Observed Parenting Practices in Early Childhood as Predictors of Child Weight Status and Behavioral Problems at Age 10

by

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ABSTRACT

Pediatric obesity is a public health concern due to its elevated prevalence rates and its relation to concurrent and long-term physical and psychosocial consequences. Pediatric obesity has been found to be associated with problem behaviors, albeit with inconsistent findings. The mechanism of this relation is unclear. It is possible that they have a shared etiology. Self-regulation and parenting practices are two factors that have been implicated in the development of problem behaviors and are garnering evidence for their relation with pediatric obesity. The goal of the present study was to examine whether self-regulation (SREC), positive behavior support (PBSEC), and coercive limit-setting (CLSEC) in early childhood are shared etiological factors of pediatric obesity and problem behaviors. Using multinomial logistic regression the likelihood of belonging to four outcome groups (Comorbid, Problem behavior only, Overweight only, and Typically developing) at age 10 based on these factors was assessed. Analyses controlled for intervention group assignment, child gender, child African-American or Bi-racial, child Hispanic, cumulative risk, child body size impression at age 2, and parent body size impression at baseline. In the models examining SREC alone, for every 1 standard deviation increase in SREC, there was a reliable reduction in the odds of the child belonging to the comorbid and problem behavior only groups at age 10, compared to the typically developing group (OR = 0.386, 95% CI [0.237, 0.628], OR = 0.281, 95% CI [0.157, 0.503], respectively). This relation was maintained when SREC was in the same model as PBSEC and CLSEC. PBSEC and CLSEC alone did not impact the likelihood of belonging to any of the outcome groups. A significant interaction was found between SREC and CLSEC, such that at high levels of both SREC and CLSEC the odds of a child

belonging to the overweight only group at age 10 increased, compared to the typically developing group. Results highlight CLSEC as a parenting practice that may place a highly regulated child at risk for becoming overweight. Overall, the findings suggest that problem behaviors and pediatric obesity do not have a shared etiology.

DEDICATION

This dissertation is dedicated to my mother, Telma, whose undying support has gotten me through tough times in life, particularly in my education, whose struggles and sacrifices have pushed me to pursue the career of my dreams, and whose unconditional love has made me the person I am today. To my sisters, Grecia and Annais, who brighten up my day, lighten up my mood, motivate me to be a better person all around, and most importantly have made life so enjoyable. To Julio, who has selflessly encouraged me to dream big and reminds me daily to believe in myself the way he believes in me. Por último, a mi papá que me guîa y cuida desde el cielo. Sin ustedes yo no sería quien soy y nada valdría la pena. ¡Los quiero mucho!

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Introduction

The prevalence of obesity in children and adolescents ages 2-19 significantly increased from 1999 to 2010 (Ogden, Carroll, Kit, & Flegal, 2012; National Center for Health Statistics, 2011). According to the most recent data, in 2010, 16.9% -18% of children and adolescents were obese (Federal Interagency Forum on Child and Family Statistics, 2013; Ogden et al., 2012). Ethnic minority children and adolescents, in particular Non-Hispanic blacks, Hispanics, and Native Americans, are more likely to be overweight or obese than their Caucasian peers (Ogden et al., 2012; Singh, Kogan, Van Dyck, Siahpush, 2008; Whitaker & Orzol, 2006). Pediatric obesity is a significant public health concern due to the high prevalence rates and related comorbidities (National Center for Health Statistics, 2011; Reilly et al., 2003; U.S. Department of Health and Human Services, 2010). Children and adolescents with obesity are at higher risk for cardiovascular complications, including high blood pressure, asthma, type 2 diabetes, sleep apnea, and nonalcoholic fatty liver disease than those with normal weight (Daniels, 2006; Reilly et al., 2003). Further, they are more likely to be obese as adults and are at increased risk for serious health problems in adulthood including, high blood pressure, heart disease, cancer, diabetes, and osteoarthritis (e.g., Daniels, 2006; Reilly et al., 2003).

Psychosocial sequelae of pediatric obesity include low self-esteem, increased levels of depression and anxiety, impaired social relationships, and externalizing problems (Vander Wal & Mitchell, 2011). Particularly, being chronically obese is related to poorer psychological outcomes (Mustillo, Worthman, Erkanli, Keeler, Angold, & Costello, 2003). Based on the Medical Expenditure Panel Survey (MEPS) in 2004, it was estimated that pediatric obesity cost $14 billion annually in direct medical costs

(Thomson Medstat, 2006) and data from the 2002-2005 MEPS showed that 6- to 19-year-old children who were overweight had higher expenses for outpatient visits, prescription drug use, and emergency room visits (Trasande & Chatterjee, 2009). Together, high prevalence, physical and psychosocial correlates, and related costs make pediatric obesity a significant and undeniable public health concern. It is imperative to identify modifiable factors that can be targeted through interventions to prevent pediatric obesity.

Children who are overweight or obese have higher rates of internalizing problems and problem behavior than their non-overweight peers (Pulgaron, 2013). The link between internalizing problems (i.e., depression, anxiety) and pediatric obesity is well supported in the literature (e.g., Pulgaron, 2013; Rofey et al., 2009). The link between pediatric obesity and behavioral problems has had inconsistent findings (e.g., Bradley, Houts, Nader, O'Brien, Belsky, & Crosnoe, 2010; Halfon, Larson, & Slusser, 2013; Pulgaron, 2013) and it is less well understood. Self-regulation and parenting practices are well-established predictors of problem behavior and are garnering more evidence for their relation with pediatric obesity. It is possible that problem behaviors and pediatric obesity share these etiological factors, but this has yet to be studied. The present study sought to address this question.

Etiology of Pediatric Obesity

In the pediatric obesity literature the term "overweight" is used for those children whose body mass index (BMI) is between the 85th and 94th age- and gender-specific BMI percentile (as determined by CDC norms) and "obese" for those children and adolescents whose BMI is at or above the 95th age- and gender- specific BMI percentile

(Barlow & and the Expert Committee, 2007). This definition is the most widely used in obesity research and will be used in the present study.

Pediatric obesity may be best understood and examined within an ecological framework (Davidson & Birch, 2001; O'Brien et al., 2007). Davison & Birch (2001) proposed the Ecological Systems Theory (EST; Bronfenbrenner, 1986), which depicts the interacting factors that may lead to pediatric overweight and obesity. EST posits that the development or change in an individual's characteristic (in this case, BMI) cannot be understood outside of that individual's context (Bronfenbrenner, 1986) and this is also true for childhood obesity. Recently Harrison and colleagues (2011) expanded Davison & Birch's model by integrating the latest research findings making a more comprehensive and developmentally flexible model (Harrison et al., 2011). The model, called the Six C's Model, is organized according to the six domains that directly and indirectly impact the development and maintenance of child and adolescent obesity, which include cell, child, clan, community, country, and culture. At the cell level are genetic and biological factors implicated in obesity. Studies suggest that there may be a genetic susceptibility to obesity that is best understood as a result of gene-gene and gene-environment interactions, particularly the interaction with the current obesogenic environment that is the U.S. (Butte, Bacino, Cole, & Comuzzie, 2006; Manco & Dallapiccola, 2012; Skelton, Irby, Grzywacz, & Miller, 2011; Spruijt-Metz, 2011). There are also a myriad of underlying physiological mechanisms that are precursors to obesity.

Etiological factors specific to the child include food preference, physical activity, and sleep habits and child characteristics such as gender, race/ethnicity, and self-regulation. The mostly widely supported behavioral correlates of obesity are diet,

exercise, and -more recently- sleep (Spruijt-Metz, 2011). The current pediatric obesity epidemic has been attributed partially to the increased intake of high energy-dense foods, including fast food, larger portion sizes, increased sugar content, and poor nutritional content (Ebbeling, Pawlak, & Ludwig, 2002; Skelton, Irby, Grzywacz, & Miller, 2011; Spruijt-Metz, 2011). However, diet alone does not account for all the variance in obesity. The *energy balance equation* posits that obesity is a result of consuming more energy than is utilized (Woods & Seeley, 2005 as cited in Spruijt-Metz, 2011). Increased sedentary lifestyles coupled with high caloric, low nutritious diets have been implicated in pediatric obesity (Spruijt-Metz, 2011). Some studies suggest that sedentary behaviors, such as watching television and playing video games, are linked to obesity usually because they are related to less physical activity (Sisson, Broyles, Baker, & Katzmarzyk, 2010; Skelton, Irby, Grzywacz, & Miller, 2011). Sleep deprivation has also been implicated in obesity (Capuccio et al, 2008; Skelton, Irby, Grzywacz, & Miller, 2011; Spruijt-Metz, 2011). Two recent meta-analyses found that less than the recommended sleep duration was related to increased risk of obesity in children and adolescents, albeit a causal relation is difficult to establish given the cross-sectional nature of the studies reviewed (Capuccio et al., 2008; Chen, Beydoun, & Wang, 2008). There are significant health disparities in the rates of pediatric obesity with ethnic minorities being disproportionately affected, specifically Hispanic adolescent boys and African-American girls more likely to be overweight or obese than their peers (Ogden et al, 2010, Taveras et al., 2010). Another child characteristic that has been garnering increased attention is emotional and behavioral self-regulation. Research shows that children with poor self-

regulation have high BMIs or are at an increased risk for becoming overweight or obese (e.g., Francis & Susman, 2009; Graziano, Calkins, & Keane, 2010).

Etiological factors within the family (clan level) include characteristics such as maternal education, parental mental health, and parents' own eating and physical activity behaviors. Parents' obesity status, particularly the mother's, has been found to be positively related to child and adolescent obesity (Classen & Hokayem, 2005; Strauss & Knight 1999), which is likely due to shared genes as well as environment (Berge, 2009). Further, parents impact their children's weight status by influencing their diet and physical activity (Spruijt-Metz, 2011). Parents may influence diet and food preference through modeling and controlling what food they make available to their children and the portion sizes they serve (Davison & Birch, 2001; Fisher, 2007). Additionally, there is some evidence that having regular family meals is related to the consumption of more fruits and vegetables and lowers the risk of obesity (e.g., Spruijt-Metz, 2011); however, the literature is inconsistent and more longitudinal, experimental studies are needed in this area (Valdés, Rodríguez-Artalejo, Aguilar, Jaén-Casquero, & Royo-Bordonada, 2012). Other parenting practices that influence child weight status include prompting children to eat, restricting access to food, and using dessert as reward for eating more healthy foods (i.e., vegetables; Rhee, 2008). Likewise, parents impact their children's' physical activity patterns through modeling, creating opportunities for activities, and encouraging their children to be active (Davison & Birch, 2001). A less obvious way that parents may impact their child's obesity is through their general parenting behaviors (Kitzmann & Beech, 2011; Rhee, 2008). In the pediatric obesity literature, studies have examined the relations between parenting styles, parenting practices, and family

functioning and pediatric obesity. For example, children and adolescents in households with authoritative parenting (high demandingness and responsiveness) have been found to be at decreased risk for obesity (Berge, Wall, Loth, & Neumark-Sztainer, 2010; Berge, 2009; Rhee, Lumeng, Appuglese, Kaclrotl, & Bradley, 2006). Also, disrupted family environments might account for health routines (i.e., sleep, diet, physical activity), which are prognostic of pediatric obesity as described.

The next three levels of analysis are community, country, and culture. The community domain includes school or daycare, peers, and neighborhood characteristics. As children grow and develop, peers have a greater influence in the child's health lifestyle. A recent study using data from the National Longitudinal Study of Adolescent Health found that adolescents were likely to choose friends who were similar in BMI and physical activity, and that this selection process subsequently influenced their own BMI and physical activity levels (Simpkins, Schaefer, Price, &Vest, 2013). Similarly, an Australian study of middle school students found that friends' consumption of "junk food" (low-nutrient, energy-dense food) predicted the participant's own consumption of "junk food" (de la Haye, Robins, Mohr, & Wilson, 2013). The community context also has a direct influence in the family's and child's health and health behaviors through the types of food available, opportunities for physical activities (e.g., accessibility to parks and neighborhood safety), and different attitudes and beliefs around diet (Caprio et al., 2008; Davison & Birch, 2001; Spruijt-Metz, 2011). The country sphere is comprised of national-level characteristics that may influence exercise and eating patterns such as the health care system structure, funding for health campaigns, etc. Lastly, the culture sphere

includes cultural norms for gender-roles, ideal body types, and eating and exercise practices.

It is evident that obesity is a condition best understood from an ecological framework. Treatment for pediatric obesity is challenging given the complex nature of obesity, which includes a variety of modifiable and non-modifiable risk and protective factors. Although there are numerous components impacting obesity, such as the ones reviewed, the present study will be focused on the role of child self-regulation and parenting practices, as these are two of the potentially modifiable factors. Thus, findings from the present study may contribute to prevention efforts.

Child Self-Regulation

One child characteristic that is implicated in the development of obesity is the child's self-regulation or temperament (Bergmeier, Skouteris, Horwood, Hooley, &Richardson, 2014; Golan & Bachner-Melman, 2011). Temperament is defined as biologically based individual differences in reactivity and self-regulation, specifically in the domains of affect, activity, and attention. Temperament has a genetic basis (Putnam et al., 2002; Rothbart, 1989), but is also influenced over time by maturation and experience (Rothbart & Bates, 2006). Temperament provides a basis for a child's interaction with the environment. Rothbart and colleagues posited that temperament consists of three broad components: surgency, negative affectivity, and effortful control (Rothbart & Bates, 2006). Effortful control, which is the self-regulatory piece of temperament, includes attention focusing, inhibitory control, low-intensity pleasure, and perceptual sensitivity. Inhibitory control is part of the behavioral self-regulation element of temperament that begins to emerge after age 2 and it is the ability to suppress inappropriate impulses under

instruction or in novel situations (Rothbart, 1989). Unfortunately, temperament and self-regulation are often used interchangeably in the literature. The present study will uniformly use the term self-regulation to refer to measures of a child's inhibitory control, self-control, and delay of gratification (Anzman-Fransca, Sifter, & Birch, 2012). These concepts refer to the child's ability to regulate behavior and inhibit responses. Deficiencies in self-regulation are expressed as the reduced capability of controlling behavioral impulses.

Poor global self-regulation (not specific to obesogenic behaviors) has been related to higher BMI in infants and preschool children (Bergmeier, Skouteris, Horwood, Hooley, & Richardson, 2014). A recent review of studies across childhood and adolescence found that overall low self-regulation in early childhood (at or before 5 years of age) is associated with higher weight status (Anzman-Fransca, Sifter, & Birch, 2012). Longitudinal studies have found that self-regulation skills in early childhood predict BMI growth and status into middle and late childhood (Francis & Susman, 2009; Piché, Fitzpatrick, & Pagani, 2012). For example, a study of 1061 children (80% non-Hispanic White) as part of the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development measured self-regulation at ages 3 and 5 and BMI bi-annually from ages 3 through 12 (Francis & Susman, 2009). The study found that children with low levels of self-regulation at both ages 3 and 5 had higher BMI at all subsequent time points and the most rapid weight gain across childhood. Another study of predominantly European-American (67%) children, found that children who were classified as overweight or obese at age 5.5 had lower levels of emotional and behavioral self-regulation at age 2 than those classified as normal weight (Graziano, Calkins, and

Keane, 2010). These studies suggest that self-regulation precedes weight outcomes, establishing it as an important child characteristic to consider when thinking about prevention interventions. Researchers posit that children with poor self-regulation may be less able to resist high-fat, high-sugar foods and may also be less responsive to their natural satiety cues (Bergmeier et al., 2014). On the other hand, when children are less self-regulated their parents may use desirable foods in an effort to soothe the child or to manage their behavior (Baughcum, Burklow, Deeks, Powers, & Whitaker, 1998; McMeekin, Jansen, Mallan, Nicholson, Magarey, Daniels, 2013).

Self-regulation is moderately stable, particularly from toddlerhood to preschool years (e.g., Lengua, Honorado, & Bush, 2007; Putnam, Gartstein, & Rothbart, 2006), with growth in the early childhood years (Rothbart & Bates, 2006). Parenting is a factor in the child's environment that interacts with the child's self-regulation to predict different competencies and problems (Gallagher, 2002; Putnam et al., 2006). As previously described, parenting also plays an important role in the development and maintenance of obesity. Further, children's differing abilities to regulate emotions and behaviors may result in differing levels of vulnerability to parenting (Lengua, Wolchik, Sandler, & West, 2010; Sanson & Rothbart, 1995). Thus, parenting may be an important factor to consider when studying the relation between self-regulation and obesity.

Parenting

Parenting practices are an important proximal environmental influence on children's development of obesity (Davison & Birch, 2001; Fiese & Jones, 2012; Rhee, 2008). Rhee has provided a conceptual model highlighting the role of positive parenting behaviors (i.e., parental warmth, adaptive behavior management strategies) on children's

eating behaviors, diet, and physical activity, which in turn impact their weight status. The majority of the studies examining parenting and pediatric obesity have focused on parenting *styles* (e.g., authoritative, authoritarian, permissive, neglectful) rather than on specific parenting *behaviors*. Parenting style is based upon two dimensions: demandingness (expectations for displays of maturity by their children, parental control, and discipline) and responsiveness (parental warmth, sensitivity, affection, and involvement with their children) (Baumrind, 1971; Maccoby & Martin, 1983 as cited in Rhee, 2008). Using data from the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development, Rhee and colleagues (2006) found that children of authoritative mothers were less likely to be overweight two years later than children of authoritarian (high levels of demandingness but low responsiveness), permissive (low on demandingness and high on responsiveness), or neglectful (neither demanding nor responsive) mothers. A recent review found that children who grow up in authoritative households are more likely to have a healthier diet, engage in more physical activity, and have lower BMI's (Sleddens, Gerards, Thijs, de Vries, & Kremers, 2011).

While parenting styles refer to the emotional climate that constitutes the context in which parenting practices are expressed, parenting practices, on the other hand, can be thought of as the mechanisms through which parents socialize their children and enforce rules (Darling & Steinberg, 1993). Further, parenting styles are not easily translated to targets for family-based intervention programs and are generally assessed through parent self-report measures. On the other hand, parenting practices can be targeted in family-based interventions and can be assessed through observational interactions in addition to

parent self-report measures. Given that planning family meals, making healthy food options available, and encouraging the family to stay active (e.g., watch less television) requires organization, appropriate monitoring from parents, and effective management of the family's daily routines, children from families with less than optimal parenting practices may be at higher risk for obesity than those from families with strong parenting practices (adequate limit-setting and monitoring, positive behavior support, and positive relationship quality). Thus, it is important to identify those parenting practices that play a role in the development and maintenance of obesity in order to target them as part of family-based prevention efforts.

Recent studies of family-based interventions targeting effective parenting practices have found indirect effects on child weight status, which suggests that foundational parenting practices may also be germane to pediatric obesity. For example, Brotman and colleagues (2012) conducted a randomized trial of a parenting intervention for parents of 4-year-old, ethnic minority children at risk for behavior problems and found that children in the treatment group had lower rates of obesity at ages 8 and 11. Research with the Family Check-Up (FCU; Dishion & Stormshak, 2007), a family intervention targeting parenting behaviors to improve child adjustment for children at risk for behavior problems, has found significant effects on BMI trajectories and obesity rates in early childhood (Smith, Montano, Dishion, Shaw, & Wilson, 2014) and adolescence (Van Ryzin & Nowicka, 2013). The FCU is a preventive intervention based on an ecological approach to family intervention (Dishion & Stormshak, 2007). This intervention was originally designed to promote positive interaction patterns in families, including positive parenting, limit-setting, and positive relationships, in order to reduce

problem behavior in children and adolescents (Dishion & Stormshak, 2007). Smith and colleagues (2014) found that participating in the FCU improved positive behavior support (PBS), which indirectly predicted less growth in BMI through the average nutritional quality of meals served to the child in early childhood. These findings suggest that targeting foundational parenting practices may help prevent pediatric obesity.

Problem Behavior

Given that family-based interventions aiming to prevent child problem behaviors by targeting foundational parenting practices have found unanticipated effects on pediatric obesity, it is possible that problem behavior and pediatric obesity share etiological factors. Like with pediatric obesity, low levels of self-regulation are implicated in negative child and adolescent adjustment, particularly in the development of problem behaviors such as disruptive behaviors and adolescent substan**ce** abuse (e.g., Martel et al., 2009; Eisenberg et al., 2001). Pediatric obesity is often studied in relation to problem behavior, however the findings are inconsistent. One set of findings shows that problem behavior predicts or increases the likelihood of being overweight or obese (e.g., Anderson, He, Schoppe-Sullivan, & Must, 2010; Duarte et al, 2010). Other studies have found that children who are overweight or obese are more likely to have concurrent problem behaviors (Datar & Sturm, 2004; Griffiths, Dezateux, & Hill, 2011; Halfon, Larson, & Slusser, 2013; Waring & Lapane, 2008). A majority of studies examining these relations are cross-sectional, precluding understanding the direction of causality. In fact, in longitudinal analyses Griffiths and colleagues found that 3-year-old who were obese were not at increased risk of developing problem behaviors at age 5. Likewise, longitudinal studies have not found any significant relations between weight status and

behavioral problems in children (Bradley et al., 2010; Garthus-Niegel, Hagtvet, & Vollrath, 2010; Jansen, Mensah, Clifford, Tiemeier, Nicholson, & Wake, 2013; Mackenbach et al., 2012). For example, in a study of 1254 children, problem behavior and BMI did not have a significant reciprocal relation from age 2 through 6th grade, (Bradley et al., 2010). The mixed findings warrant more research to understand the correlation between problem behavior and pediatric obesity.

Child self-regulation and parenting are well- established etiological factors of problem behavior and are gaining more empirical support for their role in pediatric obesity. Thus, it is possible that they are common factors implicated in both problem behavior and obesity. In other words, it may be that neither problem behaviors are causing weight problems nor vice versa but rather that they share a common etiology. Further, the studies that have controlled for stability in both problem behavior and BMI have not found one predicts the other, which lends further support for the possibility of having a shared etiology, such as parenting or self-regulation (Bradley et al., 2010; Garthus-Niegel, Hagtvet, & Vollrath, 2010). The present study aims to examine this possibility.

Two fundamental parenting practices that warrant examination in relation to problem behavior and obesity are positive behavior support (PBS) and coercive limit-setting (CLS). PBS is an effective behavior management principle described by Horner and colleagues, (Carr et al., 1999; Horner, Sugai, & Anderson, 2010) that emphasizes the use of nonaversive, reinforcing caregiver–child interactions and involves the caregiver being proactive and structuring the home in ways that promote healthy development and adaptation. PBS involves the parents' expressions of warmth, and use of praise, positive

reinforcement, monitoring strategies, and proactive parenting practices, such as structuring family routines. PBS is also a way that parents scaffold and ensure that children behave in adaptive ways. PBS is typically assessed through observational ratings of caregivers' use of positive reinforcement strategies, including stating clear expectations for positive behaviors, positively engaging with the child, and structuring the child's environment to provide a context for healthy development. Previous research has indicated that participating in the FCU leads to improvements in parents' use of PBS in toddlerhood, which in turn has been related to reduced problem behavior 2 to 5 years later (Dishion, et al., 2008; Lunkenheimer, 2008) and as previously mentioned, is also indirectly related to less steep growth in BMI in middle and late childhood (Smith et al., 2014).

Limit-setting is also a key strategy for reducing problem behavior and promoting the development of self-regulatory skills (Dishion & Stormshak, 2007). Limit-setting is evident in the parent's use of specific directives to promote the child's positive behavior and imposing consistent consequences on the child's misbehavior. CLS is similar to harsh parenting and can be conceptualized as an inadequate, inconsistent, and harsh way of setting limits. This parenting practice has not been evaluated in the context of the FCU nor self-regulation levels, nor in relation to BMI. Studies find that coercive limit-setting predicts aggressive and externalizing behaviors in children over time (Berlin et al., 2009; Chang, Olson, Sameroff, & Sexton, 2011). Further, children with poor self-regulation have been found to be more vulnerable to inconsistent limit-setting, as they might have a reduced ability to regulate their behavior without parental guidance (Lengua et al., 2010). PBS and CLS may prove to be particularly important for children with low levels of self-

regulation. The present study examined PBS and CLS as predictors of child problem behavior and weight status.

There is some evidence suggesting that children's self-regulation and parenting interact to predict child adjustment (e.g., Bates, Pettit, Dodge, & Ridge, 1998; Dishion & Patterson, 2006; Gallagher, 2002; Stright, Gallagher, & Kelley, 2008). Self-regulation has been found to moderate the relation between parental control and warmth and child adjustment such that negative control is more likely to lead to child problem behavior when the child has low levels of self-regulation (e.g., Rubin, Burgess, Dwyer, & Hastings, 2003). In a longitudinal study of 337 children followed from age 5 to 17, maternal harsh discipline predicted growth in girls' problem behavior when children's self-regulation was low (Leve, Kim, & Pears, 2005). Although the interaction was not significant for boys, maternal harsh discipline and low levels of self-regulation at age 5 significantly predicted boys' problem behaviors at age 17. Another study of infant boys found that lack of maternal sensitivity (i.e., positive regard, emotional support) and negative control (i.e., hostility and intrusiveness) at wave 1 (mean age= 16.9 months) predicted increased problem behaviors at wave 2 (mean age= 23.2 months) for children with difficult temperament (i.e., poor self-regulation) (van Aken, Junger, Verhoeven, van Aken, & Dekovic, 2007). Similarly, Morris and colleagues, in a sample of 40 first and second graders, found that high maternal hostility was related to higher levels of problem behaviors in children with low levels of self-regulation (Morris, Silk, Steinberg, Sessa, Avenevoli, & Essex, 2002). Evidence suggests that low levels of child self-regulation exacerbate the effects of poor parenting practices. On the other hand, when children have

high levels of self-regulation they may be less susceptible to the deleterious effects of negative parenting practices.

Researchers in pediatric obesity suggest the field move beyond the analysis of individual risk factors (e.g., child, clan, community) to the study of the interactions across these dimensions (Bergmeirer, Skouteris, Horwood, Hooley, & Richardson, 2014; Lytle, 2009). Two important factors to examine, as discussed, are parenting and self-regulation as both impact the development of pediatric obesity and problem behavior. Although there is evidence suggesting there is an interaction between the parenting and child self-regulation when predicting child adjustment, it has not been extensively examined when predicting pediatric obesity. Further, the limited research examining the interaction between child self-regulation and parenting when predicting obesity focuses on parent feeding practices and not on foundational parenting practices (i.e., Anzman & Birch, 2009). However, given that general parenting practices interact with self-regulation to predict child adjustment, it is possible that this interaction also predicts weight status. The present study examined the interaction between parenting practices and self-regulation in early childhood as predictors of problem behavior and weight status at age 10. Specifically, self-regulation was tested as a moderator of parenting.

Covariates

The relations described thus far may also be influenced by other characteristics of the child or the environment, such as gender, ethnicity/race, parent weight status, cumulative risk, and intervention condition. Research suggests that girls are more regulated than do boys (Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Putnam et al., 2002) and thus boys display higher rates of problem behavior. Further, there are gender

differences in rates of obesity; specifically Hispanic adolescent boys and African-American girls are more likely to be overweight or obese than their peers (Mustillo et al., 2003; Ogden et al, 2010). Ethnic/ racial differences are also important to consider because ethnic minority children and adolescents, in particular Non-Hispanic blacks, Hispanics, and Native Americans, are more likely to be overweight or obese than Caucasian peers (Ogden et al., 2012; Singh, Kogan, Van Dyck, Siahpush, 2008; Whitaker & Orzol, 2006). Further, black and Hispanic children have more risk factors in early childhood related to obesity than their white peers (Taveras, Gillman, Kleinman, Rich-Edwards, & Rifas-Shiman, 2010). There is some research showing that the effects of parenting may vary by race and ethnicity (Deater-Deckard & Dodge, 2009; Deater-Deckard, Dodge, Bates, Pettit, 1996), thus ethnic and racial differences are important to consider. The current literature shows that obesity is highly heritable, in other words genes explain a large amount of variance of pediatric obesity (e.g., Classen & Hokayem, 2005; Haworth, Carnell, Meaburn, Davis, Plomin, & Wardle, 2008; Strauss & Knight 1999; Wardell, Carnell, Haworth, & Plomin, 2008). Children who experience a greater number of risks including poverty, low maternal education, and parental substance abuse are at increased risk for both problem behavior and obesity (Caprio et al., 2008; Lane, Bluestone, & Burke, 2013; Suglia, Duarte, Chambers, and Boynton-Jarrett, 2012; Trentacosta, Hyde, Shaw, Dishion, Gardner, & Wilson, 2008). Lastly, participating in the FCU increases levels of PBS and although the effects on CLS have not been examined, it is likely that the FCU also has effects on CLS because it is one of the targeted parenting practices (Dishion et al., 2008; Dishion & Stormshak, 2007). Therefore, gender, ethnicity/race, parent body size impression, cumulative risk, and intervention condition

will be entered as covariates in all models. Further, all models will control for child's body size impression at baseline.

The Present Study: Hypotheses

The present study will examine how child-level and family-level factors in early childhood, namely child self-regulation and parenting practices, prospectively impact childhood obesity and problem behavior. The current literature suggests that obesity and problem behaviors are linked, however the reason for this is unclear. Further, there is a need to identify modifiable factors for intervention to address childhood obesity and parenting practices seem promising. The findings of the present study may make a significant contribution to the body of literature on childhood obesity by identifying factors that impact childhood obesity and problem behaviors that can be targeted through family-based interventions. The present study used data from a multi-site, long-term follow-up randomized control trial including data from parents and children from ages 2 to 10 to test the following hypotheses:

Hypothesis 1 (Self-regulation): Children with low self-regulation in early childhood (ages 2-5) will have increased odds of belonging to one of the problem groups compared to the typically developing group at age 10.

Hypothesis 2 (Positive Behavior Support): Children in families with low levels of positive behavior support in early childhood will have increased odds of belonging to one of the problem groups compared to the typically developing group at age 10.

Hypothesis 3 (Coercive Limit Setting): Children in families with high levels of coercive limit setting in early childhood will have increased odds of belonging to one of the problem groups compared to the typically developing group at age 10.

Hypothesis 4 (Self-regulation moderation of Positive Behavior Support): Low levels of positive behavior support will increase the odds of belonging to a problem group compared to the typically developing group at age 10 in the presence of low child self-regulation but not when child self-regulation is average or high.

Hypothesis 5 (Self-regulation moderation of Coercive Limit Setting): High levels of coercive limit setting will increase the odds of belonging to a problem group compared to the normal group at age 10 in the presence of low child self-regulation but not when child self-regulation is average or high.

Method

Participants

This study utilized a subsample of 716 families from the original 731 families (49% female children) recruited from Women, Infants, and Children Nutrition Program (WIC) sites in three geographically and culturally diverse U.S. regions near Charlottesville, VA, Eugene, OR, and Pittsburgh, PA, who participated in a randomized controlled trial (PIs: Dr. Thomas J. Dishion, Dr. Daniel Shaw, Dr. Melvin Wilson). Families with children between the ages of 2 years 0 months and 2 years 11 months, who also indicated risk on 2 out of 3 screening measures for socioeconomic, family, and child factors, were invited to participate in the study. Predominantly biological mothers participated with the child in the yearly assessment (>90% at each age). If mothers were

not available, alternate caregivers such as father or grandmothers were also invited to participate. The subsample used for the present study excluded children who fell in the underweight category as they could not be considered to be part of the typically developing group and research has found that underweight has a different etiology than overweight (Dubois, Farmer, Girard, Peterson, & Tatone-Tokuda, 2007; Terracciano et al., 2009). The resulting subsample is very similar demographically to the original sample (Table 1). The current sample is culturally diverse, including European American (46.6%), African American (27.4%), Latino/Hispanic (13.4%), and American Indian, Asian American, Native Hawaiian, and multiple ethnicities (12.6%). The current sample consisted of 362 boys (50.5%) and 354 girls (49.5%). The majority of the sample fell in the normal weight category (56.6%) was low-income, and most parents completed a high school education (42.7%). Most of the parents were married or living together (57.8%). Twenty-three percent of the sample had a parent with less than high school education, 12.7% of the sample had a parent who endorsed at least one symptom of drug abuse, 26% of the sample lived in a home with a single adult, 26% of the sample had a parent who had been convicted of a felony, 17% of the sample lived in a dangerous neighborhood, and 75% of the sample was below the national poverty line. The institutional review boards of the Universities of Oregon, Pittsburgh, and Virginia approved this research. Families received monetary compensation for their participation.

Procedures

Recruitment and randomization. Participants were recruited and randomly assigned to either the intervention (367 families) or the control (364 families) condition after the first assessment at age 2. Families who agreed to participate in both the control

and intervention conditions participated in yearly 2.5-hour home visits. During the home-visits the parents completed questionnaires, participated in an interview, and engaged in age-appropriate videotaped interaction tasks with their children. The assessment began by having children play with and assortment of age-appropriate toys while the caregiver completed questionnaires for 15 minutes. For ages 2 and 3, this was followed by a cleanup tasks, which lasted 5 minutes. Beginning at age 3, a delay of gratification task followed (5 minutes). Following was a set of teaching-tasks (3 minutes) and then an age-appropriate inhibition task (3-9 minutes). Lastly, caregiver-child dyads participated in a meal preparation task (10 minutes). Parenting was coded from these observational tasks. Beginning at age 5, the child's weight and height were measured by the research staff during the home visit.

Intervention condition. The FCU was offered only to caregivers randomly assigned to the intervention condition. The FCU typically involves three sessions, including an initial interview, an assessment session and a feedback session. To assure that the experimental condition did not bias the assessment sessions, for this study, families in the intervention condition engaged in the observational tasks before the initial interview and feedback session (Shaw, Dishion et al, 2006; Dishion, Shaw et al, 2008). Therefore, the intervention group participated in the feedback session and subsequent services as needed following the home-based assessment each year. During the feedback session, using MI strategies, the therapist reviews the results of the assessment. The MI component is included to engage parents in the intervention as well as to promote the change process. Lastly, also during the feedback session, the therapist and the family explored a menu of options, which may have included interventions (1-2 brief sessions or

weekly/ monthly meetings) from the Everyday Parenting curriculum (Dishion, Stormshak, & Kavanagh, 2011), community referrals, or no additional services depending on each family's needs and choice. The focus of the FCU is to improve family management skills, which can be conceptualized at the most basic level as skills for managing the child or adolescent's behavior, and include relationship quality, limit setting, and positive behavior support (Dishion & Stormshak, 2007). Relationship quality is conceptualized as the quality of the parent-child relationship, problem-solving skills, proactive parenting, and shared family routines. Limit-setting is conceptualized as monitoring and setting limits. And positive behavior support is the ability to make appropriate requests and provide praise and incentives to promote behavior change (Dishion & Stormshak, 2007). Accordingly, the FCU has been found to reduce problem behavior in children and adolescents by improving family management (e.g., Connell, Dishion, Yasui, & Kavanagh, 2007; Dishion, et al., 2008; Van Ryzin & Dishion, 2012).

Control condition. Families in the control condition were only invited to participate in the yearly home-based assessment, which included the initial interview and observational tasks.

Coding Procedures. A team of undergraduate coders was trained to provide reliable micro and macro social codes using the Relationship Affect Coding System (RACS) and Early Steps Coder Impressions (COIMP). Training usually took 3-4 weeks. Reliability was calculated using the Noldus Observer Pro 5.0 software analysis package, and was measured based on both duration and sequence of behavior codes. For RACS, coders had to reach an inter-rater reliability score of at least 70% agreement and .70 Kappa on two consecutive assignments. Coders were considered reliable on the Early

Steps COIMP once they had achieved inter-rater reliability scores of at least 85% agreement on two consecutive assignments. An Early Steps COIMP item is considered to be in agreement if the two coders' scores are within + or – 2 on each 9-point scale. For 3-point and 5-point scales, agreement requires that both coders choose the same score. Once coders completed training and achieved reliability on two consecutive Early Steps COIMPs, they were assigned real data to code. To ensure inter-rater reliability, 15% of the entire sample was coded twice. These were randomly selected and randomly assigned to coders throughout the course of the project.

Measures

Items lists for all scales are provided in Appendix C.

Positive Behavior Support. The PBS construct was measured using a latent variable composed of three behavioral observation scales. The first indicator is a composite (mean) score of five scores assessed using the COIMP (Dishion, Hogansen, Winter, & Jabson, 2004). While viewing all the home-based interaction tasks, coders used a 9-point Likert scale ranging from 1 (*not at all*) to 9 (*very much*) to rate each measure across all tasks. The five behaviors observed are: "Does the parent encourage positive child behavior with praise and/or incentives?"; "Does the parent prompt the child to transitions and/ or future requests for behavior change?"; "Is the parent appropriately contingent in responding to positive or compliant child behavior?"; "Does the parent give the child choices for behavior change whenever possible?"; "Does the parent use verbal structuring to make the task manageable?" Average interrater agreement was high at each age, ranging from 87% to 88% agreement. The second indicator is dyadic positive engagement, which was assessed using a dynamic systems approach: Relationship Affect

Coding System (RACS; Peterson, Winter, Jabson, & Dishion, 2008), a micro social coding system used to simultaneously code the verbal, physical, and affective dimensions of an interaction for each participant on various dimensions, such as positive, neutral, and negative engagement. These streams are then combined to create behavior clusters on a state space grid and calculate durations of time the dyad spent in a particular region of the grid (Hollenstein, 2007). Consistent with the approach developed by Dishion and colleagues (Dishion, Forgatch et al, 2012), state space grids were used to formulate the dyadic positive engagement score. This score is the average duration in which the caregiver and child were coded to be continuously in either positive or neutral states (4 total cells). For example, high scores describe a caregiver engaging the child in extended teaching or playful discussions without the intrusion of negative behaviors by either the child or caregiver. Reliability coefficients were in the "good" to "excellent" range, with overall kappa scores of .93 at each age and percent agreement of .93 at ages 2 and 4 and .94 at ages 3 and 5. The third indicator is based on the home visitor's observation score of positive behavior support (HOME; Caldwell & Bradley, 1984). Raters used "yes" or "no" or a Liker scale of 1 (*never*) to 5 (*almost always*) to indicate the presence of behaviors such as, "Parent caresses or kisses child at least once"; "Parent keeps child in visual range and looks often"; "Parent seemed in good control of child." The items scored on a continuous scale were recoded (1-2 was recoded into 0, 3 recoded into 0.5, and 4-5 recoded into 1). The scores were then summed to create the HOME PBS score for each age. High values on the PBS construct indicate that caregivers were attentive to young children's positive behavior, provided choices, and generally used incentives. It is important to note that the coders for COIMP and RACS are different from the ones who

coded the HOME. Thus this parenting construct is based on multiple raters using well-established observational procedures across multiple time points in early childhood.

Coercive Limit-Setting. CLS was measured using a latent variable composed of three observation scales. The first indicator is a composite (mean) score of ten scores assessed using the COIMP (Dishion, Hogansen, Winter, & Jabson, 2004). While viewing all the home-based interaction tasks, coders used a 9-point Likert scale ranging from 1 (*not at all*) to 9 (*very much*) to rate each measure across all tasks. Behaviors include: "Does the parent use directives that seem specific and clear to the child?"; "Does the parent set limits firmly without using aversive control techniques (i.e., yelling, anger, criticism, threats)?"; "Does the parent seem to be avoidant or reluctant to set limits to the child, allowing the child to engage in misbehavior without responding?"; and "Does the parent follow through with requests or directives to assure compliance and/or cooperation?". Average interrater agreement was high at each age, ranging from 87% to 88% agreement. The second indicator is dyadic coercive engagement, which was assessed using a dynamic systems approach: RACS (Peterson, Winter, Jabson, & Dishion, 2008). This score is the average duration in which either the caregiver or child was negatively engaged or directive towards the other person and the other person was either not talking, ignoring, negatively engaged, or directive (12 total cells). For example, high scores describe a caregiver instructing the child to do something and the child is ignoring the instruction. Reliability coefficients were in the "good" to "excellent" range, with overall kappa scores of .93 at each age and percent agreement of .93 at ages 2 and 4 and .94 at ages 3 and 5 (obtained from the Noldus Observed; Noldus Information Technology, 2012). The third indicator is the home visitor's observation score of harsh

parenting (HOME; Caldwell & Bradley, 1984). Raters used "yes" or "no" or a Likert scale of 1 (*never*) to 5 (*almost always*) to indicate the presence of behaviors such as, "Parent (does not) slaps or spanks child during visit "; "Parent (does not) scolds, criticizes child during visit"; "Parent (does not) interferes with or restricts child more than 3 times." The items scored on a continuous scale were recoded (1-2 was recoded into 0, 3 recoded into 0.5, and 4-5 recoded into 1). The scores were then summed to create the HOME CLS score for each age. High values on the CLS construct indicate harsher, less consistent, more coercive forms of limit setting. Like PBS, this is an observational, multi-rater measure that captures CLS across 4 time points in early childhood.

Self-regulation. The 13-item inhibitory control subscale of the child behavior questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) was used to measure children's behavioral self-regulation from the ages of two to five. The primary caregiver rated each item on a 7-point scale ranging from 1 (*extremely untrue of child*) to 7 (*extremely true of child*). Items included, 'Has difficulty waiting in line for something,' and 'Can easily stop an activity when s/he is told "no." Scale scores are an average of all numeric responses. If caregiver indicated an item was "not applicable" to their child, the item was considered missing. Scale scores were not calculated if three or more items were missing. Internal consistency was adequate at each time-point, with Cronbach's alphas ranging from .65 to .74.

Problem behavior. Child externalizing symptoms were measured through Parent report on the Child Behavior Checklist- Parent Form (CBCL- PF; Achenbach and Rescorla, 2001). The CBCL is an empirically validated measure of child behavior administered to parents at each time point. Sample items include "My child breaks rules

at home, school, or elsewhere" and "Temper tantrums or hot temper." The primary caregiver and alternative caregiver (if present) rated each item using a 3-point Likert scale: 0 (*not true*), 1 (*somewhat or sometimes true*), and 2 (*very true or often true*). Raw scores were converted to age-standardized T-scores (Mean= 50, SD= 10). An average of the two caregiver reports was calculated and used in the analyses. T-scores ≥ 65 were considered to be in the clinical range.

Child BMI and body size impression. Weight (electronic scale) and height (stadiometer), collected yearly beginning at age 5 at the home visit, were used to assess BMI. BMI was calculated using the formula (weight (lb.) / [height (in)]^2 x 703) provided by the Center for Disease Control (CDC) and the resulting BMI was compared against the CDC age- and gender- specific norms to find the percentile in which each child fell under and thus the weight category to which each child belongs. The CDC formulas were released in 2000 and their use is recommended when assessing growth in U.S. infants, children, and adolescents. The CDC growth charts were developed with data collected by the National Center for Health Statistics in five cross-sectional, nationally representative health exam surveys (Kuczmarski, Ogden, Guo, et al., 2000). The term "overweight" is used for those children whose BMI is between the 85th and 94th age- and gender-specific BMI percentile and "obese" for those children and adolescents whose BMI is at or above the 95th age- and gender- specific BMI percentile (Barlow & and the Expert Committee, 2007). Because BMI was not available at baseline, coders rated body size on the basis of observations of the interaction tasks occurring at age 2. Body size impression was rated on a 1-9 scale (1= *not at all overweight*, 5= *somewhat overweight*, 9= *overweight*). Percent agreement for body size impression ratings was high (99%).

Parent body size impression. BMI was not available for parents at any time point; thus, an observational code was used. Coders rated body size on the basis of observations of the interaction tasks occurring at child age 2. Body size was rated on a 1-9 scale (1= *not at all overweight*, 5= *somewhat overweight*, 9= *overweight*). Percent interrater agreement for body size ratings was high (99%).

Intervention status. A binary variable represents random assignment to either control or intervention condition (0= control, 1= intervention). Intent-to-treat analyses were used meaning participants' data was analyzed based on their random assignment, independent of intervention engagement.

Child Ethnicity. Child's race/ ethnicity was also based on parents' report at age 2 (1= White, 2= Black/ African-American, 3= Pacific Islander, 4= Native American, 5= Asian, 6= Hispanic/ Latino, 7= Bi-racial, 8= Other, 9= Unknown).

a) **Child Minority.** A binary variable (0= other, 1= African-American or Bi-racial) represents whether the child is a minority.
b) **Child Hispanic.** A binary variable (0= other, 1= Hispanic/ Latino) represents whether the child is Hispanic or Latino.

Gender. A binary variable (0= female, 1= male) represents child gender. Child gender is based on parents' report at age 2.

Cumulative risk. An index of cumulative risk was generated from seven socio-demographic indicators reported at entry into the study (age 2): (a) single parenthood, (b) parent substance use problem, (c) low maternal education, (d) residence in a dangerous neighborhood, (e) household overcrowding, (f) income below the national poverty line, and (g) parent with a felony conviction. Families received a score of '1' for each risk

indicator if present or a '0' if the risk indicator was absent and the scores were summed. Families received a score of '1' for single parenthood if there was only one adult in the home; this information was based on parent report. Families received a score of '1' for parent substance abuse problem if one of the parents in the home met at least one drug abuse criteria: a) sometimes, often, or very often argumentative or irritable when drinking, b) drinks everyday and drinks 3-4 or more drinks most of the time, c) uses marijuana or hard drugs more than once a month, or d) uses more than one hard drug about once per month. This information was also based on parent report. Families received a score of '1' for low maternal education if the primary caregiver had completed less than high school. Families received a score of '1' for residence in a dangerous neighborhood if their neighborhood dangerousness score was greater than 1 standard deviation above the mean of the Dangerousness subscale from "Me and my neighborhood questionnaire" (Ewart & Suchday, 2002). Families received a score of '1' for household overcrowding when there were 4 or more children or fewer rooms than people (excluding bathrooms and hallways) and this was based on parent report at an initial screening. Families received a score of '1' for income below the national poverty line if their gross household income was below the poverty line. Poverty levels were calculated by adjusting gross household income at age 2 for inflation using the U.S. Department of Labor Bureau of Labor Statistics Consumer Price Index to reflect 2010 levels. Families received a score of '1' if the parent was convicted of a felony. Cumulative risk was used as a covariate in all models.

Data Analysis

Preliminary Analyses

All data were examined for out-of-range values to assess the potential influence of outlying cases and whether variables were normally distributed. Variables with a skewness value of less than 2 and kurtosis value less than 7 were considered normally distributed (West, Finch, & Curran, 1995). Chi-square tests of independence were used to explore any potential difference in weight status between intervention groups, gender, study site, and race. Correlations were conducted to assess relations among study variables.

Self-regulation and parenting in early childhood. Confirmatory factor analysis was used as a preliminary step to create three latent variables to represent self-regulation (Figure 1) and parenting (one for PBS, one for CLS; Figure 2), respectively, in early childhood (ages 2-5). Maximum likelihood estimation was used for self-regulation and PBS given the indicators were normally distributed. MLR estimation was used for CLS given one of the indicators was non-normally distributed. Variances were set to equal 1 in all models in order to correctly scale the latent variables and to aid in future interpretation. Determination of model fit included the comparative fit index (CFI; Bentler, 1990), the root mean square error of approximation (RMSEA; Steiger, 1990), and the standardized root mean residual (SRMR; Bentler, 1995). Small chi-square values correspond to better fit to the data; comparative fit index (CFI) values greater than 0.95 indicate good fit to the data (Bentler, 1992); root mean square error of approximation (RMSEA) values less than 0.05 indicate good model fit (Browne & Cudeck, 1993); standardized root mean square residual (SRMR) values less than .08 are generally

considered good fit (Hu & Bentler, 1999). Full information maximum likelihood (FIML) estimation was used to handle missing data (Enders, 2010; Enders & Bandalos, 2001).

Outcome Groups. Four groups were created based on clinical cutoffs for BMI (at or above the 85th age- and gender-specific percentile) and problem behavior at age 10 (CBCL at or above T-score of 65): 1) *typically developing* (BMI below the 85th age-and gender- specific percentile and problem behavior with a T score below 65), 2) *problem behavior only group* (problem behavior at or above a T-score of 65, BMI below the 85th age-and gender- specific percentile), 3) *overweight only group* (BMI at or above the 85th age-and gender- specific percentile and problem behavior T score below 65), and 4) *comorbid group* (above clinical cutoff scores for both BMI and problem behavior).

Analytic Strategy

The overarching goal of this study was to examine whether child self-regulation and parenting practices (PBS and CLS) are common etiological factors for the development of problem behavior and childhood obesity (Figure 3). Study questions were addressed using multinomial logistic regression in Mplus 7.1 using FIML to account for missing data and MLR estimation robust to non-normality (Muthén, 1998-2010). Covariates in all models included intervention group, gender, child minority, child Hispanic, cumulative risk, child body size impression at age 2, and parent body size impression at age 2. Child self-regulation, PBS, and CLS, were mean centered and the variances were set to 1 prior to creating interaction terms in order to aid interpretation (Aiken & West, 1991). Significant interactions were probed to examine the effect of parenting at low (1 SD below the mean) and high (1 SD above the mean) levels of self-regulation (Aiken & West, 1991). Continuous covariates (child and parent body size

impression and cumulative risk) were also standardized to aid interpretation of results (mean set to zero and standard deviation set to one).

Ethnic, Gender, and Intervention Group Differences

Although not among the primary questions of this study, potential ethnic, gender, and intervention group differences were of interest for the significant predictors. The model constraint command was used to test whether the parameters of interest varied across groups.

Results

Model diagnostics. Descriptive statistics revealed there were no extreme outliers that seemed problematic. Descriptive statistics are included in tables 2 - 5. Most variables were normally distributed. However, one parenting latent variable indicator (RACS code for CLS at age 3, skewness = 2.13, kurtosis = 7.94) and one covariate (child body size at age 2, skewness = 3.01, kurtosis = 11.64) were significantly skewed and kurtotic. Non-normality of the latent variable indicator and covariate was addressed through maximum likelihood with robust standard errors (MLR) estimation, which provides more robust estimates of standard errors with non-normal dependent variables. As shown in Table 6, chi-square tests revealed that there were no significant differences in weight distribution between intervention groups, gender, site, or race/ ethnicity. The numbers for each outcome group are displayed on Table 7.

Self-regulation and Parenting in Early Childhood. Using confirmatory factor analysis, the score on the CBQ at each age (ages 2-5) were used as indicators to create the self-regulation in early childhood (SREC) latent variable (Figure 1). Model fit of the latent variable model was not adequate: χ^2 (2) = 33.065, p = 0.000, RMSEA = 0.147, CFI

= 0.959, SRMR = 0.033; mostly based on the RMSEA. Standardized factor loadings ranged from .581-.760. The COIMP (PBS), RACS (dyadic positive engagement), and HOME (PBS) observational codes from each age (ages 2-5) were used as indicators of the PBS in early childhood (PBSEC) latent variable (Figure 2). The COIMP (CLS), RACS (dyadic coercive engagement), and HOME (CLS) observational codes from each age (ages 2-5) were used as indicators of the CLS in early childhood (CLSEC) latent variable (Figure 2). Factor loadings for the same indicator were constrained to equality across ages for parsimony. The latent variable model for PBS in early childhood had poor fit to the data: χ^2 (75) = 262.211, p< 0.000, RMSEA = 0.059, CFI = .865, SRMR = 0.064. Standardized factor loadings ranged from .477-.583. The latent variable model for CLS in early childhood also had poor fit to the data: χ^2 (63) = 168.302, p < 0.000, RMSEA = 0.048, CFI = .820, SRMR = 0.059. Standardized factor loadings ranged from .581-.760. Although some fit indices indicated acceptable fit, other indices suggested a poor fit. There might me multiple reasons for a poor fit. For example, when the models are specified to allow all measures to load equally on one latent variable regardless of the age of assessment, it assumes that the construct is stable over time. However, if the construct is not stationary, and changes over time, such a model would result in poor fit. This is supported by some of the modification indices that suggest that indicators in subsequent years be correlated. Sensitivity analyses were conducted to examine whether making the changes suggested by the modifications indices changed the findings of the models without the modifications. The findings did not change as the fit of the latent variables was improved, thus the original unmodified models were used in the presence of conflicting fit values.

Correlations. Zero-order correlations between self-regulation indicators at ages 2-5 were positive and significant (*r*s ranged from .388 to .618, $p < .001$). The indicators for PBS were also positively and significantly correlated, with the correlations ranging from small to medium (*r*s ranged from .116 to .335, $p < .001$). Most of the indicators for CLS were positively and significantly correlated, ranging from negligible to medium (*r*s ranged from .079, $p < .05$ to .367, $p < .001$). Correlations among study variables at age 2 are presented in Table 8. All significant correlations were in the negligible to medium range. Zero-order correlations reveal that gender was significantly related to concurrent self-regulation ($r = -.126$, $p < .01$), with boys having lower levels of selfregulation. Similarly, being a boy was negligibly related to problem behavior at age 10 ($r = .075$, $p < .05$). Being a minority was related to higher levels of cumulative risk ($r = .285$, $p < .001$), to lower levels of the PBS indicators (*r*s ranged from -.149 to -.182, $p < .001$), and higher levels of dyadic coercive engagement ($r = .148$, $p < .001$); all in the small range. Higher levels of cumulative risk were related to lower levels of PBS (*r*s ranged from -.102 to -.195, $p < .001$). Cumulative risk was also significantly positively related to dyadic coercive engagement ($r = .078$, $p < .05$) and problem behavior at age 10 ($r = .090$, $p < .05$), albeit negligibly, and HOME limit-setting score ($r = .151$, $p < .001$). Parent's body size impression at baseline reliably correlated with the child's concurrent body size impression ($r = .217$, $p < .001$) and child BMI at age 10 ($r = .268$, $p < .001$), with small correlations. Higher levels of child body size impression at age 2 were moderately related to higher child BMI at age 10 ($r = .310$, $p < .001$). Problem behavior and BMI at age 10 were not significantly correlated.

Multinomial Logistic Regression

The typically developing group was used as the reference group in all models. All models controlled for intervention group assignment, gender, child minortiy, child Hispanic, child body size impression at age 2, parent body size impression, and cumulative risk.

Self-regulation in Early Childhood (SREC). Figure 4 shows the multinomial logistic regression model for hypothesis 1 using the typically developing group as a reference group. The findings for self-regulation are shown in Tables 9 – 11. These results are controlling for the identified covariates. Results indicated that children with higher levels of SREC were less likely to belong to the comorbid group (OR = 0.386, 95% CI [0.237, 0.628]) and the problem behavior only group (OR = 0.281, 95% CI [0.157, 0.503]) compared to the typically developing group at age 10. As expected, parent's body size impression when the child was 2 years olds increased the risk of belonging to the comorbid group (OR = 1.919, 95% CI [1.223, 3.009]) and the overweight only group (OR = 1.476, 95% CI [1.154, 1.887]) compared to the typically developing group at age 10. For every 1 standard deviation increase in cumulative risk the odds of the child belonging to the problem behavior only group compared to the typically developing group nearly doubled (OR = 1.741, 95% CI [1.165, 2.603]).

Positive Behavior Support in Early Childhood (PBSEC). Figure 5 shows the multinomial logistic regression model using PBSEC as a predictor. Tables 12- 14 show the results for each outcome group. The same covariates remained significant as in the model looking at SREC alone. PBSEC did not significantly predict the odds of belonging to any of the problem outcome groups compared to the typically developing group.

Coercive Limit-Setting in Early Childhood (CLSEC). Figure 6 shows the results that were obtained from the multinomial logistic regression model assessing CLSEC as the predictor controlling for the pertinent covariates. Tables 15- 17 show the results for each outcome group. Parent's body size impression when the child was 2 years olds doubled the odds of belonging to the comorbid group (OR = 2.003, 95% CI [1.317, 3.047]) and the overweight only group (OR = 1.470, 95% CI [1.145, 1.888]) compared to the typically developing group at age 10. In this model, higher levels of cumulative risk approached significance (p = .10) in increasing the odds of the child belonging to the problem behavior only group (OR = 1.700, 95% CI [1.134, 2.549]) compared to the typically developing group. CLSEC did not significantly predict the odds of belonging to any of the problem outcome groups compared to the typically developing group.

PBSEC x SREC. Figure 7 shows the multinomial logistic regression model examining the interaction between PBSEC and SREC, controlling for covariates. Tables 18- 20 show the results for each outcome group. The same covariates remained significant as in previous models. No significant interaction was found between PBSEC and SREC. Consistent with the first model, results indicated that children with high levels of SREC were less likely to belong to the comorbid group (OR = 0.337, 95% CI [0.189, 0.598]) and the problem behavior only group (OR = 0.214, 95% CI [0.096, 0.477]) compared to the typically developing group at age 10.

CLSEC x SREC. Figure 8 shows the multinomial logistic regression model examining the interaction of CLSEC and SREC controlling for covariates. Tables 21- 23 show the results for each outcome group. As seen in previous models, results indicated that children with for every 1 standard deviation increase in SREC the odds of belonging

to the comorbid group (OR = 0.313, 95% CI [0.149, 0.657]) and the problem behavior only group (OR = 0.189, 95% CI [0.071, 0.504]) decreased compared to the typically developing group at age 10. The interaction between SREC and CLSEC predicted the likelihood of belonging to the overweight only group compared to the typically developing group at age 10. At high levels of SREC, high levels of CLSEC nearly doubled the likelihood of the child belonging to the overweight group only (OR= 1.535, 95% CI [1.027, 2.296]) compared to the typically developing group at age 10 (Figure 9).

Group Differences. Interactions between the identified significant predictors and intervention condition, gender, and minority status were examined. It was not possible to evaluate Hispanic status given the small number of Hispanic/Latino children in the comorbid group (n = 1). In the model assessing SREC alone, intervention condition, gender, and minority were not significant moderators. The interaction model between CLSEC and SREC was also examined. The main effects and interaction between CLSEC and SREC were not moderated by intervention condition or gender differences. The relation of SREC and CLSEC to the odds of belonging to the comorbid group compared to the typically developing group did vary based on minority status. For children who were minorities (Black/African-American or Bi-racial) higher levels of SREC and CLSEC significantly decreased the odds of belonging to the comorbid group compared to the typically developing group at age 10. Minority children with high levels of SREC were less likely to belong to the comorbid group (OR = 0.060, 95% CI [.003, .586]) compared to the typically developing group at age 10. Additionally, minority children with high levels of CLSEC were less likely to belong to the comorbid group (OR = 0.042, 95% CI [.004, .810]) compared to the typically developing group at age 10. SREC

and CLSEC did not have the same effect for majority children. The interaction between CLSEC and SREC did not vary based on minority status.

Supplementary Analyses

Supplementary analyses examined the same models using the comorbid group as the reference group instead of the typically developing group (Tables 24-39). These models controlled for the same covariates as the original models. These results did not contribute new information to the original findings. The parenting variables did not impact the odds of belonging to any group. As seen in previous models, SREC was a significant predictor. In the models examining the main effect of SREC, for every 1 standard deviation increase in SREC, the odds of belonging to the typically developing more than doubled (OR = 2.590, 95% CI [1.592, 4.213]). Higher levels of body size impression of child and parent decreased the odds of belonging to the problem behavior only group compared to the comorbid group (OR= 0.453, 95% CI [0.212, 0.969], OR= 0.482, 95% CI [0.270, 0.862] respectively). These predictors remained significant in the same manner in all models. The effect of SREC did not differ by intervention group membership. A significant minority group by SREC interaction was found. Minority children with high levels of SREC were more likely to belong to the overweight only group (OR = 5.599, 95% CI [2.395, 13.093]) compared to the comorbid group at age 10. SREC did not have the same effect for majority children. A gender by SREC was also found. Boys with higher levels of SREC had lower odds of belonging to the problem behavior only group compared to the comorbid group at age 10 (OR = 0.308, 95% CI [0.105, 0.906]). The same was not found for girls.

Discussion

In previous research, pediatric obesity and problem behavior sometimes co-occur. To date, the hypothesis of shared etiology between the two outcomes has not been tested using longitudinal designs and intensive measurement of etiological constructs. The goal of the present study was to identify shared etiological factors of problem behavior and obesity. Specifically, the present study examined whether child self-regulation and parenting practices, namely positive behavior support and coercive limit setting, in early childhood (ages 2-5) predicted problem behavior and weight status at age 10. Contrary to expectation, problem behavior and child weight at age 10 were not significantly correlated in this study. Furthermore, the longitudinal findings did not support that problem behavior and pediatric obesity have a shared etiology

The present study evaluated five hypotheses. First, it was hypothesized that low levels of self-regulation in early childhood would be a risk factor for the development of problem behaviors and obesity at age 10. The second hypothesis was that low levels of positive behavior support would be a risk factor for the development of problem behaviors and obesity at age 10. Third, it was hypothesized that high levels of coercive limit-setting in early childhood would increase the risk of developing problem behavior and obesity at age 10. Lastly, it was hypothesized that self-regulation would moderate the relations between positive behavior support and coercive limit setting and child outcomes at age 10, respectively, such that, high levels of self-regulation would serve as a protective factor. Interactions between significant predictors and 1) intervention group, 2) gender, and 3) minority status (African-American and bi-racial) were examined when significant predictors were found.

In order to address the study questions, four outcome groups were created: typically developing, problem behavior only, overweight only, and comorbid. The expectation was that having these four groups would illustrate unique and shared etiological factors of problem behavior and pediatric obesity. Further, repeated measures of self-regulation, positive behavior support, and coercive limit setting, respectively, were used to create latent variable in order to capture these constructs across early childhood. Studies using such intensive measures of both self-regulation and parenting in early childhood with a community, non- clinical sample are rarely, if at all, seen in the pediatric obesity literature.

Results of multinomial logistic regressions suggest that SREC is an important child characteristic implicated primarily in the development of problem behavior. Consistent with previous literature, children with poor SREC had increased odds of belonging to the comorbid and the problem behavior only group than to the typically developing group. It is well-documented that children with poor self-regulation, who are less able to control their impulses or override inappropriate behaviors when instructed or when the situations calls for it, are at an increased risk of developing behavioral problems and this is supported by the findings of the present study (e.g., Martel et al., 2009; Eisenberg et al., 2001). Contrary to expectations and at odds with previous studies (Bergmeier et al, 2014; Francis & Susman, 2009; Graziano, Calkins, and Keane, 2010), SREC was not related to the risk of belonging to the overweight only group. This suggests that the relation of SREC to the risk of belonging to the comorbid group might be mostly due to its relation to problem behavior and not to weight status.

It has been posited that self-regulation may be implicated in pediatric obesity as children with poor self-regulation might be driven by external stimuli, leading to overeating or indulging in high-caloric foods (Bergmeier et al., 2014). However, the present findings do not support this hypothesis. The inconsistent findings might be due to several reasons. First, self-regulation has been conceptualized and measured in diverse ways in the literature (i.e., laboratory tasks, parent report), which may lead to inconsistent findings between studies. In some of the studies reviewed self-regulation was measured with laboratory tasks, some of which required self-regulation in the face of attractive food and others in the face of attractive toys (Anzman-Fransca, Sifter, Paul, & Birch, 2013; Francis & Susman, 2009). Researchers have posited that laboratory tasks measure more specific behaviors in very specific contexts in a more objective and performance-based manner (Thamotharan, Lange, Zale, Huffhines, & Fields, 2013). On the other hand, questionnaires might be capturing broader behaviors displayed in a wider time span, which might be sensitive to recall difficulties and bias. Further, the relation between self-regulation measured with laboratory tasks and through questionnaires is inconsistent. A study assessing inhibitory control in a laboratory setting and with the Child Behavior Questionnaire (CBQ) found that the laboratory-based assessment was not significantly related to the questionnaire measure (White, McDermott, Degnan, Henderson, & Fox, 2011). On the other hand, a different study found that children with low self-regulation in two laboratory tasks were more likely to be rated as having low inhibitory control on the CBQ (Francis & Susman, 2009). A recent meta-analysis found that the effect size of the relation between impulsivity and weight status was moderated by the way in which impulsivity was assessed, with behavioral assessments (i.e., laboratory tasks) having

larger effect sizes than self-report measures (Thamotharan et al., 2013). Although this meta-analysis focused on adolescent self-report, it is possible that similar issues are found when using parent-report. An additional reason for the lack of relation between self-regulation and weight status might be the way self-regulation was captured. Although research shows that in general self-regulation grows during early childhood (Rothbart, 1989) it is possible that some children have steeper growth than others, and such differences might result in different weight outcomes. Lastly, neither the type of food available to the child on a daily basis nor the amount of physical activity was measured in this study. It is possible that children with low self-regulation are prone to obesity in family environments with chronically poor nutrition or that they are more likely to lead sedentary lifestyles.

PBSEC and CLSEC alone did not impact the odds of belonging to any of the outcome groups. These parenting constructs were developed to understand the early development of antisocial behavior. It is possible that a broader range of parenting constructs is needed to understand the development of pediatric obesity. Rhee's conceptual model posits that positive parenting behaviors, such as those measured in PBSEC play an important role in children's diet and physical activity, which impact the child's weight status (Rhee, 2008). However, it is yet to be determined whether monitoring of child behavior is related to monitoring of the child's consumption of unhealthy foods and if proactive structuring of the child's environment to avoid behavior problems is related to proactive structuring to ensure a healthy diet and increased physical activity, which are more salient factors to obesity.

A recent study from the same dataset used in the present study found that parents who displayed higher levels of PBS offered their children meals with higher dietary quality (Montano et al., 2015), lending preliminary support for the connection between this general parenting construct and health behaviors. However, the measure of dietary quality was weak. It was limited to a 10-minute meal task of a yearly home visit. Thus, it is unclear if the meal was representative of the child's regular diet and whether the child consumed the meal. Studies examining nutrition measure the child's diet throughout the day and over a longer period of time, which is a more accurate representation of the child's diet. Likewise, inappropriate (i.e., harsh and inconsistent) ways of setting limits on general behavior may or may not be related to setting limits on diet and sedentary activity (e.g., amount of time spent watching television). It is possible that these parenting constructs are impacting the development of obesity indirectly though these pathways that were not examined in the present study.

Like with SREC, another possible reason for the lack of findings might be the way in which parenting was measured. Perhaps the parenting constructs would have been more predictive if the factor loadings were allowed to vary over time, reflecting a growth or a changing definition with development. It is possible that parenting differs across time for some families and this was not captured in the present study. Different patterns in parenting might result in different outcomes. Second, the loadings for the micro-codes (RACS) of both PBSEC and CLSEC were much lower than for the other two indicators suggesting perhaps either a two level model, given that the indicators were significant correlated, or two separate constructs.

An additional reason findings were contrary to hypothesized is the timing when BMI was measured. The present study looked at BMI at age 10 only. There is evidence that BMI has different trajectories and they are differently related to child outcomes (e.g., Jansen et al., 2013; Mustillo et al., 2003) and likewise different factors predict different trajectories or growth (e.g., Lane, Bluestone, & Burke, 2013; Smith et al., 2014). For example Jansen and colleagues found that being overweight later in childhood was more related to poor mental health outcomes at ages 10-11 than being overweight in early childhood or having fluctuating weight throughout (Jansen et al., 2013). Another study found that children who were chronically obese had an increased risk for psychiatric diagnoses compared to children who were never obese or who were only obese in childhood or adolescence (Mustillo et al., 2003). By looking at BMI at age 10 only, the present study might be missing different growth patterns in BMI to which parenting and self-regulation are differentially related. Further, the number of children who had concurrent clinical levels of problem behavior and BMI at age 10 in the present study was very small. Based on previous findings (e.g., Jansen et al., 2013; Mustillo et al., 2003) it is possible that examining chronicity or growth in BMI would give us a better picture of how BMI is related to problem behaviors and how the predictors of the present study are related to those problems. Similarly, although the longitudinal design of the study is a strength, the time between the predictors and outcome might be too large to obtain significant effects and important developmental processes, as mentioned, might be overlooked.

Only the interaction between CLSEC and SREC significantly impacted the odds of belonging to the overweight only group compared to the typically developing group.

Contrary to expectations, at high levels of SREC, when parents displayed high levels of CLSECE a child was more likely to belong to the overweight only group than to the typically developing group at age 10. The deleterious effects of poor self-regulation are well documented however, being overly regulated may also have negative effects on child outcomes. Perhaps ratings of high levels of self-regulation by parents are in fact capturing fearful and withdrawn children who are also vulnerable to poor parenting practices (Schwartz et al., 1999). Over-control is often a characteristic of children with internalizing problems, particularly anxiety (Block & Block, 1980; Carver, 2005). As described previously, the literature shows that there is a strong link between internalizing problems and obesity, albeit with some inconsistent findings (Pulgaron, 2013; Rofey et al., 2009). It is possible that these children are experiencing anxiety or depression, leaving them more vulnerable to the detrimental effects of harsh, punitive, and inconsistent parenting. Zeller and colleagues found that mother of obese youth reported higher family conflict, less cohesion and structure compared to those of non-obese youth (Zeller et al., 2007). It is possible that the mechanism by which CLSEC is increasing the likelihood of highly regulated children being classified as overweight or obese is by creating a stressful family environment.

In line with previous research, the impressionistic rating of the parent's body size was predictive of the child belonging to the comorbid or overweight group in all multivariate analyses (Zeller et al., 2007). Despite the problems of a visual rating of parent obesity, the findings are suggestive and worthy of consideration. While impressions of parent body size as a measure of weight status is problematic, these findings are consistent with previous research and support that having a parent who is

overweight or obese increases a child's risk of being overweight or obese (Classen & Hokayem, 2005; Strauss & Knight 1999). The covariation between the parent's perceived body size and the child's BMI might be due to obesity's high heritability (Classen & Hokayem, 2005; Haworth, Carnell, Meaburn, Davis, Plomin, & Wardle, 2008; Strauss & Knight 1999; Wardell, Carnell, Haworth, & Plomin, 2008) or the shared environment between the child and the parent, which may include family-wise dietary and physical activity practices.

The one factor that distinguished the comorbid group from the overweight only group was SREC. As SREC decreased, the odds of belonging to the comorbid group increased but not to the overweight only group. In supplementary analyses, when the comorbid group was used as a reference group, for every 1 standard deviation increase in SREC, the odds of belonging to the overweight only group more than doubled compared to the comorbid group, which is consistent with the models where the typically developing group was used as the reference. In other words, as a child's SREC increased the likelihood of being in the overweight only group increased when compared to the comorbid group. Thus, having both lower levels of SREC and a parent who was coded as heavier increased the likelihood that a child met criteria for comorbid clinical levels of problem behaviors and being overweight or obese.

The relation of SREC to the odds of belonging to any of the outcome groups was not moderated by intervention group, gender, or minority status. The interaction between SREC and CLSEC also was not moderated by intervention group, gender, or minority status. However, when the interaction between SREC, CLSEC, and minority status was examined, self-regulation and CLSEC alone were moderated by minority status, such that

for children who were African-American or bi-racial having higher levels of self-regulation and experiencing higher levels of CLSEC reduced their odds of belonging to the comorbid group compared to the typically developing group. This was not found for children whose parents did not identify them as minorities. The protective nature of high SREC was as expected for minority children, although it is unclear why this was not found for majority children. The effect of CLSEC is contrary to expected as experiencing high levels of CLSEC was expected to place children at higher risk for developing problem behavior and/ or obesity. As previously described, in the same model a significant interaction was found between SREC and CLSEC where high levels of CLSEC placed children at higher risk of belonging to the overweight only group when SREC was 1 standard deviation above the mean. A difference between the comorbid group and the overweight only group is the presence of clinical levels of problem behavior. There is evidence in the problem behavior literature that shows that harsh parenting does not always lead to negative outcomes for African-American children and often it is even protective (Deater-Deckard & Dodge, 2009; Deater-Deckard, Dodge, Bates, Pettit, 1996). Researchers posit that physical punishment and 'no nonsense' parenting are the norm, and thus the detrimental outcomes for harshness on children's adjustment found in Whites do not stand (Berlin et al., 2009). The moderation findings by minority status are in line with this literature.

When the comorbid group was used as a reference group different moderation was found. When SREC was evaluated alone, a minority group by SREC interaction was found. Minority children with high levels of SREC were more likely to belong to the overweight only group compared to the comorbid group, which was not found for

children who were not considered minorities. This finding is consistent with the significant interaction that was found in the primary analyses where children with high levels of SREC and whose parents displayed high levels of CLSEC were more likely to belong to the overweight only group. Further, in all analyses having less SREC increased the odds of belonging to the comorbid and problem behavior only groups, which is also consistent with these findings. Taken together, these findings suggest that if you are a minority and are regulated you are less likely to have concurrent clinical levels of problem behaviors and obesity. SREC was also moderated by gender, where boys with higher levels of SREC were less likely to be in the problem behavior only group compared to the comorbid group. The literature suggests that boys commonly have lower levels of SREC and higher levels of problem behavior (Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Putnam et al., 2002). In the present study being a boy had a negative relation with SREC, albeit small. Thus, it is possible that SREC has a more significant protective role for boys than for girls. This finding is consistent with previous research that has found that self-regulation is related to problem behavior in boys but not girls (Chang, Olson, Sameroff, & Sexton, 2011).

This study has multiple strengths. First, the study was longitudinal, spanning eight years and different developmental stages. This design can help uncover early factors in a child's life that might impact later outcomes and can thus be targeted in prevention efforts. Similarly, although the way self-regulation and parenting were measured was not without flaws, it also had strengths. Self-regulation and parenting were measured across four years in early childhood allowing us to capture these constructs in an important developmental stage where regulatory processes are growing and where parenting can

have a significant impact in establishing healthy habits and home routines. Additionally, parenting was assessed with a multi-rater, observational method. Studies most often use self-report methods to assess parenting. The use of an observational assessment of parenting may preclude recall and social desirability biases that might be present when using self-report methods. Second, the sample was ethnically, racially, and geographically diverse. The pediatric obesity literature needs studies with more diverse samples, especially given that ethnic and racial minorities experience higher rates of pediatric obesity than their White counterparts. The present study contributes to the diversification of the pediatric obesity literature. Similarly, often studies are limited to one geographic location, which may limit the generalizability of findings given that communities may share characteristics that influence pediatric obesity (e.g., availability of parks, availability of fresh produce; Harrison et al., 2011). The sample in this study comes from three different geographic locations in the U.S. making the findings more generalizable to similar populations across the country. Further, this study uses a community sample. Third, the study controlled for pertinent covariates making the analyses stringent and reliable.

Limitations

The results of this study must be considered in the context of its limitations. The use of an impression of the parent and child's body size was a clear limitation. Future research should directly assess parent and BMI at all time points, as impression ratings are potentially biased by the types of clothes being worn and other factors unrelated to actual weight of the parent or child. There is no evidence suggesting that coders can accurately rate someone's weight by coding a videotaped interaction. Although these

measures were related to weight status at age 10 in the expected direction, these findings are considered as suggestive for future research.

Self-regulation was measured by using the parent's report on an inhibitory control subscale. As previously mentioned, parent-report on such questionnaires may be subject to recall bias. Further, inhibitory control captures a limited aspect of self-regulation. Including activation control and attention regulation might provide a more complete picture of how self-regulation relates to obesity. In order to more thoroughly explore and understand ethnic and racial differences having a more balanced number of ethnic and racial minorities would be necessary. Another limitation to the predictors is that the way they were modeled had poor fit. As described earlier, this might be due to growth that is not being modeled or in the case of the parenting variables the macro and the micro codes might be capturing different aspects of parenting. Using weight status at only one time point, age 10, is also a limitation of this study. Previous research has found that children follow different weight trajectories, which are related to different predictors and outcomes. Similarly, the cutoff used for problem behaviors was very stringent making the children who met criteria for problem behaviors a small group. Lastly, although the sample is diverse in many ways (geographically, ethnically, racially) the generalizability of the findings are limited because this sample was predominantly high-risk, low-income who were receiving WIC services.

Future Directions

Future research would benefit from using objective and standardized measures of child and parent weight at all time points. Ideally when examining obesity, measures beyond BMI should be used such as skinfolds and waist circumference. It would be

important for future studies to use the complete measure of effortful control as this is more prevalent in the developmental literature and could give more insight into what aspects of self-regulation are important in pediatric obesity. Further, the addition of laboratory measures in the context of food and of other attractive objects would help understand 1) if they are capturing the same construct as paper-and-pencil measures, and 2) how general and food-related regulation relate to each other and to obesity. Self-regulation grows in early childhood, however, children might have different slopes and these might be differently related to the outcomes of interest. It would be informative to capture the change over time in self-regulation and how this relates to pediatric obesity. Similarly, the use of longitudinal growth models to explore the development of problem behavior and weight can help illustrate how these co-vary over time and help identify higher risk groups (i.e., chronically obese). Using lower t-scores to identify not only children who meet criteria for clinical levels of problem behavior but also who are in the at-risk range could be beneficial in capturing children who might at risk for developing more serious behavior problems in the future.

The literature shows that self-regulation and parenting often interact to predict child outcomes, however there is also evidence that they influence each other. Future research should also explore the reciprocal relationship between self-regulation and parenting and not only how they effect change in outcomes but also how they might effect change in each other. It would be informative to measure parenting styles and feeding practices in addition to general parenting practices in order to understand how they all relate to each other and get a better understanding of how interventions can help address each parenting domain. Lastly, future studies would benefit from including

strong measures of health behaviors of the whole family including diet, particularly the food that the child actually consumes, and physical and sedentary activity. This might help identify potential mediators or indirect effects of child and parent characteristics on weight. Additionally understanding how parenting practices influence weight in the context of health behaviors can help better inform family-centered approaches to obesity prevention.

Conclusions

The present study suggests that despite the co-occurrence of problem behavior and obesity among some children, there is little evidence for a shared etiology. Further, the current study did not find that problem behavior and obesity were highly comorbid-problem behavior and weight at age 10 were uncorrelated and the comorbid group was one of the smaller groups. This study contributes to the existing pediatric obesity literature by identifying an interaction between a child and a parent factor in early childhood that increases the likelihood of the child being overweight or obese at age 10. Research shows that children who are overweight or obese are more likely to be overweight or obese as adults. Thus, identifying these early etiological factors is important. Typically, children who have poor self-regulation are at risk for a host of negative outcomes. This is supported in the present study that found that children with low-levels of self-regulation are more likely to meet clinical levels of problem behavior alone and in conjunction with obesity. Children with high levels of self-regulation might also be at increased risk for developing problematic weight especially in the face of stressful family environments. Thus, children who are highly regulated should not be dismissed and the whole family environment should be considered when assessing for

risk of developing weight problems. Likewise, although parenting alone did not predict child outcomes in this study, coercive limit-setting did increase the likelihood of meeting criteria for overweight or obesity in the context of a highly regulated child. Thus, parenting continues to prove to be an important target for prevention and intervention efforts for pediatric obesity. Family-based interventions for pediatric obesity typically focus on increasing positive parenting but the current findings suggest that it might be important to also focus on decreasing inconsistent, punitive, and harsh forms of parenting. However, it is also important that these parenting practices are examined in relation to healthy diet and exercise practices. Lastly, family-based interventions should be mindful of potential ethnic, racial, and gender differences.

References

Achenbach, T.M. & Rescorla, L.A. (2001). *Manual for ASEBA School-Age Forms & Profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.

Aiken, L.S. & West, S.G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.

Anderson, S. E., He, X., Schoppe-Sullivan, S., & Must, A. (2010). Externalizing behavior in early childhood and BMI from age 2 to 12 years: longitudinal analyses of a prospective cohort study. *BMC Pediatrics, 10:*49. doi: 10.1186/1471-2431-10-49

Anzman, L. S. & Birch, L. L. (2009). Low inhibitory control and restrictive feeding practices predict weight outcomes. *The Journal of Pediatrics, 155,* 651-656.

Anzman-Fransca, S., Sifter, C. A., & Birch, L. L. (2012). Temperament and childhood obesity risk: Review of the literature. *Journal of Developmental and Behavioral Pediatrics, 33,* 732-745.

Barlow, S. (2007). Expert committee recommendations regarding prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics, 120*, S164- S192. doi:10.1542/peds.2007-2329C

Bates, J. E., Pettit, G. S., Dodge, K. A., & Ridge, B. (1998). Interaction of temperamental resistance to control and restrictive parenting in the development of externalizing behavior. *Developmental Psychology, 34,* 982-995.

Baughcum, A. E., Burklow, K. A., Deeks, C. M., Powers, S. W., & Whitaker, R. C. (1998). Maternal feeding practices and childhood obesity: a focus group study of low-income mothers. *Archives of Pediatric & Adolescent Medicine, 152*, 1010-1014.

Baumrind, D. (1971). Current patterns of parental authority. *Developmental Psychology Monograph, 4*, 101-103. doi:10.1037/h0030372

Beck, S. & Terry, K. (1985). A comparison of obese and normal weight families' psychological characteristics. *The American Journal of Family Therapy, 13,* 55-59. doi:10.1080/01926188508251264

Bentler, P.M. (1990). Comparative fit indexes in structural models. Psychological bulletin, 107, 238.

Bentler, P.M. (1995). EQS structural equations program manual. Encino, CA: Multivariate Software.

Berge, J.M. (2009). A review of familial correlates of child and adolescent obesity: What has the 21st century taught us so far? *International Journal of Adolescent Medical Health, 21,* 457-483. doi:10.1515/IJAMH.2009.21.4.457

Berge, J.M., Wall, M., Loth, K., & Neumark-Sztainer, D. (2010). Parenting style as a predictor of adolescent weight and weight-related behaviors. *Journal of Adolescent Health, 46,* 331-338. doi:10.1016/j.jadohealth.2009.08.004

Bergmeier, H., Skouteris, H., Horwood, S., Hooley, M., & Richardson, B. (2014). Associations between child temperament, maternal feeding practices and child body mass index during the preschool years: a systematic review of the literature. *Obesity Reviews, 15,* 9-18.doi: 10.1111/obr.12066.

Berlin, L. J., Ispa, J. M., Fine, M. A., Malone, P. S., Brooks-Gunn, J., Brady-Smith, C., . . . Bai, Y. (2009). Correlates and Consequences of Spanking and Verbal Punishment for Low-Income White, African American, and Mexican American Toddlers. *Child development, 80*(5), 1403-1420. doi: 10.1111/j.1467-8624.2009.01341.x

Bradley, R. H., Houts, R., Nader, P. R., O'Brien, M., Belsky, J., & Crosnoe, R. (2008). The relationship of BMI and behavior in children. *Journal of Pediatrics, 153,* 629-634. doi:10.1016/j.jpeds.2008.05.026.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: research perspectives. *Developmental Psychology, 22,* 723-742. doi:10.1037//0012-1649.22.6.723

Brotman, L.M., Dawson-McClure, S., Huang, K.-Y., Theise, R., Kamboukos, D., Wang, J., …Ogedehbe, G. (2012). Early childhood family intervention and long-term obesity prevention among high-risk minority youth. *Pediatrics, 129*, e621-e628. Doi: 10.1242/peds.2011-1568

Browne, W. M., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models*. Newbury Park, CA: Sage.

Butte, N. F., Bacino, C. A., Cole, S. A., & Comuzzie, A. G. (2006). Genetics of childhood obesity. In M. I. Goran & M. Southern (Eds.), Handbook of pediatric obesity: Etiology, pathophysiology and prevention (pp. 79 – 96). Boca Raton, FL: Taylor & Francis Books/CRC Press.

Caldwell, B., & Bradley, R. (1984). Home Observation for Measurement of the Environment (HOME)-revised edition. Little Rock, AR: University of Arkansas, Little Rock.

Capuccio, F. P., Taggard, F.M., Kandala, N. B., Currie, A., Peile, E., Stranges, S., & Miller, M.A. (2008). Meta-analysis of short sleep duration and obesity in children and adults. *Sleep, 31,* 619-626. PMCID: PMC2398753

Caprio, S., Daniels. S. R., Drewnowski, A., Kaufman, F. R., Palinkas, L. A., Rosenbloom, A. L., & Schwimmer, J.B. (2008). Influence of race, ethnicity, and culture on childhood obesity: implications for prevention and treatment. *Diabetes Care, 31,* 2211- 2221. doi:10.2337/dc08-9024

Carr, E. G., Horner, R. H., Turnbull, A. P., Marquis, J. G., Magito McLaughling, D., McAtee, M. L., …Doolabh, A. (1999). *Positive behavior support for people with developmental disabilities: A research synthesis*. Washington, DC: American Association on Mental Retardation.

Centers for Disease Control and Prevention (2011); National Center for Health Statistics. National Health and Nutrition Examination Survey. Retrieved on June 15, 2013 from http://www.cdc.gov /nchs/nhanes/nhanes_questionnaires.htm.

Chaney, J. M., & Peterson, L. (1989). Family variables and disease management in juvenile rheumatoid arthritis. *Journal of Pediatric Psychology*, *14*, 389–403. doi:10.1093/jpepsy/14.3.389

Chang, H., Olson, S. L., Sameroff, A. J., & Sexton, H. R. (2011). Child effortful control as a mediator of parenting practices on externalizing behavior: Evidence for a sex-differentiated pathway across the transition from preschool to school. *Journal of Abnormal Child Psychology, 39*(1), 71-81. doi:10.1007/s10802-010-9437-7

Chen, X., Beydoun, M.A., & Wang, Y. (2008). Is sleep duration associated with childhood obesity? A systematic review and meta-analysis. *Obesity, 16,* 265-274. doi:10.1038/oby.2007.63

Classen, T. & Hokayem, C. (2005). Childhood influences on youth obesity. *Economics and Human Biology, 3,* 165-187. doi:10.1016/j.ehb.2005.05.008

Collins, L.M., Murphy, S.A., & Bierman, K.L. (2004). A conceptual framework for adaptive preventive interventions. *Prevention Science, 5,* 185-196. doi:10.1023/B:PREV.0000037641.26017.00

Connell, A.M., Dishion, T.J., & Deater-Deckard, K. (2006). Variable- and person-centered approaches to the analysis of early adolescent substance use: Linking peer, family, and intervention effects with developmental trajectories. [Special Issue]. *Merrill-Palmer Quarterly, 52*(3), 421-448. doi:10.1353/mpq.2006.0025

Connell, A.M., Dishion, T.J., Yasui, M., & Kavanaugh, K. (2007). An adaptive approach to family intervention: Linking engagement in family-centered intervention to reductions in adolescent problem behavior. *Journal of Consulting and Clinical Psychology, 75*, 568-579. doi:10.1037/0022-006X.75.4.568

Dalton, W.T. & Kitzmann, K.M. (2008). Broadening parental involvement in family-based interventions for pediatric overweight: implications from family systems and child health. *Family Community Health, 31,* 259-268. doi:10.1097/01.FCH.0000336089.37280.f8

Daniels, S.R. (2006). The consequences of childhood overweight and obesity. *The Future of Children, 16,* 47-67. Retrieved on May 14, 2013 from http://www.jstor.org/stable/3556550

Darling, N., & Steinberg, L. (1993). Parenting style as context: An integrative model. *Psychological Bulletin, 3,* 487-496.

Datar, A., & Sturm, R. (2004). Childhood overweight and parent- and teacher-reported behavior problems: Evidence from a prospective study of kindergartners. *Archives of Pediatrics & Adolescent Medicine, 158,* 804- 810. doi: 10.1001/archpedi.158.8.804

Davis, M. C., Tucker, C. M., & Fennell, R. S. (1996). Family behavior, adaptation, and treatment adherence of pediatric nephrology patients. *Pediatric Nephrology, 10,* 160–166. doi:10.1007/BF00862061

Davison, K.K., & Birch, L.L. (2001). Childhood overweight: a contextual model and recommendations for future research. *Obesity Reviews, 2,* 159-171. doi:10.1046/j.1467-789x.2001.00036.x

De la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2013). Adolescents' intake of junk food: Processes and mechanisms driving consumption similarities among friends. *Journal of Research on Adolescence.* Retrieved on July 21, 2013 from http://www.gmw.rug.nl/~veenstra/JRA/Network-BehaviorDynamics/DeLaHayeJunkFood_JRA2013.pdf

Deater-Deckard, K., & Dodge, K. A. (2009). Externalizing behavior problems and discipline revisited: nonlinear effects and variation by culture, context, and gender. *Psychological Inquiry: An International Journal for the Advancement of Psychological Theory, 8,* 161-175. doi: 10.1207/s15327965pli0803_1

Deater-Deckard, K., Dodge, K. A., Bates, J. E., & Pettit, G. S. (1996). Discipline among African American and European American mothers: Links to children's externalizing behaviors. *Developmental Psychology, 32,* 1065-1072. doi: 10.1037/0012-1649.32.6.1065

Dishion, T. J., Hogansen, J., Winter, C., & Jabson, J. M. (2004). *The Coder Impressions Inventory*. Unpublished coding manual. Available from the Child and Family Center, 6217 University of Oregon Eugene, OR 9703.

Dishion, T.J., & Patterson, G.R. (2006). The development and ecology of antisocial behavior in children and adolescents. In D. Cicchetti & D. J. Cohen (Eds.), *Developmental psychopathology, Risk Disorder, and Adaptation* (2nd ed., Vol. 3, pp. 503-541). Hoboken, NJ: John Wiley & Sons.

Dishion, T.J., Shaw, D.S., Connell, A.M., Gardner, F., Weaver, C.M., & Wilson, M.N. (2008). The Family Check-Up with high-risk indigent families: Preventing problem behavior by increasing parents' positive behavior support in early childhood. *Child Development, 79*, 1395-1414. doi:10.1111/j.1467-8624.2008.01195.x

Dishion, T.J. & Stormshak, E. (2007). *Intervening in children's lives: An ecological, family-centered approach to mental health care.* Washington, DC: APA Books.

Dishion, T.J., Stormshak, E., & Kavanagh, K. (2011). *Everyday Parenting: A professional's guide to building family management skills.* Champaign, IL: Research Press.

Duarte, C. S., Sourander, A., Nikolakaros, G., Pihlajamaki, H., Helenius, H.,… Must, A. (2010). Child mental health problems and obesity in early adulthood. *The Journal of Pediatrics, 156,* 93-97.

Ebbeling, C.B., Pawlak, D.B., & Ludwig, D.S. (2002). Childhood obesity: public health crisis, common sense cure. *Lancet, 360* (9331), 473-4782. doi:10.1016/S0140-6736(02)09678-2

Eisenberg, N., Cumberland, A., Spinrad, T. L., Fabes, R. A., Shepard, S. A., Reiser, M., …Guthrie, I. K. (2001). The relations of regulation and emotionality to children's externalizing and internalizing problem behavior. *Child development, 72*, 112-1134.

Else-Quest, N. M., Hyde, J. S., Goldsmith, H. H., & Van Hulle, C. A. (2006). Gender differences in temperament: a meta-analysis. *Psychological Bulletin, 132*, 33. doi: 10.1037/0033-2909.132.1.33

Enders, C. K. (2010). *Applied Missing Data Analysis*. New York: Guilford Press.

Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling, 8*, 430-457.

Epstein, L.H., Leddy, J.J., Temple, J.L., & Faith, M.S. (2007). Food reinforcement and eating: a multilevel analysis. *Psychological Bulletin, 133,* 884-906. doi:10.1037/0033-2909.133.5.884

Epstein, L.H., Paluch, R., Roemmich, J.N., & Beecher, M.D. (2007). Family-based obesity treatment, then and now: Twenty-five years of pediatric obesity treatment. *Health Psychology, 26,* 381-391. doi:10.1037/0278-6133.26.4.381

Ewart, C.K., & Suchday, S. (2002). Discovering how urban poverty and violence affect health: Development and validation of a neighborhood stress index. *Health Psychology, 21*, 254–262. doi: 10.1037/0278-6133.21.3.254

Federal Interagency Forum on Child and Family Statistics. *America's Children: Key National Indicators of Well-Being, 2013.* Washington, DC: U.S. Government Printing Office.

Fiese, B. H., & Jones, B. L. (2012). Food and family: A socio-ecological perspective for child development. *Advances in Child Development and Behavior,* 307-337. doi: 10.1016/B978-0-12-394388-0.00009-5

Fisher, Jennifer O. (2007). Effects of age on children's intake of large and self-selected food portions. *Obesity (Silver Spring) 15*, 403-12. doi:10.1038/oby.2007.549

Francis, L.A. & Susman, E.J. (2009). Self-regulation and rapid weight gain in children from age 3 to 12 years. *Archives of Pediatric and Adolescent Medicine, 163*, 297-302. doi: 10.1001/archpediatrics.2008.579

Gallagher, K. C. (2002). Does child temperament moderate the influence of parenting on adjustment? *Developmental Review, 22,* 623-643.

Garthus-Niegel, S., Hagtvet, K. A., & Vollrath, M. E. (2010). A prospective study of weight development and behavior problems in toddlers: the Norwegian Mother and Child Cohort Study. *BMC Public Health, 10:*626. doi: 10.1186/1471-2458-10-626

Gerards, S.M.P.L., Dagnelie, P.C., Jansen, M.W.J., van der Goot, L.O.H.M., de Vries, N.K. Sanders, M.R., & Kremers, S. P.J. (2012). Lifestyle Triple P: a parenting intervention for childhood obesity. *BioMed Central Public Health, 12,* 267. doi:10.1186/1471-2458-12-267

Gerards, S.M.P.L., Sleddens, E.F.C., Dagnelie, P.C., de Vries, N.K., & Kremers, S.P.J. (2011). Interventions addressing general parenting to prevent or treat childhood obesity. *International Journal of Pediatric Obesity, 6,* e28- e45. doi:10.3109/17477166.2011.575147

Golan, M. & Bachner-Melman, R. (2011). Self-regulation and the management of childhood obesity. *Community Medicine & Health Education, 1*, 107-114. doi:10.4172/jcmhe.1000107

Golan, M., Weizman, A., Apter, A., & Fainaru, M. (1998). Parents as the exclusive agents of change in the treatment of childhood obesity. *American Journal of Clinical Nutrition, 67,* 1130-1135. doi:10.1038/sj.ijo.0800749

Golan, M. & Crow, S. (2004). Targeting parents exclusively in the treatment of childhood obesity: long-term results. *Obesity Research, 12,* 357-361. doi:10.1038/oby.2004.45

Golley, K.R. (2005). Family-focused management of overweight in prepubertal children – a randomised controlled trial. The healthy eating and lifestyle through positive parenting (HELPP) study. School of Medicine, Flinders University.

Golley, K.R., Magarey, A.M., Baur, L.A., Steinbeck, K.S., & Daniels, L.A. (2007). Twelve-month effectiveness of a parent-led, family-focused weight management program for prepubertal children: a randomized, controlled trial. *Pediatrics, 119,* 517- 525. doi:10.1542/peds.2006-1746

Golley, K.R., Perry, R.A., Magary, A.M., & Daniels, L.A. (2007). Family-focused weight management program for five- to nine-year-olds incorporating parenting skills training with healthy lifestyle information to support behaviour modification. *Nutrition & Dietetics, 64,* 144- 150. doi:10.1111/j.1747-0080.2007.00106.x

Graziano, P. A., Calkins, S. D., & Keane, S. P. (2010). Toddler self-regulation skills predict risk for pediatric obesity. *International Journal of Obesity, 34,* 633-641. doi:10.1038/ijo.2009.288

Griffiths, L. J., Dezateux, C., & Hill, A. (2011). Is obesity associated with emotional and behavioural problems in children? Findings from the Millenium Cohort Study. *International Journal of Pediatric Obesity, 6,* e423-e432.

Halfon, N., Larson, K., & Slusser, W. (2013). Associations between obesity and comorbid mental health, developmental, and physical conditions in a nationally representative sample of US children aged 10 to 17. *Academic Pediatrics, 13,* 6-13.

Harrison, K., Bost, K.K., McBride, B.A., Donovan, S.M., Grigsby-Toussaint, D.S….Jacobsohn, G.C. (2011). Toward a developmental conceptualization of contributors to overweight and obesity in childhood: the six-c's model. *Child Development Perspectives*, *5*, 50-58.

Haworth, C. M. A., Carnell, S., Meaburn, E. L., Davis, O. S. P., Plomin, R. and Wardle, J. (2008). Increasing heritability of BMI and stronger associations with the FTO gene over childhood. *Obesity, 16*, 2663–2668. doi: 10.1038/oby.2008.434

Hollenstein, T. (2007). State space grids: Analyzing dynamics across development. *International Journal of Behavioral Development, 31,* 384-396.

Horner, R. H., Sugai, G., & Anderson, C. M. (2010). Examining the evidence base for school-wide positive behavior support. *Focus on Exceptional Children, 42,* 1-14.

Hosmer, D. W. & Lemeshow, S. (2000). *Applied Logistic Regression* (2nd ed.). Hoboken, NJ: John Wiley & Sons.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*, 1-55. doi: 10.1080/10705519909540118

IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

Jansen, P. W., Mensah, F. K., Clifford, S. A., Tiemeier, H., Nicholson, J. M., & Wake, M. (2013). Development of mental health problems and overweight between ages 4 and 11 years: a population-based longitudinal study of Australian children. *Academic Pediatrics*, *13*, 159-167.

Kitzmann, K.M., Dalton, W.T., & Buscemi, J. (2008). Beyond parenting practices: Family context and the treatment of pediatric obesity. *Family Relations, 57,* 13-23. doi:10.1111/j.1741-3729.2007.00479.x

Kitzmann, K.M. & Beech, B.M. (2011). Family-based interventions for pediatric obesity: methodological and conceptual challenges from family psychology. *Couple and Family Psychology: Research and Practice, 1*(S), 45-62. doi:10.1037/2160-4096.1.S.45

Kuczmarski, R.J., Ogden, C.L., Guo, S.S., et al. (2000). *2000 CDC growth charts for the United States: Methods and development.* (National Center for Health Statistics, Vital and Health Statistics series 11, data from National Health Survey no, 246). Washington, DC: U.S. Government Printing Office.

Lane, S. P., Bluestone, C., & Burke, C. T. (2013). Trajectories of BMI from early childhood through early adolescence: SES and psychological predictors. *British Journal of Health Psychology, 18,* 66-82. doi: 10.1111/j.2044-8287.2012.02078.x

Lengua, L. J., Honorado, E., & Bush, N. R. (2007). Contextual risk and parenting as predictors of effortful control and social competence in preschool children. *Journal of Applied Developmental Psychology, 28*, 40-55. doi: 10.1207/S15374424jccp2902_910.1016/j.appdev.2006.10.001

Lengua, L. J., Wolchik, S. A., Sandler, I. N., & West, S. G., (2010). The additive and interactive effects of parenting and temperament in predicting adjustment problems of children of divorce. *Journal of Clinical Child Psychology, 29,* 232-244.

Leve, Kim, Pears, 2005. Childhood temperament and family environment as predictors of internalizing and externalizing trajectories from ages 5 to 17. *Journal of Abnormal Child Psychology, 33,* 505-520.

Lewin, A.B., Heidgerken, A.D., Geffken, G.R., Williams, L.B., Storch, E.A., Gelfand, K.M., & Silverstein, J.H. (2006). The relation between family factors and metabolic control: the role of diabetes adherence. *Journal of Pediatric Psychology, 31,* 174-183. doi:10.1093/jpepsy/jsj004

Lumeng, J. C., Gannon, K., Cabral, H. J., Frank, D. A., & Zuckerman, B. (2003). Association between clinically meaningful behavior problems and overweight in children. *Pediatrics*, 112, 1138- 1145. doi: 10.1542/peds.112.5.1138

Lunkenheimer, E. S., Dishion, T. J., Shaw, D. S., Connell, A. M., Gardner, F. E. M., Wilson, M. N., & Skuban, E. M. (2008). Collateral benefits of the Family Check-Up on early childhood school readiness: Indirect effects of parents' positive behavior support. Developmental Psychology, 44, 1737-1752. doi: 10.1037/a0013858

Lytle, L. A. (2009). Examining the etiology of childhood obesity: The IDEA Study. *American Journal of Community Psychology, 44,* 338. doi:10.1007/s10464-009-9269-1

Mackenbach, J. D., Tiemeier, H., van der Ende, J., Nijs, I. M. T., Jaddoe, V. W. V., … Jansen, P. W. (2012). Relation of emotional and behavioral problems with body mass index in preschool children: The generation R study. *Journal of Developmental and Behavioral Pediatrics, 33*, 641-648.

Mamun, A. A., O'Callaghan, M. J., Cramb, S. M., Najman, J. M., Williams, G. M., & Bor, W. (2009). Childhood behavior problems predict young adults' BMI and obesity: evidence from a birth cohort study. *Obesity, 17,* 761-766. doi:10.1038/oby.2008.594

Manco, M. & Dallapiccola, B. (2012). Genetics of Pediatric Obesity. *Pediatrics, 130,* 123-133. doi:10.1542/peds.2011-2717

Martel, M. M., Pierce, L., Nigg, J. T., Jester, J. M., Adams, K., Puttler, L. I.,…Zucker, R. A. (2009). Temperament pathways to childhood disruptive behavior and adolescent substance abuse: Testing a cascade model. *Journal of abnormal child psychology, 37*, 363-373. doi: 10.1007/s10802-008-9269-x

McMeekin, S., Jansen, E., Mallan, K. M., Nicholson, J., Magarey, A., & Daniels, L. (2013). Associations between infant temperament and early feeding practices. A cross-sectional study of Australian mother-infant dyads from the NOURISH randomized controlled trial. *Appetite, 60,* 239-245.

Miller, WR. & Rollnick, S. Motivational interviewing: Preparing people to change addictive behavior. New York: Guilford Press; 1991.

Morris, Silk, Steinberg, Sessa, Avenevoli, & Essex, 2002. Temperamental vulnerability and negative parenting as interacting predictors of child adjustment. *Journal of Marriage and Family, 64,* 461-471.

Mustillo, S., Worthman, C., Erkanli, A., Keeler, G., Angold, A., & Costello, E. J. (2003). Obesity and psychiatric disorder: developmental trajectories. *Pediatrics, 111,* 851-859. doi: 10.1542/peds.111.4.851

Muthén, B. O., & Muthén, L. K. (2012). Mplus, Version 7.1. Los Angeles, CA: Muthén & Muthén.

Noldus Information Technology. (2012). The Observer XT reference manual 11.0. Wageningen, the Netherlands: Author.

O'Brien, M., Nader, P.R., Houts, R.M., Bradley, R., Friedman, S.L., Belsky, J.... the NICHD Early Child Care Research Network. (2007). The ecology of childhood overweight: a 12-year longitudinal analysis. *International Journal of Obesity, 31,* 1469-1478. doi:10.1038/sj.ijo.0803611

Ogden, C.L., Carroll, M.D., Kit, B.K., & Flegal, K.M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA, 307*, 483-490. doi:10.1001/jama.2012.40

Ogden, C.L. & Carroll, M.D. (June 2010). Prevalence of obesity among children and adolescents: United States, trends 1963- 1965 through 2007-2008. *National Center for Health Statistics, E-Stat.* Retrieved on May 15, 2013 from http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.htm

Olsen, N. J., Pedersen, J., Handel, M. N., Stougaard, M., Mortensen, E. L., Heitmann, B. L. (2013). Child behavioural problems and body size among 2-6 year old children predisposed to overweight. Results from the "Healthy Start" Study. *PLos One, 8* (11), e78974. doi: 10.1371/journal.pone.0078974

Oude Luttikhuis, H., Baur, L., Jansen, H., Shrewsbury, V.A., O'Malley, C., Stolk, R.P., & Summerbell, C.D. (2009). Interventions for treating obesity in children. *Cochrane Database of Systematic Reviews, 3*, 1- 57. doi:10.1002/14651858.CD001872

Peterson, J., Winter, C., Jabson, J. M., & Dishion, T. J. Unpublished coding manual. University of Oregon, Child and Family Center; 2008. Relationship affect coding system.

Piché, G., Fitzpatrick, C., & Pagani, L. S. (2012). Kindergarten self-regulation as a predictor of BMI and sports participation in fourth grade students. *Mind, Brain, and Education, 6*, 19-26.

Pulgaron, E. R. (2013). Childhood obesity: a review of increased risk for physical and psychological comorbidities. *Clinical Therapeutics, 35,* A18-A32. doi: 10.1016/j.clinthera.2012.12.014

Putnam, S. P., Sanson, A., & Rothbart, M. K. (2002). Child temperament and parenting. In M. Bornstein (Ed.), *Handbook of parenting* (2nd ed., pp. 255-277). Mahwah, NJ: Erlbaum.

Putnam, S. P., Gartstein, M. A., & Rothbart, M. K. (2006). Measurement of fine-grained aspects of toddler temperament: The early childhood behavior questionnaire. *Infant Behavior and Development, 29*, 386-401.

Reilly, J.J. Methven, E., McDowell, Z.C., Hacking, B., Alexander, D., Stewart, L., & Kelnar, C.J.H. (2003). Health consequences of obesity. *Archives of Disease in Childhood, 88,* 748-752. doi:10.1136/adc.88.9.748

Rhee, K. (2008). Childhood overweight and the relationship between parent behaviors, parenting style, and family functioning. *The ANNALS of the American Academy of Political and Social Science, 615,* 11- 35. doi:10.1177/0002716207308400

Rhee, K., Lumeng, J.C., Appuglese, D.P., Kaciroti, N., & Bradley, R. H. (2006). Parenting styles and overweight status in first grade. *Pediatrics, 117*, 2005- 2259. doi:10.1542/peds.2005-2259

Rofey, D.L., Kolko, R. P., Iosif, A.M., Silk, J.S., Bost, J.E., Feng, W., … Dahl, R. E. (2009). A longitudinal study of childhood depression and anxiety in relation to weight gain. *Child psychiatry and human development, 40,* 517–526. doi: 10.1007/s10578-009-0141-1

Rothbart, M. K. (1989). Temperament and development. In G. Kohnstamm, J. Bates & M. Rothbart (Eds.), *Temperament in childhood*. New York: Wiley.

Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at three to seven years: The Children's Behavior Questionnaire. *Child Development, 72*, 1394-1408.

Rothbart, M. K., & Bates, J. E. (2006). Temperament. In W. D. N. Eisenberg & R. M. Lerner

Rubin, K. H., Burgess, K. B., Dwyer, K. M., & Hastings, P. D. (2003). Predicting preschoolers' externalizing behaviors from toddler temperament, conflict, and maternal negativity. *Developmental Psychology, 39,* 164-176. doi: 10.1037/0012-1649.39.1.164

Sanson, A. & Rothbart, M. K. (1995). Child temperament and parenting. In M. Bornstein (Ed.), *Applied and practical parenting* (Vol. 4, pp. 299-321). Mahwah, NJ: Lawrence Erlnaum.

Shrewsbury, V.A., Steinbeck, K.S., Torvaldsen, S., & Baur, L.A. (2011). The role of parents in pre-adolescent and adolescent overweight and obesity treatment: a systematic review of clinical recommendations. *Obesity Reviews, 12,* 759-769. doi:10.1111/j.1467-789X.2011.00882.x

Simpkins, S.D., Schaefer**,** D.R., Price**,** C.D., & Vest**,** A.E**.** (2013). Adolescent Friendships, Obesity, and Physical Activity: Untangling Selection and Socialization through Longitudinal Social Network Analysis. *Journal of Research on Adolescence*. Retrieved on May 10, 2013 from http://www.ppsw.rug.nl/~veenstra/JRA/Network-BehaviorDynamics/Simpkins_JRA2013.pdf

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence.* New York, NY: Oxford University Press; 2003.

Singh, G.K., Kogan, M.D., Van Dyck, P.C., & Siahpush, M. (2008). Racial/ ethnic, socioeconomic, and behavioral determinants of childhood and adolescent obesity in the United States: analyzing independent and joint associations. *Annals of Epidemiology, 18,* 671-742. doi:10.1016/j.annepidem.2008.05.001

Sisson, S.B., Broyles, S.T., Baker, B.L., & Katzmarzyk, P.T. (2010). Screen time, physical activity, and overweight in U.S. youth: National Survey of Children's Health 2003. *Journal of Adolescent Health, 47,* 308-311. doi:10.1016/j.jadohealth.2010.02.016

Skelton, J.A., Irby, M.B., Grzywacz, J., & Miller, G. (2011). Etiologies of obesity in children: Nature and nurture. *Pediatric Clinics of North America, 58,* 1333- 1354. doi:10.1016/j.pcl.2011.09.006

Smith, J. D., Montaño, Z., Dishion, T. J., Shaw, D. S., & Wilson, M. N. (2014). Preventing weight gain and obesity: Indirect effects of a family-based intervention in early childhood. *Prevention Science*, Available ahead of print.

Spruijt-Metz, D. (2011). Etiology, treatment, and prevention of obesity in childhood and adolescence: A decade in review. *Journal of Research on Adolescence, 21,* 129-152. doi:10.1111/j.1532-7795.2010.00719.x

Steele, R. & Van Allen, J. (2011). The treatment of pediatric obesity: bringing contexts and systems into focus. *Children's Health Care, 40,* 171-178. doi:10.1080/02739615.2011.590384

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate behavioral research, 25*, 173-180.

Stein, R.I., Epstein, L.H., Raynor, H.A., Kilanowski, C.K., & Paluch, R.A. (2005). The influence of parenting change on pediatric weight control. *Obesity, 10*, 1749-1755. doi:10.1038/oby.2005.213

Stormshak, E.A., Connell, A.M., Véronneau, M.H., Dishion, T.J., Kavanaugh, K., & Karuthers. A.S. (2011). An ecological approach to promoting early adolescent mental health and social adaptation: Family-centered intervention in public middle schools. *Child Development, 82,* 209-225. doi:10.1111/j.1467-8624.2010.01551.x

Strauss, R.S. & Knight, J. (1999). Influence of the home environment on the development of obesity in children. *Pediatrics, 103*, e85. Retrieved on May 13, 2013 from http://www.pediatrics.org/cgi/content/full/103/6/e85

Stright, A. D., Gallagher, K. C., & Kelley, K. (2008). Infant temperament moderates relations between maternal parenting in early childhood and children's adjustment in first grade. *Child Development, 79,* 186-200. doi: 10.1111/j.1467-8624.2007.01119.x

Suglia, S. F., Duarte, C. S, Chambers, E. C., & Boynton,-Jarrett, R. (2012). Cumulative social risk and obesity in early childhood. *Pediatrics,* 129, e1173. doi: 10.1542/peds.2011-2456

Sung-Chan, P., Sung, Y.W., Zhao, X., & Brownson, R.C. (2013). Family-based models for childhood obesity interventions: A systematic review of randomized controlled trials. *Obesity Reviews, 14*, 265-278. doi:10.1111/obr.12000

Thomson Medstat Research Brief (2006). Childhood obesity: Costs, treatment patterns, disparities in care, and prevalent medical conditions. Retrieved on May 5, 2013 from http://www.medstat.com/pdfs/childhood_obesity.pdf

Trasande, L. & Chatterjee, S. (2009). The impact of obesity on health service utilization and costs in childhood. *Obesity, 17,* 1749–1754. doi:10.1038/oby.2009.67

Trentacosta, C. J., Hyde, L. W., Shaw, D. S., Dishion, T. J., Gardner, F., & Wilson, M. (2008). The relations among cumulative risk, parenting, and behavior problems during early childhood. *Journal of Child Psychology and Psychiatry, 49*, 1211-1219.

U.S. Department of Health and Human Services. (2010). The Surgeon General's Vision for a Healthy and Fit Nation. Office of the Surgeon General, US Department of Health and Human Services: Rockville, MD. Retrieved on May 10, 2013 from http://www.surgeongeneral.gov/initiatives/healthy-fit-nation/obesityvision2010.pdf

van Aken, Junger, Verhoeven, van Aken, & Dekovic, 2007. The interactive effects of temperament and maternal parenting on toddlers' externalizing behaviours. *Infant and Child Development, 16,* 553-572.

Vander Wal, J.S. & Mitchell, E.R. (2011). Psychological complications of pediatric obesity. *Pediatric Clinics of North America, 58,* 1393–1401. doi:10.1016/j.pcl.2011.09.008

Van Ryzin, M.J. & Dishion, T.J. (2012). The impact of a family-centered intervention on the ecology of adolescent antisocial behavior: modeling developmental sequelae and trajectories during adolescence. *Development and Psychopathology, 24,* 1139-1155. doi:10.1017/S0954579412000582

Valdés, J., Rodríguez-Artalejo, F., Aguilar, L., Jaén-Casquero, M.B., & Royo-Bordonada, M.A. (2012). Frequency of family meals and childhood overweight: A systematic review. *Pediatric Obesity, 8,* E1-E13. doi: 10.1111/j.2047-6310.2012.00104.x

Wardle, J., Carnell, S., Haworth, C.M.A., & Plomin, R. (2008). Evidence for a strong genetic influence on childhood adiposity despite the force of obesogenic environments. *The American Journal of Clinical Nutrition, 87,* 398-404.

Waring, M. E. & Lapane, K. L. (2008). Overweight in children and adolescents in relation to attention-deficit/hyperactivity disorder: results from a national sample. *Pediatrics, 122*, e1-e6. doi: 10.1542/peds.2007-1955

West, S. G., Finch, J. F., & Curran, P. J. (1995). Structural equation models with non-normal variables: Problems and remedies. In R. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 56–75). Thousand Oaks, CA: Sage.

West, F., Sanders, R.M., Cleghorn, G.J., & Davies, P.S.W. (2010). Randomised clinical trial of a family-based lifestyle intervention for childhood obesity involving parents as the exclusive agents of change. *Behaviour Research and Therapy, 48,* 1170-1179. doi:10.1016/j.brat.2010.08.008

Whitaker, R.C. & Orzol, S.M. (2006). Obesity among US urban preschool children: relationships to race, ethnicity, and socioeconomic status. *Archives of Pediatric and Adolescent Medicine, 160,* 578-84. doi:10.1001/archpedi.160.6.578

Zeller, M.H., Reiter-Purtill, J., Modi**,** A.C., Gutzwiller, J., Vannatta, K., & Davies, W.H. (2007). Controlled study of critical parent and family factors in the obesigenic environment. *Obesity,* 15, 126-136. doi:10.1038/oby.2007.51

APPENDIX A

TABLES

Table 1. *Total Sample Demographics at Age 2*

Variable	N (%)
Group	
Intervention	359 (50.1)
Control	357 (49.9)
Gender	
Boys	362 (50.5)
Girls	354 (49.5)
Ethnicity	
Caucasian	334 (46.6)
African- American	196 (27.4)
Hispanic/Latino	97 (13.5)
Bi-Racial	71 (9.9)
Native American	8 (1.1)
Other/ Unknown	10 (1.4)
Weight Status Age 10 (*n*= 481)	
Normal Weight	272 (56.5)
At-Risk for Overweight	32 (6.7)
At higher risk for Overweight	50 (10.4)
Overweight	127 (26.4)
Annual Family Income (*n*= 678)	
≤ 4, 999	81 (11.9)
5, 000 – 9, 999	368 (54.3)
10, 000 – 14, 999	130 (19.2)
15, 000 – 19, 999	124 (18.3)
20, 000 – 24, 999	97 (14.3)
25, 000 – 29, 999	58 (8.6)
30, 000 – 39, 999	44 (6.5)
40, 000 – 49, 999	18 (2.7)
50, 000 – 59, 999	5 (.7)
60, 000 – 69, 999	1 (.1)
70, 000 – 79, 999	1 (.1)
N/A	5 (.7)
Parent Education Level	
7^{th} grade or less	17 (2.4)
Junior high school completed	14 (2)
Partial high school	135 (18.9)
High school graduate/ GED	306 (42.7)
Partial college/ Specialized training	167 (23.3)
Junior college	61 (8.5)
Standard college graduate	16 (2.2)
Parent Marital Status (*n*= 714)	
Not Married or Living Together	301 (42.2)
Married or Living Together	413 (57.8)

Note. $N = 716$ and at age 2 (unless otherwise noted)

Table 2. Descriptive statistics for Outcomes and Covariates.

Variable	N	Min.	Max	Mean	Std. Dev.	Skew	Kurtosis
Externalizing Mean (Age 10)$_a$	503	33	84	54.64	10.47	.130	-.364
PC body size impression	583	1	9	4.12	2.38	.118	-1.26
TC body size impression	583	1	8	1.44	.916	3.01	11.64
Cumulative Risk	701	0	6	2.09	1.25	.219	-.300
TC Minority	715	0	1 (n= 267)				
TC Hispanic	710	0	1 (n= 97)				

Note: Obtained at age 2 (unless otherwise noted).
a. Average of primary caregiver and alternative caregiver report

Table 3. Descriptive statistics for Self-Regulation.

Variable	N	Min.	Max	Mean	Std. Dev.	Skew	Kurtosis
Self-regulation Age 2	705	1.33	7	3.97	.800	-.193	.338
Self-regulation Age 3	646	1.54	6.6	4.25	.769	-.043	.254
Self-regulation Age 4	617	1.17	6.7	4.45	.803	-1.60	.523
Self-regulation Age 5	605	1.8	7	4.67	.863	-.044	-.181

Note: 13-item inhibitory control subscale of the child behavior questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) used at all ages.

Table 4. Descriptive statistics for Positive Behavior Support Indicators.

Indicator	N	Min	Max	Mean	SD	Skew	Kurtosis
W9PDPEP2C	711	.000	.808	.335	.145	.242	-.175
W9PDPEP3C	621	.011	.846	.365	.145	.169	-.147
W9PDPEP4C	550	.007	.743	.281	.130	.499	.188
W9PDPEP5C	561	.001	.730	.370	.138	.002	-.430
HOMEPBS2	715	1	7	5.52	1.40	-.927	.264
HOMEPBS3	631	0	7	5.56	1.42	-.929	.179
HOMEPBS4	584	0	7	5.57	1.50	-1.03	.564
HOMEPBS5	564	0	7	5.82	1.43	-1.43	1.85
PBSCI2	710	1	9	5.91	1.33	-.271	.544
PBSCI3	622	1.4	9	5.75	1.25	-.442	.198
PBSCI4	534	1	8.6	5.56	1.43	-.390	.058
PBSCI5	557	1.4	8.6	5.24	1.33	-.003	-.354

Note: W9DPEP= RACS (micro-code); HOMEPBS= Positive behavior support score on the HOME Inventory; PBSCI= coder impression of positive behavior support (macro-code); 2: Age 2, 3: Age 3; 4: Age 4; 5: Age 5.

Table 5. Descriptive statistics for Coercive Limit-Setting Indicators.

Variable	N	Min	Max	Mean	SD	Skew	Kurtosis
W9PDCOP2C	711	0	.540	.104	.077	1.50	2.96
W9PDCOP3C	621	0	.640	.093	.077	2.13	7.94
W9PDCOP4C	550	0	.512	.086	.063	1.87	6.19
W9PDCOP5C	561	0	.367	.066	.055	1.81	5.29
HOMELS2	715	0	4	1.01	.972	.676	-.378
HOMELS3	631	0	4	.861	.955	.951	.127
HOMELS4	584	0	4	.437	.826	2.14	4.15
HOMELS5	563	0	4	.341	.749	2.54	6.09
COERCI2	710	1	6.1	2.87	.857	.190	-.003
COERCI3	622	1	6.5	2.92	.893	.730	.882
COERCI4	534	1	6.4	2.95	.850	.631	.692
COERCI5	557	1	5.5	2.58	.800	.550	.522

Note: W9DCOP= RACS (micro-code); HOMELS= Coercive limit setting score on the HOME Inventory; COERCI= coder impression of coercive limit setting (macro-code). 2: Age 2; 3: Age 3; 4: Age 4; 5: Age 5.

Table 6. *Chi- Square Analysis: Distribution of Weight Status*

	Weight Status						
	Normal	At-Risk for Overweight	At Higher Risk for Overweight	Overweight	x^2	df	*p*
Group					3.91	3	.272
Intervention	141	11	26	60			
Control	131	21	24	67			
Gender					3.40	3	.334
Boys	141	15	19	61			
Girls	131	17	31	66			
Site					2.92	6	.818
Charlotesville	64	8	11	33			
Eugene	104	13	23	42			
Pittsburgh	104	11	16	52			
Race/ Ethnicity					18.35	15	.245
Caucasian	130	15	19	53			
African-American	78	7	13	48			
Native American	2	0	2	0			
Hispanic/ Latino	28	5	9	15			
Bi-racial	30	4	7	10			
Other	4	1	0	1			

Table 7. *Outcome group frequency*

	N (%)
Group	
Comorbid	37 (8.4)
Problem behavior only	37 (8.4)
Overweight only	155 (35.2)
Typically developing	211 (48)

Note. $N = 440$. Comorbid: above clinical cutoff for both BMI and problem behavior. Problem behavior only: problem behavior at or above a T-score of 65, BMI below the 85th age-and gender-specific percentile. Overweight only: BMI at or above the 85th age-and gender- specific percentile and problem behavior T score below 65. Typically developing: BMI below the 85th age-and gender- specific percentile and problem behavior with a T score below 65.

Table 8. *Correlations among Study Variables for the Total Sample at Age 2*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Group	-	.003	.008	.023	-.044	-.011	-.018	-.007	-.022	-.031	.033	-.001	-.039	.007	.050	-.046
2. Gender		-	-.025	-.012	-.005	-.045	-.082*	-.126***	-.023	-.089*	.018	-.012	.074*	.087*	.075*	-.077*
3. TC Hispanic			-	-.308***	.003	.073	-.008	.060	-.135***	.028	-.072	.165***	-.061	-.123***	-.061	.062
4. TC Minority				-	.285***	.030	-.043	.035	-.149***	-.165***	-.187***	.148***	.054	.093*	-.005	.073
5. Cumulative Risk					-	.060	.076	.036	-.133***	-.195***	-.102***	.078*	.151***	.067	.090*	.073
6. PC Body Size Impression						-	.217***	-.024	-.044	-.127***	-.117***	.038	.006	.072	.053	.268***
7. TC Body Size Impression							-	-.014	.000	-.073	-.016	.029	.066	.031	-.019	.310***
8. Self- Regulation								-	.032	.044	.051	-.018	-.096*	-.122***	-.152***	.041
9. DPEP									-	.262***	.297***	-.550***	-.082*	-.119***	-.009	.016
10. HPBS										-	.267***	-.141***	-.330***	-.274***	-.081*	.035
11. PBCI											-	-.262***	-.071	-.519***	-.003	-.003
12. DCOP												-	.144***	.163***	.021	.003
13. HLS													-	.220***	.106***	.020
14. COERCI														-	.070	.014
15. Externalizing Mean Age 10[a]															-	0.015
16. BMI Age 10[b]																-

Note. *p < 05; **p < .01, ***p < .001. PC: primary caregiver, TC: target child, DPEP: dyadic positive engagement, HPBS: HOME score for PBS, PBCI: COIMP score for PBS, DCOP: dyadic coercive engagement, HLS: HOME score for coercive limit-setting, COERCI: COIMP score for coercive limit-setting. a: average score of primary and alternative caregiver report, b: raw BMI

Table 9. *SREC- Comorbid Group*

		95% CI for Odds Ratio		
	B $(SE)_a$	Lower	Odds Ratio	Upper
Group	0.295 (0.385)	0.632	1.343	2.855
Gender	-0.285 (0.415)	0.334	0.752	1.695
TC Minority	-0.221 (0.406)	0.362	0.802	1.778
TC Hispanic	-1.123 (1.104)	0.037	0.325	2.835
Cumulative Risk	0.182 (0.215)	0.788	1.200	1.828
TC body size Age 2_b	0.310 (0.196)	0.929	1.363	2.001
PC body size Age 2_b	0.652 (0.230)**	1.223	1.919	3.009
SREC	-0.952 (0.248)***	0.237	0.386	0.628

Note. **p < .01, ***p < .001. a: unstandardized; b: impression; SR: self-regulation EC: early childhood. TC: target child; PC: primary caregiver. SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 10. *SREC-Problem Behavior Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.407 (0.402)	0.684	1.503	3.301
Gender	0.323 (0.416)	0.611	1.381	3.119
TC Minority	-0.553 (0.460)	0.234	0.575	1.416
TC Hispanic	0.461 (0.729)	0.380	1.586	6.619
Cumulative Risk	0.554 (0.205)***	1.165	1.741	2.603
TC body size Age 2$_b$	-0.481 (0.358)	0.306	0.618	1.247
PC body size Age 2$_b$	-0.078 (0.230)	0.590	0.925	1.453
SREC	-1.271 (0.298)***	0.157	0.281	0.503

Note. ***p < .001. a: unstandardized; b: impression, SR: self-regulation, EC: early childhood. TC: target child; PC: primary caregiver. SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 11. *SREC-Overweight Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	-0.301 (0.220)	0.480	0.740	1.139
Gender	-0.136 (0.224)	0.563	0.873	1.353
TC Minority	0.270 (0.250)	0.803	1.310	2.136
TC Hispanic	0.602 (0.374)	0.877	1.825	3.800
Cumulative Risk	0.005 (0.123)	0.788	1.005	1.828
TC body size Age 2$_b$	0.237 (0.132)†	0.929	1.268	2.001
PC body size Age 2$_b$	0.389 (0.125)**	1.154	1.476	1.887
SREC	0.008 (0.134)	0.776	1.008	1.310

Note. **p < .01. a: unstandardized; b: impression; SR: self-regulation EC: early childhood. TC: target child; PC: primary caregiver. SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 12. *PBSEC- Comorbid Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.136 (0.366)	0.559	1.145	2.348
Gender	-0.057 (0.373)	0.455	0.945	1.961
TC Minority	-0.234 (0.449)	0.328	0.792	1.907
TC Hispanic	-1.262 (0.985)	0.041	0.283	1.951
Cumulative Risk	0.230 (0.214)	0.828	1.259	1.913
TC body size Age 2$_b$	0.269 (0.188)	0.905	1.309	1.893
PC body size Age 2$_b$	0.705 (0.214)**	1.330	2.025	3.083
PBSEC	0.038 (0.244)	0.644	1.039	1.676

Note. **p < .01. a: unstandardized; b: impression; PBS: positive behavior support EC: early childhood. TC: target child; PC: primary caregiver. PBSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 13. *PBSEC- Problem Behavior Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.219 (0.381)	0.590	1.245	2.624
Gender	0.607 (0.388)	0.858	1.834	3.924
TC Minority	-0.583 (0.473)	0.221	0.558	1.411
TC Hispanic	0.011(0.707)	0.253	1.011	4.041
Cumulative Risk	0.599 (0.203)**	1.222	1.820	2.711
TC body size Age 2$_b$	-0.604 (0.425)	0.238	0.547	1.257
PC body size Age 2$_b$	0.042 (0.205)	0.699	1.043	1.558
PBSEC	0.002 (0.223)	0.648	1.002	1.550

Note. **p < .01. a: unstandardized; b: impression; PBS: positive behavior support EC: early childhood. TC: target child; PC: primary caregiver. PBSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 14. *PBSEC- Overweight Only Group*

		95% CI for Odds Ratio		
	B $(SE)_a$	Lower	Odds Ratio	Upper
Group	-0.304 (0.219)	0.480	0.738	1.133
Gender	-0.137 (0.221)	0.566	0.872	1.345
TC Minority	0.369 (0.262)	0.865	1.446	2.418
TC Hispanic	0.609 (0.378)	0.877	1.839	3.855
Cumulative Risk	0.038 (0.128)	0.808	1.038	1.335
TC body size Age 2_b	0.229 (0.134)†	0.967	1.257	1.635
PC body size Age 2_b	0.399 (0.127)**	1.162	1.490	1.911
PBSEC	0.156 (0.143)	0.883	1.169	1.546

Note. †p <.10, **p < .01. a: unstandardized; b: impression; PBS: positive behavior support EC: early childhood. TC: target child; PC: primary caregiver. PBSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 15. *CLSEC- Comorbid Group*

		95% CI for Odds Ratio		
	B $(SE)_a$	Lower	Odds Ratio	Upper
Group	0.151 (0.364)	0.569	1.162	2.373
Gender	-0.111 (0.381)	0.424	0.895	1.890
TC Minority	-0.372 (0.435)	0.294	0.689	1.616
TC Hispanic	-1.317 (1.038)	0.035	0.268	2.051
Cumulative Risk	0.184 (0.207)	0.801	1.202	1.802
TC body size Age 2_b	0.254 (0.193)	0.884	1.289	1.882
PC body size Age 2_b	0.695 (0.214)**	1.317	2.003	3.047
CLSEC	0.256 (0.248)	0.794	1.292	2.101

Note. **p < .01. a: unstandardized; b: impression; CLS: positive behavior support; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 16. *CLSEC- Problem Behavior Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.255 (0.381)	0.611	1.290	2.725
Gender	0.549 (0.389)	0.807	1.731	3.711
TC Minority	-0.713 (0.458)	0.200	0.490	1.202
TC Hispanic	-0.024 (0.703)	0.246	0.976	3.870
Cumulative Risk	0.531 (0.207) †	1.134	1.700	2.549
TC body size Age 2$_b$	-0.623 (0.429)	0.231	0.536	1.243
PC body size Age 2$_b$	0.034 (0.210)	0.686	1.034	1.560
CLSEC	0.320 (0.280)	0.795	1.377	2.386

Note. †p <.10. a: unstandardized; b: impression; CLS: positive behavior support; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 17. *CLSEC- Overweight Only Group*

		95% CI for Odds Ratio		
	B $(SE)_a$	Lower	Odds Ratio	Upper
Group	-0.283 (0.219)	0.490	0.753	1.158
Gender	-0.146 (0.223)	0.558	0.864	1.338
TC Minority	0.235 (0.255)	0.768	1.265	2.084
TC Hispanic	0.590 (0.372)	0.870	1.804	3.740
Cumulative Risk	-0.012 (0.127)	0.771	0.988	1.266
TC body size Age 2_b	0.233 (0.132)†	0.974	1.262	1.635
PC body size Age 2_b	0.385 (0.127)**	1.145	1.470	1.888
CLSEC	0.084 (0.152)	0.807	1.087	1.466

Note. †p <.10, **p < .01. a: unstandardized; b: impression; CLS: positive behavior support; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 18. *PBSECxSREC- Comorbid Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.289 (0.387)	0.625	1.335	2.849
Gender	-0.335 (0.422)	0.313	0.715	1.635
TC Minority	0.024 (0.479)	0.400	1.024	2.618
TC Hispanic	-0.914 (1.066)	0.050	0.401	3.240
Cumulative Risk	0.255 (0.227)	0.827	1.290	2.012
TC body size Age 2$_b$	0.309 (0.199)	0.922	1.362	2.010
PC body size Age 2$_b$	0.660 (0.234)**	1.223	1.936	3.064
PBSEC	0.401 (0.322)	0.794	1.493	2.808
SREC	-1.089 (0.294)***	0.189	0.337	0.598
PBSEC X SREC	0.009 (0.276)	0.588	1.009	1.732

Note. **p < .01, ***p < .001. a: unstandardized; b: impression; PBS: positive behavior support; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. PBSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 19. *PBSECxSREC- Problem Behavior Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.405 (0.409)	0.673	1.500	3.344
Gender	0.272 (0.436)	0.559	1.313	2.161
TC Minority	-0.192 (0.491)	0.472	0.826	2.502
TC Hispanic	0.683 (0.732)	0.906	1.980	8.309
Cumulative Risk	0.677 (0.220)**	1.278	1.969	3.032
TC body size Age 2$_b$	-0.434 (0.359)	0.321	0.648	1.310
PC body size Age 2$_b$	-0.079 (0.236)	0.582	0.924	1.467
PBSEC	0.827 (0.503)	0.852	2.286	6.131
SREC	-1.540 (0.408)***	0.096	0.214	0.477
PBSEC X SREC	0.236 (0.354)	0.633	1.266	2.534

Note. **p < .01, ***p < .001. a: unstandardized; b: impression; PBS: positive behavior support; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 20. *PBSECxSREC- Overweight Only Group*

		95% CI for Odds Ratio		
	B $(SE)_a$	Lower	Odds Ratio	Upper
Group	-0.314 (0.221)	0.474	0.730	1.126
Gender	-0.160 (0.225)	0.548	0.852	1.326
TC Minority	0.393 (0.268)	0.876	1.481	2.502
TC Hispanic	0.651 (0.382)†	0.906	1.918	4.060
Cumulative Risk	0.039 (0.129)	0.807	1.040	1.340
TC body size Age 2_b	0.231 (0.134)†	0.970	1.260	1.637
PC body size Age 2_b	0.387 (0.127)**	1.148	1.473	1.890
PBSEC	0.201 (0.157)	0.898	1.222	1.664
SREC	-0.041 (0.145)	0.723	0.960	1.274
PBSEC X SREC	-0.159 (0.148)	0.638	0.853	1.139

Note. †p <.10, **p < .01. a: unstandardized; b: impression; PBS: positive behavior support; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 21. *CLSECxSREC- Comorbid Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.324 (0.389)	0.644	1.382	2.965
Gender	-0.241 (0.417)	0.347	0.786	1.780
TC Minority	-0.096 (0.476)	0.357	0.909	2.311
TC Hispanic	-0.986 (1.098)	0.043	0.373	3.212
Cumulative Risk	0.242 (0.239)	0.798	1.274	2.035
TC body size Age 2$_b$	0.345 (0.203)†	0.948	1.412	2.104
PC body size Age 2$_b$	0.647 (0.233)**	1.210	1.910	3.015
CLSEC	-0.391 (0.474)	0.267	0.677	1.713
SREC	-1.163 (0.379)**	0.149	0.313	0.657
CLSEC X SREC	0.029 (0.290)	0.584	1.030	1.817

Note. †p <.10, **p < .01. a: unstandardized; b: impression; CLS: coercive limit-setting; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 22. *CLSECxSREC- Problem Behavior Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.454 (0.422)	0.688	1.574	3.600
Gender	0.467 (0.449)	0.662	1.595	3.842
TC Minority	-0.345 (0.517)	0. 257	0.708	1.950
TC Hispanic	0.630 (0.779)	0.408	1.877	8.645
Cumulative Risk	0.697 (0.238)**	1.260	2.007	3.197
TC body size Age 2$_b$	-0.368 (0.359)	0.343	0.692	1.398
PC body size Age 2$_b$	-0.127 (0.245)	0.545	0.881	1.423
CLSEC	-1.002 (0.588)†	0.116	0.367	1.163
SREC	-1.667 (0.501)**	0.071	0.189	0.504
CLSEC X SREC	-0.360 (0.281)	0.402	0.698	1.210

Note. †p <.10, **p < .01. a: unstandardized; b: impression; CLS: coercive limit-setting; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 23. *CLSXSREC- Overweight Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	-0.309 (0.226)	0.471	0.734	1.145
Gender	-0.166 (0.232)	0.538	0.847	1.335
TC Minority	0.153 (0.271)	0. 685	1.165	1.981
TC Hispanic	0.626 (0.391)	0.869	1.871	4.028
Cumulative Risk	-0.061 (0.135)	0.722	0.941	1.226
TC body size Age 2$_b$	0.247 (0.138)†	0.977	1.280	1.677
PC body size Age 2$_b$	0.379 (0.131)**	1.131	1.461	1.887
CLS EC	0.200 (0.213)	0.804	1.221	1.854
SR EC	0.139 (0.186)	0.798	1.149	1.655
CLSEC X SREC	0.429 (0.205)*	1.027	1.535	2.296

Note. †p <.10 *p < 05; **p < .01. a: unstandardized; b: impression; CLS: coercive limit-setting; SR: self-regulation EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The typically developing group is the reference.

Table 24. *Supplementary SREC- Typically Developing Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	-0.295 (0.385)	0.350	0.744	1.583
Gender	0.285 (0.415)	0.590	1.330	2.997
TC Minority	0.221 (0.406)	0.562	1.247	2.764
TC Hispanic	1.123 (1.104)	0.353	3.073	26.773
Cumulative Risk	-0.182 (0.215)	0.547	0.833	1.269
TC body size Age 2$_b$	-0.310 (0.196)	0.500	0.734	1.077
PC body size Age 2$_b$	-0.652 (0.230)**	0.332	0.521	0.817
SREC	0.952 (0.248)***	1.592	2.590	4.213

Note. **p < .01, ***p < .001. a: unstandardized; b: impression; SR: self-regulation EC: early childhood. TC: target child; PC: primary caregiver. SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 25. *Supplementary SREC-Problem Behavior only Group*

		95% CI for Odds Ratio		
	B $(SE)_a$	Lower	Odds Ratio	Upper
Group	0.112 (0.494)	0.425	1.119	2.943
Gender	0.608 (0.517)	0.666	1.836	5.062
TC Minority	-0.333 (0.551)	0.244	0.717	2.110
TC Hispanic	1.584 (1.237)	0.431	4.874	55.071
Cumulative Risk	0.372 (0.260)	0.871	1.451	2.416
TC body size Age 2_b	-0.791 (0.387)*	0.212	0.453	0.969
PC body size Age 2_b	-0.729 (0.296)*	0.270	0.482	0.862
SREC	-0.319 (0.330)	0.381	0.727	1.387

Note. *p < 05. a: unstandardized; b: impression; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 26. *Supplementary SREC-Overweight only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	-0.596 (0.388)	0.257	0.551	1.178
Gender	0.149 (0.417)	0.513	1.160	2.626
TC Minority	0.491 (0.411)	0.730	1.633	3.657
TC Hispanic	1.724 (1.094)	0.657	5.610	47.920
Cumulative Risk	-0.177 (0.218)	0.547	0.838	1.284
TC body size Age 2$_b$	-0.072 (0.187)	0.644	0.930	1.343
PC body size Age 2$_b$	-0.262 (0.235)	0.486	0.769	1.218
SREC	0.960 (0.237)***	1.643	2.612	4.152

Note. ***p < .001. a: unstandardized; b: impression; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 27. *Supplementary PBSEC-Typically Developing Group*

		95% CI for Odds Ratio		
	B $(SE)_a$	Lower	Odds Ratio	Upper
Group	-0.136 (0.366)	0.426	0.873	1.790
Gender	0.057 (0.373)	0.510	1.058	2.196
TC Minority	0.234 (0.449)	0.524	1.263	3.044
TC Hispanic	1.262 (0.985)	0.512	3.532	24.343
Cumulative Risk	-0.230 (0.214)	0.523	0.794	1.207
TC body size Age 2_b	-0.269 (0.188)	0.528	0.764	1.105
PC body size Age 2_b	-0.705(0.214)**	0.324	0.494	0.752
PBSEC	-0.038 (0.244)	0.597	0.963	1.553

Note. **p < .01. a: unstandardized; b: impression; PBS: positive behavior support EC: early childhood. TC: target child; PC: primary caregiver. PBSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference. The comorbid group is the reference.

Table 28. *Supplementary PBSEC-Problem Behavior Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.083 (0.488)	0.417	1.087	2.830
Gender	0.663 (0.497)	0.733	1.941	5.140
TC Minority	-0.349 (0.602)	0.217	0.705	2.295
TC Hispanic	1.273 (1.171)	0.360	3.572	35.445
Cumulative Risk	0.368 (0.266)	0.858	1.446	2.436
TC body size Age 2$_b$	-0.873 (0.442)*	0.175	0.418	0.994
PC body size Age 2$_b$	-0.663 (0.275)*	0.300	0.515	0.884
PBSEC	-0.036 (0.297)	0.539	0.965	1.728

Note. *p < 05. a: unstandardized; b: impression; PBS: positive behavior support EC: early childhood. TC: target child; PC: primary caregiver. PBSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 29. *Supplementary PBSEC-Overweight Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	-0.440 (0.370)	0.312	0.644	1.330
Gender	-0.080 (0.377)	0.441	0.923	1.931
TC Minority	0.603 (0.454)	0.750	1.827	4.452
TC Hispanic	1.871 (0.966) †	0.978	6.494	43.138
Cumulative Risk	-0.193 (0.213)	0.543	0.825	1.252
TC body size Age 2$_b$	-0.040 (0.172)	0.686	0.960	1.345
PC body size Age 2$_b$	-0.306 (0.219)	0.479	0.736	1.131
PBSEC	0.118 (0.248)	0.692	1.125	1.831

Note. †p <.10. a: unstandardized; b: impression; PBS: positive behavior support; EC: early childhood. TC: target child; PC: primary caregiver. PBSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 30. *Supplementary CLSEC-Typically Developing Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	-.151 (0.364)	0.421	0.860	1.756
Gender	0.111 (0.381)	0.529	1.117	2.359
TC Minority	0.372 (0.435)	0.619	1.451	3.404
TC Hispanic	1.317 (1.038)	0.487	3.731	28.562
Cumulative Risk	-0.184 (0.207)	0.555	0.832	1.248
TC body size Age 2$_b$	-0.254 (0.193)	0.531	0.776	1.132
PC body size Age 2$_b$	-0.695 (0.214)**	0.328	0.499	0.759
CLSEC	-0.256 (0.248)	0.476	0.774	1.259

Note. **p < .01. a: unstandardized; b: impression; CLS: coercive limit-setting; EC: early childhood TC: target child; PC: primary caregiver. CLSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 31. *Supplementary CLSEC-Problem Behavior Only Group*

		95% CI for Odds Ratio		
	B $(SE)_a$	Lower	Odds Ratio	Upper
Group	0.104 (0.485)	0.429	1.110	2.870
Gender	0.659 (0.503)	0.721	1.934	5.186
TC Minority	-0.341 (0.582)	0.227	0.711	2.227
TC Hispanic	1.292 (1.205)	0.343	3.642	38.643
Cumulative Risk	0.347 (0.265)	0.842	1.415	2.378
TC body size Age 2_b	-0.877 (0.448)†	0.173	0.416	1.000
PC body size Age 2_b	-0.661 (0.277)*	0.300	0.516	0.888
CLSEC	0.064 (0.341)	0.547	1.066	2.079

Note. †p <.10 *p < 05. a: unstandardized; b: impression; CLS: coercive limit-setting; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 32. *Supplementary CLSEC-Overweight Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	-0.434 (0.367)	0.315	0.648	1.332
Gender	-0.035 (0.386)	0.453	0.965	2.058
TC Minority	0.608 (0.437)	0.779	1.836	4.325
TC Hispanic	1.907 (1.025)	0.903	6.730	50.163
Cumulative Risk	-0.196 (0.207)	0.548	0.822	1.126
TC body size Age 2$_b$	-0.022 (0.176)	0.694	0.979	1.381
PC body size Age 2$_b$	-0.309 (0.218)	0.478	0.734	1.051
CLSEC	-0.172 (0.251)	0.515	0.842	1.376

Note. a: unstandardized; b: impression. CLS: coercive limit-setting; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 33. *Supplementary PBSECxSREC- Typically Developing Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	-0.289 (0.387)	0.351	0.749	1.600
Gender	0.335 (0.422)	0.612	1.399	3.198
TC Minority	-0.024 (0.479)	0.382	0.977	2.497
TC Hispanic	0.914 (1.066)	0.309	2.494	20.144
Cumulative Risk	-0.255 (0.227)	0.497	0.775	1.209
TC body size Age 2$_b$	-0.309 (0.199)	0.497	0.734	1.084
PC body size Age 2$_b$	-0.660 (0.234)**	0.326	0.517	0.818
PBSEC	-0.401 (0.322)	0.356	0.670	1.259
SREC	1.089 (0.294)***	1.671	2.972	5.283
PBSEC X SREC	-0.009 (0.276)	0.578	0.991	1.702

Note. **p < .01, ***p < .001. a: unstandardized; b: impression. PBS: positive behavior support; SR: self-regulation EC: early childhood. TC: target child; PC: primary caregiver. PBSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 34. *Supplementary PBSECxSREC- Problem Behavior Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.117 (0.494)	0.427	1.124	2.961
Gender	0.607 (0.528)	0.652	1.836	5.169
TC Minority	-0.215 (0.614)	0.242	0.806	2.685
TC Hispanic	1.597 (1.188)	0.481	4.937	50.638
Cumulative Risk	0.423 (0.276)	0.888	1.526	2.623
TC body size Age 2$_b$	-0.742 (0.385) †	0.224	0.476	1.012
PC body size Age 2$_b$	-0.739 (0.302)*	0.264	0.478	0.863
PBSEC	0.426 (0.546)	0.525	1.530	4.460
SREC	-0.451 (0.426)	0.277	0.637	1.467
PBSEC X SREC	0.228 (0.369)	0.609	1.255	2.590

Note. †p <.10; *p < 05. a: unstandardized; b: impression. PBS: positive behavior support; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. PBSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 35. *Supplementary PBSECxSREC- Overweight Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	-0.603 (0.389)	0.255	0.547	1.174
Gender	0.176 (0.422)	0.521	1.192	2.727
TC Minority	0.369 (0.489)	0.554	1.446	3.775
TC Hispanic	1.565 (1.053)	0.607	4.784	37.693
Cumulative Risk	-0.215 (0.228)	0.515	0.806	1.261
TC body size Age 2$_b$	-0.077 (0.189)	0.640	0.926	1.340
PC body size Age 2$_b$	-0.273 (0.240)	0.475	0.761	1.219
PBSEC	-0.200 (0.328)	0.430	0.818	1.558
SREC	1.048 (0.279)***	1.652	2.852	4.924
PBSEC X SREC	-0.168 (0.268)	0.500	0.845	1.428

Note. ***p < .001. a: unstandardized; b: impression. PBS: positive behavior support; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. PBSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 36. *Supplementary CLSECxSREC- Typically Developing Group*

		95% CI for Odds Ratio		
	B $(SE)_a$	Lower	Odds Ratio	Upper
Group	-0.324 (0.389)	0.337	0.723	1.552
Gender	0.241(0.417)	0.562	1.273	2.882
TC Minority	0.096 (0.476)	0.433	1.100	2.798
TC Hispanic	0.986 (1.098)	0.311	2.681	23.082
Cumulative Risk	-0.242 (0.239)	0.491	0.785	1.253
TC body size Age 2_b	-0.345 (0.203)†	0.475	0.708	1.054
PC body size Age 2_b	-0.647 (0.233)**	0.332	0.524	0.827
CLSEC	0.391 (0.474)	0.584	1.478	3.743
SREC	1.163 (0.379)**	1.523	3.199	6.720
CLSEC X SREC	-0.029 (0.290)	0.550	0.971	1.713

Note. †p <.10 ;**p < .01.a: unstandardized; b: impression. CLS: coercive limit-setting; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 37. *Supplementary CLSECxSREC- Problem Behavior Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	0.130 (0.508)	0.420	1.139	3.084
Gender	0.708 (0.539)	0.706	2.029	5.836
TC Minority	-0.250 (0.622)	0.230	0.779	2.637
TC Hispanic	1.616 (1.258)	0.428	5.032	59.226
Cumulative Risk	0.454 (0.291)	0.891	1.575	2.786
TC body size Age 2$_b$	-0.713 (0.390)†	0.228	0.490	1.053
PC body size Age 2$_b$	-0.774 (0.307)*	0.253	0.461	0.842
CLSEC	-0.611 (0.673)	0.145	0.543	2.030
SREC	-0.504 (0.531)	0.213	0.604	1.709
CLSEC X SREC	-0.390 (0.370)	0.328	0.677	1.398

Note. †p <.10; *p < 05. a: unstandardized; b: impression. CLS: coercive limit-setting; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

Table 38. *Supplementary CLSECxSREC- Overweight Only Group*

		95% CI for Odds Ratio		
	B (SE)$_a$	Lower	Odds Ratio	Upper
Group	-0.632 (0.398)	0.244	0.531	1.159
Gender	0.075 (0.427)	0.467	1.078	2.488
TC Minority	0.248 (0.492)	0.488	1.282	3.363
TC Hispanic	1.612 (1.091)	0.591	5.015	42.536
Cumulative Risk	-0.303 (0.252)	0.451	0.738	1.210
TC body size Age 2$_b$	-0.098 (0.196)	0.617	0.906	1.331
PC body size Age 2$_b$	-0.268 (0.242)	0.476	0.765	1.229
CLSEC	0.591 (0.493)	0.687	1.805	4.740
SREC	1.302 (0.375)**	1.763	3.677	7.668
CLSEC X SREC	0.399 (0.326)	0.788	1.491	2.822

Note. **p < .01. a: unstandardized; b: impression. CLS: coercive limit-setting; SR: self-regulation; EC: early childhood. TC: target child; PC: primary caregiver. CLSEC, SREC, cumulative risk, TC and PC body size impression were standardized to have a mean of zero and standard deviation of one. The comorbid group is the reference.

APPENDIX B

FIGURES

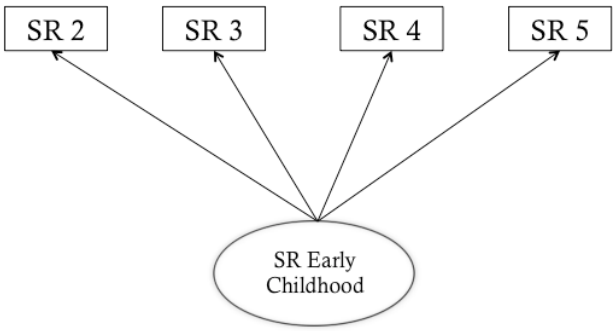

Figure 1. Self-regulation (SR) in early childhood model.
SR2= Age 2; SR3= Age 3; SR4= Age 4; SR5= Age 5.

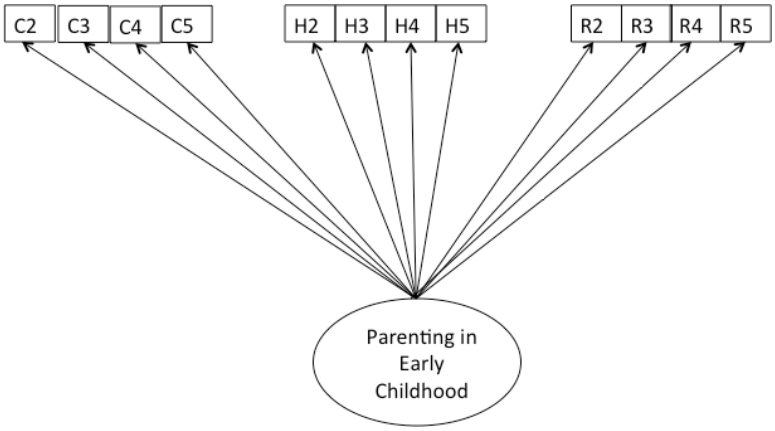

Figure 2. Parenting in early childhood model. C= COIMP; H= HOME, R= RACS. Indicators from the same measure were constrained to be equal to each other across time points. Positive behavior support and coercive limit-setting were measured this way.

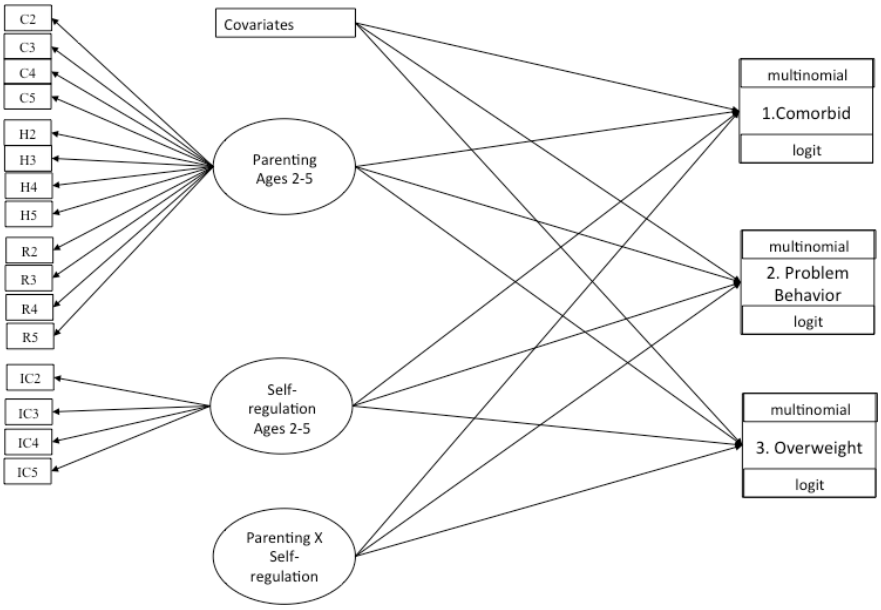

Figure 3. Conceptual Model. Typically developing is the reference group. Covariates: intervention condition, child gender, child body size impression at age 2, parent body size impression at age 2, child African-American or bi-racial. child Hispanic, cumulative risk.

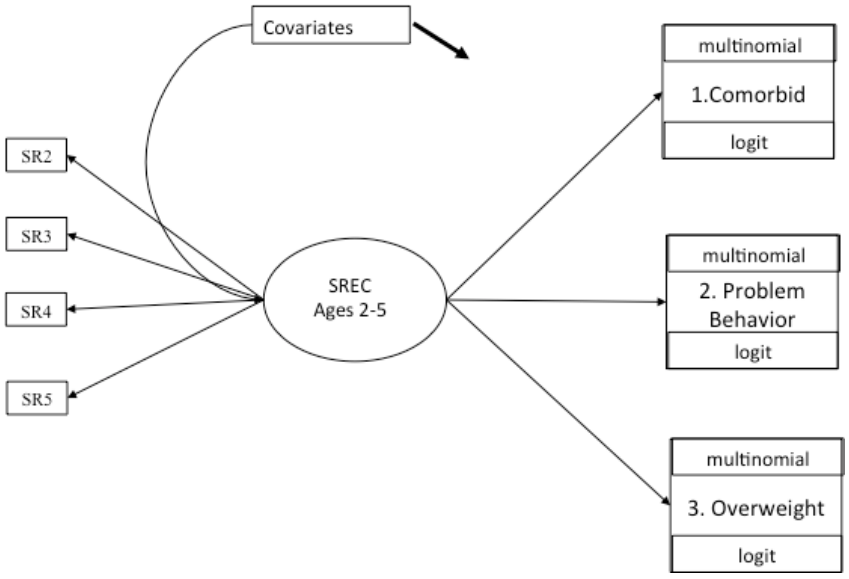

Figure 4. Model for Hypothesis 1. SR: self-regulation; EC: early childhood. Multinomial logistic regression with the typically developing group as the reference group. Covariates: intervention condition, child gender, child body size impression at age 2, parent body size impression at age 2, child African-American or bi-racial. child Hispanic, cumulative risk. 2: Age 2; 3: Age 3; 4: Age 4; 5: Age 5.

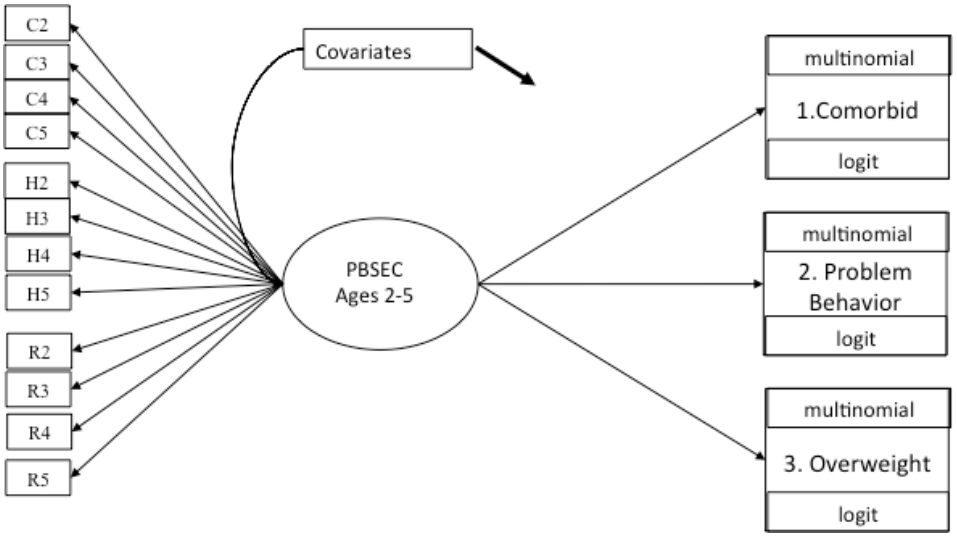

Figure 5. Model for Hypothesis 2**.** PBS: positive behavior support; EC: early childhood. Multinomial logistic regression with the typically developing group as the reference group. Covariates: intervention condition, child gender, child body size impression at age 2, parent body size impression at age 2, child African-American or bi-racial. child Hispanic, cumulative risk. C: COIMP; H: HOME, R: RACS. Indicators from the same measure were constrained to be equal to each other across time points. 2: Age 2; 3: Age 3; 4: Age 4; 5: Age 5.

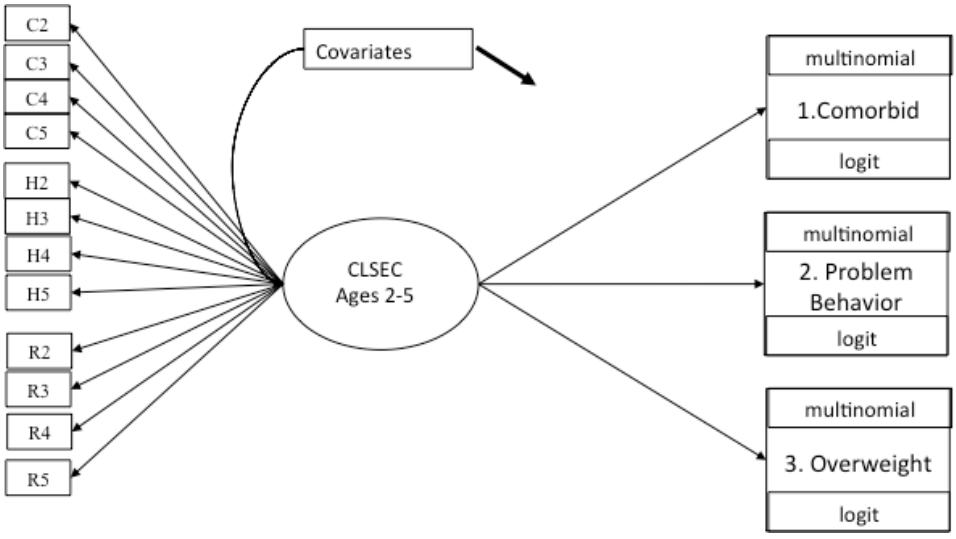

Figure 6. Model for Hypothesis 3. CLS: coercive limit-setting; EC: early childhood. Multinomial logistic regression with the typically developing group as the reference group. Covariates: intervention condition, child gender, child body size impression at age 2, parent body size impression at age 2, child African-American or bi-racial. child Hispanic, cumulative risk. C: COIMP; H: HOME, R: RACS. Indicators from the same measure were constrained to be equal to each other across time points. 2: Age 2; 3: Age 3; 4: Age 4; 5: Age 5.

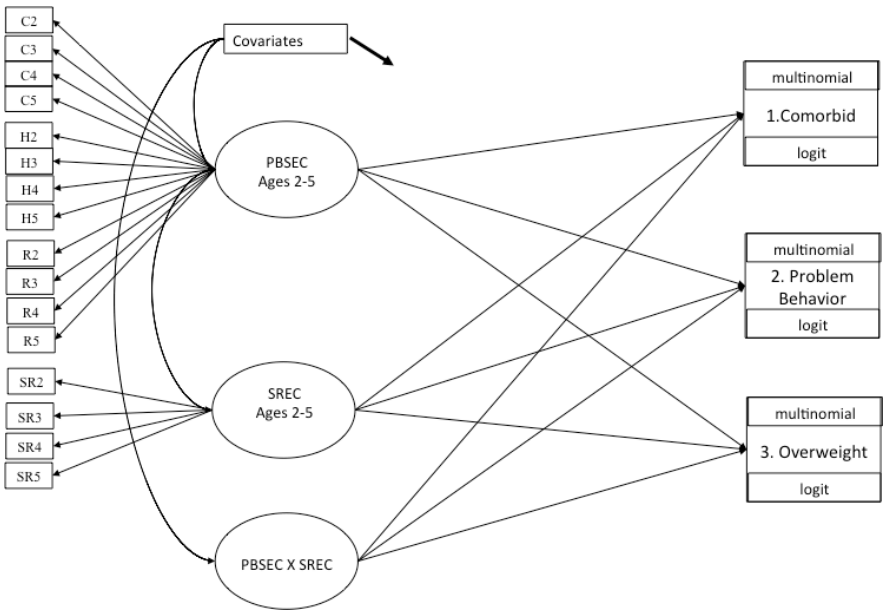

Figure 7. Model for Hypothesis 4. PBS: positive behavior support; SR: self-regulation; EC: early childhood. Multinomial logistic regression with the typically developing group as the reference group. Covariates: intervention condition, child gender, child body size impression at age 2, parent body size impression at age 2, child African-American or bi-racial. child Hispanic, cumulative risk. C: COIMP; H: HOME, R: RACS. For CLSEC, indicators from the same measure were constrained to be equal to each other across time points. 2: Age 2; 3: Age 3; 4: Age 4; 5: Age 5.

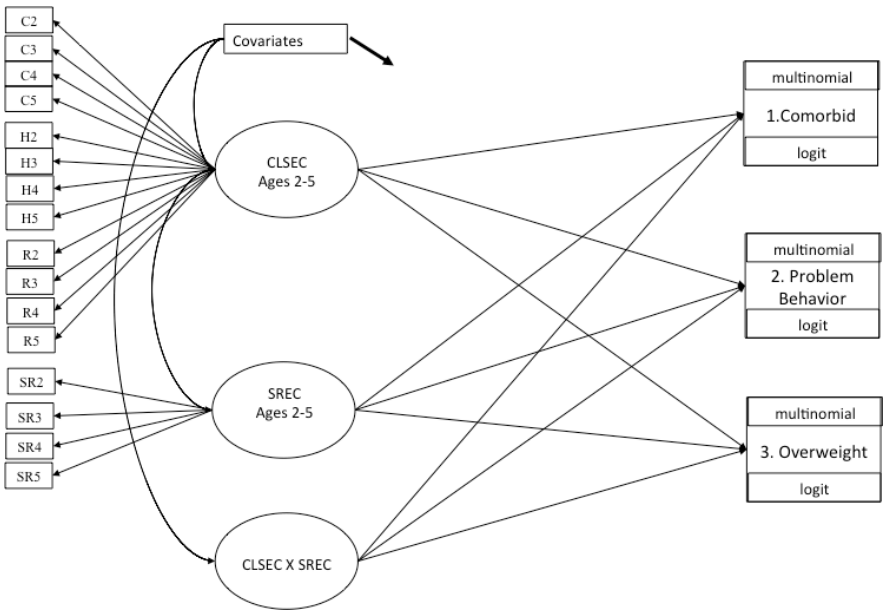

Figure 8. Model for Hypothesis 5. CLS: coercive limit-setting; SR: self-regulation; EC: early childhood. Multinomial logistic regression with the typically developing group as the reference group. Covariates: intervention condition, child gender, child body size impression at age 2, parent body size impression at age 2, child African-American or bi-racial. child Hispanic, cumulative risk. C: COIMP; H: HOME, R: RACS. For CLSEC, indicators from the same measure were constrained to be equal to each other across time points. 2: Age 2; 3: Age 3; 4: Age 4; 5: Age 5.

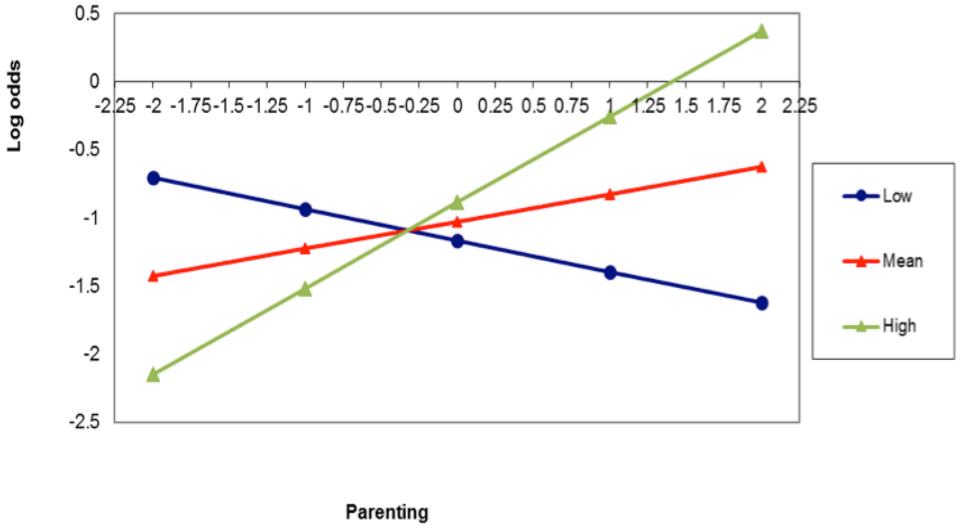

Figure 9. Simple regressions of CLSEC on the odds of belonging to the Comorbid group at different levels of SREC. Parenting= CLSEC. At high levels of SREC the simple slope for CLSEC approached significance (p= .06) and all the intercepts were significant.

APPENDIX C

INDIVIDUAL ITEMS OF MEASURES

Coercive Limit-Setting

COIMP (1= *not at all*, 9= *very much*)

1. Does the parent use directives that seem specific and clear to the child?
2. Does the parent set limits firmly without using aversive control techniques (i.e., yelling, anger, criticism, threats)?
3. Does the parent seem to be avoidant or reluctant to set limits to the child, allowing the child to engage in misbehavior without responding?
4. Does the parent follow through with requests or directives to assure compliance and/or cooperation?
5. Is the parent appropriately contingent in responding to negative or non-compliant child behavior?
6. Does the parent seem to be mindful of the child's behavior, whereabouts, activities, and feelings?
7. Does the parent seem to be haphazard, unpredictable, and inconsistent in responding to the child's behavior?
8. Does the parent use verbal structuring to make the task manageable?
9. Does the parent threaten the child with any sort of punishment to gain compliance?
10. Does the parent use physical discipline during the observation session?
11. Does the parent seem in firm control and in leadership role with the child?

Home-Visitor Scores (yes/no)

1. Parent (does not) slap or spank child during visit (reversed scored)
2. Parent (does not) scolds or criticizes child during visit (reversed scored)

3. Parent (does not) interfere with/ restricts child more than 3 times (reversed scored)

4. Parent seemed in good control of child during visit (reversed scored)

Positive Behavior Support

COIMP (1= *not at all*, 9= *very much*)

1. Does the parent encourage positive child behavior with praise and/or incentives?

2. Does the parent prompt the child to transitions and/ or future requests for behavior change?

3. Is the parent appropriately contingent in responding to positive or compliant child behavior?

4. Does the parent give the child choices for behavior change whenever possible?

5. Does the parent use verbal structuring to make the task manageable?

Home-Visitor Scores (yes/no)

1. Parent responds verbally to child vocalizations

2. Parent's voice conveys positive feelings toward child

3. Parent caresses or kisses child at least once

4. Parent responds positively to praise child offered by visitor

5. Parent keeps child in visual range and looks often

6. Parent talks to child while doing household

7. Parent structures child's play period

8. Parent attempt to be warm, friendly

9. Parent seemed in good control of child

10. Parent seems to enjoy parenting

11. Parent seemed generally accepting of child

12. Parent disciplines child appropriately

13. Parent has good family problem solving skills

Child Behavior Questionnaire- Inhibitory Control Subscale

1. Can lower his/ her voice when asked to do so.

2. Is good at games like "Simon Says," "Mother, May I?" and "Red Light, Green Light."

3. Has a hard time following instructions.

4. Prepares for trips and outings by planning things s/he will need.

5. Can wait before entering into new activities if s/he asked to.

6. Has difficulty waiting in line for something.

7. Has trouble sitting still when s/he is told to (at movies, church, etc.)

8. Is able to resist laughing or smiling when it isn't appropriate.

9. Is good at following instructions.

10. Approaches places s/he has been told are dangerous slowly and cautiously.

11. Is not very careful and cautious in crossing streets.

12. Can easily stop an activity when s/he is told "no."

13. Is usually able to resist temptation when told s/he is not supposed to do something.

Child Behavior Checklist (CBCL) Externalizing Scale Items

1. Drinks alcohol without parents' approval.
2. Doesn't seem to feel guilty after misbehaving.

3. Breaks rules at home, school, or elsewhere.
4. Hangs around with others who get in trouble.
5. Lying or cheating.
6. Prefers being with older kids.
7. Runs away from home.
8. Sets fires.
9. Steals at home.
10. Steals outside the home.
11. Swearing or obscene language.
12. Thinks about sex too much.
13. Smokes, chews, or sniffs tobacco.
14. Truancy, skips school.
15. Uses drugs for nonmedical purposes please do not include alcohol or tobacco.
16. Argues a lot.
17. Cruelty, bullying, or meanness to others.
18. Demands a lot of attention.
19. Destroys his/her own things.
20. Destroys things belonging to [his/her] family or others.
21. Disobedient at home.
22. Disobedient at school.
23. Gets in many fights.
24. Physically attacks people.
25. Screams a lot.

26. Stubborn, sullen, or irritable.

27. Sudden changes in mood or feelings.

28. Suspicious.

29. Teases a lot.

30. Temper tantrums or hot temper.

31. Threatens people.