parental concern of child weight was a significant, concurrent predictor of internalizing behaviors ( $\gamma = 0.38, p = .01$ ) above and beyond actual BMI, indicating children of parents who were overly concerned about child weight reported higher levels of internalizing behaviors at age 4.5; however, the concern x age interaction was not significant ( $\gamma = -0.04, p = .22$ ). Figure 1 illustrates the estimated trajectories of internalizing behaviors by the levels of parental concern.

***The mismatch between actual BMI and parental appraisals of child overweight.***

Furthermore, to address the questions whether the mismatch between children's actual weight and parental appraisals of weight affect children's internalizing behaviors, Model G included an interaction between children's actual BMI and parental perceptions of weight, which was not significant ( $\gamma = 0.003, p = .99$ ). Similarly, the model tested for the BMI x parental perception x age interaction, but it was also not significant ( $\gamma = 0.02, p = .82$ ).

Analogous to the previous model, Model H assessed the mismatch between children's actual weight and parental concerns of child weight. Like in the previous model neither BMI x parental concern ( $\gamma = -0.08, p = .78$ ) nor the three-way BMI x parental concern x age interaction ( $\gamma = -0.03, p = .72$ ) was a significant predictor of children's internalizing behaviors.



*Figure 1.* Age trajectories of internalizing behaviors by levels of parental concern

Table 4. Fixed and Random Coefficients for Trajectories of Internalizing Behaviors: Unconditional Model

	Model A	SE	Model B	SE	Model C	SE
Intercept	11.79***	0.07	11.18***	0.08	11.19***	0.09
BMI_4.5	-----	-----	-----	-----	-----	-----
Parental Perception of Child's Weight	-----	-----	-----	-----	-----	-----
Parental Concern of Child's weight	-----	-----	-----	-----	-----	-----
BMI x Parental Perception of Child's Weight	-----	-----	-----	-----	-----	-----
BMI x Parental Concern of Child Weight	-----	-----	-----	-----	-----	-----
Rate of Change						
Age	-----	-----	0.26***	0.03	0.24**	0.06
Age <sup>2</sup>	-----	-----	-----	-----	0.003	0.009
BMI x Age	-----	-----	-----	-----	-----	-----
Parental Perception x Age	-----	-----	-----	-----	-----	-----
Parental Concern x Age	-----	-----	-----	-----	-----	-----
BMI x Parental Appraisal x Age	-----	-----	-----	-----	-----	-----
BMI x Parental Concern x Age	-----	-----	-----	-----	-----	-----
Variance Components						
Level 1						
Within-Person	3.34***	-----	2.62***	-----	2.63***	-----
Level 2						
In Intercept	1.19***	-----	0.75***	-----	0.75***	-----
In Linear Slope	-----	-----	0.05***	-----	0.05***	-----
Covariance	-----	-----	0.06	-----	0.06	-----
Goodness of Fit						
-2 Log Likelihood	7661.18	-----	7405.72	-----	7413.03	-----
AIC	7665.18	-----	7413.72	-----	7421.03	-----
BIC	7672.98	-----	7429.31	-----	7436.57	-----



Table 5. Fixed and Random Coefficients for Trajectories of Internalizing Behaviors: Conditional Models

	Model D	SE	Model E	SE	Model F	SE	Model G	SE	Model H	SE
Intercept	11.04***	0.32	11.20**	0.35	11.07***	0.29	11.11***	0.39	11.05***	0.26
Parental Anxiety	0.07**	0.02	0.07**	0.02	0.07***	0.02	0.07**	0.02	0.07***	0.02
Child Sex	0.23	0.16	0.23	0.16	0.31 <sup>+</sup>	0.16	0.24	0.16	0.24	0.16
Child Ethnicity/Race	0.14	0.15	0.14	0.16	0.10	0.14	0.13	0.16	0.16	0.15
BMI_4.5	-0.13	0.23	-0.14	0.22	-0.13	0.21	-0.01	0.26	-0.14	0.16
Parental Perception of Child's Weight	-----	-----	-0.15	0.28	-----	-----	-0.23	0.52	-----	-----
Parental Concern of Child's weight	-----	-----	-----	-----	0.38**	0.14	-----	-----	0.52	0.48
BMI x Parental Perception of Child's Weight	-----	-----	-----	-----	-----	-----	0.003	0.34	-----	-----
BMI x Parental Concern of Child's Weight	-----	-----	-----	-----	-----	-----	-----	-----	-0.08	0.31
Rate of Change										
Age	0.26**	0.08	0.18 <sup>+</sup>	0.10	0.25***	0.02	0.17	0.17	0.28**	0.08
Age <sup>2</sup>	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BMI x Age	-0.002	0.05	-----	-----	-----	-----	-0.01	0.11	-0.01	0.05
Parental Perception x Age	-----	-----	0.08	0.09	-----	-----	0.14	0.18	-----	-----
Parental Concern x Age	-----	-----	-----	-----	0.04	0.04	-----	-----	0.08	0.13
BMI x Parental Perception x Age	-----	-----	-----	-----	-----	-----	-0.02	0.11	-----	-----
BMI x Parental Concern x Age	-----	-----	-----	-----	-----	-----	-----	-----	-0.03	0.09
Variance Components										
Level 1										
Within-Person	2.60***	-----	2.60***	-----	2.62***	-----	2.60***	-----	2.58***	-----
Level 2										
In Intercept	0.62***	-----	0.62***	-----	0.48***	-----	0.63***	-----	0.59***	-----
In Linear Slope	0.05***	-----	0.04***	-----	0.04***	-----	0.05***	-----	0.04***	-----
Covariance	0.04	-----	0.04	-----	0.05	-----	0.04	-----	0.04	-----

	Model D	Model E	Model F	Model G	Model H
Goodness of Fit					
-2 Log Likelihood	7407.99	7406.22	7385.70	7412.97	7392.66
AIC	7415.99	7414.22	7393.70	7420.97	7400.66
BIC	7431.56	7429.80	7409.25	7426.54	7416.22

## CHAPTER 4: GENERAL DISCUSSION

Existing empirical evidence has painted a clear picture that overweight status in childhood is a potent risk factor for internalizing behaviors in childhood and adolescence (Gibson et al., 2017; Fang & Rizzo, 2010; Phillips et al., 2012). Most of this work in young children, however, has considered concurrent associations between overweight status and internalizing behaviors, with surprisingly little information regarding the possible longitudinal associations. This study aimed to fill this void in the literature by evaluating whether and how children's overweight status at the age of 4.5 years affects the trajectory of internalizing behaviors between ages 4.5 and 11. Additionally, I was specifically interested in understanding the roles of parental appraisals of child weight and its discrepancy from children's actual weight in the developmental trajectory of internalizing behaviors in childhood.

Using data from a sample of 361 families who participated in a longitudinal adoption study, I addressed the following questions: 1) Does child's actual weight influence the developmental trajectory of internalizing behaviors from ages 4.5 to 11?; 2) Do parental appraisals of child's weight (i.e., parental perception of child overweight status and their concerns about child weight and feeding) matter for children's internalizing behaviors; 3) Is there any discrepancy between children's actual weight and parental perceptions of child weight?; 4) Do discrepancy between children's actual weight and parental perceptions of child weight affect children's internalizing behaviors over time?

Obtained findings provided some support of the original hypotheses. Overall, internalizing behaviors seemed to increase linearly and gradually between the ages of 4.5 and 11 years for both boys and girls. Interestingly, no association between children's actual BMI and internalizing behaviors was observed. Parental concern (but not perception) of child weight status was positively associated with child internalizing behaviors concurrently, but no long-term effect was observed. Lastly, the discrepancy between children's actual weight and parental appraisals of child weight was not significant predictors of children's internalizing behaviors, either concurrently or longitudinally.

### **Children's actual BMI and the Trajectory of Internalizing Behaviors in Childhood**

Results indicated that children's actual BMI was not significantly related to internalizing behaviors at age 4.5. These results seem to contradict a growing body of evidence that reports concurrent effects of child overweight on internalizing behaviors, such as withdrawal, anxiety, and somatic complaints (Erickson, Robinson, Haydel & Killen, 2000; Gibson et al., 2017). The inconsistency between previous work and this study may be attributed to the age difference between the current sample and samples used in prior studies. One explanation offered to understand the association between BMI and internalizing psychopathology comes from Ross' (1994) reflective self-appraisal perspective, which argues that low self-esteem, which could eventuate in depression, in overweight individuals stems from social stigma toward devaluation of the obese. While this perspective may be applicable to cohorts of older children and adolescents who have necessary socio-cognitive skills to internalize others' perspectives and attitudes into their

self-construct, younger children such as preschoolers may not have the capacity to do the same. Although research has shown that preschool-aged children are able to capture differences in body shape and size and form evaluative opinion about others based on their body shape (Spiel et al., 2012; Tremblay et al., 2011), they may be too young to process the information and incorporate stigma and negative feelings related to body weight as part of self-concept (Puhl & Latner, 2007). Body satisfaction also is a well-known mechanism that links BMI and internalizing behaviors in both youths and adults. In cultures that endorse beauty of thinness, an increase weight predicts lower body dissatisfaction (McLaren & Gauvin, 2002), which may precipitate internalizing psychopathology. However, body dissatisfaction tends to emerge later in adolescence (Tiggemann, 1992), thus, for preschool-aged children, weight-related issues may not be related to internalizing behaviors in the same way.

Interestingly, children's actual BMI did not exert any longitudinal impact on internalizing behaviors either. This result is consistent with other reports that also saw the absence of significant effects of children's BMI on internalizing psychopathology in childhood (e.g., Lawlor, Mamun, O'Callaghan, Bor, Williams, & Najman, 2005; Sawyer, Miller-Lewis, Guy, Wake, Canterford, & Carlin, 2006). For instance, an earlier investigation of 5 and 14 -year old children did not find associations between overweight status at 5 years old and internalizing behaviors at age 14 (Lawlor, et al., 2005). Although the exact explanation for the lack of longitudinal associations is currently unknown, I speculate that for the majority of individuals, BMI, especially at very young age, is a short-term influencer that alters how one and others think of the body *at the*

*moment*, not having a persistent effect on later development. In fact, some evidence on dieting shows that weight loss significantly predicts improvements in psychological well-being in children, as suggested by an earlier investigation where change in BMI was significantly correlated with an increase in body satisfaction, physical appearance esteem, and global self-worth (Walker, Bewick, & Hills, 2003).

### **Parental Appraisals of Child Weight**

#### **The Role of Parental Concern in Children's Internalizing Behaviors.**

Another important aim of this investigation was to examine the concurrent and persistent effects of parents' appraisals about child weight in internalizing behaviors in childhood. Obtained results partially supported the original hypotheses. Specifically, results indicated that at age 4.5, children of parents who were more concerned about their child's overweight reported higher scores of internalizing behaviors than children of parents who were less concerned. This effect of parental concern existed even after controlling for children's actual BMI and parents' anxiety symptoms. No prior work that I am aware of has directly assessed the importance of parental concern of child overweight on child psychological outcomes especially at this young age. It is also important to highlight that these results are especially interesting because they came from data in which children and parents are not biologically unrelated. The utility of an adoption design gives credence in my result in that the observed association between parental concern and child internalizing psychopathology could be attributed to *environmental* mechanisms.

Why would parental concern about child overweight be associated with child internalizing behaviors? Although this study was not designed to delineate the mechanisms of association, clues from the related literature suggests that concerned parents may directly or indirectly criticize the weight of their child, which may in turn send a signal to children that they are imperfect, not meeting parental expectation, and not loved, which negatively impact their evolving self-concept (Davison, Markey & Birch, 2000; Smolak et al., 1999). For example, Pierce and colleagues (1993) found that parental dissatisfaction with children's body size, as well as children's beliefs regarding parental dissatisfaction, were associated with lower global self-concept. Future research should evaluate whether parental concerns are expressed in the form of disapproval such as criticism and expression of dissatisfaction with child weight, which may influence children's mental health outcomes.

It is also noteworthy that the cross-sectional nature of the findings unfortunately restricts my ability to make an accurate conclusion regarding the directionality of the effect. For instance, it is generally assumed that parental concern would influence children's emotional well-being, but the opposite direction is also possible. For example, there is compelling evidence that behavioral and emotional problems in normal weight school-aged children predict development of overweight several years later (Lumeng et al., 2003), which could facilitate parental concern about child weight. Although our findings cannot speak to the presence of bidirectional effects, I suspect that the relationships between parental appraisals and children's weight are more complicated and potentially bidirectional.

Interestingly, no sex difference in the effects of parental concern on internalizing symptoms was found. Previous work has identified girls' heightened vulnerability to parental criticisms about their weight (e.g., Davison & Birch, 2002). For instance, Davison and Birch (2004) reported that in response to their parents' concern of their weight, girls displayed more negative stereotypes of weight and emphasized weight loss a lot more than boys. However, contrary to that expectation, my results revealed that boys and girls in the current analytical sample were equally affected by parental concerns of their weight. One reason for the lack of sex differences could be that children in our sample were quiet young, and sex differences in the effect of parental concerns about child weight may appear later in adolescence when physical appearance and architecture of self becomes tightly intertwined especially in girls. Clearly, more work is required to explore when and how sex differences in the association between parental concerns of weight and internalizing behaviors emerge.

Lastly, I was interested whether parental concerns of child weight at age 4.5 would have significant long-term impact on child internalizing behaviors. Findings did not support my original hypothesis. Thus, parental concern about child overweight at a very young age (i.e., age 4.5) may not have meaningful long-term influences on children's psychological well-being.

### **The Role of Parental Perceptions in Children's Internalizing Behaviors.**

Another question that I had in this study was whether parental perceptions predicted children's internalizing behaviors both short and long-term. Interestingly, while parents' concern about child overweight concurrently predicted children's internalizing



behaviors, parental perceptions (i.e., whether parents think of the child as underweight, normal, or overweight) did not seem to be a significant correlate of children's psychological well-being. The difference between the effects of parental perception and concern are interesting. Parental concern, for instance, can be manifested in a form of verbal criticism and overt restriction of food intake (e.g., Lampard, Byrne, Zubrick, & Davis, 2008), which may in turn lead to adverse child outcomes (Taylor et al., 2006), but perceptions are generally covert and less evaluative cognitive processes that may not necessarily be observed by the child. Without doubt, current results warrant further investigations that will assess how perception and concern of weight are manifested and whether they will have implications for children's psychological well-being.

### **Parental Misperceptions of Child Weight**

Another question that I raised in this study was: are parents accurate judge of children's weight status, or do they have tendency to misconstrue the risks associated with child overweight? Results regarding parental perception of child weight indicated that more than 60% of mothers and fathers of normal-weight children in our study correctly identified their children as being of normal weight. However, about 24% of both mothers and fathers incorrectly classified their children as "normal weight" while the actual BMI recorded at pediatrician's office indicated that these children were overweight. Obtained results regarding parents' tendency to underestimate the weight of their overweight children are in line with prior findings (e.g., Crawford, Timperio, Telford, & Salmon, 2006; Maynard et al., 2003, West et al., 2008). These findings are not

surprising given that adults are unable to recognize overweight in themselves (Timperio, Cameron-Smith, Burns, & Crawford, 2000).

Why would a significant portion of parents misperceive their children's weight and underestimate the overweight risk, when pediatricians most likely measured the child's weight in front of the parents and informed them about their children's actual weight? The tendency to underestimate child weight may reflect parents' reluctance to admit the true weight status of their children or their failure to tie the objective measurement of weight (e.g., pounds, kg) into the concept of overweight status or risks associated with overweight. Existing qualitative research suggest that mothers frequently evaluate their children's overweight not in terms of height and weight, but in terms of physical limitations (Jain, Sherman, Chamberlin, Carter, Powers, & Whitaker, 2001). Mothers expressed distrust of growth charts and considered children to be of healthy weight as long as their social functioning and activity levels were not impaired (Jain et al., 2001). Additionally, there may be differences between clinical and non-clinical definitions of overweight. As the rates of obesity continue to increase in the community, people's perceptions of "overweight" vs. "normal weight" may have shifted, such that children who could clinically get labeled as overweight may be viewed by their parents and the community as normal weight (Lampard et al, 2008). Importantly, research has shown that parents of very young children are particularly prone to underestimate weight risk of overweight or at-risk-of-overweight children (Maynard et al., 2003; Eckstein et al., 2006). In fact, in their investigation of 2- to 11-year old children, Maynard and colleagues (2003) found that mothers of older children were less likely to misperceive the

weight of their children, compared to those of younger children. With younger children, parents perhaps believe that children will outgrow being overweight, especially when they become older, taller, and more physically active (Jaballas, Clark-Ott, Clasen, Stolfi, & Ubran, 2011).

However, it is important to note that while our results echo prior findings regarding parental misperception of their children's actual weight, the rates of mismatch were lower in the current sample compared to previous reports which estimated that as high as 70 to 80% of parents fail to accurately perceive the weight of their overweight children (Baughcum et al., 2000; West et al., 2008). The lower rate of parental misappraisal in the current study may be related to the nature of our sample. Evidence shows that the higher levels of education may help parents accurately identify the weight of their children (Baughcum et al., 2000; Genovesi et al., 2005). Mothers and fathers in our sample were typically college-educated, with the majority of them having at least four-year college degree.

### **The Interplay between Child's Actual Weight and Parental Appraisals: Does it Matter for Child Internalizing Behaviors?**

Another aim of the current study was to explore the effects of parental appraisals of child weight (i.e., concern about overweight status and perceived weight status) and its interaction with children's actual BMI on children's internalizing behaviors. To my best knowledge, no studies have examined the effects of parental misperception of child's weight on their emotional well-being; therefore, this study was the first attempt to move beyond simple assessments of misperceptions trying to understand whether this

misperception have implications for children's internalizing outcomes. Despite the fact that about a quarter of parents in this study underestimated the overweight status of their child, this apparent overestimation did not seem to predict children's internalizing behavior outcomes. More detailed assessments of the lack of significant associations are required, but several possible explanations could be offered at this point. First, the rates of parental underestimation of child weight were relatively lower in the current sample, which could have been insufficient for a clear detection of its impact on children's internalizing behaviors. Another more probable explanation is that parental underestimation of child weight creates a positive bias for children, by sending them a signal that their weight is up to their parents' standards of weight, and therefore, meet societal expectations of accepted body weight. On the other hand, parental overestimation of child weight (i.e., parents perceive a child to be overweight when she or he is at the normal weight range) could have detrimental outcomes for children self-esteem, as children become exposed to weight-related stigma and negative comments from parents. In our study, however, none of the parents overestimated the weight of their children, thus limiting our abilities to draw meaningful conclusion regarding its effects of children's internalizing behaviors. Clearly, more work is required to carefully assess the importance of parental misperceptions of child weight on children's internalizing outcomes.

### **Strength and Limitations**

This study incorporates several methodological strengths that lend credence to the reported results. The first advantage is the utility of objective medical records for child

BMI which is likely to produce a more accurate estimate of children's weight. Height and weight self-reported by either children or their parents (rather than measured) may result in systematic bias in the calculation of BMI, as reported weight has been found to be lower than actual weight and reported height to be slightly taller than measured one (Strauss, 1999).

Relatedly, this study utilized multiple sources of information including maternal and paternal reports and medical records. Assessments based on reports from multiple sources are recommended for rich and more reliable source of information, as characteristics of informants, contexts and even discrepancies between informants provide different perspectives and information, which when combined, provide more accurate assessments (Achenbach, 2006).

Another strength worth mentioning is the utility of an adoption design, which allows for a clear separation of underlying common genetic and environment effects in the association between parent and child-level variables. Data from this study supported the importance of parental concerns of children's weight as an environmental risk for children's psychological outcomes. Finally, although no significant longitudinal influences were observed in this study, the use of longitudinal design has the potential to clarify the source of association between observed longitudinal effects.

However, these strengths should be considered in light of several caveats. The first limitation pertains to the combination of the two versions of the CBCL (The preschool version for children age 1.5 and 5 and school-age version for children ages 6-18). The long-term longitudinal projects, such as EGDS, necessarily change the survey

questions to keep the instruments age appropriate. However, in this study, I selected common items across the two versions, which inevitably stripped the age-specific items. It is also important to mention that this analytical sample consisted of predominantly white/Caucasian parents, which could limit the generalizability of the findings. There is evidence to suggest that cultural beliefs regarding body shape and size may influence parents' perceptions of child's true weight, such that cultural acceptance of larger body size, for instance, may result in failure to recognize e overweight status in children (Young-Hyman, Herman, Scott, & Schlundt, 2000). Relatedly, the majority of the parents in the current analytical sample were college-educated, which according to research could also bias parental perceptions of weight, such that higher levels of education may predict more accurate perceptions of children's actual weight (Genovesi et al., 2005). Consequently, for accuracy and generalizability of results, future research should use more ethnically and educationally diverse samples. Lastly, the high number of missingness on the BMI information retrieved by medical records (~54%) is another limitation worth mentioning. Although multiple imputation technique was utilized to ensure more reliable parameter estimates, future work should try replicating these findings using complete datasets.

## **Conclusion**

The current study investigated the synergetic influences of actual and perceived child weight on internalizing behaviors in childhood. Findings suggested that children's actual weight, measured by BMI from medical records, at age 4.5 did not predict internalizing behaviors either concurrently or longitudinally. However, interestingly,

parental concerns of child weight were identified as significant predictors of concurrent internalizing behaviors. Approximately ¼ of parents in this study misperceived children's overweight status, underplaying the risk of overweight, but parental misperception did not affect child internalizing behaviors either concurrently or longitudinally. Overall, findings convey hopeful news that overweight status in preschool age does not seem to have lingering negative impact on children's emotional well-being later in development, but parental worry and concern about child weight, regardless of children's actual weight, seem to spill over to children's psychological health.

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