HHS Public Access

Author manuscript

J Behav Med. Author manuscript; available in PMC 2021 August 01.

Published in final edited form as:

J Behav Med. 2020 August ; 43(4): 587–595. doi:10.1007/s10865-019-00081-w.

Defining Picky Eating and its Relationship to Feeding Behaviors and Weight Status

Callie L. Brown, MD, MPH[a,b], **Eliana M. Perrin, MD, MPH**[a,c]

[a]Department of Pediatrics, University of North Carolina at Chapel Hill, Chapel Hill, NC

[b]Present affiliation: Departments of Pediatrics and Epidemiology and Prevention, Wake Forest School of Medicine, Winston-Salem, NC

[c]Present affiliation: Department of Pediatrics and Duke Center for Childhood Obesity Research, Duke University School of Medicine, Durham, NC

Abstract

We assessed the individual constructs that comprise “picky eaters” and determined the relationship of each construct to parental perception of their child’s weight status, parental pressure-to-eat, and the child’s body mass index z-score (BMIz). We developed a questionnaire including 7 commonly used measures of picky eating, which was completed by parents of 2-8 year-olds in pediatric clinics. We performed exploratory factor analysis, confirmatory factor analysis, and model fit. Regression models assessed the association of each picky eating factor to weight perception, pressure-to-eat, and BMIz. We identified three distinct picky eating factors: trying new foods, eating sufficient quantity, and desire for specific food preparation. Each factor had Cronbach’s alpha >0.7 and acceptable model fit. No factors were associated with weight perception. Parents who were more concerned their child did not eat enough were more likely to pressure-to-eat, and these children had lower BMIz. These components of picky eating should be addressed by primary care providers.

Keywords

picky eating; feeding behavior; eating behavior; eating habit; weight perception

Address Correspondence To: Callie Brown, MD, MPH, Department of Pediatrics, Wake Forest School of Medicine, Medical Center Boulevard, Winston-Salem NC, 27157, [calbrown@wakehealth.edu], (336) 716-4987.

Conflict of Interest: The authors declare that they have no conflict of interest.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

INTRODUCTION

As a feature of normal development, most children experience a decrease in appetite (Tharner et al., 2014) and a decreased rate of growth (Kuczmarski et al., 2000) between two and six years old. Picky eating is a common concern for parents and they frequently raise this worry with their child's primary care provider, looking for advice. Food preferences are typically established during toddlerhood, though toddlers' preferences for certain foods may vary significantly weekly or even daily (Birch et al., 1987). Most young children must try a novel food as many as 15 times before they will accept it as a component of their normal diet (Birch et al., 1987). While there is no uniform definition for picky eating, children who eat a "decreased variety of foods" are often considered to be fussy or picky eaters (Galloway et al., 2005).

The wide range of what is considered "decreased variety" is why picky eating is described on a spectrum. Picky eating is generally considered a developmentally normal behavior in young children that usually resolves by school age (Hagen et al., 2008) and does not affect growth. In contrast, avoidant-restrictive food intake disorder (ARFID) is a feeding disorder that leads to deficits in energy or nutritional intake associated with significant weight loss or growth failure, significant nutritional deficiency, dependence on enteral feeding or oral nutritional supplements, or marked interference with psychosocial functioning (American Psychiatric Association, 2013). ARFID has been conceptualized as both a feeding and an eating disorder(Kennedy et al., 2018) and although its incidence and prevalence are not well understood, one study among 8-13 year olds in Switzerland found a prevalence of 3.2% by self-reported symptoms (Kurz et al., 2015). Because a diagnosis of ARFID requires a significant medical or psychosocial problem that necessitates an independent intervention (Thomas et al., 2017), for the purposes of this study we consider ARFID to be distinct from picky eating.

Despite some evidence suggesting that picky eaters may become underweight (Wright et al., 2007) , parents often compensate for children's pickiness by offering foods their children may find more acceptable, such as calorie-dense foods (Agras et al., 2004) that may inadvertently increase their long term risk for obesity. Many parents (14.3%) underestimate their healthy weight child's healthy weight status, incorrectly perceiving them as underweight.(Lundahl et al., 2014) These misperceptions may impact parent feeding practices or a parent's perception of their child's feeding behaviors. A recent study by Li et al found that caregivers of picky eating children were more likely to report that their child was underweight compared to caregivers of non-picky children (Li et al., 2017).

A recent systematic review (Brown, Schaaf, et al., 2016) found that the prevalence of fussy or picky eating in children varies from 6-60% (Agras et al., 2004; Tharner et al., 2014) and that a variety of questionnaires are used to quantify picky eating (Taylor et al., 2015). These questionnaires assess different aspects of picky eating, such as measuring child eating behaviors (Agras et al., 2004), types of food eaten (Galloway et al., 2005), or rely exclusively on parental reports of "picky eating" (Jacobi et al., 2003). Questionnaires that rely exclusively on parents defining "picky eating" (e.g. "Is your child a picky eater?") instead of describing child behaviors are especially problematic, since parents likely have

very different perceptions about what is considered “picky.” Differences in prevalence estimates also arise as questionnaires also vary in frequency of the behavior, cut offs for defining picky eating, and using dichotomous vs. more nuanced responses (Brown, Schaaf, et al., 2016; Taylor et al., 2015). The most commonly used measure of picky eating is the food fussiness subscale of the Child Eating Behavior Questionnaire (CEBQ); however, this is most commonly scored as a continuous variable (there are no accepted cut offs for picky vs non-picky) limiting its usefulness clinically. Additionally, this subscale does not include whether the parent is concerned about the amount their child is eating, which may be an important component of the perception of picky eating. The terms picky eating and fussy eating are often used synonymously in the literature (Galloway et al., 2005; Taylor et al., 2015), and we will use the term picky eating in this manuscript to encompass both. In contrast, food neophobia is well defined as an unwillingness to try new foods, (Tan & Holub, 2012) with a reported prevalence of 40-60% (Brown, Schaaf, et al., 2016; Faith et al., 2013).

Heterogeneous definitions of picky eating make it difficult to assess risk in general pediatrics settings, generalize findings across studies, and understand relationships among picky eating, weight perception, and actual subsequent weight trajectories. Therefore, we sought to assess the individual constructs that comprise picky eating using factor analysis. If these constructs are not encompassed within an existing measure of picky eating, these items and constructs could be used in the future to develop a new measure of picky eating. We also aimed to determine the relationship of these picky eating constructs to: a) parental perception of their child’s weight status; b) parental pressure-to-eat; and, c) the child’s actual weight status. We hypothesized that picky eating would be associated with parental underestimation of their child’s weight status and pressure to eat, and that picky eating would not be associated with a child’s weight status.

METHODS

Study Design and Overview

This cross-sectional study elicited information from parents on perception of picky eating, parental perception of weight status, and parent feeding practices. We developed a picky eating questionnaire for parents and then performed cognitive interviews and pilot tested the questionnaire with 10 parents to ensure comprehension. We recruited parents of children ages 2 to 8 years, as this age range includes children who are independently feeding themselves and surrounds the peak picky eating age of preschool children (Hagen et al., 2008). Participants were recruited through (a) fliers in the clinic lobby and examination rooms and (b) direct recruitment through conversations between research personnel and parents. Parents completed the questionnaire online with Qualtrics and the order of feeding questions was randomized. At an academic pediatric clinic, participants could either complete the questionnaire at home, on a tablet in clinic, or have the study personnel read them the questions in clinic (to address issues of literacy). Participants recruited from other community pediatric clinics were given a link to complete the questionnaire from home. The study was approved by the Institutional Review Board of the University of North Carolina at Chapel Hill.

Participants

Participants were included if: the parent was ≥18 years and if the child was between 2-8 years and had his/her weight and height recorded at clinic in the preceding 6 months. Participants were excluded if the child was born prematurely (before 34 weeks gestation), had a birth weight <1500 g, had a chronic medical problem affecting weight gain patterns (e.g. congenital heart disease) or prompting special dietary recommendations (e.g. severe food allergies), or had a major developmental disability or significant developmental delay. They were also excluded if they were participating in another research study. While picky eating is also common and important among these subpopulations, the reasons and correlates for picky eating may be different in healthy children.

Picky Eating Questionnaire

The questionnaire compiled 7 previously published measures of picky eating standardized to a 5-point Likert scale. Duplicate items were removed, and the wording of a few items was changed to improve clarity and understandability. The following 7 measures were identified by expert consensus and included:

1) The 6-item Food Fussiness Subscale of the CEBQ (Carnell & Wardle, 2007) assesses both food neophobia (fear of eating new foods) and picky eating and is generally thought to capture developmentally typical picky eating (Carnell & Wardle, 2007). Examples of questions include “my child refuses new foods at first,” “my child is difficult to please with meals,” and “my child enjoys a wide variety of foods.” Parents responded on a 5-point scale (1=never; 5=always) and responses were averaged (Cronbach’s alpha = 0.86).

2) Three items from the Child Feeding Questionnaire (CFQ) (Antoniou et al., 2015; Birch et al., 2001) assess whether the child is picky/fussy about what he or she eats, whether the diet consists of only a few foods, or whether the child is unwilling to eat many foods served. Parents responded on a 5-point scale (1=disagree, 5=agree) and responses were averaged (Cronbach’s alpha=0.73).

3) The 8-item Stanford Feeding Questionnaire assesses feeding behaviors such as eating a limited variety of foods and having food prepared in specific ways. Parents responded on a 5-point Likert scale (1=disagree, 5=agree) and responses were averaged (Cronbach’s alpha=0.65) (Jacobi et al., 2003).

4) The Eating Behavior Questionnaire (Dubois et al., 2007) is a 3-item assessment of whether the child eats a different meal from other members of the family, refuses to eat the foods prepared, or refuses to eat. Parents responded on a 5-point scale (1=never; 5=always) and responses were averaged (Cronbach’s alpha = 0.64).

5) Seven items from the Oregon Research Institute Child Eating Behavior Inventory (Lewinsohn et al., 2005) assess the variety of foods eaten and whether the child refuses fruit, vegetables, meats, and fish. Parents responded on a 5-point scale (1=never; 5=always) and responses were averaged (Cronbach’s alpha = 0.77).

6) The 6-item Child Food Neophobia Scale assesses children's willingness to try new foods, such as “My child is afraid to eat things that she's never eaten before.” Parents responded on a 5-point scale (1=disagree, 5=agree) and responses were averaged (Cronbach’s alpha = 0.86) (Pliner, 1994).

7) The 10-item Picky Eating Questionnaire assesses the degree that children are willing to try new foods and eat a wide variety of foods and that parents are bothered by their child’s eating or use persuasion/rewards. Parents responded on a 7-point scale (1=almost never, 7=extremely willing) and responses were averaged (Carruth & Skinner, 2000; Pelchat & Pliner, 1986).

Child, Parent, and Family Characteristics

Parents self-reported basic demographic information, including the child’s sex and race/ethnicity (categorized as White, Black, Hispanic, or other), parent’s education (categorized as less than high school graduate, high school graduate, associate degree, bachelor degree, and master’s degree or higher), household income (<$10,000, $10,000-19,999, $20,000-39,999, $40,000-59,999, and $60,000 or more), and household food insecurity (as measured by the USDA 2-item screener (Hager et al., 2010)). Parents also reported their perception of their own weight status, and their own height and weight. Parents’ perception of their child’s weight status was assessed by asking “Right now, do you think your child is very underweight, underweight, at a healthy weight, overweight, or obese?” Parental weight perception was classified as underestimated, accurate, or overestimated depending on their assessment of their child’s weight status categories and the child’s actual BMI percentile. Analysis was initially performed using groupings of accurate vs. inaccurate (under- or over-estimated), however, since so few parents overestimated their child’s weight status (N=8) we elected to remove these participants from the model and only compare underestimated vs. accurate perception for the purposes of this analysis. Parental self-report of pressuring the child to eat was captured using the 4-item Pressure to Eat subscale (Cronbach’s alpha=0.57) of the Child Feeding Questionnaire (CFQ)(Birch et al., 2001) ; items were answered on a 5-point Fikert scale (1=disagree, 5=agree) and responses were averaged such that a higher score indicates more pressure to eat. We extracted the child’s height, weight, and date of birth from the electronic medical record. We used growth charts from the United States Centers for Disease Control and Prevention for age and sex to generate BMI z-scores (BMIz) and to categorize children as underweight (BMI < 5th percentile), healthy weight (BMI≥5th to <85th percentile), overweight (BMI≥85th to < 95th percentile), or obese (BMI≥95th percentile) (Kuczmarski et al., 2000).

Statistical Analysis

We used exploratory factor analysis to assess the individual constructs that comprise “picky eating.” Factors were named by expert consensus. While sample size calculations for exploratory factor analysis are not uniformly agreed upon, some have suggested that sample sizes of 100 or 200 total are sufficient while others recommend three to six subjects per variable regardless of total. Most importantly, the factors must converge to an appropriate solution and communalities must be high (MacCallum et al., 1999). As we assessed 40 variables, we aimed for a sample size of at least 240 participants. We tested reliability with

Cronbach's alpha coefficients and correlation between all items with Pearson correlations. Items were removed if <20% of the correlations for that item exceeded 0.3 (i.e. the item did not adequately correlate with other items in the matrix). Factors were retained if the Eigenvalue was >1. We examined model fit and factor loadings and iteratively changed models by eliminating items with non-significant or low factor loadings to improve model fit. We also removed items that had high covariance with other similarly worded items to create the most parsimonious group of items. Items with a negative factor loading indicate that the item was negatively associated with that factor and should be reverse coded in future validation studies.

Several measures of model goodness-of-fit were examined on the same sample, including root mean square error of approximation (RSMEA), comparative fit index, and Bayesian information criteria. The RMSEA and comparative fit index assess comparative fit against a model of "reasonable" fit to the data, with values of <0.06 and >0.95, respectively, generally suggested as cutoffs for acceptable model fit (Hu & Bentler, 1999). Negative changes in Bayesian information criteria between models generally indicate the preferred model. These measures, taken together, provide a comprehensive assessment of model fit.

We performed univariate statistics to describe the sample. Separate linear or logistic regression models were used to estimate examine the association of each construct to: a) parental perception of the child's weight status (accurate vs. inaccurate); b) parental pressure-to-eat; and c) the child's actual weight status (BMIz). In the adjusted regression models all models were adjusted for child age, sex, and race/ethnicity, parental BMI, and family income. Including the clinic site as a covariate did not change any of the associations, so clinic site was not included in the final models. Of note, we also performed analysis examining the association of each construct with parental weight perception as categorized additionally as underestimated vs all others (accurate and overestimated), underestimated vs accurate perception, and perceived underweight vs all others (perceived healthy weight and perceived overweight). There were no significant differences between models, so for ease of understanding we report accurate vs inaccurate in this paper. All p-values were based on 2-tailed tests with a significance level of 0.05. All statistical analysis was performed using Stata v14.2 software.

RESULTS

At the academic pediatric clinic, 343 parents were screened and 262 (68%) were eligible for this study. The most common reasons for ineligibility included participation in another research study (for which they had agreed not to participate in any other research studies), non-English speaking, and history of prematurity in the child. Two families declined to participate, a response rate of 99%. Overall, 260 participants were successfully recruited from the academic pediatric clinic. The remaining 26 questionnaires were from community pediatric clinic, but we could not calculate a response rate for this population. Characteristics of the study population (N=286) are shown in Table 1. The group was balanced by child sex (52.5% male) with a mean child age of 4.9 years. Children were 25.5% White, 37.4% Black, and 24.1% Hispanic, and 28% were food insecure. The majority (64%) of children were healthy weight.

The correlation matrix was examined for all 49 items, and 9 items were dropped because the item did not adequately correlate with other items in the matrix. Exploratory factor analysis was performed on the remaining 40 items and a three-factor solution emerged such that the Eigenvalues were greater than one. The factors were: trying new foods, quantity (concern that the child is not eating a sufficient quantity), and preparation (the child prefers for food to be prepared in specific ways). These three factors were assessed by a total of 10 questions, and each factor had a Cronbach's alpha >0.7. The items generally had high commonality (the extent to which an item correlates with all other items) ranging from 0.36 to 0.75; items had a mean of 0.6 (SD 0.13). The factor loadings for each retained item were generally quite high with most >0.7 (Table 2). Confirmatory factor analysis resulted in a comparative fit index of 0.98 and a RMSEA of 0.056, indicating acceptable model fit.

In the adjusted models, none of the picky eating factors were associated with the parental underestimation of their children's weight status (Table 3). Pressure to eat was negatively associated with the sufficient quantity factor such that each 1-point increase in the pressure to eat factor was associated with a 0.3 lower score of the quantity factor. The child's BMIz was not associated with any of the picky eating factors, although an increasing BMIz was associated with increasing child age and increasing parental BMI (Table 3).

DISCUSSION

In this study, the concept of picky eating has three distinct components in young children: trying new foods, concern for whether the child is eating a sufficient quantity of food, and a child's desire for specific food preparation. These three components were assessed by 10 items which demonstrated acceptable model fit in confirmatory factor analysis. None of the picky eating factors was associated with parental accuracy of their perception of their child's weight status or with the child's BMIz. However, the sufficient quantity factor was negatively associated with pressure to eat.

No existing measure of picky eating includes an assessment of trying new foods, concern for whether the child is eating a sufficient quantity, and desire for specific food preparation. The food fussiness subscale of the CEBQ, the most commonly used measure of picky eating, includes some components of food neophobia (refuses new foods at first, enjoys tasting new foods, interested in tasting food she hasn't tasted before, and decides she doesn't like a food even without tasting it) and some components related to variety (enjoys a wide variety of foods, difficulty to please with meals). The food fussiness subscale does not address quantity or preparation. The Sanford Feeding Questionnaire assesses preparation with 1 item (will your child only eat foods if they are prepared in a specific way) and food neophobia with 1 item (my child accepts new foods readily) but does not address quantity (Jacobi et al., 2003). Other measures that address preparation concerns (CFQ) do not address undereating or food neophobia (Birch et al., 2001).

We propose that these three components should be used in future work to validate a new measure of picky eating. This new measure would have research applications as well as clinical applications, as it would be short enough to use in the clinical setting. It is currently challenging for providers to know how best to counsel families of picky eaters, as this term

can mean different things to different people. By examining the factor scores, providers can offer specific interventions for parents to address their specific concerns underlying their child's picky eating, For example, parents with children scoring low on the tries new foods factor can be counseled on strategies for introducing new foods into their diet and parents with children scoring high on the quantity factor can be counseled on appropriate portion sizes for a child of that age. By limiting picky eating to these domains, this aids the clinician by distinguishing it from more serious disorders such as medically significant feeding impairment.

Parents who were concerned that their child did not eat enough were more likely to pressure their child to eat. This is consistent with prior research showing that parental concern for undereating is associated with greater reported pressure to eat and higher observed pressure to eat during a videotaped mealtime observation (Brown, Pesch, et al., 2016). Previous work has also shown an association between picky eating and greater pressure to eat (Harris et al., 2016; Tharner et al., 2014). Because pressure to eat was associated with concern for their children eating a sufficient quantity, but not associated with trying new foods or food preparation preferences, concern for insufficient intake may be driving the change in parental feeding practices in response to their child's perceived picky eating. Therefore, in children who are reported to be picky eaters, providers should carefully assess the child's growth and nutritional intake. If the child's growth is normal (which it was for the vast majority of these children) then parental misunderstandings about age-appropriate appetites or portion sizes may play a part in their concerns. Additionally, parents may be worried that their children are not eating enough of the right foods, and interventions to improve dietary variety may be most helpful for the family. All families should be counseled on how to manage the child's picky eating behaviors to achieve a healthy diet while avoiding maladaptive feeding practices, such as excessive pressuring and controlling during mealtimes.

Accuracy of parents' perception of their child's weight status was not associated with any of the picky eating factor components. This finding was contradictory to previous work in the field, which demonstrated that parents of children who are picky eaters were more likely to report their children to be underweight than were parents of children who are not picky eaters (Li et al., 2017). However, this prior study examined a younger age range (6-35 months), assessed picky eating with a single question, and did not include important covariates such as the child or parent weight status in their analysis. We hypothesize that it is actually the child's slimmer (but still normal weight) body habitus that triggers parental underestimation of their child's weight status, not the child's feeding behaviors. Providers should reassure parents of their child's normal growth patterns as part of anticipatory guidance and nutrition counseling.

The child's weight status (BMIz) was not associated with any picky eating factor components. Prior research has demonstrated contradictory results with the association between picky eating and weight status, with some studies finding an association with overweight (Finistrella et al., 2012; Jiang et al., 2014), others with underweight (Wright et al., 2007), and still others finding no association at all (Jacobi et al., 2003; Johnson et al., 2015; Werthmann et al., 2015). A recent systematic review demonstrated no association

between food neophobia and weight status, and mixed results for picky eating, likely at least in part because picky eating had heterogeneous definitions.(Brown, Schaaf, et al., 2016) Almost all assessments of picky eating rely on parental report of picky eating, and it is not clear how the child's weight may impact these perceptions. For example, a parent of child with a lower BMIz may be more likely to describe their child as a picky eater to explain his or her low weight status. Conversely, a parent of a child with a high BMIz may be more likely to provide their child with higher-calorie and more palatable foods if they perceive their child is a picky eater.

There are several limitations to this study. Participants were English-speaking parents recruited from a single geographical area, so our findings may not be generalizable to other cultures and populations. Additionally, we did not have research staff present at the community pediatric clinic, so we had lower uptake from these clinics and could not calculate response rates. While participants from the community pediatric clinics were more likely to have a higher income and were less likely to be Black, site was not significant when included in regression analyses. Given the low income and racial/ethnic diversity of the population in this study, we cannot say that these culturally determined constructs necessarily apply in wealthier, more predominantly white populations. Additionally, although we attempted to include questions assessing all known components of picky eating, other components may exist that our questionnaire did not assess. For example, we did not include assessment of enteral feeding or nutritional supplements, so our measure is unlikely to be helpful in screening for ARFID. We also did not directly assess sensory-based feeding problems, so this measure will not explicitly identify children with sensory sensitivities. Providers will need to continue to assess the child's overall nutritional status and growth as an important component of picky eating evaluation. While our sample size was sufficient by many metrics, other authors recommend larger sample sizes of 500-1000 participants or 10-20 participants per variable(MacCallum et al., 1999) and it is possible that our large number of variables could have decreased the accuracy of the findings. Finally, this was a cross-sectional study, so conclusions cannot be drawn about temporality. Future research should examine these associations over time.

Questionnaire items assessing the three picky eating components could be used to develop and validate a new measure of picking eating. This new questionnaire would promote effective preventive service delivery through its use as an in-office assessment tool and allow researchers to consistently define the spectrum of picky eating. Such a tool would enhance research on nutrition, feeding, and weight; and help elucidate differences between problematic picky eating related to poor health outcomes, and expected normal picky eating. By incorporating such a measure into their clinical practice, primary care providers could improve their counseling and anticipatory guidance by better targeting of families in whom this is a concern. Parents of children with age-appropriate picky eating can be reassured and encouraged to avoid behaviors like pressuring to eat or overfeeding. For problematic picky eating, primary care providers can intervene to establish healthy feeding patterns to enhance appropriate nutrition and more closely monitor growth.

Acknowledgements:

The authors would like to thank Abu Azad for recruiting patients for this study and Dr. Charles Wood and Karen Klein (Ms. Klein from the Wake Forest Clinical and Translational Science Institute [UL1 TR001420; PI: McClain]) for their helpful edits of the manuscript.

Funding: The study was supported by the Academic Pediatric Association/Maternal Child Health Bureau's Bright Futures Young Investigator Awards; and the National Center for Advancing Translational Sciences (NCATS)/ National Institutes of Health [UL1TR001111]; and Dr. Brown was supported by a grant from the Health Resources and Service Administration's National Research Service Award [T32 HP014001]. The content is solely the responsibility of the authors and does not necessarily represent the official views of the funders. The funding sources had no role in study design, in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the report for publication.

Abbreviations:

BMI	body mass index
BMIz	body mass index z-score
HEI	Healthy Eating Index
CEBQ	Children's Eating Behavior Questionnaire
CFQ	Child Feeding Questionnaire

References:

Agras WS, Hammer LD, McNicholas F, & Kraemer HC (2004). Risk factors for childhood overweight: a prospective study from birth to 9.5 years. Journal of Pediatrics, 145(1), 20–25. doi:10.1016/j.jpeds.2004.03.023

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (DSM-5®). Washington, D.C.: American Psychiatric Association Publishing.

Antoniou EE, Roefs A, Kremers SP, Jansen A, Gubbels JS, Sleddens EF, & Thijs C (2015). Picky eating and child weight status development: a longitudinal study. Journal of Human Nutrition and Dietetics. doi:10.1111/jhn.12322

Birch LL, Fisher JO, Grimm-Thomas K, Markey CN, Sawyer R, & Johnson SL (2001). Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. Appetite, 36(3), 201–210. doi:10.1006/appe.2001.0398 [PubMed: 11358344]

Birch LL, McPhee L, Shoba B, Pirok E, & Steinberg L (1987). What kind of exposure reduces children's food neophobia?: Looking vs. tasting. Appetite, 9(3), 171–178. [PubMed: 3435134]

Brown CL, Pesch MH, Perrin EM, Appugliese DP, Miller AL, Rosenblum K, & Lumeng JC (2016). Maternal Concern for Child Undereating. Academic Pediatrics.

Brown CL, Schaaf EBV, Cohen GM, Irby MB, & Skelton JA (2016). Association of Picky Eating and Food Neophobia with Weight: A Systematic Review. Childhood Obesity, 12(4), 247–262. [PubMed: 27135525]

Carnell S, & Wardle J (2007). Measuring behavioural susceptibility to obesity: validation of the child eating behaviour questionnaire. Appetite, 48(1), 104–113. [PubMed: 16962207]

Carruth BR, & Skinner JD (2000). Revisiting the Picky Eater Phenomenon: Neophobic Behaviors of Young Children. Journal of the American College of Nutrition, 19(6), 771–780. doi:10.1080/07315724.2000.10718077 [PubMed: 11194531]

Dubois L, Farmer AP, Girard M, & Peterson K (2007). Preschool children's eating behaviours are related to dietary adequacy and body weight. European Journal of Clinical Nutrition, 61(7), 846–855. doi:10.1038/sj.ejcn.1602586 [PubMed: 17180152]

Faith MS, Heo M, Keller KL, & Pietrobelli A (2013). Child food neophobia is heritable, associated with less compliant eating, and moderates familial resemblance for BMI. Obesity (Silver Spring), 21(8), 1650–1655. doi:10.1002/oby.20369 [PubMed: 23512929]

Finistrella V, Manco M, Ferrara A, Rustico C, Presaghi F, & Morino G (2012). Cross-Sectional Exploration of Maternal Reports of Food Neophobia and Pickiness in Preschooler-Mother Dyads. Journal of the American College of Nutrition, 31(3), 152–159. doi:10.1080/07315724.2012.10720022 [PubMed: 23204151]

Galloway AT, Fiorito L, Lee Y, & Birch LL (2005). Parental pressure, dietary patterns, and weight status among girls who are “picky eaters”. Journal of the American Dietetic Association, 105(4), 541–548. doi:10.1016/j.jada.2005.01.029 [PubMed: 15800554]

Hagen Shaw, & Duncan. (2008). Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents (Thirds ed.).

Hager ER, Quigg AM, Black MM, Coleman SM, Heeren T, Rose-Jacobs R, … Chilton M (2010). Development and validity of a 2-item screen to identify families at risk for food insecurity. Pediatrics, 126(1), e26–e32. [PubMed: 20595453]

Harris HA, Fildes A, Mallan KM, & Llewellyn CH (2016). Maternal feeding practices and fussy eating in toddlerhood: a discordant twin analysis. International Journal of Behavioral Nutrition and Physical Activity, 13(1), 81.

Hu L. t., & Bentler PM (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural equation modeling: a multidisciplinary journal, 6(1), 1–55.

Jacobi C, Agras WS, Bryson S, & Hammer LD (2003). Behavioral validation, precursors, and concomitants of picky eating in childhood. Journal of the American Academy of Child and Adolescent Psychiatry, 42(1), 76–84. doi:10.1097/00004583-200301000-00013 [PubMed: 12500079]

Jiang X, Yang X, Zhang Y, Wang B, Sun L, & Shang L (2014). Development and preliminary validation of Chinese preschoolers' eating behavior questionnaire. PloS One, 9(2), e88255. doi:10.1371/journal.pone.0088255 [PubMed: 24520359]

Johnson SL, Davies PL, Boles RE, Gavin WJ, & Bellows LL (2015). Young Children's Food Neophobia Characteristics and Sensory Behaviors Are Related to Their Food Intake. Journal of Nutrition, 145(11), 2610–2616. doi:10.3945/jn.115.217299

Kennedy GA, Wick MR, & Keel PK (2018). Eating disorders in children: is avoidant-restrictive food intake disorder a feeding disorder or an eating disorder and what are the implications for treatment? F1000Research, 7.

Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, Flegal KM, Guo SS, Wei R, … Johnson CL (2000). CDC growth charts: United States. Advance Data(314), 1–27.

Kurz S, Van Dyck Z, Dremmel D, Munsch S, & Hilbert A (2015). Early-onset restrictive eating disturbances in primary school boys and girls. European child & adolescent psychiatry, 24(7), 779–785. [PubMed: 25296563]

Lewinsohn PM, Holm-Denoma JM, Gau JM, Joiner TE Jr., Striegel-Moore R, Bear P, & Lamoureux B (2005). Problematic eating and feeding behaviors of 36-month-old children. International Journal of Eating Disorders, 38(3), 208–219. doi:10.1002/eat.20175

Li Z, van der Horst K, Edelson-Fries LR, Yu K, You L, Zhang Y, … Yang X (2017). Perceptions of food intake and weight status among parents of picky eating infants and toddlers in China: A cross-sectional study. Appetite, 108, 456–463. [PubMed: 27825943]

Lundahl A, Kidwell KM, & Nelson TD (2014). Parental underestimates of child weight: a meta-analysis. Pediatrics, 133(3), e689–703. doi:10.1542/peds.2013-2690 [doi] [PubMed: 24488736]

MacCallum RC, Widaman KF, Zhang S, & Hong S (1999). Sample size in factor analysis. Psychological methods, 4(1), 84.

Pelchat ML, & Pliner P (1986). Antecedents and correlates of feeding problems in young children. Journal of nutrition education, 18(1), 23–29.

Pliner P (1994). Development of measures of food neophobia in children. Appetite, 23(2), 147–163. [PubMed: 7864609]

Tan CC, & Holub SC (2012). Maternal feeding practices associated with food neophobia. Appetite, 59(2), 483–487. [PubMed: 22735332]

Taylor CM, Wernimont SM, Northstone K, & Emmett PM (2015). Picky/fussy eating in children: Review of definitions, assessment, prevalence and dietary intakes. Appetite, 95, 349–359. [PubMed: 26232139]

Tharner A, Jansen PW, Kiefte-de Jong JC, Moll HA, van der Ende J, Jaddoe VW, … Franco OH (2014). Toward an operative diagnosis of fussy/picky eating: a latent profile approach in a population-based cohort. International Journal of Behavioral Nutrition and Physical Activity, 11(1), 14.

Thomas JJ, Lawson EA, Micali N, Misra M, Deckersbach T, & Eddy KT (2017). Avoidant/restrictive food intake disorder: a three-dimensional model of neurobiology with implications for etiology and treatment. Curr Psychiatry Rep, 19(8), 54. [PubMed: 28714048]

Werthmann J, Jansen A, Havermans R, Nederkoorn C, Kremers S, & Roefs A (2015). Bits and pieces. Food texture influences food acceptance in young children. Appetite, 84, 181–187. doi:10.1016/j.appet.2014.09.025 [PubMed: 25312750]

Wright CM, Parkinson KN, Shipton D, & Drewett RF (2007). How do toddler eating problems relate to their eating behavior, food preferences, and growth? Pediatrics, 120(4), e1069–1075. doi:10.1542/peds.2006-2961 [PubMed: 17908727]

Table 1:

Participant Characteristics

Variable	Total N (%) or Mean (SD)
Child Variables	
Male Sex	150 (52.5%)
Age (years)	4.9 (2.3)
Race/Ethnicity	
White	73 (25.5%)
Black	107 (37.4%)
Hispanic	69 (24.1%)
Other	37 (12.9%)
BMIz	0.4 (1.2)
Weight Status	
Underweight	11 (3.8%)
Healthy Weight	182 (64.1%)
Overweight	50 (17.6%)
Obese	41 (14.4%)
Accuracy of parent's perception of their child's weight status	
Underestimated	78 (27.5%)
Accurate perception	198 (69.7%)
Overestimated	8 (2.8%)
Parent Variables	
Highest Level of Completed Education	
Less than High School Graduate	40 (14.0%)
High School Graduate	128 (44.8%)
Associate Degree	43 (15.0%)
Bachelor's Degree	34 (11.9%)
Master's Degree or Higher	41 (14.3%)
BMI	29.3 (8.2)
Weight Status	
Underweight	7 (2.4%)
Healthy Weight	81 (28.3%)
Overweight	88 (30.8%)
Obese	110 (38.5%)
Household Variables	
Household Income Level	
Less than $10,000	34 (11.9%)
$10,000-19,999	51 (17.8%)
$20,000-39,999	88 (30.8%)
$40,000-59,999	62 (21.7%)

Variable	Total N (%) or Mean (SD)
$60,000 or more	51 (17.8%)
Food Insecure	81 (28.3%)

Table 2:

Three factor solution with associated factor loadings and corresponding items

Item Question	Factor Loading: Tries New Foods	Factor Loading: Sufficient Quantity	Factor Loading: Specific Preparation
My child enjoys tasting new foods	0.78		
My child tries new foods at home	0.77		
My child accepts new foods readily	0.79		
My child will eat foods that she has never tried before	0.83		
My child is a good eater		0.62	
My child eats the amount I think he/she should eat		0.56	
In general, my child refuses to eat		−0.63	
I prepare a special food for my child because she/he does not like what the rest of the family is eating			0.73
When my child is at home with me for the main meal, he/she eats a meal that is different from the other members of the family			0.74
My child wants food to be made in specific ways	−0.24		0.38

Table 3:

Association of picky eating factors with: parental underestimation of their child's weight status, parental pressure to eat, and the child's actual weight status

	Underestimation of child's weight status[a] OR (95 % CI)	**Pressure to Eat[b] β (95 % CI)**	**Child's BMIz[b] β (95 % CI)**
Tries New Foods factor	0.69 (0.41, 1.14)	−0.01 (−0.14, 0.14)	−0.07 (−0.29, 0.14)
Quantity factor	0.92 (0.52, 1.62)	**−0.29 (−0.46, −0.12)** **	0.21 (−0.05, 0.46)
Preparation factor	1.5 (0.71, 1.85)	0.02 (−0.12, 0.16)	0.08 (−0.14, 0.30)

[a]Results from logistic regression model, adjusted for other factors, child age, sex, race/ethnicity, and BMIz; parental BMI; and family income. OR represents for each one point increase in factor scale, the odds that parents will underestimate their child's weight status.

[b]Results from linear regression model, adjusted for other factors, child age, sex, race/ethnicity, and BMIz; parental BMI; and family income. β represents change in pressure to eat subscale for each one point increase in factor scale, with a higher pressure to eat score indicating more pressure

[c]Results from linear regression model, adjusted for other factors, child age, sex, and race/ethnicity; parental BMI; and family income. β represents change in BMIz for each one point increase in factor scale

* denotes p<0.05

** denotes p<0.01

*** denotes p<0.001