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Appetitive Traits and Weight in Children: Evidence for Parents' Controlling Feeding Practices as Mediating Mechanisms

Zhiqing Zhou^a, Jeffrey Liew^a, Yu-Chen Yeh^a, Marisol Perez^b

^aTexas A&M University

^bArizona State University

Abstract

Children's food approach and food avoidance are appetitive traits with genetic or biological bases. Nonetheless, parents play a critical role in children's dietary intake through parenting and feeding practices. The present study tested parents' controlling feeding practices (i.e., restriction and pressure to eat) as mediating mechanisms between child appetitive traits and child BMI in an economically and ethnically diverse sample. Participants were 139 children aged 4 to 6 years (51.8% males, $M = 4.77$ years, $SD = 0.84$) and their parents. Results showed that restriction and pressure to eat mediated the relation between child food approach or food avoidance and child BMI. Mediation effects did not differ across poverty status or ethnic groups. Also, the type of controlling feeding that parents exert related to children's weight status in diametrically different or opposite ways. Thus, food-related parenting appears to be a promising point of entry for childhood obesity prevention programs. Findings are consistent with a biopsychosocial model of the development of eating and weight in childhood which takes into account both parent and child behavior and characteristics and links child biology and behavior with psychosocial processes and environment.

Keywords

appetite; feeding practices; restriction; pressure to eat; eating behaviors; childhood obesity

Introduction

Pediatric obesity is a public health concern that poses serious threat and risk to children's health, life satisfaction, and life expectancy (Ogden, Carroll, Kit, & Flegal, 2014; Skinner, Perrin, & Skelton, 2016). Previous research have identified multiple modifiable risk factors associated with severe pediatric obesity (Porter et al., 2018), with parents' feeding practices and child eating behaviors as two such factors that directly contribute to childhood obesity

Correspondence concerning this article should be addressed to Jeffrey Liew, Department of Educational Psychology, Texas A&M University, College Station, TX 77845. jeffrey.liew@tamu.edu. Office phone: (979) 845-1239.
Zhiqing Zhou, M.Ed., Texas A&M University, 4225 TAMU, College Station, Texas 77843
Jeffrey Liew, PhD, Texas A&M University, 4225 TAMU, College Station, Texas 77843
Yu-Chen Yeh, PhD, Texas A&M University, 4225 TAMU, College Station, Texas 77843
Marisol Perez, PhD, Arizona State University, Tempe, AZ 85287

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or overweight (Farrow, Haycraft, & Blissett, 2015). Parents' feeding practices can be influential for young children's development of eating habits, because young children rely on their parents or caregivers for feeding and dietary intake (Bergmeier, Skouteris, Horwood, Hooley, & Richardson, 2014; Farrow et al., 2015). However, children are not passive participants in their environments. As early as in infancy, children's early expressions of appetitive traits are evident and exert influence on their eating behaviors, which further impact their interactions with their parents or caregivers and their weight trajectories (Carnell, Benson, Pryor, & Driggin, 2013). According to Russell and Russell's (2019) biopsychosocial model of the development of children's eating and weight, child biological foundations (e.g., appetitive traits) are assumed to influence parental cognitions, expectations, and interpretations in addition to parents' reactions or behaviors such as parents' feeding styles and practices. Guided by a biopsychosocial perspective on the development of children's eating and weight, we test parent controlling feeding practices as mediating mechanisms by which child appetitive traits have influence on child weight status.

Family demographic or ethnocultural factors are also critical in understanding childhood obesity because the prevalence and severity of obesity differ across socioeconomic status (SES) and ethnic groups. Growing up in low-income communities or poverty are risk factors for pediatric obesity (Shrewsbury & Wardle, 2008), and ethnic minority children are at particularly high risk (Ogden et al., 2014; Skinner et al., 2016). Thus, in the present study we test our research questions in an economically and ethnically diverse sample of 4- to 6-year-old children.

Child Appetitive Traits: Food Approach and Avoidance

Children's eating styles or appetitive traits can be broadly characterized as approach and avoidant tendencies toward foods (Webber, Cooke, Hill, & Wardle, 2010). *Food approach* refers to attentional, affective, and behavioral reactions toward palatable foods or drinks as well as consuming foods or drinks to feel comfort or to reduce distress. *Food avoidance* refers to attentional, affective, and behavioral reactions toward eating or drinking due to hypersensitivity to satiety cues, fussiness, or distress (e.g., eat less or drink slowly). Studies found that children's genetic dispositions can explain about 17% to 43% of these appetitive traits (Dubois et al., 2013; also see Wood, 2018). Appetitive traits at 3 months of age have been linked to subsequent weight gain 6 months later. Further, associations between appetitive traits and subsequent weight were stronger than between weight and subsequent appetite, which suggests that appetitive traits are precursors to weight status (van Jaarsveld, Llewellyn, Johnson, & Wardle, 2011).

Importantly, food approach and avoidance are two risk factors of pediatric obesity (Carnell & Wardle, 2008). Food avoidance tendencies (such as food fussiness and slowness in eating) have been linked to low child weight, while food approach tendencies (such as food responsiveness, enjoyment of food, and emotional overeating) have been linked to child weight gain, after controlling for age, sex, ethnicity and SES (Webber, Hill, Saxton, Van Jaarsveld, & Wardle, 2009). A possible mechanism by which children's appetitive traits may impact their weight status is through their eating behaviors. For example, children's fussiness, food responsiveness, and enjoyment of food could predispose them to food

preferences and eating habits that, over time, could have positive or negative impacts on their health and weight (Russell & Worsley, 2016).

Controlling Parental Feeding Practices: Pressure to Eat and Restrictive Feeding

During early childhood, parents play a critical role in children's dietary intake because children are highly reliant on parents on the types and amounts of food they eat (Larsen et al., 2015). In the literature, pressure to eat and restrictive feeding are two prominently studied parents' feeding or food parenting practices (Wehrly, Bonilla, Perez, & Liew, 2014). *Pressure to eat* refers to parents' encouragement of eating, while *restrictive feeding* refers to parents' control over their children's consumption of food, especially sugary or high-fat food (Ventura & Birch, 2008). Restrictive feeding needs to be differentiated from positive structure-oriented feeding. While parents exert some control over their children's eating behaviors in both restrictive and structure-oriented feeding, restrictive feeding is coercive and intrusive while structure-oriented feeding allows children the autonomy or choice to have a reasonable amount of palatable foods instead of restricting or banning it (Rollins, Savage, Fisher, & Birch, 2016).

A sizable body of research shows that controlling parental feeding practices are linked to child weight, but the relations between these feeding practices and child weight remain complex and the research findings have been somewhat mixed (Shloim, Edelson, Martin, & Hetherington, 2015; Ventura & Birch, 2008). The majority of studies found that pressure to eat was related to lower child BMI while restrictive feeding was related to higher child BMI (Hurley, Cross, & Hughes, 2011; P. W. Jansen et al., 2014; Keller, Pietrobelli, Johnson, & Faith, 2006; Nowicka, Sorjonen, Pietrobelli, Flodmark, & Faith, 2014; Rodgers et al., 2013). For example, in a longitudinal study Faith et al. (2004) found that restriction predicted higher, while pressure to eat predicted lower, weight status, even when controlling for children's initial weight status.

A limited number of longitudinal studies has been conducted to examine the nature and direction of influence between child appetitive traits and controlling parental feeding practices. In a study on 2-year-old children, Rodgers et al. (2013) found that child food approach predicted less maternal instrumental feeding one year later. Studies have also shown that controlling parental feeding practices can predict child appetitive traits. Parental restrictive feeding at two years is predictive of increased child satiety responsiveness more than one year later (E. Jansen, Mallan, & Daniels, 2015), and parental emotional feeding at two years is predictive of increased child overeating and food responsiveness (Rodgers et al., 2013). In addition, several longitudinal studies have confirmed reciprocal relations between child appetitive traits and controlling parental feeding practices in early childhood (Kidwell, Kozikowski, Roth, Lundahl, & Nelson, 2018; P. W. Jansen et al., 2017; Steinsbekk, Barker, Llewellyn, Fildes, & Wichstrøm, 2017).

The Present Study

While prior research has documented bidirectional relations between parental controlling feeding practices and child appetitive traits, the processes or mechanisms by which child appetitive traits and/or controlling parental feeding practices transmit influence on child

weight remain unclear, particularly amongst economically and ethnically diverse families. The present study addresses this research gap by testing controlling parental feeding practices (pressure to eat and restrictive feeding) as mediating mechanisms by which child appetitive traits (food approach and food avoidance) are linked to child weight in an economically and ethnically diverse sample of 4- to 6-year-old children. Our hypothesized mediation model is based on two scientific premises. First, child appetitive traits are influenced by genetic dispositions and are evident as early as infancy (Dubois et al., 2013; Wood, 2018). Second, we test controlling parental feeding practices as mediating mechanisms between child appetitive traits and child weight, because parents' feeding practices are behaviors that are modifiable (Birch & Ventura, 2009). We also tested whether the paths in our hypothesized mediation model would differ across income and ethnic (Hispanic and Non-Hispanic) groups.

Method

Study participants

Participants were 139 children aged 4 to 6 years old (51.8% males, $M = 4.77$ years, $SD = 0.84$) and their parents (majority biological mothers). The majority of parents ($n = 82$, 58.7%) reported a monthly household income of \$3,000 or below, and 9 parents (6.5%) reported a monthly household income above \$9,000. Using persons per household and monthly household income data and the U.S. Department of Human Health and Human Services guidelines, families were classified as living above or at/below the poverty line; 53 (38.1%) families were considered living at or below the poverty line. All the households were classified as food secure families using the The US Department of Agriculture Household Food Security questionnaire (Nord, Andrews, & Winicki, 2002), because no families scored 3 or higher which is a cut-off score for food insecurity. Parents reported on children's ethnicity, with the sample consisting of Hispanic ($n = 61$, 43.9%), European American ($n = 46$, 33.1%), African American ($n = 29$, 20.1%), and Asian American ($n = 4$, 2.9%).

Procedures

This study was part of a larger study on children's emotion and self-regulation, eating behaviors, and body composition. Recruitment and data collection protocols for this study were approved by the university Institutional Review Board (IRB). Participants were recruited with informational flyers about the study posted in the waiting rooms of pediatricians' offices, daycare centers and preschools, and local businesses that were commonly frequented by families. A snowball sampling procedure was also employed whereby parents who participated in the study referred friends and family who met the study criteria to also participate. Eligibility for the study required that the participating children be between the ages of 4 and 6 years old. Children and their parents were not eligible if (1) they were unable to use English fluently, (2) had a history of traumatic brain injury, (3) had a significant disability that would prevent them from completing the tasks in this study (e.g., blindness), or (4) had food allergies related to the food groups (chocolate or grapes) that were provided in the larger study. Parents provided written informed consent before they and their children participated in the study. For the larger study, children and their parents visited

the study laboratory for one session that lasted approximately 90 minutes that included a series of observational tasks not included in the present study. Parents received \$50 and each child received a toy as an appreciation for their participation in the study.

Measures

Primary study measures included child appetitive traits, controlling parental feeding practices, and child BMI. Parents provided family sociodemographic information and information on child appetitive traits and controlling parental feeding practices. Child weight was indexed by BMI-for-age (which is sex- and age-specific).

Child appetitive traits—The Children’s Eating Behavior Questionnaire (CEBQ; Wardle, Guthrie, Sanderson, & Rapoport, 2001) is a parent-report measure on variations in appetitive traits among children. Consistent with the structure of the measure (Vandeweghe, Vervoort, Verbeken, Moens, & Braet, 2016), food approach tendencies were assessed using the food responsiveness (e.g., “My child’s always asking for food.”), enjoyment of food (e.g., “My child loves food.”), desire for drinks (e.g., “My child is always asking for a drink.”), and emotional overeating (e.g., “My child eats more when anxious.”) subscales, with ratings averaged across the 16 items ($\alpha = .86$) to compute a score for food approach. Food avoidance tendencies were assessed using the satiety responsiveness (e.g., “My child gets full up easily.”), slowness in eating (e.g., “My child eats slowly.”), fussiness (e.g., “My child refuses new foods at first.”), and emotional under-eating (e.g., “My child eats less when s/he is upset.”) subscales, with ratings being averaged across the 19 items ($\alpha = .71$) to compute a score for food avoidance. All the items were rated on a 5-point Likert scale, with higher scores indicative of food approach or food avoidance.

Controlling parental feeding practices—Controlling parental feeding practices were assessed as pressure and restrictive feeding using the parents’ ratings on Pressure to Eat and Restriction subscales (α s = .76 and .81, respectively) on the Child Feeding Questionnaire (CFQ; Birch et al., 2001). Pressure to Eat consisted of 4 items such as “My child should always eat all of the food in his/her bowl.” Restriction consisted of 10 items such as “I have to be sure that my child does not eat too much of his/her favorite foods.” All the items were rated on a 5-point Likert scale with higher scores indicative of pressure to eat or restrictive feeding.

Child BMI—Child weight and height were measured by an experimenter. With the data on children’s weight and height, the U.S. Centers for Disease Control (CDC) sex- and age-specific growth charts were used to calculate child BMI. The BMI-for-age scores (which are sex- and age-specific) were used in analyses.

Statistical Methods

Descriptive statistics were first conducted, including an ANOVA test to examine whether there were sociodemographic differences (i.e., child age, sex, poverty status, and ethnicity) on major study variables. Then a structural equation modeling (SEM) technique was conducted to examine the relations between the major study variables using *Mplus 7.2* (Muthén & Muthén, 1998–2014). The hypothesized model was tested (see Figure 1) to

evaluate whether controlling parent feeding practices mediated the relations between child appetitive traits and child BMI. A model-fit chi-square test (χ^2) and related model fit indices, including the root mean square error of approximation (RMSEA), the comparative fit index (CFI), and the standardized root mean square residual (SRMR) were used to assess the adequacy of the hypothesized model. For a model that fits the data, the χ^2 would not be significant ($p > .05$). A value of the RMSEA between .05 and .08 is indicated fair fit (Browne & Cudeck, 1993). A value of the CFI .95 and value of the SRMR .08 were adopted as the criteria for a well-specified model (Hu & Bentler, 1999). In addition, the bootstrap confidence interval method was employed to obtain mediation effects. Compared to traditional methods (e.g., Sobel's method), the bootstrap confidence interval method is recommended when dealing with small sample sizes and small mediation effects (MacKinnon, Lockwood, & Williams, 2004). We also applied CINTERVAL(bcbootstrap), since bias-corrected confidence intervals can correct bias and thus give more accurate estimations (MacKinnon & Lockwood, 2001). The effect is considered statistically significant if zero is not included in the 95% confidence interval. Moreover, multiple-group path analysis was conducted to test if there were differences in the structural parameters across ethnic or economic groups, because Perez et al. (2018) found that the factor structures for Pressure to Eat and Restriction from the CFQ varied across ethnic groups and food secure and insecure households (also see Anderson, Hughes, Fisher, & Nicklas, 2005; Cross, Hallett, Ledoux, O'Connor, & Hughes, 2014). The full information maximum likelihood (FIML, Arbuckle, 1996) estimation was used to handle missing data (Hancock & Mueller, 2010).

Results

Descriptive Statistics

Descriptive statistics and correlational analyses were conducted using IBM SPSS Statistics 22, and results are displayed in Table 1. Data were first screened for normality and outliers. Skewness (ranged from $-.48$ to $.78$) and kurtosis (ranged from -1.00 to 3.60) indicated no serious bias to normal distribution of the data (Kline, 2010). No outliers in the data were detected according to Mahalanobis distance statistics (Zijlstra, van der Ark, & Sijtsma, 2011). Overall, most correlations amongst variables were in the expected or hypothesized directions.

Tests of Sex, Age, Poverty Status, and Ethnic Group Differences

A series of single-factor analysis of variance (ANOVA) were conducted to examine if there were between-group variations for child age, sex, poverty status, and ethnicity among the major study variables. No sex or age differences were found. However, differences were found for poverty status, with parents living at or below the poverty line endorsing more pressure to eat ($M = 3.11$, $SE = .16$) than those living above the poverty line ($M = 2.51$, $SE = .11$), $F(1, 134) = 9.78$, $p = .002$. In addition, ethnic differences were found for parental pressure to eat, $F(3, 135) = 4.33$, $p = .006$, with European American parents reporting lower levels of pressure to eat ($M = 2.39$, $SE = .16$) than African American parents ($M = 3.33$, $SE = .22$), $p = .006$.

Results from Path Analysis and Mediation Analyses

The overall model chi-square test and the model fit indices were: $\chi^2(3, N=139) = 5.26$ ($p = .15$), RMSEA = .07, CFI = .95, and SRMR = .04, respectively, indicating that the hypothesized model fit the data adequately. As shown in Figure 2, child food avoidance predicted high levels of parental pressure to eat ($\beta = .24, p < .01$); child food approach predicted high levels of parental restrictive feeding and parental pressure to eat ($\beta = .31, p < .001$ and $\beta = .23, p < .01$, respectively). Restrictive feeding predicted high levels of child BMI ($\beta = .17, p < .05$) whereas pressure to eat predicted low levels of child BMI ($\beta = -.28, p < .001$). The variance explained was 10.6% for restrictive feeding, 11.3% for pressure to eat, and 9.8% for child BMI with statistical significance at $p < .05$ level. Analyses were also conducted to test for the hypothesized mediation effects and results were summarized in Table 2. Three mediation effects were found. The total indirect effect of child food avoidance on child BMI was marginally significant, and mediated through parental pressure to eat. The two specific indirect effects through restrictive feeding and pressure to eat were significant, although the total indirect effect of child food approach on child BMI was not significant.

Multiple-group path analysis was completed to test for ethnic or economic group differences in structural parameters of the mediation model. Results indicated that the path coefficients were equal across poverty status and across Hispanic and Non-Hispanic groups, $\chi^2_s = 9.7$ and 11.9, $dfs = 6$, $ps = .14$ and $.06$, respectively. For poverty status, all of the four indirect effects of the model were invariant across groups, $\chi^2 = .20, df = 1, p = .65$ for the indirect effect of Food Avoidance on Child BMI via Restrictive Feeding; $\chi^2 = 2.77, df = 1, p = .09$ for the indirect effect of Food Avoidance on Child BMI via Pressure to Eat; $\chi^2 = .73, df = 1, p = .39$ for the indirect effect of Food Approach on Child BMI via Restrictive Feeding; $\chi^2 = .68, df = 1, p = .41$ for the indirect effect of Food Approach on Child BMI via Pressure to Eat, respectively. For ethnic groups, all of the four indirect effects of the model were invariant across ethnic groups as well, $\chi^2 = .92, df = 1, p = .34$ for the indirect effect of Food Avoidance on Child BMI via Restrictive Feeding; $\chi^2 = .95, df = 1, p = .33$ for the indirect effect of Food Avoidance on Child BMI via Pressure to Eat; $\chi^2 = .54, df = 1, p = .46$ for the indirect effect of Food Approach on Child BMI via Restrictive Feeding; $\chi^2 = 1.40, df = 1, p = .24$ for the indirect effect of Food Approach on Child BMI via Pressure to Eat, respectively.

Discussion

The primary purpose of the present study was to examine whether controlling parental feeding practices served as modifiable food parenting behaviors that mediate the relations between child appetitive traits and child BMI. Study results confirmed that child appetitive traits are linked to child BMI through restrictive feeding or pressure to eat. Thus, the relation between child eating styles and their BMI can be partly explained by parents' use of controlling feeding practices. Study findings are consistent with a biopsychosocial model of the development of eating and weight in childhood (Russell & Russell, 2019) which takes into account both parent and child behavior and characteristics and links child biology and behavior with psychosocial processes and environment.

Links between Child Appetitive Traits and Parental Feeding Practices

Food approach and food avoidance are two temperament-based appetitive traits that are influenced by genetic dispositions (Dubois et al., 2013; Wood, 2018), and previous studies have shown associations between child appetitive traits and controlling parental feeding practices. Prior studies show that child food avoidance is positively related to controlling parental feeding practices such as pressure to eat, while child food approach is positively related to restrictive feeding and negatively related to pressure to eat (Gregory, Paxton, & Brozovic, 2010; Webber et al., 2010). Our findings were similar, except that we found food approach and pressure to eat were positively related to one another in our sample. This pattern of a positive relation between food approach and pressure to eat may reflect parents' attempts to manage or control children's eating behaviors through getting their children to eat healthy rather than unhealthy or junk foods.

Prior studies have shown that child food approach and parents' restrictive feeding are linked, possibly because children may desire high-sugar or high-fat foods and parents feel the need to restrict over-consumption of such foods and/or parents who restrict certain foods make those foods more desirable to their children (Rollins et al., 2016; Webber et al., 2010). Unlike the Restrictive Feeding subscale, items in the Pressure to Eat subscale do not specify the type of food. The association between child food approach and parental pressuring to eat may suggest that parents pressure their children to eat more healthy foods, or pressure their children to eat more during mealtime to limit their consumption of snacks or unhealthy foods. Parents' beliefs and motivation that underlie pressuring children to eat and the types of foods that parents offer their children to eat warrant further attention in future studies.

Restrictive Feeding and Pressure to Eat as Mediating Mechanisms

One of the primary aims of this study was to examine whether controlling parental feeding practices served as modifiable behaviors that mediated the relations between child appetitive traits and child BMI. Results from path analyses showed that both parents' restrictive feeding and pressure to eat mediated the relations between child appetitive traits and child BMI. Results also showed that mediation pathways did not differ across income and ethnic groups, and suggest that study findings are generalizable to diverse income and ethnic groups. Specifically, the linkage between child food approach and child BMI was through either parents' restrictive feeding or through parents' pressure to eat. In addition, the linkage between child avoidance and child BMI was through parents' pressure to eat (but not restrictive feeding). Importantly, the type of control that parents exert over their children's eating (i.e., restrictive feeding or pressure to eat) related to their children's weight status in diametrically different or opposite ways. Thus, while child appetitive traits are linked to child weight, our findings of controlling feeding as mediating mechanisms show that parental feeding practices matter because children with food approach tendencies are likely to have different weight status when parents engage in restrictive feeding versus pressuring their children to eat.

Our results are consistent with the view that parents' controlling feeding practices often have unintended or counterproductive influences on children's weight status (Farrow & Blissett, 2008). Such parental control over children's eating may include restricting or limiting

children's consumption of snacks and unhealthy foods, as well as encouraging or even pressuring children to eat more healthy foods such as fruits and vegetables. Our findings are generally consistent with findings from previous studies on controlling parental feeding practices. The use of parental restrictive feeding may interfere with the development of children's self-regulation of eating and also reinforce children's insensitivity to satiety cues that could lead to elevated child BMI (Anzman & Birch, 2009; Bergmeier et al., 2014). Regarding pressure to eat, parents might exert such pressure in response to either children's food avoidance or food approach that could shape children's food preference and eating behaviors that subsequently contribute to low child BMI (Bryant-Waugh, Markham, Kreipe, & Walsh, 2010; Galloway, Fiorito, Francis, & Birch, 2006).

Poverty Status and Parents' Pressure to Eat

Study results suggest that poverty status is a risk factor for controlling parental feeding. Specifically, parents living in poverty endorsed higher levels of pressure to eat than those not in poverty. Researchers have speculated that one reason that socioeconomic differences are found in parents' feeding practices is that parents or caregivers who live in poverty not only lack resources but also access to knowledge of the role of nutrition and feeding practices in child health and weight (Saxton, Carnell, van Jaarsveld, & Wardle, 2009).

Ethnocultural Differences in Controlling Parental Feeding

Results showed ethnic differences in controlling parental feeding practices, with Non-Hispanic African American parents endorsing higher levels of pressure to eat than Non-Hispanic European American parents. Our findings are somewhat consistent with those from prior studies that also show ethnic or cultural differences in parents' feeding or food parenting practices, with multiple studies suggesting that Non-Hispanic African-American parents display more authoritarian or controlling food parenting practices and are more likely to use food to calm or to reward their children than Hispanic parents (Evans et al., 2011; Skala et al., 2012; Wehrly et al., 2014). These ethnic and sociocultural differences in controlling parental feeding practices might be attributed to differences in the meaning and the use of food within the family that have been observed across cultural or ethnic groups, because culture can influence parents' feeding practices through parents' beliefs, values, and behaviors related to foods and health (Caprio et al., 2008; Cheah & Van Hook, 2012; Wehrly et al., 2014).

Implications

Our results indicated that parents' feeding practices could be interpreted as parents' responses to child appetite traits, which can further impact child weight status. Thus, food-related parenting appears to be a promising point of entry for prevention/intervention programs for childhood obesity through healthy eating. Findings support the importance of adopting a family-based approach and targeting food-related parenting practices in the development of prevention/intervention programs for childhood obesity (see Golan & Crow, 2004). In addition, it is important for prevention/intervention programs to take children's appetite traits into consideration, and tailor the program to meet families' needs. For example, when a child exhibits food avoidance, decreasing parental pressure to eat and substituting that with parental encouragement of eating could be an effective approach.

However, when a child appears to exhibit food approach, knowing that parents tend to endorse both pressure to eat and restriction in this situation, an in-depth evaluation of children's current diet and food preferences, parents' beliefs and expectations about diet and eating, and how parents react to children's eating behaviors could be an effective approach.

Limitations and Conclusion

While the mediation models that were tested were based on the theoretical framework and empirical observations that food approach and food avoidance have genetic or biological (temperament) bases (Dubois et al., 2013; Wood, 2018) and parents' feeding practices are partly in response to their children's appetitive traits (Webber et al., 2010), additional studies with longitudinal designs are needed to address the causal influences or directionality of effects between appetitive traits, parents' feeding, and BMI. In addition, child appetitive traits and controlling parental feeding practices were both assessed using parent reports, which may introduce biases depending on parental perceptions of child behavior. Future studies that include observational data in naturalistic or laboratory settings are needed to assess appetitive traits and/or feeding practices to overcome issues with same-reporter or shared method variance.

In summary, our study contributes to the literature on the roles of child appetitive traits and parental control in child feeding on child BMI. Consistent with a biopsychosocial model of the development of eating and weight in childhood proposed by Russell and Russell (2019), our findings highlight the contributions from both parent and child behavior and characteristics to child weight status. Our results showed that controlling feeding practices are mediating mechanisms by which child appetitive traits of food approach or food avoidance are linked to child BMI. Of particular interest is that the two types of controlling feeding (i.e., restrictive feeding or pressure to eat) related to child BMI in opposite ways, highlighting that parents' controlling feeding practices often have unintended or counterproductive influences on children's weight status. The findings of mediation effects for controlling parental feeding practices are promising, because parents' feeding behaviors are modifiable and could be targets of parent- or caregiver-focused interventions and education (Lindsay, Sussner, Kim, & Gortmaker, 2006; Steinsbekk, Belsky, & Wichstrøm, 2016). Further, our findings highlight that parents could be empowered as agents of change in their children's lives through promoting children's healthy eating habits and healthy weight.

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Author Bios

Zhiqing Zhou is a doctoral student in the department of Educational Psychology at Texas A&M University. She completed her Bachelor of Science degree in Psychology from Peking

University. Her research interests focus on individual differences and cultural factors related to eating behaviors and eating disturbance.

Jeffrey Liew is a professor in the department of Educational Psychology at Texas A&M University. His research expertise is on social-emotional development with an emphasis on emotion, self-regulation, and executive functions. Majority of his research focuses on early childhood, but the body of his research spans early childhood through emerging adulthood.

Yu-Chen Yeh is a post-doctoral research scientist at Texas A&M University. Her research expertise is on measurement, structural equation modeling, and multilevel modeling.

Marisol Perez is an associate professor in the department of Psychology at Arizona State University. Her research expertise is on eating psychopathology and obesity, prevention of eating disorders and obesity, intergenerational transmission of eating, and improving the assessment of eating behaviors across cultural and economic groups.

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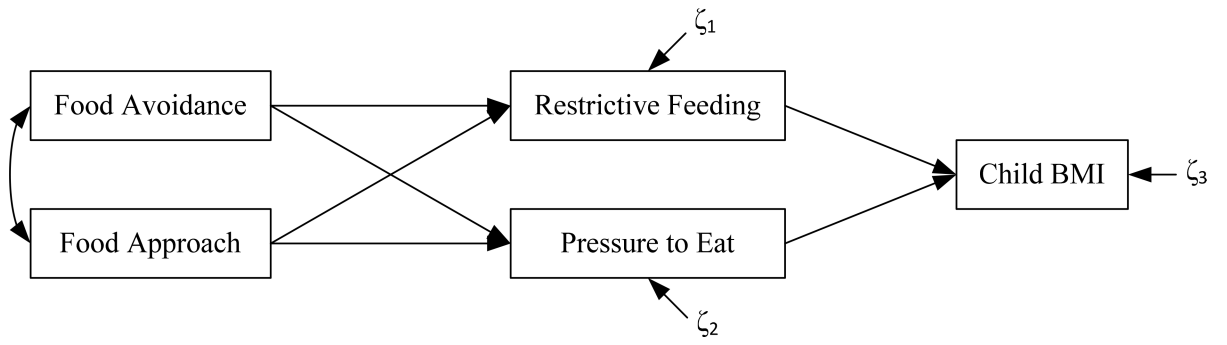


Fig.1.
Hypothesized mediation model

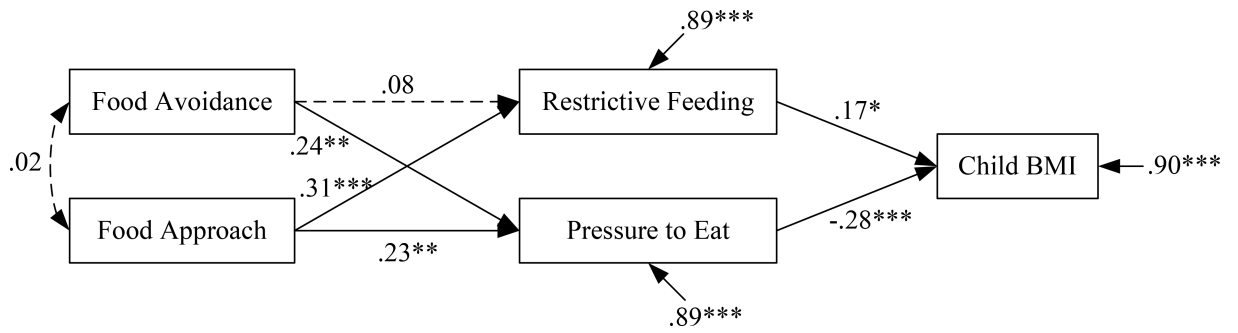


Fig. 2. Path analysis testing restrictive feeding and pressure to eat as mediating mechanisms between food avoidance or food approach and BMI
 Note. All the coefficients were standardized. Dashed lines represent no significant association. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 1.

Descriptive statistics of major variables

	Mean	SD	Skewness	Kurtosis	1	2	3	4	5
1 Food Avoidance	1.34	.62	.35	1.02	1				
2 Food Approach	2.46	.58	.41	.29	.02	1			
3 Restrictive Feeding	3.44	.96	-.48	-.55	.09	.32***	1		
4 Pressure to Eat	2.75	1.12	.12	-1.00	.25**	.23**	.18*	1	
5 BMI	16.47	2.06	.78	3.60	-.15	.11	.12	-.25**	1

Note.

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

Table 2.

The unstandardized indirect effects for path analysis testing restrictive feeding or pressure to eat as mediating mechanisms between food avoidance or food approach and BMI

Indirect effect	Estimate	SE	95% CI
Food Avoidance → Restrictive Feeding	.05	.05	[-.02, .19]
Food Avoidance → Pressure to Eat	-.23*	.10	[-.44, -.06]
Food Approach → Restrictive Feeding	.19*	.10	[.04, .43]
Food Approach → Pressure to Eat	-.22*	.10	[-.47, -.06]

Note.

*
 $p < 0.05$

**
 $p < 0.01$.

95% CI: If the confidence interval did not include zero, the null hypothesis of no mediation was rejected.