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Parental Restrictive Feeding with Latino Adolescents: Examining the Role of Adolescent Self-Regulation in Associations with Body Mass Index

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PARENTAL RESTRICTIVE FEEDING WITH LATINO ADOLESCENTS: EXAMINING THE ROLE OF ADOLESCENT SELF-REGULATION IN ASSOCIATIONS WITH BODY MASS INDEX

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

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Latino adolescents in the U.S. are disproportionately affected by obesity compared to adolescents of other racial and ethnic backgrounds. Previous studies have suggested that parental restrictive feeding may serve as a modifiable risk factor. However, given that obesity in youth often develops as a function of a child’s susceptibility for weight gain interacting with their environment, the suggested negative effects of parental restrictive feeding may not generalize across all Latino adolescents. One marker of susceptibility for weight gain in youth is poor self-regulation, which can lead to reliance on others to help regulate eating behavior. However, the potential for self-regulation to modify the effect of parental restrictive feeding on weight outcomes has not been assessed in Latino adolescents. In turn, the primary objective of the present study was to test conditional effects of parental restrictive feeding, based on the self-regulation processes of executive functioning and effortful control, on BMI z-score in Latino adolescents. The study sample consisted of Latino fifth and sixth-graders and their mothers residing in the Midwestern U.S. (N = 123 dyads). Restrictive feeding, BMI z-score, and self-regulation skills were measured across two waves of data collection approximately one year apart. It was hypothesized that the effect of parental restrictive feeding would be moderated by youth self-regulation such that restrictive feeding would predict lower BMI z-scores in adolescents with poorer executive functioning skills and effortful control. Additionally, it was also hypothesized that adolescents with better executive functioning skills and effortful control would have higher BMI z-scores. Results showed that mothers engaged in moderate use of restrictive feeding at both waves. In turn, parental restrictive feeding was a marginally significant positive predictor of concurrent BMI-z-score at wave 1. However, neither executive functioning nor effortful control emerged as significant moderators. These findings demonstrate the need for testing of additional moderators that may condition the effect of restrictive feeding. Future

research would also benefit from testing bidirectional associations between parental restrictive feeding and BMI z-score in Latino adolescents.

INTRODUCTION

Adolescence represents a critical period for the development of overweight and obesity (Alberga, Sigal, Goldfield, Prud'homme, & Kenny, 2012). Traditionally "overweight" refers to having excess weight relative to a weight standard, while "obesity" refers to excess fat mass, though both terms are still commonly operationalized as a high body mass index-for-age (BMI) (Flegal & Ogden, 2011). Therefore, the term "obesity" was selected for use throughout this paper based on expert opinion that it most effectively captures the severity of the problem (Koplan, Liverman, & Kraak, 2005). As a chronic disease, obesity in adolescence is associated with concurrent health and adjustment problems including high blood pressure, asthma, depression, unhealthy body image, and peer-victimization (Daniels, 2009; van Geel, Vedder, & Tanilon, 2014; Voelker, Reel, & Greenleaf, 2015). Obesity in adolescence is also predictive of other chronic diseases such as hypertension, as well as premature mortality in adulthood (Engeland, Bjørge, Tverdal, & Søgaard, 2004; Ford, Nonnemaker, & Wirth, 2008). Prevalence of obesity in adolescence is highest among ethnic minority youth with Latino youth being among the most affected (Ogden et al., 2016). Cauce and colleagues (2011) report that Latino youth are more likely than their Caucasian peers to be born into poverty and raised in socioeconomically- and ethnically-isolated neighborhoods, which are associated with concentrated disadvantage by means of limited access to resources, such as social and health services, as well as recreational green spaces (Acevedo-Garcia, Lochner, Osypuk, & Subramanian, 2003; Wen & Maloney, 2011). Relatedly, Wen and Maloney (2011) found that neighborhood ethnic isolation was positively associated with obesity risk among Latino adults. Given these sociocultural risk factors, it is crucial to identify key psychosocial factors that predict and contribute to obesity in

Latino adolescents in order to prevent early onset as well as persistence of the disease into adulthood.

Theory and empirical research suggest that parental feeding practices may be one of these key factors. The interpersonal and intrapersonal model of child obesity (Harrist et al., 2012) suggests that parental feeding practices are indirectly related to child obesity through their impact on child dietary intake and activity levels. Parental feeding practices are also predicted by family dynamics including high parental control (Harrist et al., 2012), which in turn has been found to be empirically related to weight outcomes in adolescents (Lohman, Gillette, & Neppl, 2016). Some empirical research has shown that parental restrictive feeding, an overtly-controlling feeding practice that involves placing limits on children's access to certain foods (Birch et al., 2001), is concurrently related to higher weight outcomes in adolescents (Cardel et al., 2012; Kaur et al., 2006; Spruijt-Metz, Li, Cohen, Birch, & Goran, 2006), but not over time (Campbell et al., 2010; Spruijt-Metz et al., 2006). The limited research conducted on parental restrictive feeding and weight outcomes in Latino adolescent samples has also found restrictive feeding to be related to higher weight outcomes concurrently (Penilla et al., 2017; Tschann et al., 2013) as well as over time (Tschann et al., 2015), though nonsignificant associations have also been found (Matheson, Robinson, Varady, & Killen, 2006).

The interpersonal and intrapersonal model of child obesity (Harrist et al., 2012) identifies poor self-regulation as a path through which high parental control impacts weight outcomes. Theoretically, Harrist and colleagues (2012) explain that children with poor self-regulation may be more likely to rely on external sources to regulate their eating behavior. Therefore, Latino adolescents with lower self-regulation skills may be less at risk for being overweight as a result of parental restrictive feeding, while those with higher self-regulation skills may experience the opposite due to restrictive feeding interfering with their own ability to self-regulate.

Ultimately, despite the high rates of obesity among Latino adolescents (Ogden et al., 2016), few studies have examined the role of parental restrictive feeding and how its impact may differ in accordance with adolescent self-regulation. Therefore, the purposes of the current study are to test parental restrictive feeding as a unique predictor of weight status in a sample of Midwestern Latino adolescents, and to evaluate the potential moderating effects of self-regulation indices on this relation. Addressing these gaps is critical for identifying modifiable factors related to adolescent obesity on which we can intervene to improve health outcomes for Latino adolescents.

LITERATURE REVIEW

Adolescent Obesity in the U.S.

Adolescence traditionally marks the period between ages 12 and 19, though in recent years, some researchers suggest it begins as early as age 10 and spans roughly 10 to 15 years (Steinberg & Morris, 2001). As a developmental stage, it reflects a time when children often undergo physiological, behavioral, and emotional changes that leave them vulnerable for weight gain (Alberga et al., 2012). Physiological changes tend to coincide with pubertal transitions and include increased fat mass in the body and differences in its distribution between genders, as well as decreased insulin sensitivity, a condition that increases storage of fat (Goran & Gower, 2001; Mihalopoulos, Holubkov, Young, Dai, & Labarthe, 2010). Common behavioral changes during adolescence include increased calorie intake, largely from foods and beverages high in fat and sugar, increased meals away from home, and changes in physical activity and sedentary behavior (Bassett, John, Conger, Fitzhugh, & Coe, 2015; Drewnowski & Rehm, 2014; Nelson, Neumark-Sztainer, Hannan, & Story, 2009; Neumark-Sztainer, Larson, Fulkerson, Eisenberg, & Story, 2010). An increase in experiences of stress related to heightened emotionality and rapid brain development during adolescence also plays a role in weight gain (Casey et al., 2010; Pervanidou & Chrousos, 2012).

As a result, an estimated 20.5% of all adolescents in the U.S. are obese as defined by having a BMI at or above the 95th percentile for age and sex, with sex differences typically being small (20.1% boys, 21.0% girls) (Ogden et al., 2016; Sweeting, 2008). This figure generally continues to rise despite obesity trends leveling off among younger children (Ogden et al., 2016), the reasons for which remain unclear (Rokholm, Baker, & Sørensen, 2010). Obese adolescents tend to remain obese as adults (Singh, Mulder, Twisk, Van Mechelen, & Chinapaw, 2008) and are more at risk than their non-obese peers for developing other chronic diseases including diabetes and heart disease, two of the leading causes of adult mortality in the U.S. (Freedman, Mei, Srinivasan, Berenson, & Dietz, 2007; Heron, 2013; Lee, Okumura, Davis, Herman, & Gurney, 2006). Relatedly, a recent review of child and adolescent obesity literature captured a body of evidence linking childhood obesity with premature mortality in adulthood (Reilly & Kelly, 2011).

Prevalence rates of obesity in adolescence differ by race and ethnicity, as well as income (Ogden et al., 2016; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). There is evidence to show that racial disparities are larger among adolescent girls compared to boys (Taber, Robinson, Bleich, & Wang, 2016). Furthermore, obesity tends to disproportionately impact low-income youth (Frederick, Snellman, & Putnam, 2014). One ethnic minority population that has been particularly impacted by obesity is the Latino population.

Obesity among Latino adolescents. Latinos represent the fastest growing ethnic minority population in the country and are projected to represent 29% of the U.S. population by 2060 (Colby & Ortman, 2014). The ethnic and socioeconomic disparities in U.S. obesity prevalence are evident in the Latino population, but are not limited to Latino adults (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016). Among adolescents ages 12-19, obesity prevalence is highest for Latino adolescents at 22.8 % compared with 22.6% for non-Hispanic Black adolescents, 19.6% for non-Hispanic White adolescents, and 9.4% for non-Hispanic Asian adolescents (Ogden et al., 2016). Moreover, among Latino adolescents there tends to be a higher prevalence of obesity and cardiometabolic risk factors among Latino boys than girls (Isasi et al., 2016). The obesity trend continues into adulthood with approximately 42.6% of Latino adults over the age of 20 classified as obese (Flegal et al., 2016). Consequently, Latino adolescents represent a particularly high-risk group for development of obesity, the reasons for which are widespread.

Rooted in Bioecological Systems Theory (Bronfenbrenner & Morris, 2006), Harrison and colleagues (2011) developed the Six-Cs model to conceptualize the spheres of influence on child and adolescent obesity, which include the cell, child, clan, community, country, and culture. Not only are Latino adolescents susceptible to the same age-related vulnerabilities for weight gain as their non-Latino peers, but they are also faced with sociocultural risk factors relevant to their communities and cultures. For example, while 94% of Latino youth under 18 living in the U.S. are U.S.-born (Patten, 2016), many are raised by foreign-born parents or caregivers and are thereby exposed to stressors associated with immigration including acculturation, discrimination, financial instability, food insecurity, and limited access to healthcare (Cauce, Cruz, Corona, & Conger, 2011; Cervantes, Padilla, Napper, & Goldbach, 2013; Coleman-Jensen, Rabbitt, Gregory, & Singh, 2016; Fiese & Jones, 2012; Fry & Passel, 2009; Livingston, Minushkin, & Cohn, 2008). The experience of chronic stress can lead to disruptions in physiological functioning related to the stress response system, and this dysregulation has been linked to increased vulnerability for weight gain (De Vriendt, Moreno, & De Henauw, 2009).

There is also some evidence that risk for obesity among Latino youth is greater for those of later generations (i.e., U.S.-born) as compared with early-generation youth (foreign-born or youth of foreign-born parents), a phenomenon best captured by the immigrant paradox (Marks, Ejesi, & García Coll, 2014; McCullough & Marks, 2014). Marks and colleagues (2014) explain that the likelihood of poorer developmental outcomes for Latino youth, such as engagement in high-risk health behaviors and overweight/obesity, increases in parallel with years lived in the

U.S. This is somewhat paradoxical considering that early-generation youth tend to be more socioeconomically disadvantaged, a known risk for obesity and other health disparities (Kumanyika, 2005). One proposed explanation is that the U.S. offers more exposure to obesogenic environments, which offer increased availability of calorie-dense food and more opportunities to engage in sedentary behavior (McCullough & Marks, 2014; Sussner, Lindsay, Greaney, & Peterson, 2008). As a consequence, the problem of obesity is often transmitted across several generations of Latino families.

One possible explanation for the intergenerational transmission of obesity across Latino families is that the sociocultural risks to which many are exposed may negatively impact family and peer dynamics, which in turn may leave younger generations vulnerable for weight gain. Related to the Six-Cs model, Harrist and colleagues (2012) developed the interpersonal and intrapersonal model of child obesity to show how intrapersonal characteristics of the child (e.g., self-regulatory abilities, interpersonal skills) may serve as pathways by which the psychosocial nature of family (the clan) and peer dynamics impacts child weight outcomes. One example of family dynamics is high parental control, which is manifested through parenting practices.

Parenting Practices in Latino Families

Darling and Steinberg (1993) define parenting practices as the behaviors a parent engages in to help their child meet goals within a particular domain of socialization. Furthermore, they assert that these practices directly affect a child’s development of certain behaviors or characteristics. Traditionally, Latino families tend to place a certain level of importance on achieving goals related to the cultural value of interdependence such as respect for authority and for one’s family (Fuller & García Coll, 2010; Halgunseth, Ispa, & Rudy, 2006). Qualitative research has shown that Latina mothers will often use similar means including clear and direct commands to help young children reach those goals early on (Calzada, Fernandez, & Cortes, 2010; Livas-Dlott et al., 2010; McCabe et al., 2013). These practices vary, however, relative to ethnic subgroup, parental education level, acculturation, and age, and are likely to change over time as youth grow older and families adapt to changing contexts (White, Roosa, Weaver, & Nair, 2009). The effectiveness of parenting practices depends on parenting style, the emotional climate in which practices are carried out, as well as the child's openness to the parent's expectations (Darling & Steinberg, 1993). For example, despite their firmness, Latino parents often make demands and set limits while still being warm and supportive (Domenech Rodríguez, Donovick, & Crowley, 2009; White, Zeiders, Gonzales, Tein, & Roosa, 2013). The consistency with which Latino parents demand respect leads to predictable interactions for Latino youth. Over time, Latino youth become familiar with their parents' practices of achieving respect, thereby enhancing their effectiveness (Livas-Dlott et al., 2010).

The demands and limits placed on youth by their parents are referred to as parental control (Halgunseth et al., 2006). In Latino families, parents tend to increase behavioral control as their children grow older as evidenced by increased parental monitoring and more rule setting in adolescence (Halgunseth et al., 2006; Stein et al., 2014). This may be explained by parents' beliefs that older youth are more capable of adapting their behavior to the well-established goals of the family. However, this control is nuanced in that it varies within and across domains of socialization in accordance with the goals that Latino families value (Halgunseth et al., 2006). Much of the research in this area has also largely focused on Latina mothers, which may in part be due to mothers being the primary agents of socialization within Latino families (Knight et al., 2011). In the interest of promoting the health and well-being of their children, one domain in which Latina mothers commonly exercise control is child feeding/eating.

Parental feeding practices in Latino families. Child and adolescent eating behaviors are largely shaped through early, food-related interactions with parents or caregivers, otherwise known as food-related parenting (Savage, Fisher, & Birch, 2007; Vereecken, Legtest, De Bourdeaudhuij, & Maes, 2009). In fact, Ogden, Reynolds, and Smith (2006) argue that parental feeding practices, behaviors parents engage in to get their children to eat, are rooted in parental control. Consistent with the conceptualization of Halgunseth and colleagues (2006), parental control in the context of child feeding is complex. Ogden and colleagues (2006) assert that there are two types: overt and covert. Overt control refers to controlling a child’s food intake in a way that is likely to be noticed by the child, such as limiting and monitoring the child’s intake of certain foods. In contrast, covert control involves managing the child’s eating environment. This is done using more discreet means unlikely to be noticed by the child, but still effective for controlling food intake. Examples include limiting availability of certain foods in the home, avoiding particular restaurants, and modeling of food intake.

Savage and colleagues (2007) explain that parental feeding practices that are often considered to be routine, such as responding to infants’ distress with food and actively encouraging young children to clean their plates, evolved in response to issues of food scarcity and infectious diseases. Consequently, research on parental feeding practices in early childhood, which constitutes much of the parental feeding literature, demonstrates continued use of overtly-controlling feeding practices by parents, including the use of pressure and incentives to encourage children to eat (Edelson, Mokdad, & Martin, 2016; Haycraft, Farrow, & Blissett, 2013). Use of these practices persists, despite food abundance and chronic diseases having replaced food scarcity and infectious diseases as major threats to human health in the developed world (Savage et al., 2007). In turn, parental feeding practices may be differentially related to the development of obesity in youth as a function of the type of control used (Loth, 2016), given that some studies have demonstrated associations between more demanding feeding practices (e.g., pressure to eat) and child weight outcomes (e.g., Cardel et al., 2012; Wehrly, Bonilla, Perez, & Liew, 2014). However, few longitudinal studies have been conducted to support this hypothesis.

Consistent with the literature on parenting practices, however, it is expected that parents' use of controlling feeding practices will change as youth develop (Pulley, Galloway, Webb, & Payne, 2014). For example, parents of adolescents have reported setting limits, monitoring their children's food intake, as well as pressuring their adolescents to eat (Loth, MacLehose, Fulkerson, Crow, & Neumark-Sztainer, 2013; Spruijt-Metz et al., 2006), though there is evidence that use of these feeding practices is negatively related to age in both White and African American adolescents (Kaur et al., 2006). A limited number of studies have examined parental feeding practices of Latino parents (e.g., Birch et al., 2001; Martinez, Rhee, Blanco, & Boutelle, 2014; Silva, Power, Fisher, O'Connor, & Hughes, 2016), and fewer still have examined practices applied to Latino adolescents (e.g., Matheson et al., 2006). Given that parental control is known to increase in Latino families as youth grow older (Halgunseth et al., 2006), controlling feeding practices may still be relevant for Latino adolescent health outcomes including obesity, which makes this an important gap to fill in the parental feeding literature.

In accordance with other parenting practices, parental feeding practices are also goal-oriented behaviors (Vollmer & Mobley, 2013), and thus their usage is likely to vary depending on parents' goals for their children, which may be culturally bound (Savage et al., 2007). As mentioned previously, Latino parents traditionally socialize their children to be respectful and interdependent (Fuller & García Coll, 2010). Consequently, they may use more overtly-controlling feeding practices relative to parents of other racial/ethnic backgrounds, given that more covert feeding practices provide youth with more behavioral autonomy, a characteristic that is traditionally less valued in Latino families (Cardel et al., 2012; Halgunseth et al., 2006; Savage et al., 2007). In particular, one overtly-controlling parental feeding practice that has been found to be more common in Latino families in comparison to White and African American families is parental restrictive feeding (Cardel et al., 2012).

Parental restrictive feeding in Latino families. Parental restrictive feeding has been commonly defined as parental limitation of palatable foods including those high in fat or sugar, the child's favorite foods, as well as use of food as a reward (Spruijt-Metz et al., 2006). Parents may be motivated to engage in restrictive feeding due to economic stressors such as financial instability or experiences of food insecurity (Kuyper, Smith, & Kaiser, 2009). However, Costanzo and Woody's Obesity Proneness Model (1985) suggests another reason that parents engage in restrictive feeding is in response to concerns about their child becoming overweight or obese. Rhee and colleagues (2009) offer partial support for this model in school-age children. They found that a change in child BMI z-scores between the ages of 4-7 predicted increased use of maternal controlling feeding practices in girls ages 7-9, though no relation was found for boys. Additionally, a more recent study conducted in the Netherlands found that child BMI at age two positively predicted restrictive feeding at age four (Jansen et al., 2014). However, scant research in this area has focused on adolescents, even though parental concern about child weight may not arise until this period of development (Nickelson, Bryant, McDermott, Buhi, & DeBate, 2012). Even fewer studies have focused on Latino adolescents, despite evidence that restrictive feeding may be more common among Latino parents than parents of other racial or ethnic groups, and that Latino adolescents are more at risk than their peers for developing obesity (Cardel et al., 2012; Ogden et al., 2016).

Despite well-meaning intentions of parents, theory suggests that restrictive feeding may promote poor body image and unhealthy weight outcomes for youth by inciting preoccupation with weight and restricted foods, or by disrupting a child's innate ability to self-regulate their eating, which could lead to overeating or eating in the absence of hunger (Costanzo & Woody, 1985; Harrist et al., 2012; Lindsay, Sussner, Greaney, & Peterson, 2011; Savage et al., 2007). In turn, current research offers mixed support for restrictive feeding being in service of healthy weight in youth. For example, a study conducted in Australia found that parent-reported restrictive feeding was predictive of lower BMI z-scores in 5-6-year-olds three years later (Campbell et al., 2010). This finding is consistent with earlier longitudinal studies conducted in the U.S. that found parental restrictive feeding to be predictive of lower BMI z-scores in younger cohorts (Farrow & Blissett, 2008; Rhee et al., 2009).

Among adolescents, however, Kaur and colleagues (2006) found that parental restrictive feeding was positively related to BMI percentiles in adolescents. Relatedly, Spruijt-Metz and colleagues (2006) found a positive, concurrent relation with higher fat mass in adolescents, though restrictive feeding did not significantly predict fat mass two years later. Mirroring the lack of a longitudinal association, parental restrictive feeding was found to be unrelated to BMI z-scores in 10-12-year-olds after three years in Campbell and colleagues' study (2010). Narrowing to Latino adolescents, the few studies conducted with this population found parental restrictive feeding to be related to higher BMI scores concurrently (Penilla et al., 2017; Tschann et al., 2013) and up to two years later (Tschann et al., 2015) in samples of 8-10-year-old Mexican-American youth. In contrast, one study did find a nonsignificant association in a sample of 9-12-year-old Mexican American youth (Matheson et al., 2006).

Taken together, the current body of research offers mixed support for an association between parental restrictive feeding and weight outcomes in adolescents. One explanation for the equivocal findings may be methodological differences between studies. While restrictive feeding is most commonly captured using parent reports on the Restriction subscale of the Child Feeding Questionnaire (Birch et al., 2001), studies have used different indicators to capture child weight outcomes. These indicators include BMI z-scores and percentiles derived from both parent reports (e.g., Kaur et al., 2006) as well as objective measures of child height and weight (e.g., Campbell et al., 2010; Tschann et al., 2015), along with direct measures of body composition including percent and distribution of fat mass (e.g., Spruijt-Metz et al., 2006). Although nationally-representative data has shown that parent-reported measurements tend to be more accurate for adolescents than for younger children, it has been found that parents of heavier adolescents often underreport weight, leading to underestimation of adolescent obesity prevalence (Weden et al., 2013). Parental perceptions of adolescent weight, which are tied to parental concerns about adolescent weight (Kaur et al., 2006), may contribute to underreporting (Rietmeijer-Mentink, Paulis, Middelkoop, Bindels, & Wouden, 2013). Given that parental restrictive feeding may be motivated by parental concerns (Costanzo & Woody, 1985), underreporting of weight may cause parent reports to be less strongly or even inversely associated with restrictive feeding than objective measures of weight in adolescents, or direct measures of body composition.

Beyond methodological differences, however, an additional explanation may be that the relation between parental restrictive feeding and weight outcomes is not generalizable to all youth. Instead, the strength or even direction of the effect of restrictive feeding might differ in accordance with contextual or child-level factors. For example, while it is possible that restrictive feeding could be counterproductive, it has been suggested that greater parental control may be beneficial for youth residing in high-risk environments (White et al., 2013). In addition, a warm and supportive home environment may serve as a buffer for negative effects of restrictive feeding on weight outcomes in youth (van der Horst et al., 2007) Latino youth are more likely to grow up in high-risk environments than their peers due to experiences of poverty and multicultural stressors (Cauce et al., 2011). Therefore, Latino parents may make more demands and set greater limits on their children's behaviors in response to these risks (Stein et al., 2014). However, given the warm and supportive parenting style that is characteristic of Latino families (Livas-Dlott et al., 2010; White et al., 2013), controlling parenting practices such as restrictive feeding may still be beneficial.

This idea is at odds with the current research on Latino families described previously, which generally supports restrictive feeding as being less than beneficial for adolescent weight outcomes. However, it's possible that the nuances of the restrictive feeding-weight association are being masked such that restriction may be more beneficial for the weight outcomes of some adolescents than others. In turn, one child-level characteristic that may explain which adolescents benefit from restrictive feeding is self-regulation.

Self-Regulation and Adolescent Obesity

Self-regulation refers to change of one's own cognition, emotion, behavior, or internal state for an adaptive purpose such as problem-solving, addressing a conflict, preparing to meet a goal, or maintaining ideal levels of arousal (Nigg, 2017). Humans engage in self-regulation across the lifespan, though childhood and adolescence have been identified as critical periods for its development (Bridgett, Burt, Edwards, & Deater-Deckard, 2015). Adolescents are of particular interest due to the increased reward sensitivity that is characteristic of their developmental stage, which may compromise self-regulatory abilities (Casey, 2015). Researchers have identified voluntary (i.e., top-down) and involuntary (i.e., bottom-up) processes that enable self-regulation across domains of human development with voluntary processes exerting greater influence with age on behavior and emotion (Rubia, 2013). Two voluntary processes that have dominated much of the self-regulation literature focused on youth are executive functioning and effortful control.

Executive functioning (EF) refers to a set of core and higher-level cognitive skills that underlie goal-oriented behavior and can be called upon in service of self-regulation among other tasks (Nigg, 2017). Core skills include working memory (the ability to mentally hold and shape information), inhibitory control (the ability to override a natural response in the interest of one that is more adaptive), and cognitive flexibility (the ability to adapt and focus in the face of changing stimuli), whereas higher-level skills include planning, reasoning, and problem-solving (Bridgett et al., 2015; Diamond, 2013). EF skills develop in a hierarchical fashion with the core skills of working memory and inhibitory control tending to emerge first, setting the stage for cognitive flexibility to develop, all of which work together to promote later development of higher-level EF skills (Diamond, 2013). In turn, these components of EF are generally considered distinct (Miyake et al., 2000), and thus tend to be measured separately. Effortful control (EC), an overlapping but distinct construct relative to EF, is rooted in temperament and refers to an attentional-control system that Rothbart and colleagues (2004) consider to be the basis of self-regulation. EC skills or capacities, which like EF skills may be used for purposes other than self-regulation, include inhibition or activation of a behavior in the face of conflict, shifting and focusing attention, planning, and detecting errors (Eisenberg, Hofer, Sulik, & Spinrad, 2014; Mary K. Rothbart, 2007).

Despite being viewed as separate self-regulatory processes, both EF skills and EC have been identified as correlates of weight status and other weight-related outcomes in adolescents. A small number of cross-sectional studies have provided empirical support for relations between BMI and BMI percentile and poorer performance on objective measures of core EF skills including inhibitory control (Delgado-Rico, Río-Valle, Albein-Urios, et al., 2012; Maayan, Hoogendoorn, Sweat, & Convit, 2011; Reyes, Peirano, Peigneux, Lozoff, & Algarin, 2015), cognitive flexibility (Delgado-Rico, Río-Valle, González-Jiménez, Campoy, & Verdejo-García, 2012; Verdejo-García et al., 2010), and working memory (Li, Dai, Jackson, & Zhang, 2008). Relatedly, Schwartz and colleagues (2013) found adipose tissue volume to be negatively related to EF in adolescents. The EC literature, however, is less conclusive. Only a few studies have examined relations between EC and weight-related outcomes in youth (e.g., Hughes, Power, O'Connor, & Fisher, 2015; Pieper & Laugero, 2013; Tandon, Thompson, Moran, & Lengua, 2015). Fewer still have specifically considered these relations in adolescent samples (Godefroy, Trinchera, Romo, & Rigal, 2016; Walther & Hilbert, 2016), even though EC may continue to develop as a function of experience during adolescence (Lengua, 2006). From this small body of research, there is emerging evidence that EC may play a role in weight status and BMI/BMI percentile in youth similar to that of EF skills, though non-supportive evidence has also been found (Godefroy et al., 2016; Hughes et al., 2015; Tandon et al., 2015).

Poorer self-regulation, including EF skills and EC, may enhance youth's susceptibility for weight gain. Studies have shown that both EF and EC may predict obesogenic behaviors in youth, including overeating and eating in the absence of hunger, which may contribute to excess body mass (Godefroy et al., 2016; Pieper & Laugero, 2013). However, these findings should be considered in light of a few limitations. For example, most studies that have offered support for these relations in youth have been cross-sectional, so directionality remains uncertain. It is possible that these relations are bi-directional such that the hypertensive effects of being overweight or obese may negatively impact cognitive functioning, though existing evidence primarily stems from adult samples (e.g., Sabia, Kivimaki, Shipley, Marmot, & Singh-Manoux, 2009). An additional limitation is that much of the current research has centered on independent and mediating effects of EF skills and EC. Given that weight-related outcomes are often the result of an interaction between a child's susceptibility and their environment (Godefroy et al., 2016), it is possible that EF and EC may interact with environmental factors to predict obesity development. Therefore, more research is needed to evaluate moderating effects of EF and EC on weight outcomes in youth. Finally, scant research has focused on examining these relations among Latino youth and specifically Latino adolescents (Hughes et al., 2015), which signifies an important gap to fill. Self-regulation skills may moderate the impact of contextual factors such as parental restrictive feeding, thereby reflecting a potential point of intervention for obesity in this population.

Parental Restrictive Feeding and Adolescent Self-Regulation

According to Bioecological Systems Theory, human development unfolds across time as a function of proximal processes or interactions between the developing individual, who resides at the center, and their environment (Bronfenbrenner & Morris, 2007). Developing adolescents interact with parents/caregivers who communicate with them about the goals and expectations they have for their children (Darling, 2007). However, as youth begin to place more importance on being autonomous during adolescence, belief in parental authority tends to decline in parallel, which in turn predicts decreased obedience of parental rules (Darling, Cumsille, & Loreto Martínez, 2007). Evidence exists to support a similar relation among Latino adolescents for whom the value of familism may decrease as autonomy becomes more valued (Updegraff, Umaña-Taylor, McHale, Wheeler, & Perez-Brena, 2012). As a consequence, Latino parents may adopt less traditional goals that they believe are more adaptive such as independence, which could lead to less restrictive feeding.

On the contrary, parents who believe that their child has difficulty regulating their behavior may be more hesitant to allow them to behave autonomously (Costanzo & Woody, 1985). For example, parents who engage in restrictive feeding report that if they did not limit their child's food intake, their child would consume too many foods high in fat/sugar or too much of their favorite foods (Birch et al., 2001). Beyond parental beliefs, there is also evidence of greater disinhibited eating being related to poorer EF skills in adolescents (e.g., Maayan et al., 2011). As mentioned before, the presence of strong self-regulation skills (e.g., EF skills, EC) helps youth to adapt flexibly to changing contexts and inhibit dominant thoughts, actions, or emotions in favor of ones that are more adaptive (Nigg, 2017). Both EF and EC may help adolescents respond appropriately to issues commonly encountered within eating contexts such as selecting foods to consume when a variety of options are available, deciding how much food to consume, and adapting to novel eating environments (e.g., eating without parental supervision). However, there is some evidence to support that restrictive feeding may be counterproductive such that it can undermine further development of a child's self-regulatory abilities, though generalizability of findings is limited to younger children (Savage et al., 2007).

In line with the Bioecological Model, parent-adolescent interactions in the context of eating serve as proximal processes that contribute to weight-related outcomes. Bronfenbrenner and Morris (2007) explain that the impact of proximal processes on developmental outcomes vary in accordance with characteristics of the developing child including resources (e.g., EF skills) and disposition (e.g., temperament). Therefore, it is possible that the effect of parental restrictive feeding on adolescent weight status may differ depending on the child's self-regulatory abilities (EF skills and EC). Given that youth with poor self-regulation skills tend to rely on external cues to help regulate their eating behavior (Savage et al., 2007), parental restrictive feeding may actually have a positive impact on the weight outcomes of these youth. For their peers with better self-regulation skills, however, parental restrictive feeding may undermine or interfere with those skills and consequently do more harm than good by having a negative impact on weight outcomes. These relations may be considerably relevant among Latino adolescents, due to the importance traditionally placed upon parental control and interdependence within Latino families.

THE PRESENT STUDY

The study aimed to test whether parental restrictive feeding was a unique predictor of adolescent weight status in Midwestern Latino families, and whether core EF skills of inhibitory control and cognitive flexibility as well as EC were unique moderators of the relation between parental restrictive feeding and youth BMI z-score. EF skills were assessed separately, given that they develop hierarchically and are considered distinct factors of EF (Diamond, 2013; Miyake et al., 2000). In turn, this study may add to our understanding of the impact of parental restrictive feeding as well as for whom it is most impactful. Using data from Project SALUD, a study designed to assess the health and well-being of Midwestern Latino adolescents across two years during their transition from elementary into middle school, the following questions will be examined:

Research Questions

Question 1. Does parental restrictive feeding predict BMI z-score concurrently and across time in Latino adolescents?

Hypothesis 1a. Based on previous findings (Penilla et al., 2017; Tschann et al., 2013), it is anticipated that parental restrictive feeding will positively predict BMI z-score concurrently within both waves.

Hypothesis 1b. Akin to the findings of Tschann and colleagues (2015), is also anticipated that parental restrictive feeding will positively predict BMI z-score across time in Latino adolescents.

Question 2. Does executive functioning (EF) moderate the relation between parental restrictive feeding and BMI z-score in Latino adolescents?

Hypothesis 2a. It is anticipated that cognitive flexibility at wave 2 will moderate the relation between parental restrictive feeding and BMI z-score at wave 2 such that the effect of restrictive feeding will be negative for adolescents with lower cognitive flexibility scores and positive for those with higher cognitive flexibility scores. This hypothesis is based on the awareness that youth with poor self-regulation skills often rely on external cues to help regulate their eating behavior (Savage et al., 2007).

Hypothesis 2b. Based on the same rationale for hypothesis 2a, it is anticipated that inhibitory control at wave 2 will moderate the relation between parental restrictive feeding and BMI z-score at wave 2 such that the effect of restrictive feeding will be negative for adolescents with lower inhibitory control scores and positive for those with higher inhibitory control scores.

Question 3. Does effortful control (EC) moderate the relation between parental restrictive feeding and BMI z-score in Latino adolescents?

Hypothesis 3. Based on the same rationale for hypotheses 2a and 2b, it is anticipated that EC at wave 1 will moderate the relation between parental restrictive feeding at wave 1 and BMI z-score at wave 2 such that the effect of restrictive feeding will be negative for adolescents with lower EC scores and positive for those with higher EC scores.

METHOD

Participants

Data for the present study were drawn from waves 1 and 2 of Project SALUD, a longitudinal study designed to assess the health and well-being of Midwestern Latino families as their children transition from elementary into middle school. Analyses are based on 123 mother-child dyads that participated in either wave 1 (*n* = 119), wave 2 (*n* = 101), or both waves 1 and 2 (*n* = 97). [1] All mothers and youth self-reported as Latino and lived in semi-urban and rural areas of Northwest Indiana. Youth were in either fifth (*n* = 48) or sixth grade (*n* = 71) at wave 1. Mothers in wave 1 ranged in age from 26-53 years (*M* = 37.94 years, *SD* = 5.30) and 90.8% reported having an education level of high school or less. Most of the mothers (87.4%) were born outside of the U.S. with the majority reporting Mexico as their country of origin. Mothers born outside of the U.S. reported living in the U.S. for an average of 16.40 years (*SD* = 5.60). For youth, 58.8% were female (*n* = 70) at wave 1 and ranged in age from 10-12 years (*M* = 11.54, *SD* = 0.68). Most of the youth were born in the U.S. (86.6%).

Procedure

Upon receiving approval from the Institutional Review Board at Purdue University, participants were recruited during the academic years of 2015-2016 and 2016-2017. Recruitment methods included flyers and brochures posted at community locations in the Greater Lafayette, IN area (e.g., grocery stores, restaurants, community centers, libraries, churches), and through Purdue Extension. Information about the study was also provided by research assistants through

[1] Descriptive analyses exclude 4 mother-child dyads who did not participate in wave 1 but did participate in wave 2.

tabling during parent-teacher conferences and informational meetings held at local schools. The biological mother and one child from each interested family were invited to participate, provided the following inclusion criteria were met: 1) both mother and child self-identified as Latino, 2) the child was in fifth or sixth grade at the time of wave 1, and 3) the mother and child resided in the same home. For interested families with more than one eligible child, the oldest child was invited to participate.

During all waves, interested families eligible for participation were visited in their homes by at least two trained research assistants (at the undergraduate or graduate level). At least one of the research assistants was conversational in both English and Spanish. During the initial home visits, the research assistants explained study procedures and obtained informed consent and assent for each mother and child in their preferred language. Upon consenting to participate, surveys were provided to each mother and child in their preferred language. Mothers and youth were asked to complete the surveys independently prior to the second home visit (approximately three days later). Surveys were expected to take 90 minutes to complete for mothers and 60 minutes for youth. While working on and upon completion of the surveys, each mother and child was asked to store their survey in a manila envelope in efforts to maintain confidentiality.

After survey instructions were given, objective measurements of height and weight were collected for each mother and child by the research assistants. At wave 2, youth were also asked to complete two EF tasks as part of the NIH Toolbox Cognition Battery (Weintraub et al., 2013). Using iPads, each child completed the Dimensional Change Card Sort (DCCS) and a flanker task in their preferred language, the order of which was rotated across youth. At the second home visits, surveys were collected and each mother and child was paid for their time. Mothers were paid $50 and youth were paid $40 in wave 1. In wave 2, mothers were paid $60 and youth were paid $45 due to the addition of the NIH Toolbox tasks.

Measures

Parental restrictive feeding. Parental restrictive feeding was measured at waves 1 and 2 using mother reports on the 8-item Restriction subscale of the Child Feeding Questionnaire (CFQ; Birch et al., 2001), which captures the extent to which parents place limits on their children's access to certain foods (e.g., *I have to be sure that my child does not eat too many high fat foods*; *I offer my child his/her favorite foods in exchange for good behavior*). Response options ranged from 1 (*Disagree*) to 5 (*Agree*). Scores were averaged across the items to create a total score with higher scores reflecting greater restrictive feeding. A Spanish version was created through forward and backward translation by bilingual and bicultural Project SALUD research assistants. Internal consistency of the subscale was good at wave 1 ($\alpha = 0.80$) and acceptable at wave 2 ($\alpha = 0.79$).

Youth executive functioning (EF). EF was assessed at wave 2 using age-corrected child scores on two tasks of the NIH Toolbox (NIH-TB) Cognition Battery (Weintraub et al., 2013). The tasks included (1) the NIH-TB Dimensional Change Card Sort Test of Executive Function (DCCS), a measure of cognitive flexibility, and (2) the NIH-TB Flanker Inhibitory Control and Attention Test of Executive Function, a measure of inhibitory control and attention. The order of the tasks was rotated across youth to avoid any potential bias of one task being completed first. Test-retest reliability of each task was considered excellent in a normative sample of youth, ages 3-15 (Zelazo et al., 2013).

Cognitive flexibility. Youth completed the DCCS in their preferred language (English or Spanish) on iPads using their dominant hand. Each child was presented with a focal image of a ball or a truck colored yellow or blue and was asked to quickly tap one of two corresponding images that matched the focal image according to the dimensions of shape or color as indicated on the screen. Prior to the test trials, the youth completed two sets of four practice trials with images of rabbits and boats colored brown or white. They were asked to match by shape during the first set and color during the second set. After completing the practice trials, a total of thirty timed test trials were completed by each child, during which youth were asked to switch between shape and color of the balls or trucks. Age-corrected standard scores for the test trials were created from raw scores (M = 100, SD = 15). A score of 100 indicated task performance at the national average for a child’s year of age. Scores of 115 and 85 indicated performance that was at +/-1 SD, respectively, from the national average for a child’s year of age.

Inhibitory control. Youth completed the NIH-TB Flanker Inhibitory Control and Attention Test of Executive Function in their preferred language (English or Spanish) on iPads using their dominant hand. Each child was presented with a row of arrows. The row contained a focal arrow in the middle pointing either left or right that was flanked by adjacent arrows pointing in either the same or opposite directions. The child was asked to indicate the direction the focal arrow was pointing by quickly tapping either a left-pointing or right-pointing arrow at the bottom of the screen. The flanking arrows pointed in the same direction as the focal arrow in congruent trials, and in opposite directions in incongruent trials. After completing four practice trials, a total of twenty timed test trials (mixed congruent and incongruent) were completed by each child. Identical to scoring of the DCCS, age-corrected standard scores for the test trials were created from raw scores (M = 100, SD = 15).

Youth effortful control (EC). EC was measured at wave 1 using self-reports on three subscales of the Early Adolescent Temperament Questionnaire (EATQ-R; Ellis & Rothbart, 2001). The three subscales included Inhibitory Control (5 items), which reflects an adolescent's ability to suppress inappropriate behavior (e.g., *I can stick with my plans and goals*); Activation Control (5 items), which captures an adolescent's capacity to engage in a behavior despite a desire to avoid it (e.g., *I have a hard time finishing things on time*); and Attentional Control (6 items), which signifies an adolescent's ability to maintain as well as shift focus (e.g., *It is easy for me to really concentrate on homework problems*). Response options ranged from 1 (*Almost always false*) to 5 (*Almost always true*). Scores on each subscale were averaged together to create a total score representing EC with higher scores reflecting greater EC. Internal consistency at wave 1 was considered acceptable ($\alpha = 0.77$).

Youth BMI z-score. During waves 1 and 2, youth height and weight were independently measured by two trained research assistants using standard CDC protocols. Youth were asked to remove shoes and bulky clothing (e.g., heavy sweatshirts) that could interfere with measurement accuracy. Height was measured to the nearest 0.1 cm using a SECA 213 Stadiometer. A third measurement was taken if the first two measurements differed by more than 0.5 cm. Weight was measured to the nearest 0.1 kg using a Seca 869 digital floor scale. A third measurement was taken if the first two measurements differed by more than 0.1 kg. Height and weight measurements for each child were averaged and inputted into the Children's Hospital of Philadelphia Research Institute's Pediatric Z-Score Calculator (2018) to determine sex-specific, BMI z-scores for each child.

Covariates. To control for the effect of potential confounders on the relation between parental restrictive feeding and child BMI z-score, the following variables were evaluated as covariates prior to conducting the main analyses.

Child sex. Sex (1 = males, 2 = females) was controlled for in all analyses, given that some evidence suggests adolescent boys tend to have slightly higher BMI percentiles than adolescent girls (Ogden et al., 2016). There is also evidence that Latina mothers may engage in differential restrictive feeding with daughters compared to sons. For example, one qualitative study showed that Latina mothers reported less restrictive feeding with daughters than sons in attempts to avoid inciting or contributing to their daughters' preoccupation with weight (Lindsay et al., 2011; Silva et al., 2016). Results from two recent studies on Latina mothers of younger children also showed that mothers of boys were more likely to use restriction and food as a reward, a form of restrictive feeding, than mothers of girls (Power, O'Connor, Orlet Fisher, & Hughes, 2015).

Child age. Child age in years was examined as a potential control variable, given that BMI tends to increase with age (Mihalopoulos et al., 2010) and that mothers have reported less restrictive feeding toward older youth (Gray, Janicke, Wistedt, & Dumont-Driscoll, 2010; Kaur et al., 2006).

Pubertal status. Given that increases in BMI for youth tend to coincide with pubertal transitions (Mihalopoulos et al., 2010), pubertal status was considered as a potential control variable. For measurement, the Pubertal Development Scale was used, which consists of five items (Petersen, Crockett, Richards, & Boxer, 1988). The first two items were asked of both boys and girls in regard to growth in height and pubic hair with response options ranging from 1 (*not yet begun/started*) to 4 (*growth definitely seems underway/completed*). The third item asked both boys and girls about skin changes with response options ranging from 1 (*No*) to 3 (*Yes, definitely*). The fourth and fifth items were asked separately of boys and girls on the same 1 to 3 scale. Boys were asked about vocal and facial hair changes, and girls were asked about breast development and onset of menstruation. Scores across the five items were averaged for both boys and girls and then combined into one variable with higher scores indicating more advanced pubertal status. Given that internal consistency was considered unacceptable at wave 1 (boys: α = 0.34; girls: α = 0.47), but acceptable at wave 2 (boys: α = 0.74; girls: α = 0.73), only wave 2 pubertal status was examined as a potential control variable.

Prior child BMI z-score. Prior child BMI z-score was included where applicable to control for its effect on BMI z-score at wave 2.

Child body image. Child body image was evaluated as a potential control variable, given that self-perception of body size has been quantitatively related to weight status in Latino adolescents (Edwards, Pettingell, & Borowsky, 2010), as well as qualitatively to Latina mothers' feeding practices (Lindsay et al., 2011). Body image was measured using one item from the Collin's Body Image Scale (Collins, 1991), which asked youth to select the same-gender figure from a series of seven figures that best represented what they looked like. The figures were designed to range from very thin to obese (Collins, 1991). Higher scores indicated larger, self-perceived body size.

Economic stress. Economic stress was evaluated as a control variable, given that socioeconomically-disadvantaged adolescents can be affected by family economic stress (Hernandez & Pressler, 2015), which may in turn contribute to weight-related outcomes via biological mechanisms (De Vriendt et al., 2009). As a possible marker or cause of food insecurity, economic stress may also prompt restrictive feeding practices (Crawford et al., 2007).

Economic stress was measured using the 10-item Economic Hassles subscale of the Multicultural Events Schedule for Adolescents (Gonzales, Gunnoe, Samaniego, & Jackson, 1995). Youth were asked to report on negative, economic-related events they had experienced in the last three months (e.g., *During the past 3 months, your parent talked about having serious money problems; You had to go without a meal because your family did not have enough money*). Number of events endorsed were summed for each child to create a total score with higher scores indicating greater experience of economic stress. Two-week test-retest reliability of this subscale was described by Liu and colleagues (2011) as being between 0.69-0.81 in the original validation study (Gonzales et al., 1995).

Maternal BMI. Maternal BMI was included as a control variable, because BMI across childhood and adolescence is not only highly heritable (Hur et al., 2008; Silventoinen, Rokholm, Kaprio, & Sørensen, 2010), but findings have shown a positive relation between maternal BMI and restrictive feeding in school-age youth (Gray et al., 2010). Height and weight measurements for each mother were measured using the same protocol as youth. Measurements were averaged, and BMI was calculated for each mother by dividing average weight in kilograms by the square of average height in meters.

Maternal education level. There is some support for maternal education level being negatively related to adolescent weight status (Gordon-Larsen, Adair, & Popkin, 2003). Maternal education level may also predict the values and beliefs that underlie Latina mothers' feeding practices (Lindsay et al., 2011). Therefore, maternal education level was evaluated as a potential control variable. Mothers were asked to self-report their highest level of education with response options ranging from 1 (*less than 7th grade*) to 7 (*College graduate (B.A., B.S.)*).

Family income. Annual family income was evaluated as a control variable because obesity tends to disproportionately affect youth from low-income families (Frederick et al., 2014). Analogous to economic stress, family income may also indicate limited resources (e.g., food security) and thus be a contributor to mothers' use of restrictive feeding.

Maternal monitoring. Given that parental restrictive feeding is rooted in parental control (Ogden et al., 2006), maternal monitoring was evaluated as a potential control variable. Maternal monitoring was measured using the 5-item, Monitoring subscale of the Comprehensive General Parenting Questionnaire (Sleddens et al., 2014). Sleddens' and colleagues' (2014) construct of monitoring is a sub-construct under behavioral control. The subscale was designed to assess the degree to which parents supervise their child's activities and behavior (e.g., *I watch my child to make sure he/she is behaving appropriately*) (Sleddens et al., 2014). Response options ranged from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Scores were averaged to create a total score with higher scores reflecting greater maternal monitoring. A Spanish version of the subscale was created through forward and backward translation by bilingual and bicultural Project SALUD research assistants. Internal consistency of the subscale was good at wave 1 ($\alpha = 0.85$) and wave 2 ($\alpha = 0.88$).

Maternal proportion of time spent in the U.S. Maternal years in the U.S. have been used as a proxy measure for acculturation (e.g., Sussner et al., 2008). One study showed that more acculturated, Latina mothers engaged in less restrictive feeding than mothers born in the U.S. (Power et al., 2015). Maternal level of acculturation has also been related to increased risk for overweight in school-age youth (Elder et al., 2010). Therefore, mothers' proportion of time spent living in the U.S., calculated as a ratio of mother-reported years in the U.S. to age in years, was considered a proxy for acculturation and thus examined as a potential control variable.

Analytic Strategy

Data for the present study was analyzed using IBM SPSS Statistics 24. For questions 2 and 3, Hayes' (2013) PROCESS macro for SPSS (version 2.16) was used to estimate moderation models using Ordinary Least Squares (OLS) multiple regression. In each model, child BMI z-score was used as the dependent variable, and parental restrictive feeding was used as the independent variable. Specific moderator variables unique to questions 2 and 3 are presented below. Child sex, age, pubertal status, prior BMI z-score, child body image, economic stress, maternal BMI, maternal education level, family income, maternal monitoring, and maternal (proportion) of years in the U.S. were tested as control variables prior to conducting the main analyses. Conceptual diagrams of the models for questions 2 and 3 can be found in the Appendix.

Question 1. Does parental restrictive feeding predict BMI z-score concurrently and across time in Latino adolescents?

Analytic Plan 1. Three hierarchical regression analyses were conducted to test the hypothesis that there would be predictive associations between parental restrictive feeding and BMI z-score in Latino adolescents concurrently and across time. In Models 1 and 2, child BMI z-score measured at wave 1 (Model 1) and wave 2 (Model 2) was entered as the dependent variable. Control variables measured at corresponding waves were then entered at step 1 of each model. Then, parental restrictive feeding was entered at step 2 of each model to test it is a concurrent predictor of child BMI z-score at waves 1 and 2 above and beyond the controls.

In Model 3, child BMI z-score measured at wave 2 was entered as the dependent variable. Control variables measured at wave 1 were then entered at step 1. Then, parental restrictive feeding measured at wave 1 was entered at step 2 to test it as a significant predictor of child BMI z-score at wave 2 above and beyond the controls.

Question 2. Does executive functioning (EF) moderate the relation between parental restrictive feeding and BMI z-score in Latino adolescents?

Analytic Plan 2. Two separate multiple regression analyses were conducted to test the hypothesis that the relation between parental restrictive feeding and BMI z-score at wave 2 would be negative for adolescents with EF scores (i.e., cognitive flexibility and inhibitory control) below average and positive for those with scores above average. For each model (Models 4 and 5), bivariate correlations were examined first to check for multicollinearity between restrictive feeding and cognitive flexibility, as well as between restrictive feeding and inhibitory control. Following this, Model 1 of the PROCESS macro for SPSS was used. Parental restrictive feeding at wave 2 was centered at the grand mean by PROCESS and entered as the independent variable in each model. Grand mean centering was used to ensure that the regression coefficients would be interpretable and meaningful. Cognitive flexibility and inhibitory control at wave 2 were also grand mean centered and entered as the moderating variables. In turn, an interaction term was created by PROCESS for each model by multiplying together the mean-centered parental restrictive feeding and cognitive flexibility/inhibitory control variables. Then, child BMI z-score at wave 2 was entered as the dependent variable in each model. Finally, control variables were entered.

After running each of the regression models, evidence of moderation was evaluated by examining the statistical significance of the interaction term in each as well as the R^2 change after adding the interaction term to the model.

Question 3. Does effortful control moderate the relation between parental restrictive feeding and BMI z-score in Latino adolescents?

Analytic Plan 3. Model 6, another multiple regression analysis, was conducted to test the hypothesis that the relation between parental restrictive feeding at wave 1 and BMI z-score at wave 2 would be negative for adolescents with lower EC scores and positive for those with higher EC scores. Prior to this, bivariate correlations were examined to check for multicollinearity between parental restrictive feeding and EC. Model 1 of the PROCESS macro for SPSS was again used. Parental restrictive feeding measured at wave 1 was grand mean centered by PROCESS and entered as the independent variable. EC at wave 1 was also grand mean centered and entered as the moderating variable. In turn, an interaction term was created by PROCESS from the cross-products of the mean-centered parental restrictive feeding and EC variables. Following, child BMI z-score measured at wave 2 was entered as the dependent variable. Finally, control variables were entered into the model.

Upon running the regression, evidence of moderation was again evaluated by examining the statistical significance of the interaction term as well as the R^2 change after adding the interaction term to the model.

RESULTS

Preliminary Analyses

Prior to conducting the main analyses, the skewness and kurtosis of each variable were examined to check for the assumption of normality. In addition, scores that were at or beyond three standard deviations above or below the mean were considered outliers and removed from the data. In each wave, these included one DCCS score, one Flanker score, and two maternal BMI scores, as well as two maternal proportion of years in the U.S. in wave 1 (all more than three standard deviations above the mean). One maternal monitoring score in each wave was also more than three standard deviations below the mean. In addition, one child BMI z-score in wave 1 was also more than three standard deviations below the mean; however, given that skewness and kurtosis values were acceptable, this score was retained.

To assess the potential for confounding, bivariate correlations between potential control variables and key study variables were conducted. Results are presented in Tables 3 and 4. In sum, Table 3 shows that restrictive feeding at wave 1 was related to wave 1 maternal education level (r = -0.20, p = <.05) and maternal monitoring (r = 0.26, p < .01). Furthermore, child BMI z-score at wave 1 was related to child sex (r = -0.30, p < .01; boys had higher scores), body image (r = 0.67, p < .01), and maternal BMI (r = 0.34, p < .01). Similar correlations held between child BMI z-score at wave 2 and child sex (r = -0.27, p < .01), body image (r = 0.66, p < .01), and maternal BMI (r = 0.37, p < .01). Given these findings, control variables included in Models 1, 3, and 6 included child sex, wave 1 child body image (Model 1 only), wave 1 maternal BMI, wave 1 maternal education level, wave 1 maternal monitoring, and wave 1 child BMI z-score (Models 3 and 6).

In addition, Table 4 shows that restrictive feeding at wave 2 was not significantly related to any of the potential control variables. Child BMI z-score at wave 2, however, was related to child sex (mentioned above), wave 2 body image ($r = 0.80$, $p < .01$) and maternal BMI ($r = 0.41$, $p < .01$). However, after checking for violations of assumptions underlying regression analysis including homoscedasticity, linearity, independent and normally distributed residuals, and multicollinearity, both child body image and BMI z-score measured at wave 1 demonstrated consistently high variance inflation factors, indicating multicollinearity. To correct for this, child body image was not used as a control variable in any model that adjusted for wave 1 child BMI z-score (i.e., Models 2-6). Therefore, control variables included in Models 2, 4, and 5 included child sex, wave 2 maternal BMI, and wave 1 child BMI z-score.

Descriptives

Descriptive statistics for controls and key study variables are presented in Tables 1 and 2. Mothers reported a moderate level of restrictive feeding at wave 1 ($M = 3.13$, $SD = 0.87$) and wave 2 ($M = 3.01$, $SD = 0.85$) on average. In addition, youth had an average BMI z-score of 1.22 ($SD = 0.92$) at wave 1 and 1.21 ($SD = 0.97$) at wave 2. Youth also had modest EC scores on average at wave 1 ($M = 3.44$, $SD = 0.55$) and wave 2 ($M = 3.29$, $SD = 0.54$). In terms of EF, youth on average scored just below the national average on the DCCS, a measure of cognitive flexibility ($M = 95.27$, $SD = 16.80$), and approximately one standard deviation below the national average on the Flanker task, a measure of inhibitory control ($M = 84.51$, $SD = 14.21$).

In terms of bivariate correlations (Tables 3 and 4), parental restrictive feeding at wave 1 was related to child BMI z-score at wave 1 ($r = 0.27$, $p < .01$) and wave 2 ($r = 0.27$, $p < .01$). Restrictive feeding at wave 2 was also related to child BMI z-score at wave 2 ($r = 0.29$, $p < .01$).

Main Analyses

Question 1. Does parental restrictive feeding predict BMI z-score concurrently and across time in Latino adolescents?

Hypothesis 1a. Model 1 presented in Table 5 predicting child BMI z-score at wave 1 from parental restrictive feeding at wave 1 was significant, $F(6, 99) = 24.95$, $p < 0.001$, $R^2 = 0.60$. However, the relation between parental restrictive feeding at wave 1 and child BMI z-score at wave 1 was only marginally significant after accounting for child sex, body image, maternal BMI, education, and monitoring (b = 0.14, $p = 0.06$). For every 1-unit change in restrictive feeding, child BMI z-scores were .14 points higher. In contrast, Table 6 shows that while model 2 predicting child BMI z-score at wave 2 from parental restrictive feeding at wave 2 was significant, $F(4, 86) = 332.71$, $p < 0.001$, $R^2 = 0.94$, the relation between restrictive feeding and BMI z-score was not statistically significant after accounting for child sex, maternal BMI, and prior child BMI z-score (b = -0.04, $p = 0.25$). Therefore, this hypothesis was only partially supported.

Hypothesis 1b. Overall, Model 3 presented in Table 7 predicting child BMI z-score at wave 2 from parental restrictive feeding at wave 1 was also significant, $F(6, 75) = 192.21$, $p < 0.001$, $R^2 = 0.94$. However, parental restrictive feeding at wave 1 did not significantly predict child BMI z-score at wave 2 after accounting for child sex, maternal BMI, education, and monitoring, as well as wave 1 child BMI z-score (b = -0.03, $p = 0.43$). Consequently, this hypothesis was not supported.

Question 2. Does executive functioning (EF) moderate the relation between parental restrictive feeding and BMI z-score in Latino adolescents?

Hypothesis 2a. Overall, Model 4 presented in Table 8 predicting child BMI z-score at wave 2 from wave 2 parental restrictive feeding, cognitive flexibility (DCCS scores), and their interaction was significant, $F(6, 82) = 250.62$, $p < 0.001$, $R^2 = 0.94$. However, the interaction term, $b = -0.00$, $t(82) = -0.25$, $p = 0.80$, was not significant. This indicates that cognitive flexibility did not moderate the relation between parental restrictive feeding and child BMI z-score at wave 2; thus, this hypothesis was not supported.

Hypothesis 2b. Comparable to Model 4, Model 5 presented in Table 9 predicting child BMI z-score at wave 2 from wave 2 parental restrictive feeding, inhibitory control (Flanker scores), and their interaction was significant, $F(6, 82) = 282.78$, $p < 0.001$, $R^2 = 0.94$. However, the interaction term, $b = 0.00$, $t(82) = 0.44$, $p = 0.66$, was again not significant. This indicates that inhibitory control also did not moderate the relation between parental restrictive feeding and child BMI z-score at wave 2; thus, this hypothesis was not supported.

Question 3. Does effortful control (EC) moderate the relation between parental restrictive feeding and BMI z-score in Latino adolescents?

Hypothesis 3. As for Model 6, the overall model presented in Table 10 predicting child BMI z-score at wave 2 from wave 1 parental restrictive feeding, EC, and their interaction was significant, $F(8, 73) = 158.02$, $p < 0.001$, $R^2 = 0.94$. However, the interaction term was not, $b = -0.04$, $t(73) = -0.57$, $p = 0.57$. This indicates that EC did not moderate the relation between parental restrictive feeding at wave 1 and child BMI z-score at wave 2. Therefore, this hypothesis was not supported.

DISCUSSION

Parental feeding practices have been identified as potential risk factors for the development of child and adolescent obesity (Cardel et al., 2012; Loth et al., 2013). In particular, overtly-controlling feeding practices like restrictive feeding have received attention primarily out of concern that being too controlling could undermine the development of children's self-regulation skills in the context of eating (Harrist et al., 2012). For adolescents, there has also been concern that restrictive feeding may contribute to unhealthy, weight control behaviors such as disordered eating (Loth, MacLehose, Fulkerson, Crow, & Neumark-Sztainer, 2014). However, little is known about the prevalence of restrictive feeding in Latino families, specifically that which is directed toward older youth, as well as if restrictive feeding is associated with weight outcomes for Latino adolescents (Tschann et al., 2015). Furthermore, there is limited understanding of the role youth self-regulation may play in the direction of the effect restrictive feeding has on weight outcomes among Latino youth.

These limitations in the current parental feeding literature represent important gaps to fill for several reasons. One reason is that Latino youth have been disproportionately affected by childhood obesity (Ogden et al., 2016); thus, it is important to identify factors that can help explain this disparity, factors which may be different from those that account for weight outcomes among youth of other racial/ethnic backgrounds. Another reason is that Latino families traditionally place importance on parental control (Halgunseth et al., 2006), which could manifest in controlling feeding practices such as restrictive feeding. Moreover, although parental feeding research has naturally centered on younger children, parental feeding practices remain relevant for older youth, especially considering that parents' concerns about weight might not surface until their children reach adolescence (Nickelson et al., 2012). Finally, since youth with poorer self-regulation may need to rely on external cues to regulate their eating behavior (Savage et al., 2007), their weight may be positively affected by parental restrictive feeding. For youth with better self-regulation skills, however, parental restrictive feeding may have negative impacts on weight by potentially undermining their ability to regulate their own eating and inciting preoccupation with restricted foods. Therefore, the present study aimed to address these gaps by broadly exploring the relation between parental restrictive feeding and BMI z-score in a sample of Latino adolescents residing in the Midwest. EF skills (i.e., cognitive flexibility and inhibitory control) and EC were also tested as moderators of this relation.

Parental Restrictive Feeding of Latino Adolescents

On average, mothers reported only modest levels of restrictive feeding of their adolescent children at waves 1 and 2. Although average levels were expected to be slightly higher given the value traditionally placed on parental control in Latino families as mentioned earlier (Halgunseth et al., 2006), they are generally consistent with levels previously reported by parents of adolescents (Loth et al., 2013). Mothers in the present study may generally feel that restrictively feeding their adolescent children is unnecessary. In other words, mothers may think that their adolescent children do not need them to monitor or regulate their intake of palatable foods to prevent overeating. Therefore, modest average levels of restrictive feeding could indicate mothers' confidence in their adolescent children's abilities to regulate their own eating of palatable foods.

It's also important to consider how mothers' engagement in restrictive feeding may be attributable to the context within which families are situated. Low family income and low maternal education level on average suggest that the majority of adolescents reside in low-SES home environments, which may contribute to increased susceptibility for obesity (Frederick et al., 2014) and consequent engagement in parental restrictive feeding out of concern for child's weight (Costanzo & Woody, 1985; Nickelson et al., 2012). Other scholars have suggested that low-SES parents may also be motivated to restrictively feed their children if they are concerned about food shortages in the home (Ruzicka, Darling, Fahrenkamp, & Sato, 2018). Interestingly, however, 78% of families in wave 1 and 63% of families in wave 2 were considered food secure. This may be one explanation for the overall modest levels of restrictive feeding reported by mothers.

Related to food security, mothers' acculturation may also have played a role in their modest engagement in restrictive feeding. Buscemi and colleagues (2011) found that increased acculturation was associated with greater food security in a sample of Latina mothers. Given that mothers in the present study had lived in the U.S. for approximately 16 years on average, it's also possible that they may value autonomy more than interdependence as a function of having spent considerable time living in the U.S. and being exposed to mainstream, U.S. values (Halgunseth et al., 2006). In turn, mothers' intentions to socialize their children to be independent could manifest in modest engagement in restrictive feeding.

Relations with BMI z-score. Within and across study waves, mothers who reported higher levels of restrictive feeding also had adolescents with higher BMI z-scores. Interestingly, however, after accounting for relevant child and mother demographics, restrictive feeding was only concurrently (and marginally) predictive of child BMI z-score, and this positive relation only held at wave 1. Restrictive feeding was not predictive of child BMI z-score approximately one year later. These findings partially align with the work of Tschann and colleagues (2013, 2015) and Penilla and colleagues (2017) who found parental restrictive feeding to be positively predictive of concurrent BMI in a sample of 8-10-year-old Latino adolescents. However, the lack of significant relations at wave 2 and across time could be tied to child age and maturation. By wave 2, more than half of participating youth were in seventh grade. Mothers also reported slightly less restrictive feeding on average compared to wave 1, despite BMI z-scores remaining stable. Given that youth tend to experience an increase in independent eating occasions by middle-school (Reicks et al., 2015), parents may have fewer opportunities to engage in restrictive feeding after elementary school. Consequently, youth in wave 2 may have been less exposed or susceptible to parental restrictive feeding compared to those in wave 1. In turn, parental restrictive feeding in Latino families may be most prevalent and meaningful for weight outcomes prior to the middle-school transition.

Interactions with executive functioning skills and effortful control. The generally weak association between parental restrictive feeding and BMI in adolescents seen in current literature prompted identification of moderators that could better explain the strength of the association in terms of who might be most affected by parental restrictive feeding (Wu & Zumbo, 2008). Theory and previous research have suggested that possessing poor self-regulation skills might predispose youth to obesity (Harrison et al., 2011; Reinert, Po'e, & Barkin, 2013). The Obesity Proneness Model also suggests that poor self-regulation skills may deter parents from allowing their children behavioral autonomy (Costanzo & Woody, 1985). Therefore, if parents recognize self-regulation deficits, it's possible that they may be more inclined to intervene using restrictive feeding. What might follow then is restrictive feeding being predictive of lower BMI z-score only for youth who exhibit below-average self-regulation skills.

In efforts to test conditional effects of parental restrictive feeding, the EF skills of cognitive flexibility and inhibitory control as well as the temperament-based construct of EC were individually tested as moderators. It was anticipated that restrictive feeding would be a negative predictor of BMI z-score for youth who were less cognitively flexible and had poorer inhibitory control, as well as poorer EC. Contrary to expectations, however, there was no evidence of moderation by cognitive flexibility, inhibitory control, or EC.

Some reasons for the lack of significant findings may be related to study design such as insufficient power to detect moderation effects. The control variables of child sex and body image accounted for sizeable amounts of variance in BMI z-score at wave 1, while prior BMI z-score explained most of the variance in BMI z-score at wave 2. Therefore, the expected R^2 change (i.e., effect size) upon adding the interaction terms to each regression model was small and thus might have required a larger sample of youth to be detected. Another reason may be lack of temporal precedence. Cognitive flexibility and inhibitory control were measured at the same time as BMI z-scores in wave 2, though EC was measured approximately one year prior. Beyond methodological reasons, the role of a moderator according to Wu and Zumbo (2008) is to explain the strength or direction of the effect of an independent variable. Consequently, the lack of significant moderation by any of the three self-regulation markers tested suggests that other child attributes or even contextual factors may be more relevant.

Strengths and Limitations

Despite a lack of support for most of the tested hypotheses, the present study had a considerable number of strengths. First, to the author's knowledge, the present study is novel in its attempts to examine conditional effects of parental restrictive feeding on BMI z-score in a sample of Latino adolescents. Latino adolescents reflect a growing Latino population in the U.S. that remains understudied in the parental feeding literature, which may be attributable to common difficulties with recruitment and retention of Latino families in research (Haack, Gerdes, & Lawton, 2014). More specifically, families were drawn from the Midwestern U.S. The Midwest has experienced considerable growth in Latino populations (Conger, Reeb, & Chan, 2016), but has received less attention in research on Latino families compared to the Southwestern areas of the U.S., which encompass the “gateway states” for immigrant families including Texas, California, and Arizona (Ramos, Su, Lander, & Rivera, 2015). Second, measurement of key study variables utilized mothers and youth as informants along with objective measures, which add to the reliability of study findings and help to eliminate shared method variance as a source of measurement error. Third, the study examined both contemporaneous and across-time associations between restrictive feeding and child BMI z-score to better approximate potential direction of effects.

Alongside these strengths, however, the present study must also be considered in the context of several methodological limitations. For example, the study design being a longitudinal, cross-sectional survey precluded establishment of temporal precedence for all independent variables and conclusion of causality in the restrictive feeding-BMI z-score relation. As mentioned earlier, the study’s small sample size may have also undermined statistical power to detect hypothesized effects. Furthermore, other potential confounding factors exist that could not be included in the regression models. For example, both parental restrictive feeding and child BMI z-score could be driven by youth sport participation, particularly in weight-dependent sports that require youth to have lean body compositions (Van Durme, Goossens, & Braet, 2012); however, data on sport participation was not collected, and thus could not be accounted for in the present study. Finally, parental restrictive feeding was measured using mothers’ responses on an 8-item subscale of the Child Feeding Questionnaire (CFQ; Birch et al., 2001). An alternate measure of parental restrictive feeding designed exclusively for use with adolescents may have been more relevant for the present sample. In addition, other researchers have raised concerns that the CFQ captures only a limited range of feeding practices used by Latino parents (Tschann et al., 2013), which could contribute to lack of measurement invariance in parental restrictive feeding across studies. This may have had implications for variability in mothers' responses, as well as construct validity.

Future Directions

Despite parental restrictive feeding being only a marginally significant positive predictor of child BMI z-score in the present study, it may be premature to renounce it as a meaningful contributor to obesity in Latino adolescents. Future research in this area would benefit from methodological improvements including longitudinal study designs that incorporate larger sample sizes and more culturally-specific measures of parental restrictive feeding. For example, the Parental Feeding Practices measure (Tschann et al., 2013) used in Tschann and colleagues' (2015) longitudinal study was developed for exclusive use with Latino samples. This measure incorporates modified items from the Restriction subscale of the CFQ (Birch et al., 2001), but also excludes items that tap into use of food as a reward. This is consistent with previous research that suggests Latino parents may not interpret use of food as a reward as a form of restrictive feeding (Anderson, Hughes, Fisher, & Nicklas, 2005). Furthermore, measurement of EC may be enhanced by combining mother and youth reports, given previous research has suggested that multiple informants may be necessary for truly capturing adolescent EC (Snyder et al., 2015) To improve future statistical models, controlling for more potential confounders of the restrictive feeding-BMI association by design may help to eliminate the need for inclusion of a large number of covariates in the models. For example, the regression models in the present study could be conducted separately for boys and girls. Relatedly, re-examining the wave 2 regression models in the present study without wave 1 child BMI z-score as a covariate may reveal effects of restrictive feeding that were otherwise obscured.

Comparing frequency of parental restrictive feeding in the present study sample to restrictive feeding evidenced in other studies of Latino adolescents (e.g., Matheson et al., 2006) would also provide more insight into the prevalence of restrictive feeding practices in this population. Consideration of additional moderators that may condition the effect of restrictive feeding might also be of merit. For example, finding that the predictive nature of restrictive feeding for BMI z-score did not extend beyond wave 1 when youth ranged in age from 10-12 suggests that the effect of restrictive feeding for Latino youth may be moderated by child age. In addition, although this was beyond the scope of the present study, it will be particularly important to explore potential moderation by child sex, given that Latino boys tend to be more impacted by obesity than Latina girls (Isasi et al., 2016). Latina mothers have been shown to use less restriction with young girls than young boys (Silva et al., 2016). Finally, the relation between parental restrictive feeding and adolescent weight outcomes is most likely bi-directional. Although restrictive feeding may positively predict weight status, the Obesity Proneness Model posits that parental concerns about child weight likely drive restrictive feeding (Costanzo & Woody, 1985). Therefore, future research would also benefit from the use of a cross-lagged panel model to test for significant bi-directional associations.

CONCLUSION

In sum, the present study expanded on the work of previous researchers (Penilla et al., 2017; Tschann et al., 2013, 2015) by providing evidence of moderate use of restrictive feeding by mothers of Latino adolescents residing in the Midwest. In turn, restrictive feeding played a small role in explaining child BMI z-score when youth were in fifth and sixth grade. These limited findings provide considerable space for new questions to be explored regarding the conditions under which restrictive feeding has an effect on the weight outcomes of Latino adolescents, as well as for whom restrictive feeding is most impactful. Continuing this line of research could reveal novel, modifiable determinants of obesity for Latino adolescents that could ultimately serve as points of intervention.

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APPENDIX

Table 1

Descriptive Statistics for Wave 1 Variables

Variable	*N*	*M*	*SD*	*Min.*	*Max.*	*Skewness*	*Kurtosis*
Controls							
Child age	119	11.54	0.68	10.07	12.86	-0.29	-0.74
Pubertal status	118	1.97	0.46	1.00	3.40	0.78	0.94
Child body image	117	4.67	0.89	3.00	7.00	0.19	0.08
Economic stress	119	0.62	1.18	0.00	7.00	2.80	10.01
Maternal BMI	110	31.53	5.73	21.69	50.71	0.80	0.83
Maternal education level	117	2.48	1.48	1.00	7.00	0.79	-0.20
Family income	108	5.06	2.76	1.00	13.00	0.42	-0.48
Maternal monitoring	118	4.63	0.46	3.00	5.00	-1.51	1.80
Maternal proportion of years in U.S.	104	0.43	0.13	0.03	0.84	0.25	2.22
Predictors and Outcome							
Restrictive feeding	119	3.13	0.87	1.00	5.00	-0.58	0.05
Child BMI z-score	118	1.22	0.92	-1.61	2.72	-0.62	-0.19
Effortful control (EC)	119	3.44	0.55	2.38	5.00	0.50	-0.03

Note. N = 119

Table 2

Descriptive Statistics for Wave 2 Variables

Variable	*N*	*M*	*SD*	*Min.*	*Max.*	*Skewness*	*Kurtosis*
Controls							
Child age	101	12.63	0.65	11.17	13.79	-0.56	-0.36
Pubertal status	100	2.35	0.54	1.20	3.40	-0.12	-0.81
Child body image	100	4.68	0.96	3.00	6.00	-0.15	-0.94
Economic stress	101	0.60	1.30	0.00	10.00	4.39	26.96
Maternal BMI	95	31.81	5.75	21.45	51.45	0.96	1.35
Maternal education level	99	2.56	1.55	1.00	7.00	0.71	-0.47
Family income	87	5.44	2.92	1.00	14.00	0.29	-0.31
Maternal monitoring	100	4.56	0.62	2.40	5.00	-1.79	3.09
Predictors and Outcome							
Restrictive feeding	97	3.01	0.85	1.00	4.63	-0.27	-0.48
Child BMI z-score	98	1.21	0.97	-1.36	2.83	-0.50	-0.62
Cognitive flexibility (DCCS)	99	95.27	16.80	61.00	141.00	0.20	-0.21
Inhibitory control (Flanker)	99	84.51	14.21	61.00	129.00	1.06	0.84
Effortful control (EC)	100	3.29	0.54	2.13	4.60	0.49	0.30

Note. N = 101; DCCS = Dimensional Change Card Sort task

Table 3

Bi-Variate Correlations between Wave 1 Potential Control Variables, Wave 1 Predictors, and Waves 1 and 2 Child BMI Z-Score

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Child sex	-												
2. Child age	-0.04	-											
3. Child body image	0.03	0.19*	-										
4. Economic stress	0.02	-0.07	0.03	-									
5. Maternal BMI	-0.01	-0.02	0.31**	0.01	-								
6. Maternal education level	0.02	0.02	-0.13	-0.04	-0.06	-							
7. Family income	-0.12	0.14	0.03	-0.19	-0.20	0.28**	-						
8. Maternal monitoring	0.10	-0.11	-0.01	0.05	0.01	-0.12	-0.01	-					
9. Maternal proportion of years in U.S.	-0.08	0.25**	0.12	0.09	-0.02	0.13	0.34**	-0.26**	-				
10. Restrictive feeding	-0.17	-0.05	0.16	-0.01	0.06	-0.20*	0.08	0.26**	-0.06	-			
11. Effortful control	0.09	-0.01	-0.04	-0.30**	0.06	0.11	0.05	-0.06	-0.05	-0.17	-		
12. W1 BMI z-score	-0.30**	0.12	0.67**	0.06	0.34**	-0.07	0.02	-0.06	0.12	0.27**	-0.04	-	
13. W2 BMI z-score	-0.27**	0.12	0.66**	0.01	0.37**	-0.03	0.04	-0.07	0.15	0.27**	0.05	0.97**	-

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$

Table 4

Bi-Variate Correlations between Wave 2 Potential Control Variables, Wave 2 Predictors, and Wave 2 Child BMI Z-Score

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Child sex	-												
2. Child age	-.01	-											
3. Pubertal status	.19	.28**	-										
4. Child body image	-.16	.14	-.03	-									
5. Economic stress	.05	.11	.10	.08	-								
6. Maternal BMI	-.07	-.15	-.19	.31**	-.06	-							
7. Maternal education level	-.02	.01	.07	-.08	.14	-.12	-						
8. Family income	-.04	.07	.22*	-.13	-.05	-.22	.25*	-					
9. Maternal monitoring	-.03	-.04	-.09	-.09	-.41**	.08	-.04	.07	-				
10. Restrictive feeding	-.16	-.10	-.07	.20	-.06	.17	-.09	-.21	.16	-			
11. Cognitive flexibility (DCCS)	.09	.06	-.01	.04	-.10	.00	-.03	-.02	-.03	-.03	-		
12. Inhibitory control (Flanker)	-.08	-.30**	-.22*	-.09	-.17	-.05	.06	.06	.02	.12	.50**	-	
13. W2 BMI z-score	-.27**	.11	.02	.80**	.00	.41**	-.03	-.14	-.04	.29**	.12	-.13	-

Note. DCCS = Dimensional Change Card Sort task; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 5

Hierarchical Regressions Predicting Wave 1 Child BMI Z-Score from Wave 1 Parental Restrictive Feeding

Predictor	Step 1				Step 2			
	B	*SE B*	β	sr^2	*B*	*SE B*	β	sr^2
Child sex	-0.62***	0.12	-0.33	0.11	-0.57***	0.12	-0.31	0.09
W1 Body image	0.67***	0.07	0.62	0.35	0.64***	0.07	0.59	0.31
W1 Maternal BMI	0.02*	0.01	0.15	0.02	0.03*	0.01	0.15	0.02
W1 Maternal education	0.00	0.04	0.00	0.00	0.02	0.04	0.03	0.00
W1 Maternal monitoring	-0.07	0.14	-0.03	0.00	-0.15	0.14	-0.07	0.00
W1 Restrictive feeding (RF)					0.14+	0.07	0.14	0.02
R^2 (Adjusted R^2)	0.59 (0.57)				0.60 (0.58)			
RF change in R^2					0.02 (p = 0.06)			

Note. N = 119; *B* = unstandardized regression coefficients; *SE B* = estimates of standard errors based on *B*; β = standardized regression coefficients; sr^2 = square of the semi-partial correlation coefficients; Control variables included child sex, wave 1 body image, maternal BMI, maternal education level, and maternal monitoring; $+p < 0.1$, $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Table 6

Hierarchical Regressions Predicting Wave 2 Child BMI Z-Score from Wave 2 Parental Restrictive Feeding

Predictor	Step 1				Step 2			
	B	*SE B*	*β*	sr^2	*B*	*SE B*	*β*	sr^2
Child sex	0.05	0.06	0.03	0.00	0.04	0.06	0.02	0.00
W2 Maternal BMI	0.01+	0.01	0.05	0.00	0.01+	0.01	0.05	0.00
W1 Child BMI z-score	0.96***	0.03	0.96	0.72	0.97***	0.03	0.97	0.67
W2 Restrictive feeding (RF)					-0.04	0.03	-0.03	0.00
R^2 (Adjusted R^2)	0.94 (0.94)				0.94 (0.94)			
RF change in R^2					0.00 (p = 0.25)			

Note. N = 101; *B* = unstandardized regression coefficients; *SE B* = estimates of standard errors based on *B*; *β* = standardized regression coefficients; sr^2 = square of the semi-partial correlation coefficients; Control variables included child sex, W2 maternal BMI, and wave 1 child BMI z-score; +$p < 0.1$, *$p < 0.05$,**$p < 0.01$, ***$p < 0.001$.

Table 7

Hierarchical Regressions Predicting Wave 2 Child BMI Z-Score from Wave 1 Parental Restrictive Feeding

Predictor	Step 1				Step 2			
	B	*SE B*	*β*	sr^2	*B*	*SE B*	*β*	sr^2
Child sex	0.04	0.06	0.02	0.00	0.02	0.06	0.01	0.00
W1 Maternal BMI	0.01	0.01	0.05	0.00	0.01	0.01	0.05	0.00
W1 Maternal education	0.04*	0.02	0.06	0.00	0.03+	0.02	0.06	0.00
W1 Maternal monitoring	-0.07	0.07	-0.03	0.00	-0.06	0.07	-0.03	0.00
W1 Child BMI z-score	0.95***	0.03	0.96	0.69	0.96***	0.03	0.97	0.64
W1 Restrictive feeding (RF)					-0.03	0.04	-0.03	0.00
R^2 (Adjusted R^2)	0.94 (0.93)				0.94 (0.93)			
RF change in R^2					0.00 (p = 0.43)			

Note. *N* = 97; *B* = unstandardized regression coefficients; *SE B* = estimates of standard errors based on *B*; *β* = standardized regression coefficients; sr^2 = square of the semi-partial correlation coefficients; Control variables included child sex, wave 1 maternal BMI, maternal education level, maternal monitoring, and child BMI z-score; +p < 0.1, *p < 0.05, **p < 0.01, ***p < 0.001.

Table 8

Hierarchical Regression Predicting Wave 2 Child BMI Z-Score from Wave 2 Parental Restrictive Feeding, Cognitive Flexibility, and their Product

Predictor	*B*	*SE B*	*p*
Child sex	0.05	0.06	0.44
W2 Maternal BMI	0.01	0.01	0.09
W1 Child BMI z-score	0.97	0.03	< 0.001
W2 Restrictive feeding (RF)	-0.04	0.04	0.36
W2 Cognitive flexibility (DCCS)	0.00	0.00	0.97
RF x DCCS	0.00	0.00	0.80
R^2	0.94		0.94
Interaction change in R^2			0.00 (p = 0.80)

Note. N = 97; B = unstandardized regression coefficients; $SE\ B$ = estimates of standard errors based on HC3 estimator; DCCS = Dimensional Change Card Sort task; Restrictive feeding and cognitive flexibility were mean centered to ensure parameter estimates were within the range of the data. Control variables included child sex, wave 2 maternal BMI, and wave 1 child BMI z-score.

Table 9

Hierarchical Regression Predicting Wave 2 Child BMI Z-Score from Wave 2 Parental Restrictive Feeding, Inhibitory Control, and their Product

Predictor	*B*	*SE B*	*p*
Child sex	0.02	0.06	0.70
W2 Maternal BMI	0.01	0.01	0.06
W1 Child BMI z-score	0.97	0.03	< 0.001
W2 Restrictive feeding (RF)	-0.03	0.04	0.42
W2 Inhibitory control (Flanker)	0.00	0.00	0.22
RF x Flanker	0.00	0.00	0.66
R^2	0.94		0.94
Interaction change in R^2			0.00 (p = 0.66)

Note. N = 97; *B* = unstandardized regression coefficients; *SE B* = estimates of standard errors based on HC3 estimator; Restrictive feeding and inhibitory control were mean centered to ensure parameter estimates were within the range of the data. Control variables included child sex, wave 2 maternal BMI, and wave 1 child BMI z-score.

Table 10

Hierarchical Regression Predicting Wave 2 Child BMI Z-Score from Wave 1 Parental Restrictive Feeding, Effortful Control, and their Product

Predictor	*B*	*SE B*	*p*
Child sex	0.02	0.07	0.74
W1 Maternal BMI	0.01	0.01	0.23
W1 Maternal education	0.03	0.02	0.12
W1 Maternal monitoring	-0.04	0.08	0.60
W1 Child BMI z-score	0.96	0.04	< 0.001
W1 Restrictive feeding (RF)	-0.02	0.05	0.67
W1 Effortful control (EC)	0.02	0.06	0.70
RF x EC	-0.04	0.06	0.57
R^2	0.94		0.94
Interaction change in R^2			0.00 ($p = 0.57$)

Note. $N = 97$; *B* = unstandardized regression coefficients; *SE B* = estimates of standard errors based on HC3 estimator; Restrictive feeding and effortful control were mean centered to ensure parameter estimates were within the range of the data. Control variables included child sex, wave 1 maternal BMI, maternal education level, maternal monitoring, and child BMI z-score.

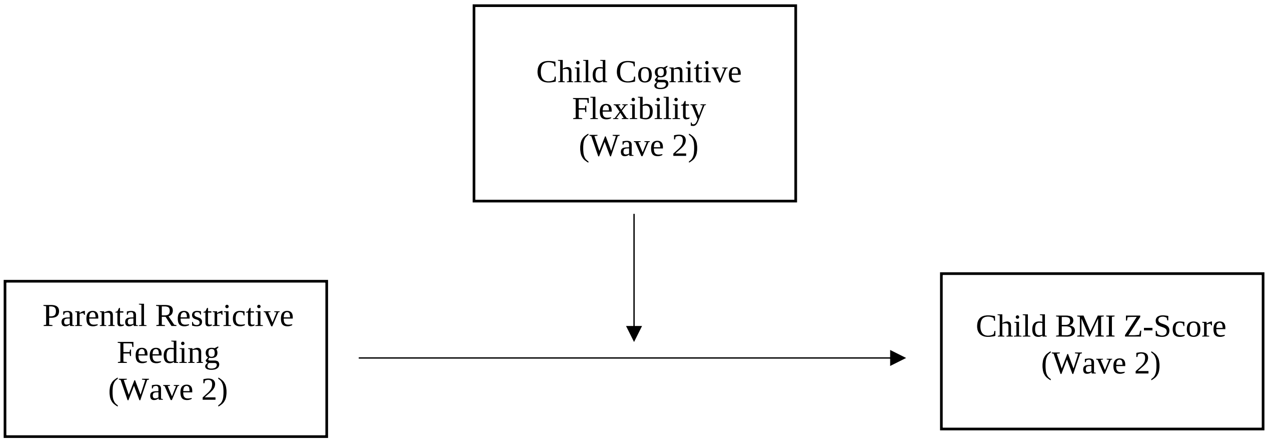

Figure 1. Conceptual diagram of moderation model for hypothesis 2a. Child sex, wave 1 BMI z-score, and wave 2 maternal BMI were included as control variables.

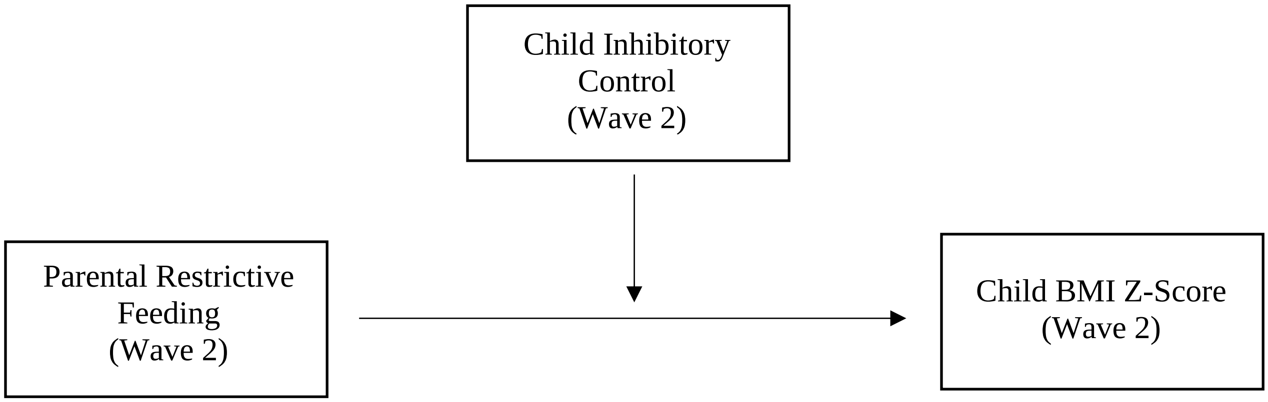

Figure 2. Conceptual diagram of moderation model for hypothesis 2b. Child sex, wave 1 BMI z-score, and wave 2 maternal BMI were included as control variables.

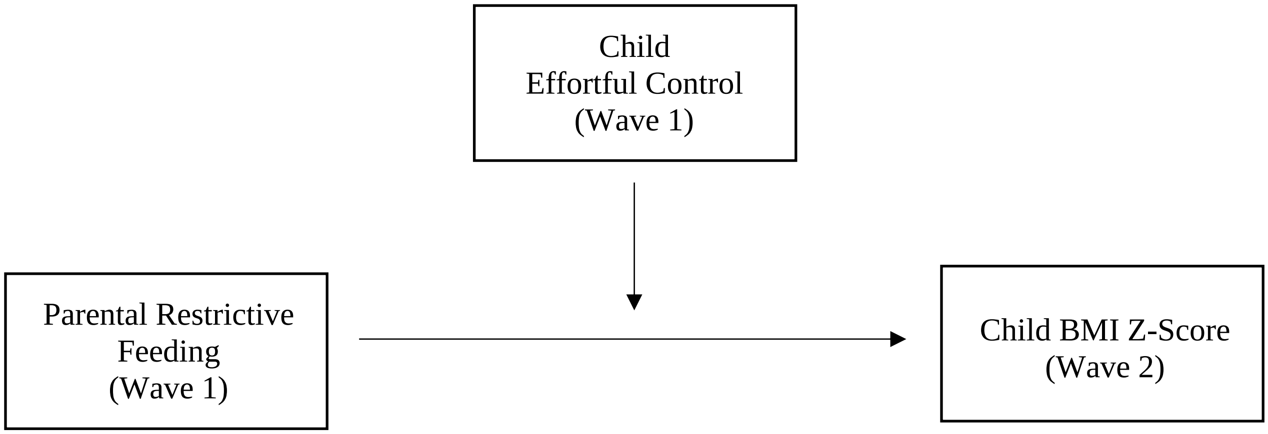

Figure 3. Conceptual diagram of moderation model for hypothesis 3. Child sex, wave 1 BMI z-score, wave 1 maternal BMI, wave 1 maternal education level, and wave 1 maternal monitoring were included as control variables.