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Application of Latent Profile Analysis to Define Subgroups of Parenting Styles and Food Parenting Practices

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Abstract

Food parenting practices and parenting styles are associated with child weight status, dietary intake, and eating behaviors. Although parents maintain a parenting style while also engaging in food parenting practices day-to-day, most studies have examined the separate impact of these two constructs on child outcomes. An examination of both practices and styles will facilitate the identification of how they mutually co-exist and influence child weight and weight-related outcomes. The current study examined the clustering of food parenting practices and parenting styles and evaluated the relationship between these parenting characteristics and child weight status, diet quality and eating behaviors. Children aged 5–7 and their parents ($N = 150$) from six racial/ethnic groups were recruited through primary care clinics. Latent class analysis classified subgroups based on parenting practices and styles. Regression analyses examined relationships between subgroups and child outcomes. The best-fitting model was two subgroups. Parents in subgroup 1 ($n = 37$) were more likely to restrict foods, pressure children to eat and less likely to engage in food modeling compared to subgroup 2 ($n = 112$). Parents in subgroup 1 were more likely to report authoritarian and permissive parenting styles and less likely to report an authoritative parenting style, compared to subgroup 2. Parents in subgroup 1 were more likely to report children who ate to obtain pleasure and who lacked internal cues for hunger than those in subgroup 2. There were no association between subgroups and child weight status, diet quality and other eating behaviors. Future research and interventions should take into consideration how parenting styles and practices mutually influence child weight and weight-related outcomes.

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Contributors' Statement

Dr. Jennings conceptualized the study, carried out the initial analyses, drafted the initial manuscript, and reviewed and revised the manuscript. Drs. Loth and Berge designed the study, coordinated and supervised data collection, and reviewed and revised the manuscript for important intellectual content. Dr. Miner and Mr. Tate supervised data analyses, reviewed and revised manuscript for important intellectual content. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Keywords

latent class analysis; parenting styles; parenting practices; eating; behaviors; child weight

Introduction

A growing body of evidence suggests that food parenting practices and parenting styles are significant correlates of weight status and eating behaviors in youth (Berge, Wall, Loth, & Neumark-Sztainer, 2010; Vaughn et al., 2016; Yee, Lwin, & Ho, 2017). *Parenting styles* refer to emotional and relational aspects of parents and are based on the degree of responsiveness and the degree of demandingness of the parent (Maccoby, 1992). The four classic parenting styles are: authoritative (high responsiveness, high demandingness), authoritarian (low responsiveness, high demandingness), permissive (high responsiveness, low demandingness), and neglectful (low responsiveness, low demandingness)(Maccoby, 1992). Review papers have found an association between specific parenting styles and child weight-related outcomes (Berge, 2009; Pinquart, 2014; Vollmer & Mobley, 2013). Specifically, studies suggest an association between authoritative parenting style (high responsiveness, high demandingness) and lower child weight status, healthy dietary intake and physical activity. *Parenting practices* refer to context-specific behaviors or actions of parents for child-rearing purposes that influence children's attitudes, behaviors, or beliefs (Vaughn et al., 2016). Thus, *food parenting practices* refer to feeding-specific behaviors or actions of parents. Recent content and concept maps of fundamental food parenting practices constructs define three higher-order constructs: coercive control, structure, and autonomy support; and each higher-order construct consists of subconstructs (O'Connor et al., 2017; Vaughn et al., 2016). For example, pressure to eat and restriction are subconstructs of coercive control; nutrition support is a subconstruct of autonomy support; and, parental modeling and covert feeding practices are subconstructs of structure. Covert feeding practices refers to controlling food intake in a way that is undetected by the child such as not purchasing unhealthy foods or avoiding specific restaurants (Ogden, Reynolds, & Smith, 2006). Figure 1 illustrates individual, dyadic, and familial factors (e.g., parenting styles and practices) that may influence child health behaviors and weight status.

Reviews of the existing literature suggest that the food parenting practice constructs and subconstructs described in Vaughn's construct table significantly influence child eating behaviors and weight status (Vaughn et al., 2016; Yee et al., 2017). Indeed, most of the constructs in Vaughn's construct map have been found to be either positively or negatively associated with child weight-related outcomes. For example, studies consistently found that parental modeling was positively associated with child healthy dietary intake, and pressure to eat was negatively associated with child weight status and healthy dietary intake but had a positive correlation with unhealthy food consumption. Most studies also found a positive relationship between restriction and child desire for restricted foods, tendency to overeat, intake of snack foods, and adiposity. Unfortunately, studies tend to examine the relationship between parenting practices and one specific child outcome, and do not explore how parenting practices influence a variety of child outcomes. Thus, an examination of more than one child outcome will provide knowledge about how parenting practices uniquely influence

various child outcomes. For example, it is possible that covert feeding practices impact child eating behaviors but not weight status. Knowledge about various food parenting practices and child outcomes may lead to novel interventions that are more individualized based on parental characteristics and targeted child outcome.

Research to date has examined specific food parenting practices or parenting styles with child outcomes, but these studies rarely explore how food parenting practices and parenting styles jointly impact child outcomes. For example, researchers have found that food parenting practices are dynamic and that there is an interplay among different practices (Loth, Uy, Neumark-Sztainer, Fisher, & Berge, 2018; Wiggins, Potter, & Wildsmith, 2001). In addition, another study recently showed that parent feeding practices are more state-like than trait-like and fluctuate throughout the day and across the week (Berge, Tate, Trofholz, Loth, et al., 2018). Furthermore, recent review papers argued that parenting styles are more trait-like compared to parenting practices which are less static, and that exploring the interaction of parenting styles and practices may improve intervention efficacy (Kremers et al., 2013; Patrick, Hennessy, McSpadden, & Oh, 2013). Given that all parents engage in multiple food parenting practices within the context of their own parenting style, an examination of both parenting practices and styles will provide knowledge of whether certain food parenting practices align with certain parenting styles. For example, it is possible that more coercive control practices exist alongside specific parenting styles and the co-occurrence of coercive control practices which in turn influences child weight and weight-related behaviors (e.g., dietary intake, physical activity, sedentary behavior). Such knowledge may lead to more real-world recommendations for parents and more efficacious interventions.

In the current study, latent profile analysis was used to examine the clustering of parenting styles and multiple food parenting practices among a cohort of racially, ethnically and socioeconomically diverse families. Latent profile analysis is a statistical approach that evaluates *unobserved* population heterogeneity and addresses the question: “Can individuals from a heterogenous population be divided into clinically meaningful subgroups?”. One of the primary advantages of this analytic approach is that subgroups are created to maximize homogeneity within groups and are based on *observed* data used to model theoretical concepts which are not directly measured (Lubke & Muthen, 2005). For example, latent profile analysis may lead to the identification of a common set of food parenting practices and parenting styles associated with healthful child outcomes. Such knowledge may inform interventions that move parents towards the approach with best outcomes and possibly detect parents at greater risk of engaging in food parenting practices that negatively impact child outcomes. In this context, the study addressed the following research questions: (a) Are there unique latent profiles (subgroups) based on food parenting practices (i.e., restriction, pressure to eat, modeling, covert feeding practices) and parenting styles (i.e., permissive, authoritarian, authoritative)? (b) What are the differences and similarities of the latent profiles in food parenting practices and parenting styles? (c) Do latent profiles predict child outcomes (i.e., weight status, healthy dietary intake, eating behaviors)?

Materials and Methods

Study Design and Population

Data in the current study are from the *Family Matters* study, a 5-year incremental (Phase I = 2014 – 2016; Phase II: 2017 – 2019), mix-methods, longitudinal study designed to identify factors in the home environment that may be risk and protective factors for childhood obesity. Phase I included an in-depth, mixed-methods, cross-sectional analysis of the home environment for children ages 5 to 7 years from six racial and/ or ethnic groups including African American, Hispanic/Latino, Hmong, Native American, Somali, and white (N = 150; n = 25 per group). The sample was intentionally stratified by race/ethnicity and weight status (overweight/obese = body mass index (BMI) ≥ 85%ile; non-overweight = BMI > 5%ile and < 85%ile) of the study child. Additionally, families were from low-income households (Department of Human and Health Services, 2019), with 70% of families earning less than $35,000 per year.

Eligible children and parents were recruited from primary care clinics within Minneapolis and St. Paul, Minnesota. Potential participants received a phone call (in their own language) within two weeks after recruitment letters had been sent from their clinic to confirm receipt of recruitment letter, answer any questions, review eligibility requirements, and invite study participation. Eligible families participated in two in-home visits over a 10-day period. During the first home visit, written consent/assent were obtained from caregivers and children. In-depth information about the recruitment and eligibility criteria and the procedures and data collection have been published elsewhere (Berge, Trofholz, et al., 2017). Of the original sample, one child/family did not have scores for food parenting practices and was excluded from the current study. The University of Minnesota's Institutional Review Board Human Subjects Committee approved all protocols used in the *Family Matters* study.

Measures

Details about study variables (e.g., definition, measure) are described in Table 1.

The current study did not assess for neglectful parenting style, a fourth parenting style which has been measured in other literature, because prior research has shown that this parenting style has low prevalence (Berge, Wall, Bauer, & Neumark-Sztainer, 2010; Berge, Wall, Loth, et al., 2010). Secondly, c*hild diet quality*, was calculated from three 24-hour dietary recall interviews conducted with the primary caregiver using the Nutrition Data System for Research system, developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN (Center, 2016; Schakel, Buzzard, & Gebhardt, 1997; Schakel & Himes, 2001; Schakel, Sievert, & Buzzard, 1988). Finally, validation variables were selected based on prior empirical support for associations with parenting practices and styles as well as expert opinion among coauthors of clinical relevance. Validation analyses served two purposes: (1) examination of correlates that may support clinical validity of latent profiles, and (2) description of latent profiles. For example, emotional atmosphere (i.e., chaotic) has been shown to be a predictor of restriction feeding practices during a meal (Berge, Tate,

Trofholz, Loth, et al., 2018), and primary caregiver's level of education was included for descriptive purpose.

Statistical Analyses

Latent profile analysis.—Latent profile analysis, an extension of latent class analysis that allows for the use of continuous "indicator" variables, was used to determine the optimal number and composition in which participants aggregated based on food parenting practices (food restriction, pressure to eat, parent modeling, covert feeding practices) and parenting styles (authoritative, authoritarian, and permissive)(Muthén & Muthén, 1998–2015). An advantage of this analytic approach is that objective criteria (e.g., parsimony indices) are used to evaluate the existence of meaningful subgroups, or latent profiles, including optimal number and composition (Lubke & Muthen, 2005). Since there is not an a priori assumption (e.g., it is not known beforehand which participant belongs to which subgroup), *observed* data are used to model theoretical concepts which cannot be directly measured (Lubke & Muthen, 2005). These observed data, or indicators, used to characterize latent profiles were selected based on prior theoretical evidence (Vaughn et al., 2016; Yee et al., 2017). Correlations among indicators were small to moderate (*r*s ranged from .004 for food restriction with parent modeling to .53 for teaching about nutrition with parent modeling), indicating the assumption of conditional independence was likely met.

Analyses were conducted in Mplus Version 7 (Muthén & Muthén, 1998–2015). In this study, latent profile analysis was utilized to create a more representative measurement of feeding-related parenting by combining food parenting practices and styles into exclusive latent profiles. Individuals were assigned to one of the latent profiles based on their highest posterior probability of profile membership derived from responses to the indicators. We tested the fit of a series of models, ranging from one to six profiles, to the observed data. To approximate the best-fitting model, or correct number of classes, we compared standard fit indices including the Akaike Information Criterion, consistent Akaike Information Criterion, Bayesian Information Criterion, sample-size adjusted Bayesian Information Criterion, Bayes factor, bootstrap likelihood ratio test; Vuong-Lo-Mendell-Rubin adjusted likelihood ratio test, and entropy (Nylund-Gibson & Choi, 2018). We also examined the mean posterior probability of each latent profile (a profile-specific measure of how well the observed variables predict latent profile membership).

Validation analyses compared groups on demographic characteristics, child temperament, household factors and general parenting practices. Analyses were conducted using analyses of variance or Fisher's Exact test.

Multiple regression models were used to examine the relationship between child dietary intake summary and eating behaviors and latent profiles based on food parenting practices and parenting styles. Logistic regression model was used to examine the relationship between child weight status (non-overweight versus overweight/obese status) and latent profiles based on food parenting practices and parenting styles. All models were controlled for the potential confounders of parent age and weight status, child age, sex and race/ethnicity, and household income and structure. All analyses were conducted in SPSS© software version 22 (IBM, Released 2013).

Results

Latent Profile Analysis

As shown in Table 2, the two-group solution had a higher sample-size adjusted Bayesian Information Criterion compared to other solutions (better fit is associated with lower score) but also had the lowest values for parameters, consistent Akaike Information Criterion and Bayesian Information Criterion as well as the highest value for entropy. Moreover, the two likelihood-based tests (i.e., bootstrap likelihood ratio test; Vuong-Lo-Mendell-Rubin adjusted likelihood ratio test) and the Bayes factor, or the pairwise comparison of fit between two neighboring class models, supported a two-group model.

Although fit indices did not converge on a single model, which is common, the likelihood and pairwise comparison of fit tests, parsimony, and two of the information criteria supported the two-group model (Nylund-Gibson & Choi, 2018). These results suggest that two subgroups, or latent profiles, within this population fit the data best and provide the clearest delineation of latent profiles based on food parenting practices and parenting styles.

Table 3 provides the average posterior probabilities associated with latent profiles to which individuals were assigned, and values indicate the probability that a parent belongs to the assigned latent profile and no other latent profile (posterior probability).

Based on posterior probability of profile membership for each parent, parents were assigned into one of the two profiles, with 37 parents being assigned to latent profile 1 (LP1) and 112 parents being assigned to latent profile 2 (LP2). For parents assigned to LP1, the mean score for parenting practices were: 21.76 (SD = 5.24) for food restriction, 13.16 (SD = 4.02) for pressure to eat, 11.54 (SD = 2.80) for parent modeling, and 19.92 (SD = 5.64) for covert feeding practices. Regarding parenting styles, the mean scores were 14.14 (SD = 2.75) for authoritative, 11.92 (SD = 1.85) for authoritarian, and 8.35 (SD = 1.48) for permissive. Compared to LP1, parents assigned to LP2 had lower mean scores on food restriction and pressure to eat, 18.24 (SD = 6.74 and 10.88 (SD = 3.71), respectively; and, higher scores on parent modeling and covert feeding practices, 12.59 (SD = 2.41) and 20.80 (SD = 6.19), respectively. For parenting styles, the means scores for LP2 were 15.78 (SD = 2.68) for authoritative, 8.29 (SD = 2.16) for authoritarian, and 4.63 (SD = 1.33) for permissive. Table 4 presents comparisons between the two latent profiles on indicator variables (food parenting practices and parenting styles).

Parents assigned to LP1 had higher scores on food restriction, $F(1, 147) = 8.39$, $p = .004$, partial $\eta^2 = .05$ and pressure to eat, $F(1, 147) = 10.04$, $p = .002$, partial $\eta^2 = .056$, and lower scores on parent modeling, $F(1, 147) = 4.85$, $p = .03$, partial $\eta^2 = .03$, compared to those assigned to LP2. In other words, parents in LP1 were more likely to restrict certain foods offered to child and pressure child to eat, and less likely to engage in food modeling, compared to parents in LP2. However, effect sizes were small (< .1). Regarding parenting styles, parents in LP1 had higher scores on authoritarian, $F(1, 147) = 84.11$, $p < .001$, partial $\eta^2 = .36$, and permissive, $F(1, 147) = 205.88$, $p < .001$, partial $\eta^2 = .58$, and lower scores on authoritative, $F(1, 147) = 10.30$, $p = .002$, partial $\eta^2 = .07$, compared to parents in LP2. These findings suggest that parents in LP1 were more likely to report permissive and

authoritarian parenting and less likely to report authoritative parenting, compared to those in LP2. Going forward, LP1 will be referred to as, “Authoritarian and Permissive Parenting Style and Controlling Feeding Practices” and LP2 will be referred to as “Authoritative Parenting Style and Less Controlling Feeding Practices.” Controlling Feeding Practices refers to restricting foods offered to the child and pressuring the child to eat. Effect sizes were moderate for permissive and authoritarian parenting, and small for authoritative parenting.

Validation Analyses

Tables 5 and 6 present distributions of demographic characteristics, child temperament, household factors and general parenting practices between latent profiles.

Parent weight status differed between latent profiles (Fisher’s Exact $p = .03$), in that the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group had more parents who were obese compared to the Authoritative Parenting Style and Less Controlling Feeding Practices group. Although effect sizes were small (< .1), there were significant differences in children’s temperament (anger/frustration), $F(1, 147) = 13.02$, $p < .001$, partial $\eta^2 = .08$, parenting energy, $F(1, 147) = 4.64$, $p = .03$, partial $\eta^2 = .03$, teaching about nutrition, $F(1, 147) = 1.07$, $p = .001$, partial $\eta^2 = .07$, household chaos, $F(1, 147) = 12.40$, $p = .001$, partial $\eta^2 = .08$, and food insecurity, $F(1, 147) = 6.08$, $p = .02$, partial $\eta^2 = .04$. Specifically, parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group reported children with higher negative affect, had less time or energy to feed their child “right”, were less likely to teach their child about nutrition, had higher household chaos, and had higher food insecurity, compared to parents in the Authoritative Parenting Style and Less Controlling Feeding Practices group. There were not significantly differences between latent profiles on child age, sex, race and temperament (impulsivity and inhibitory control), primary caregiver education level and income, and kitchen appliance adequacy.

Latent Profiles and Children’s Weight Status, Healthy Dietary Intake, and Eating Behaviors

Membership to a particular latent profile contributed significantly to the model predicting food responsiveness, explaining 3.9% of the variance after adjusting for parent age and weight status, child age, sex and race/ethnicity, and household income and structure, adjusted $R^2 = .125$, Δ adjusted $R^2 = .036$, $F(17, 131) = 2.25$, $p = .006$. Specifically, on average, parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group were more likely to have children who ate to obtain pleasure and who lacked internal cues for hunger than parents in the Authoritative Parenting Style and Less Controlling Feeding Practices group (see Table 7).

None of the other variables in the model were significantly associated with food responsiveness. Membership to a particular latent profile did not contribute to the models predicting child weight status, dietary intake summary, and other eating behaviors (i.e., food fussiness, satiety responsiveness) (see Table 8).

Discussion

The current study addressed significant research gaps by using latent profile analysis to identify homogenous subgroups of parents based on both food parenting practices and parenting styles. In addition, this study examined the relationship between subgroups of parents and child weight, eating behaviors, and diet quality. Results suggest two subgroups of parents, and significant differences between the two groups in food parenting practices and parenting styles. Certain parenting styles appear to be related to more controlling parental behaviors, while others appear related to more teaching and modeling food-related behaviors. Specifically, parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group were more likely to restrict certain foods offered to child and pressure child to eat, and less likely to engage in food modeling, compared to parents in the Authoritative Parenting Style and Less Controlling Feeding Practices. Related to child outcomes, parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group were more likely to have children who ate to obtain pleasure and who lacked internal cues for hunger compared to parents in the Authoritative Parenting Style and Less Controlling Feeding Practices group. These findings extend prior research using parenting practices or styles and indicate that profiles related to both style and practices influence important child food-related outcomes and suggests that future research and interventions should consider the interaction of parenting styles and food parenting practices.

In the current study, there were significant differences in parenting styles between the two parent groups. Parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group were more likely to engage in coercive control parenting practices such as restricting certain foods and pressuring child to eat compared to the Authoritative Parenting Style and Less Controlling Feeding Practices group. This finding supports the notion that parents with an authoritarian style of parenting tend to exhibit high demandingness/control and low responsiveness/nurturance. Although slightly counterintuitive, parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group also were more likely to endorse a permissive parenting style compared to the Authoritative Parenting Style and Less Controlling Feeding Practices group. An explanation for this finding is that parents who use a permissive parenting style may be more influenced by contextual factors such as stress and chaos resulting in more controlling food parenting practices.(Berge, Tate, Trofholz, Fertig, et al., 2018; Berge, Tate, Trofholz, Loth, et al., 2018; Loth et al., 2018). Indeed, our previous research indicates that environmental factors influence parents use of more coercive feeding practices (Berge, Tate, et al., 2017; Loth et al., 2018) and we found parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group reported higher household chaos, higher food insecurity, less time or energy to feed their child “right,” and a child with higher negative affect.

Consistent with previous research, findings in this study indicate that parents engage in multiple food parenting practices (Berge, Tate, Trofholz, Loth, et al., 2018; Loth, MacLehose, Fulkerson, Crow, & Neumark-Sztainer, 2013a, 2013b; Loth et al., 2018; Vaughn et al., 2016). In a qualitative study that explored momentary impacts on food

parenting practices (Loth et al., 2018), parents described how their feeding practices were easily influenced by momentary factors (e.g., schedule changes, parental stress, child behavior) and how such factors shifted parents away from structure and autonomy supportive feeding practices towards coercive and indulgent feeding practices. Thus, it is possible that parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group engage in multiple feeding practices such as restricting "unhealthy" foods and pressuring child to eat "healthy" foods in response to their chaotic environment and stress. It also is possible that using numerous parenting practices contribute to the chaotic environment that influences eating regulation in children (Berge, Wall, Loth, et al., 2010).

Results from this study showed that latent profile predicted food responsiveness such that on average parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group had higher food responsiveness scores or were more likely to report their child ate to obtain pleasure and lacked internal cues for hunger. Prior research indicates that restricting food and pressuring to eat are linked to both desirable and undesirable food consumption (Yee et al., 2017). In fact, coercive parenting practices (e.g., food restriction, pressure to eat) have been shown to have unintended negative consequences on child eating behaviors such as increased unhealthy food consumption, tendency towards overeating and increased desire for restricted foods (Vaughn et al., 2016; Yee et al., 2017). Although coercive parenting practice may lead to the child eating more healthy foods in the moment, the child tends to choose less healthy options once independent. Thus, structure and autonomy support provide the child with scaffolding which allows freedom to learn within a supportive environment and make more healthful choices in the future. In this study, not only were their children more likely to eat to obtain pleasure and lacked internal cues for hunger, but parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group also were more likely to restrict foods and pressure their child to eat. Since parents in the Authoritarian and Permissive Parenting Style and Controlling Feeding Practices group also reported a more chaotic environment, it is possible that the relationship between chaotic environments and food parenting practices is bi-directional; and both affect the regulation of eating. For example, a chaotic environment (i.e., disorganization and hurriedness) during dinner may contribute to coercive parenting practices and the increased use of coercive parenting practices may contribute to a more chaotic environment. Future research should aim to better understand how and why environmental factors influence engagement in different food parenting practices, and how this complex relationship impacts child outcomes. Future studies also should examine whether parenting styles function as moderators or mediators of the association between parenting practices and child outcomes.

This study had several strengths, including the use of more advanced statistical analysis, adjustments for confounding factors, the measurement of both parenting style and parenting practices, in addition to child eating behaviors, and a sample that included racially/ethnically and socioeconomically diverse families. There are several limitations that should be taken into consideration when interpreting the findings. First, self-report measures and interview were used, and responses may be based on expectations and societal norms. Future studies would benefit from multiple informants and more objective measures such as observations

(Berge et al., 2014). Second, the developmental stage of children included in this study is a limitation because results are not generalizable to other stages of development. In a meta-analysis, Yee et al. (2017) examined age as a moderator for the relationship between parenting practices and child food consumption and found that the effects of pressuring to eat on healthy food consumption was significant only among younger, and not older, children. Thus, it is possible that findings from this study may not be generalizable or replicable in populations of older children. Third, this is a cross-sectional study and thus we have identified associations and not causality. Finally, our relatively small sample size and analytic strategy both limit the generalizable of the results to other populations. For example, based on the uneven group sizes in the two-group solution, it is possible that we identified one unique group and the other group was the remaining heterogeneous sample. Although the two-group solution appears to have theoretical clarity, the model was not predictive of numerous outcomes. Thus, future studies would benefit from larger sample sizes to determine whether a more nuanced grouping of parents better differentiate child eating and weight outcomes. Additionally, latent profile analysis is dependent on the indicators included in the models, and thus there may be other food parenting practices and styles (e.g., neglectful parenting style) that were not included and may be more helpful in explaining how practices and styles together impact child weight and weight-related outcomes. Although our results may reflect our unique sample, there may be high internal validity to identify processes that exist for this sample.

Conclusions

This study identified unique latent profiles (subgroups) based on food parenting practices and parenting styles and explored differences and similarities of the latent profiles (i.e., demographics, general parenting, child temperament, and household factors). Moreover, this study demonstrated how latent profiles predict child food responsiveness, or susceptibility to the hedonistic qualities of food and lack of internal cues for hunger. Indeed, findings from this study indicate that parents of children aged 5–7 years utilize a broad range of food parenting practices, and a subgroup of parents may use more coercive control and structure strategies. Results suggest that it may be important for clinicians to provide guidance and education to parents about the dynamic interplay among parenting styles and food parenting practices such as ecological momentary interventions. Future interventions may help parents to identify ways of establishing and maintaining structure and autonomy supportive parenting practices despite the environment and life stressors.

Since parenting practices are more fluid and parents engage in multiple goal-oriented approaches throughout a meal or day or week, identification of ways to help parents adopt food parenting practices that do not necessarily fit with their parenting style may be beneficial. For example, a more authoritarian parent may require assistance in learning autonomy supportive parenting practices, and a more permissive parent may require assistance in establishing structure parenting practices. This study provided another approach to examining the complexity of food parenting practices and gives clinicians and researchers an opportunity to better understand how combinations of parenting practices and styles impact child eating outcomes. Future research should continue to examine the broad

range and interplay of parenting styles and food parenting practices to better understand the role of parents in child's weight and eating behaviors.

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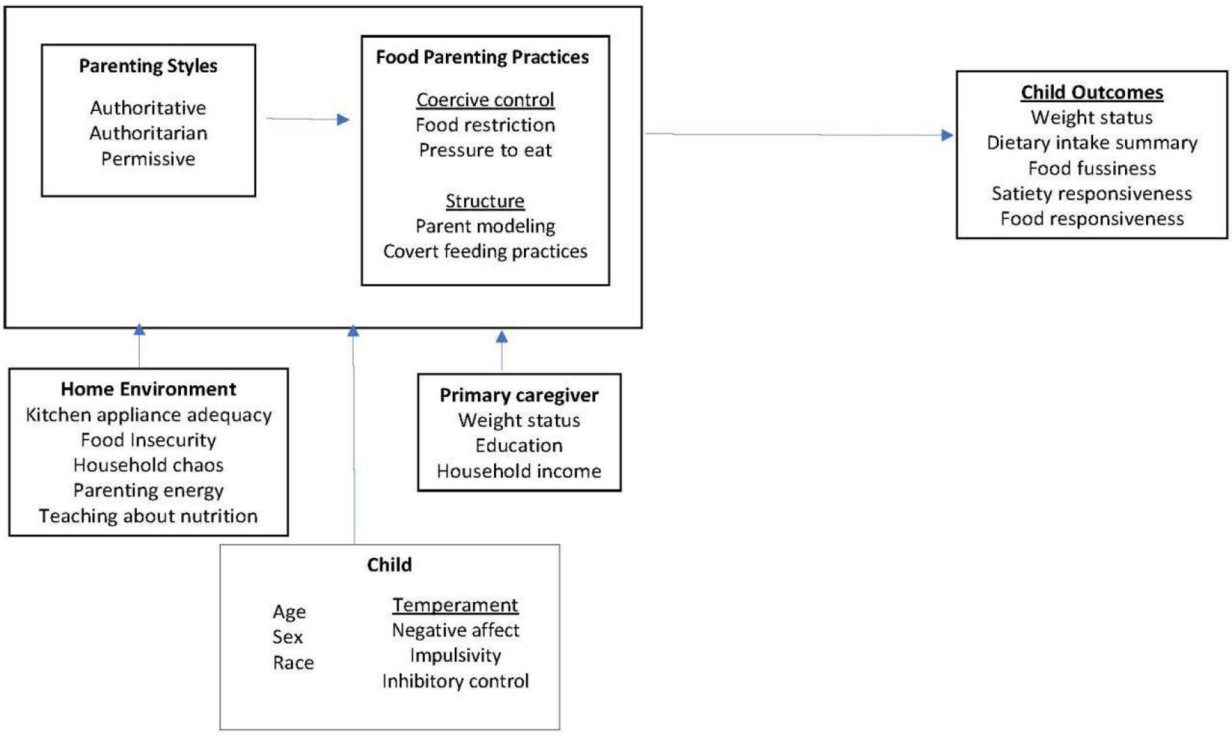

Figure 1.
Conceptual Framework

Table 1.

Description of Study Variables

Study Variables	Definition	*M (SD)*	Description
Indicators			
Food restriction[1]	Extent to which parents restrict child's access to foods	19.11 (6.56) Range: 6–30	Constructed from 6 items : 1) "I have to watch out that my child does not eat too many sweets (candy, ice cream, cake, or pastries)," 2) "I have to watch out that my child does not eat too many high-fat foods," 3) "I have to watch out that my child does not eat too much of his/her favorite foods," 4) "I intentionally keep some foods out of my child's reach," 5) "if I do not guide or regulate my child's eating, he/she would eat too much of his/her favorite foods," and 6) "if I do not guide or regulate my child's eating, he/she would eat too many junk foods." Higher scores indicating higher restriction.
Pressure to eat[1]	Parents' tendency to pressure their children to eat more food	11.45 (3.91) Range: 4–20	Constructed from 4 items: 1) "my child should always eat all of the food on his/her plate," 2) "I have to be especially careful to make sure my child eats enough," 3) "if my child says 'I'm not hungry,' I try to get him/her to eat anyway," and 4) if I do not guide or regulate my child's eating, he/she would eat much less than he/she should." Higher scores indicating higher pressure to eat.
Covert feeding practices[2]	Controlling food intake in a way that is undetected by the child	20.58 (6.05) Range: 7–34	Constructed from 7 items: 1) "How often do you avoid going to restaurants or fast food places which sell unhealthy foods with your child?", 2) "How often do you avoid buying candy and chips to avoid bringing them into the house?", 3) "How often do you not buy foods that you would like because you do not want your child to have them?", 4) How often do you try not to eat unhealthy foods when your child is around?", 5) "How often do you avoid buying cookies, candy, and other treats to avoid bringing them into the house?", 6) "How often do you avoid having snack foods such as candy and chips in the house?", and 7) "How often do you avoid having unhealthy foods in the house?". Higher score indicating higher covert feeding practices.
Parent food modeling[2]	Parent modeling of healthy food behaviors	12.33 (2.54) Range: 5–15	Constructed from 3 items: 1) "I model healthy eating for my child by eating healthy foods myself," 2) "I try to eat healthy foods in front of my child, even if they are not my favorite," and 3) "I show my child how much I enjoy eating healthy foods." Higher score indicates higher food modeling.
Authoritative parenting style[3]	Style of parenting that involves warmth & involvement, reasoning/induction, democratic participation, and good- nature/ easy-going (high responsiveness, high demandingness)	15.37(2.78) Range: 8–20	Constructed from 4 items: 1) "I know the names of my child's friends," 2) "I explain the consequences of my child's behavior," 3) "I show patience with my child," and 4) "I take into account my child's preferences in making plans for the family." Higher scores indicating a more authoritative parenting style.
Authoritarian parenting style[3]	Style of parenting that involves verbal hostility, corporal punishment, nonreasoning/ punitive strategies, and directiveness (low responsiveness, high demandingness)	9.19(2.61) Range: 5–16	Constructed from 4 items: 1) "I yell or shout when my child misbehaves," 2) "I use physical punishment as a way of disciplining my child," 3) "I punish by taking privileges away from my child with little, if any explanation," and 4) "I tell my child what to do." Higher scores indicating a more authoritarian parenting style.
Permissive parenting style[3]	Style of parenting that involves lack of follow through, ignoring of misbehaviors, and self-confidence (high responsiveness, low demandingness)	5.76 (2.11) Range: 3–13	Constructed from 3 items: 1) "I threaten my child with punishment more often than I actually punish him/her," 2) "I ignore my child's misbehavior," and 3) "I find it difficult to discipline my child." Higher scores indicating a more permissive parenting style.
Child Outcomes			

Study Variables	Definition	*M (SD)*	Description
Food fussiness[4]	Being highly selective about the range of foods that are accepted	16.49 (4.17) Range: 8–30	Constructed from 6 items: 1) “my child refuses new foods at first,” 2) “my child enjoys tasting new foods,” 3) “my child enjoys a wide variety of foods,” 4) “my child is difficult to please with meals,” 5) “my child is interested in tasting food he/she hasn’t tasted before,” and 6) my child decides that he/she doesn’t like food even without tasting it.” Three items were reverse coded, and then a score was calculated by summing responses. Higher scores indicate higher food fussiness.
Satiety responsiveness[4]	Ability to regulate intake of food in relation to satiety	13.87 (2.91) Range: 6–23	Constructed from 5 items:: 1) “my child has a big appetite,” 2) “my child leaves food on his/her plate at the end of a meal,” 3) “my child gets full before his/her meal is finished,” 4) my child cannot eat a meal if he/she has had a snack just before,” and 5) “my child gets full easily.” One item was reverse coded, and then a score was calculated by summing responses. Higher scores indicate higher satiety responsiveness
Food responsiveness[4]	Susceptibility to the hedonistic qualities of food and lack of internal cues for hunger	12.49 (3.96) Range: 5–24	Constructed from 5 items: 1) “my child is always asking for food,” 2) “given the choice, my child would eat most of the time,” 3) “even if my child is full he/she finds room to eat his/her favorite food,” 4) if given the chance my child would always have food in his/her mouth,” and 5) “if allowed to, my child would eat too much.” A score was calculated by summing responses. Higher score indicates higher food responsiveness.
Child’s dietary quality[5]	Healthfulness of child dietary intake summary	57.11 (9.37) Range: 31.18–76.74	Constructed from 12 components. Nine components assess adequacy of the diet: (1) total fruit (0–5 points); (2) whole fruit (0–5 points); (3) total vegetables (0–5 points); (4) greens and beans (0–5 points); (5) whole grains (0–10 points); (6) dairy (0–10 points); (7) total protein foods (0–5 points); (8) seafood and plant proteins (0–5 points); and (9) fatty acids (0–10 points). Higher scores reflect higher intake which are desirable. Three components assess food groups and dietary elements that should be consumed in moderation: (10) refined grains (0–10 points); (11) sodium (0–10 points); and (12) empty calories (i.e., energy from solid fats, alcohol, and added sugars; (0–20 points). Higher scores reflect lower intake which are desirable.
Child’s weight status	Sex- and age-specific cutoffs were used to classify children as overweight/obese (body mass index [BMI] > 85%ile) or nonoverweight (> 5%ile < 85%ile) (Himes & Dietz, 1994; Kuczmarski et al., 2000).	75.78 (23.14) Range: 5–99	Constructed from child heights and weights which were converted to child body mass index percentile, using Centers for Disease Control and Prevention (CDC) criteria (Kuczmarski et al., 2000).
Validation Variables			
Demographic characteristics[6]	All demographic variables were based on responses to demographics survey including primary caregiver’s BMI, education, household income, and child’s age, sex and race		Primary caregiver’s BMI was calculated using parent’s reported height and weight, and weight status was classified based on the CDC descriptions (CDC, 2015).
Negative affect (child temperament)[7]	Amount of negative affect related to interruption of ongoing tasks or goal blocking	19.36 (6.82) Range: 1–35	Constructed from 5 items: 1) “my child gets quite frustrated when prevented from doing something she/he wants to do”; 2) “my child is quite upset by a little cut or bruise”; 3) “my child tends to become sad if the family’s plans don’t work out”; 4) “when angry about something, my child tends to stay upset for ten minutes or longer”; 5) “my child is NOT afraid of the dark”. One item was reverse coded, and then a score was calculated by summing responses. Higher scores indicate higher negative affect.
Impulsivity (child temperament)[7]	Speed of response initiation	16.61 (4.70) Range: 4–27	Constructed from 4 items: 1) “my child often rushes into new situations”; 2) “my child seems to be at ease with almost any person”; 3) “my child seems always in a big hurry to get from one place to another”; 4) “my child likes going down high slides or other adventurous activities”. A score was calculated by summing responses. Higher scores indicate higher impulsivity.

Study Variables	Definition	*M (SD)*	Description
Inhibitory control (child temperament)[7]	Capacity to plan and to suppress inappropriate approach responses under instructions or in novel or uncertain situations	22.00 (4.39) Range: 4–28	Constructed from 4 items: 1) “my child is good at following instructions”; 2) “my child when drawing or coloring in a book, shows strong concentration”; 3) “my child likes the sound of words, such as nursery rhymes”; 4) “my child comments when a parent has changed his/her appearance”. A score was calculated by summing responses. Higher scores indicate higher effortful control.
Food insecurity scale[8]	Financially-based food insecurity and hunger	0.85 (1.76) Range: 0–6	Constructed from 1) “In the last 12 months, did you (or other adults in your household) ever cut the size of your meals or skip meals because there wasn’t enough money for food?”; 2) “How often did this happen?” (recoded: 1 or 2 = 1, and 3=0); 3) “In the last 12 months, did you ever eat less than you felt you should because there wasn’t enough money to buy food?”; 4) “In the last 12 months, were you ever hungry but didn’t eat because you couldn’t afford enough food?”; 5) “In the last 12 months, the food that we bought just didn’t last, and we didn’t have money to get more”; 6) “In the last 12 months, we couldn’t afford to eat balanced meals”. All 6 are summed to create scale and then the scale is used to create categories (0–1 = high or marginal food security, 2–4: low food security, 5–6: very low food security).
Kitchen appliance adequacy[9]	Availability of food preparation supplies used for various aspects of food preparation	17.32 (2.56) Range: 3–19	Constructed from yes/no responses to “Do you currently have a (appliance) in working condition in your home? Appliances include: stove, refrigerator, microwave, freezer, large spoon, spatula, can opener, knife, colander, measuring cup, cutting board, measuring spoons, peeler, grater, oven mitt, skillet, saucepan, baking pan, and bowl. All 19 are summed to create scale. Higher scores indicate higher kitchen appliance adequacy.
Household chaos[10]	Degree of environmental confusion (i.e., disorganization and hurriedness)	7.60 (2.66) Range: 4–16	Constructed from 1) “We almost always seem to be rushed”, 2) “It’s a real zoo in our home”; 3) “No matter what our family plans, it usually doesn’t seem to work out”; 4) “You can’t hear yourself think in our home”. A score was calculated by summing responses. Higher scores indicate higher household chaos.
Parenting energy[11]	Time scarcity and fatigue as a barrier to planning/preparing meals	1.36 (0.70) Range: 1–4	Constructed from response to the following: “I do not have enough time or energy to feed my child ‘right’”
Teaching about nutrition[12]	Extent to which parents try to teach children about nutrition	11.90 (2.20) Range: 7–15	Constructed from 1) “I discuss with my child why it’s important to eat healthy foods”; 2) “I discuss with my child the nutritional value of foods”; 3) “I tell my child what to eat and what not to eat without explanation” (reverse coded). All 3 are summed to create scale. A higher score indicates higher parent teaching about nutrition.

Note:

[1]Child Feeding Questionnaire (Birch et al., 2001);

[2]adapted from previous studies (Berge, Trofholz, et al., 2017; Ogden et al., 2006);

[3]Parenting Practices Questionnaire (Robinson et al., 1995);

[4]Child’s Eating Behavior Questionnaire (Wardle, Guthrie, Sanderson, & Rapoport, 2001);

[5]Healthy Eating Index-2010 scores (Guenther et al., 2014);

[6]Demographics Survey;

[7]Children’s Behavior Questionnaire (Rothbart, Ahadi, Hershey, & Fisher, 2001);

[8]Short Form of the Household Food Security Scale (Blumberg, Bialostosky, Hamilton, & Briefel, 1999);

[9] Food Preparation Checklist (Appelhans, Waring, Schneider, & Pagoto, 2014);

[10] adapted from Confusion, Hubbub, and Order Scale (CHAOS)(Matheny, Wachs, Ludwig, & Phillips, 1995);

[11] adapted from previous studies (Storfer-Isser & Musher-Eizenman, 2013);

[12] adapted from Comprehensive Feeding Practices Questionnaire (Musher-Eizenman & Holub, 2007).

Table 2.

Model Fit Statistics for Latent Profile Analyses (LCA)

LCA	Log L	Parameters	AIC	cAIC	BIC	aBIC	BF	BLRT *p*	VLMR-LRT *p*	Entropy
1	−2773.71	14	5575.43	5631.48	5617.48	5573.18	0.00	–	–	–
2	−2734.78	22	5513.56	**5601.64**	**5579.64**	5510.02	**8.94**	**<.001**	**.004**	**.833**
3	−2716.95	30	5493.89	5614.01	5584.01	5489.07	**>15.00**	**<.001**	.51	.739
4	−2706.92	38	5489.84	5641.99	5603.99	5483.73	**>15.00**	.25	.68	.701
5	−2694.77	46	5481.53	5665.72	5619.72	5474.14	**>15.00**	.04	.03	.786
6	**−2684.74**	54	**5477.49**	5693.69	5639.69	**5468.80**	–	.60	.51	.831

Note: AIC = Akaike Information Criterion; aBIC = adjusted BIC; BIC = Bayesian Information Criterion; BF = Bayes factor; BLRT = bootstrap likelihood ratio test; cAIC = consistent AIC; *p* = p-value; VLMR-LRT = Vuong-Lo-Mendell-Rubin adjusted likelihood ratio test. Bold values indicate “best” fit for each respective statistic.

Table 3.

Means for the Posterior Probabilities Associated with the Two-Profile Model

Latent Profile	*N*	1	2
1	37	.92	.08
2	112	.03	.97

Note. Posterior probabilities are the probability that an individual belongs to the assigned profile and to no other profiles. Values are the average posterior probabilities associated with the profiles to which individuals were assigned.

Table 4.

Distribution of Food Parenting Practices and General Parenting Styles between Latent Profiles

	Latent Profile 1 (*n* = 37)		Latent Profile 2 (*n*=112)		Test Statistic		
Variable	***M***	***SD***	***M***	***SD***	***F***	***p***	***Effect size***
Food restriction	21.76	5.24	18.24	6.74	8.39	.004	.05
Pressure to eat	13.16	4.02	10.88	3.71	10.04	.002	.06
Parent modeling	11.54	2.80	12.59	2.41	4.85	.03	.03
Covert feeding practices	19.92	5.64	20.80	6.19	.59	.44	
Parenting styles							
Authoritative	14.14	2.75	15.78	2.68	10.30	.002	.07
Authoritarian	11.92	1.85	8.29	2.16	84.11	< .001	.36
Permissive	8.35	1.48	4.63	1.33	205.88	< .001	.58

Note: Effect sizes for ANOVAs are partial η^2.

Table 5.

Distribution of Demographics Characteristics between Latent Profiles

	Latent Profile 1 (*n* = 37)		Latent Profile 2 (*n*=112)		Test Statistic		
Variable	***M***	***SD***	***M***	***SD***	***F***	***p***	**ES**
Child's age in years	6.30	.74	6.43	.82	.78	.38	
Primary caregiver's body mass index	32.92	7.34	30.09	7.09	4.34	.04	.03
	N	**%**	***n***	**%**	**Fisher's Exact *p***		
Child							
Sex (female)	17	46	53	47	.99		
Race							
White	2	8	22	20	.10		
Black	11	30	13	12			
Hispanic	8	22	17	15			
Hmong	4	11	21	19			
Native American	5	14	20	18			
Somali	6	16	19	17			
Primary Caregiver							
Education							
Middle school or junior high	7	19	8	7	.13		
Some high school	3	8	14	13			
High school or GED	16	43	44	39			
Vocational, technical, trade, or other certification program	7	19	10	9			
Associate degree	2	5	9	8			
Bachelor's degree	1	3	10	9			
Graduate or professional degree	1	3	13	12			
Other	0	0	4	4			
Income							
Less than $20,000	15	41	35	31	.88		
$20,000–$34,000	14	38	41	37			
$35,000–$49.999	3	8	13	12			
$50,000–$74,999	3	8	9	8			

	Latent Profile 1 (*n* = 37)		Latent Profile 2 (*n*=112)		Test Statistic		
Variable	***M***	***SD***	***M***	***SD***	***F***	***p***	**ES**
$75,000–$99,999	1	3	6	5			
$100,000 or more	1	3	8	7			
Weight status							
Non-overweight	3	8	32	29	.03		
Overweight	10	27	28	25			
Obese	24	65	52	46			

Note: ES = effect size. Effect sizes for ANOVAs are partial η^2.

Table 6.

Distribution of Child Temperament, Household Factors, and General Parenting between Latent Profiles

	Latent Profile 1 (*n* = 37)		Latent Profile 2 (*n* = 112)		Test Statistic		
Variable	***M***	***SD***	***M***	***SD***	***F***	***p***	**ES**
Child Temperament							
Negative affect	22.73	6.14	18.24	6.69	13.02	< .001	.08
Impulsivity	17.89	4.45	16.19	4.72	3.73	.06	
Inhibitory control	21.32	4.21	22.22	4.44	1.17	.28	
Parenting energy	1.57	.90	1.29	.61	4.64	.03	.03
Kitchen appliance adequacy	16.73	2.74	17.51	2.49	2.60	.11	
Teaching about nutrition	10.89	2.45	12.23	2.01	11.07	.001	.07
Household chaos	8.89	2.61	7.18	2.55	12.40	.001	.08
Food insecurity scale	1.46	2.21	.65	1.54	6.08	.02	.04

Note: ES = effect size. Effect sizes for ANOVAs are partial η^2.

Table 7.

Multiple Regression Predicting Child Food Responsiveness

Predictor Variables	Step 1				Step 2				Step 3			
	R^2	β	95.0% CIs		R^2	β	95.0% CIs		R^2	β	95.0% CIs	
	.067 *				.089 *				.125 **			
PC's age		−.101	−.154	.042		−.124	−.169	.031		−.107	−.158	.039
TC's age		.075	−.417	1.165		.062	−.522	1.143		.081	−.415	1.222
TC's Sex (Male)		−.020	−1.422	1.104		−.074	−1.884	.717		−.082	−1.923	.627
Black		.314	1.007	5.740		.283	.398	5.680		.229	−.172	5.081
Hispanic		.150	−.590	3.761		.187	−.546	4.485		.157	−.818	4.135
Hmong		.126	−.972	3.640		.151	−.921	4.117		.158	−.799	4.138
Native American		.158	−.523	3.858		.130	−1.191	3.936		.119	−1.262	3.765
Somali		.010	−2.086	2.295		−.003	−2.597	2.535		−.022	−2.755	2.283
Two Parents with Others						.002	−2.047	2.084		−.004	−2.076	1.972
One Parents Only						.023	−1.843	2.404		.005	−2.025	2.150
One Parent with Others						.114	−.664	2.764		.138	−.412	2.964
Income 2						−.165	−2.894	.192		−.157	−2.800	.226
Income 3						.016	−2.137	2.541		.019	−2.047	2.537
Income 4						.045	−1.949	3.245		.046	−1.879	3.209
Income 5						.116	−1.238	5.562		.124	−1.014	5.652
Income 6						−.120	−5.207	1.235		−.108	−4.946	1.373
Latent Profile										−.209	−3.378	−.431

Note. PC = primary caregiver. TC = target child. β = standardized β. R^2 = adjusted R^2

* $p < .05$,

** $p < .01$ for change in adjusted R^2.

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Table 8.

Multiple Regression Predicting Child Food Responsiveness

	Child Weight Status		Dietary Intake		Food Fussiness		Satiety Responsiveness	
	Cox & Snell R^2	*B*	Adjusted R^2	Standardized β	Adjusted R^2	Standardized β	Adjusted R^2	Standardized β
Step 1	.151**		.193**		.065*		.002	
PC's age		.303		.025		.001		.004
PC's weight status		2.105						
TC's age		.020		−.122		−.084		−.029
TC's sex		−.141		.028		.151		−.007
TC's race/ethnicity								
Black		−.614		−.339		.050		−.199
Hispanic		−.022		.124		.207		−.186
Hmong		.191		−.124		.071		.027
Native		−.482		−.080		.303		−.089
American								
Somali		−.373		.192		.017		−.036
Step 2	.281**		.170		.042		.021	
Household composition								
2 parents with other adults		1.650		−.012		.012		−.024
1 parent only		−1.069		−.053		.088		.259
1 parents with other adults		−.841		.031		.081		.026
Household income								
Income 2		−1.146		−.125		−.012		.086
Income 3		−1.708		−.070		.033		.078
Income 4		−.680		−.069		−.053		.018
Income 5		.808		.053		.045		−.028
Income 6		2.517		−.027		−.139		.109
Step 3	.284		.172		.045		.033	
Latent profile		−.365		.093		−.104		−.138

Note. PC = primary caregiver. TC = target child. Coefficients are from the last step of each analysis.

* $p < .05$,

** $p < .01$ for change in R^2.