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Picky eating: Associations with child eating characteristics and food intake

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ABSTRACT

Food rejection behaviors such as picky eating are of concern for many parents and attempts to increase healthy food intake can cause distress at mealtimes. An important limitation in most of the picky eating studies is that they cover few characteristics of picky eating behaviors and use limited measures of food intake. The objective of this study was to explore the associations between picky eating, child eating characteristics, and food intake among toddlers 12–47.9 months old (n = 2371) using data from the 2008 Feeding Infants and Toddlers Study (FITS). Logistic regression was used to examine associations between demographic and feeding characteristics and picky eater status. Differences in food group intake between picky and non-picky eaters were analyzed. Picky eaters were more likely to be neophobic, texture resistant, and to eat only favorite foods, In addition, the parents of picky eaters tend to offer new food a greater number of times than those of non-picky eaters before deciding that the child does not like it. Picky eaters showed significant lower intakes of eggs, burritos/tacos/enchiladas/nachos and sandwiches than non-picky eaters. Picky eaters consumed fewer vegetables from the "other vegetables" category and less raw vegetables than non-picky eaters. Neophobia, eating only favorite foods and difficulties with texture are all important characteristics of picky eaters which need to be integrated in studies measuring picky eating behaviors. Food intake of picky eaters differs only slightly from non-picky eaters. Because picky eating is a major parental concern, feeding strategies and advice related to the relevant characteristics of picky eating behavior need to be developed and assessed for their effectiveness.

1. Introduction

Many parents struggle to teach their children healthy eating behaviors because food rejection behaviors such as picky eating and neophobia are common in preschool children (Cardona Cano et al., 2015; Mascola, Bryson, & Agras, 2010). Picky eating can cause distress in families, and in their attempts to increase healthy food intake, parents might use wrong strategies that hinder the development of healthy eating habits (Galloway, Fiorito, Lee, & Birch, 2005). Parents are mainly concerned about their child's rejection of healthy foods like fruits and vegetables and the potential lack of nutrients in the child's diet. However, there is no clear evidence from existing studies that nutrient intake differs between picky eaters and non-picky eaters (Carruth & Skinner, 2000; Carruth, Ziegler, Gordon, & Barr, 2004; Carruth et al., 1998; Dubois, Farmer, Girard, & Peterson, 2007). A consistently reported difference in food intake, is the lower vegetable intake in picky eaters (Cooke et al., 2004; Cooke, Wardle, & Gibson, 2003; Dubois et al., 2007; Galloway et al., 2005; Galloway, Lee, & Birch, 2003; Jacobi, Agras, Bryson, & Hammer, 2003). Some studies also report lower intakes of meat and fish (Cooke et al., 2003; Dubois et al., 2007; Tharner et al., 2014). For intake of sweets and snacks, studies show inconsistent results (Galloway et al., 2005; Tharner et al., 2014). A potential reason for not finding a consistent difference in food intake between picky and non-picky eaters could be related to the number and age of the children studied and measurements used. Most published studies on food intake in picky

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eaters had a limited sample size (Carruth & Skinner, 2000; Carruth et al., 1998; Galloway et al., 2003; Galloway et al., 2005; Jacobi et al., 2003) and limited dietary intake measures from food frequency questionnaires from which detailed information on food group intake cannot be calculated (Cooke et al., 2004; Cooke et al., 2003; Tharner et al., 2014). Therefore, in the current study, a 24-h recall was used to explore food intake in picky eaters in a large nationally representative sample of young children to overcome these limitations.

Another limitation in most of the picky eating studies is that they cover only one or a few characteristics of picky eating behaviors due to the absence of a single definition of picky eating (Taylor, Wernimont, Northstone, & Emmett, 2015). Picky eating is a term used to cover a broad set of behavior issues without a concise definition (Boquin, Moskowitz, Donovan, & Lee, 2014; Jacobi, Schmitz, & Agras, 2008). Two main eating characteristics that parents use to describe their picky eating child are: unwilling to try new foods and consuming a limited type and amount of food (Boquin, Moskowitz, et al., 2014; Jacobi et al., 2003). Some studies use a single item to measure picky eating, not covering any of the picky eating characteristics (Carruth et al., 2004), while other studies use a series of questions that address several aspects of picky eating, such as the fussiness subscale of the Child Eating Behavior Questionnaire (Wardle, Guthrie, Sanderson, & Rapoport, 2001). Other studies focus solely on neophobia, which is one aspect of picky eating (Birch, McPhee, Shoba, Pirok, & Steinberg, 1987; Cooke, Carnell, & Wardle, 2006; Cooke et al., 2003; Coulthard & Thakker, 2015).

The influence of texture and sensory aspects on food preferences was explored in former studies, however often without a specific focus on picky eating behaviors. From these studies it is known that in general, children in the second year of life will start to reject foods they initially accepted and will place higher importance on the physical properties of food such as color and texture (Williams, 2013). Experiences with different textures early in life might facilitate infants' acceptance of more complex textures at a later stage (Blossfeld, Collins, Kiely, & Delahunty, 2007; Coulthard, Harris, & Emmett, 2009; Le Reverend, Edelson, & Loret, 2014; Lukasewycz & Mennella, 2012; Lundy et al., 1998; Northstone & Emmett, 2013; Werthmann et al., 2015). Even though the importance of texture on the development children's food preferences is recognized in studies, texture acceptance seems to be a concept that is currently not measured in commonly used questionnaires to assess picky eating, such as the fussiness subscale of the Child Eating Behavior Questionnaire (Wardle et al., 2001) or the Preschooler Feeding Questionnaire (Baughcum et al., 2001). Recent findings from qualitative and quantitative studies on picky eating confirmed that picky eaters exhibit negative reactions to sensory properties of foods, particularly texture and aroma (Boquin, Moskowitz, et al., 2014; Nederkoorn, Jansen, & Havermans, 2015; Russell & Worsley, 2013). It is therefore important to integrate and further explore the role of texture acceptance together with other picky eating characteristics.

The aim of the present study was to explore how the main characteristics of picky eating; neophobia, texture acceptance and the consumption of only favorite foods are related to a single measure of picky eating. The second objective was to explore the intake of major food categories between picky and non-picky eaters, and to determine which foods contribute most to the differences in intake found in major food categories based on a 24-h dietary recall in a nationally representative sample of US preschoolers.

2. Methods

2.1. Study design

The 2008 Feeding Infants and Toddlers Study (FITS) is a cross-sectional, dietary intake study of a random sample of US infants and children from all states and the District of Columbia weighted to reflect vital records birth data. The purpose of the FITS study was to explore the diets and feeding practices of US infants and children from birth to 47.9 months. The FITS 2008 study consisted of a recruitment interview to collect data on child and household characteristics, including feeding practices and eating behaviors, and a dietary interview composed of a 24-h dietary recall. All study instruments and protocols, including incentives and informed consent procedures, were reviewed and approved by an independent institutional review board, Public/Private Ventures in Philadelphia, PA. Extensive details of the recruitment, design, dietary data collection and analysis methods, and study limitations were described elsewhere (Briefel et al., 2010).

2.2. Measures

Telephone interviews were conducted with the primary caregiver. For all children, data included one 24-h recall of the child's food intake as well as demographic characteristics of the child and caregiver (e.g. child age, gender, child ethnicity, household income, mother's education, child height and weight (based on parents self-report), birth order of the child, breastfeeding information), and child eating characteristics i.e. picky eating and neophobia. All foods and beverages reported in the 24-h dietary recalls were assigned to food groups using the FITS 2002 classification scheme (Fox, Condon, Briefel, Reidy, & Deming, 2010; Fox, Pac, Devaney, & Jankowski, 2004; Siega-Riz et al., 2010). Main food categories such as fruits, milk and milk products, vegetables, and the sub-groups of this classification scheme were used in this analysis. Food intake estimates were based on foods as consumed; food mixtures such as soup and pasta-based dishes were considered single items and not broken down into their constituent ingredients (i.e. vegetables consumed in mixed dishes were not counted in the vegetable food group). Caregivers were asked whether they considered their child to be a very picky eater, a somewhat picky eater, or not a picky eater (Carruth et al., 2004). The following child eating characteristics were measured: texture acceptance, periods of consumption of only favorite foods, neophobia and how many times parents offered a new food. The exact wording of the items and answering options can be found in Table 1. These questions were evaluated in a pilot test to validate the content of the child eating characteristics questions to ensure that the participants understood what was being asked.

2.3. Analyses

A large proportion of infants are breastfed and in the first year of life infants make the transition from a milk diet to eating family foods. In the second year of life children start to reject foods and place higher importance on the physical properties of food (Williams, 2013), therefore, only children 12–47.9 months old were included in the analysis (n = 2371). Chi-square tests were conducted to assess differences in picky-eating characteristics across the three categories of picky eating: not picky, somewhat picky and very picky as reported by the parents. Picky eaters demonstrated to have similar but more pronounced eating characteristics (resistance to new foods and texture) as somewhat picky eaters. Therefore, data for children who were considered as “very picky” and “somewhat picky” were combined into one group to make a

Table 1
Prevalence of demographic and child eating characteristics by picky eater status.

	Not picky (n = 1315)		Somewhat picky (n = 815)		Very picky (n = 241)		*P*-value[a]
	N (SE)	%[b]	N (SE)	%	N (SE)	%	
Gender							0.843
boys	660 (2.3)	51.6	436 (2.9)	53.7	136 (5.2)	53.2	
Girls	655 (2.3)	48.4	379 (2.9)	46.3	105 (5.2)	46.8	
Age							0.000
12–23.9 months	600 (1.8)	42.7	256 (2.2)	25.5	61 (2.9)	17.7	
24–35.9 months	395 (1.9)	32.1	268 (2.5)	33.1	70 (5.1)	37.3	
36–47.9 months	320 (1.6)	25.2	291 (2.7)	41.4	110 (4.8)	45.0	
Birth order							0.003
First child	422 (2.1)	31.5	355 (3.0)	43.8	106 (4.9)	39.4	
Not first child	835 (2.1)	68.5	455 (3.0)	56.2	127 (4.9)	60.6	
Breastfeeding							0.005
Ever breastfed	1068 (1.4)	84.1	641 (2.5)	78.3	179 (4.8)	71.3	
Not ever breastfed	233 (1.4)	15.9	164 (2.5)	21.7	60 (4.8)	28.7	
Weight-for-age-percentile							0.863
1st Weight-for-age quartile	264 (2.0)	21.0	147 (2.3)	18.6	48 (4.4)	24.6	
2nd Weight-for-age quartile	334 (2.1)	28.1	194 (3.1)	29.7	73 (4.5)	26.1	
3rd Weight-for-age quartile	266 (2.1)	22.2	186 (2.7)	25.0	49 (4.1)	20.7	
4th Weight-for-age quartile	325 (2.2)	28.8	187 (2.7)	26.7	51 (5.5)	28.6	
Ethnicity							0.041
Non-Hispanic White	991 (2.1)	55.0	644 (3.0)	59.7	168 (4.8)	45.7	
Non-Hispanic Black	85 (1.5)	12.5	65 (2.4)	16.6	19 (3.7)	16.2	
Other	97 (1.2)	8.4	53 (1.3)	8.1	23 (1.8)	7.2	
Hispanic	142 (2.1)	24.1	53 (2.8)	15.6	31 (5.5)	31.0	
Mother's education							0.006
9th grade or less	19 (0.8)	2.3	8 (1.6)	3.0	7 (1.7)	3.6	
10th to 11th grade	32 (0.7)	3.1	20 (0.7)	2.2	8 (4.9)	10.9	
Completed high school	216 (1.8)	18.1	146 (1.8)	15.5	60 (4.6)	27.5	
Some post-secondary	403 (2.1)	31.1	248 (2.8)	30.6	70 (3.7)	23.6	
Completed college	404 (1.9)	27.4	243 (2.7)	29.9	55 (4.2)	21.3	
Some graduate work/degree	240 (1.8)	18.0	150 (2.4)	18.8	39 (2.8)	13.2	
Household income							0.262
Under 10,000	42 (1.0)	4.8	32 (1.0)	4.4	13 (2.9)	7.8	
10,000 to 19,999	64 (1.3)	6.1	47 (2.7)	11.3	13 (4.3)	13.3	
20,000 to 34,999	151 (1.6)	13.5	87 (2.5)	14.9	26 (3.6)	14.5	
35,000 to 49,999	189 (1.6)	16.1	112 (2.0)	14.1	40 (5.0)	18.5	
50,000 to 74,999	289 (1.7)	21.0	187 (2.4)	21.3	58 (4.0)	21.6	
75,000 to 99,999	221 (2.0)	18.9	132 (2.1)	15.9	35 (3.7)	13.5	
100,000 to 149,999	163 (1.7)	13.2	91 (1.8)	11.0	23 (0.7)	9.2	
150,000 and over	78 (1.4)	6.5	48 (1.8)	7.1	8 (0.6)	1.6	
How many times do you offer a new food before you decide your child does not like it							0.000
Once	51 (1.4)	6.0	26 (1.3)	4.6	8 (1.1)	2.5	
Twice	146 (1.7)	13.3	101 (2.4)	15.1	24 (3.6)	12.2	
Three to five times	537 (2.3)	40.9	408 (3.0)	52.9	116 (5.0)	44.7	
Six to ten times	103 (0.8)	6.1	94 (1.7)	10.7	40 (3.3)	16.1	
More than ten times	164 (1.4)	11.9	162 (1.7)	15.0	43 (5.0)	18.1	
Child likes everything	307 (1.9)	21.8	15 (0.8)	1.8	7 (3.1)	6.6	
How does child react to new foods							0.000
Willing to try new foods	1010 (1.8)	78.8	297 (2.9)	37.6	47 (4.7)	25.9	
Have to be convinced to try new foods, but generally accepts them	272 (1.8)	19.8	370 (3.0)	47.0	62 (5.3)	29.0	
Does child generally resist new foods?	22 (0.4)	1.5	134 (1.8)	15.4	130 (5.0)	45.1	
Which best describes child's acceptance of different food textures							0.000
Willingly eats a number of different food textures	1085 (1.9)	81.3	471 (3.0)	56.4	59 (4.0)	23.9	
Resists eating certain food textures	184 (1.8)	16.0	261 (2.9)	32.8	99 (5.1)	42.4	
Refuses to eat certain food textures	34 (0.8)	2.7	70 (2.1)	10.9	78 (5.3)	33.8	
Within the last month has child gone through periods where he/she will only eat favorite foods							0.000
Yes	394 (2.2)	31.9	493 (2.8)	62.8	198 (4.3)	79.5	
No	918 (2.2)	68.2	320 (2.8)	37.2	43 (4.3)	20.5	

[a] *P*-value from Chi-square test.
[b] Percentages are calculated within each picky eating category to facilitate comparison between the categories of picky eating.

dichotomous variable for picky eating with groups of sufficient size. This is a similar approach as the publication on the FITS data from 2002 (Carruth et al., 2004), and studies with similar measures of picky eating (Boquin, Smith-Simpson, Donovan, & Lee, 2014; Jacobi et al., 2003; Shim, Kim, Mathai, & Team, 2011). Logistic regression, combining somewhat and very picky eaters into one group, was used to examine associations with picky eater status using the following variables in the adjusted model: child's gender, age, ethnicity, weight-for-age quartile, birth order, ever-breastfed status, mother's level of education, household income, number of times new foods are offered, willingness to try new foods, willingness to try different textures, and eats-only-favorite-foods status. Analysis of variance, including age in days as covariate, was used to assess differences in food group consumption between picky and non-picky eaters. In the case of significant results, the sub-categories of the relevant main food category were further

explored with analysis of variance, with age in days as covariate. All analyses were conducted at the 95% confidence level ($p = 0.05$) and weighted so that the results were representative of the US age and racial/ethnic distribution of children up to age 4 years. All analyses were conducted using the Statistical Analysis System (version 9.3, SAS Institute, Cary, NC, 2012) using the appropriate sample weights and design effects.

3. Results

3.1. Sample

Of the sample, 52% (n = 1232) were males and 48% females (n = 1239). Most of the toddlers were from non-Hispanic white ethnicity (76%), 7% were non-Hispanic black, 9.5% were Hispanic, and 7.3% were from "other" or multiracial groups. About 8.9% of the children lived in a household with an annual income level below $20,000 and 17.2% lived in a household with an annual income above $100,000. About 47.7% of mothers had a college degree or higher. Other sample characteristics can be found in Table 1.

3.2. Prevalence of picky eating and associations with child eating characteristics

Among, 12–47.9 month old young children, the percentage of caregivers who described their child as a very picky eater was 10.2% and the percentage of somewhat picky eaters was 34.4%. Table 1 describes the prevalence of child eating characteristics by picky eater status. Picky eating was more common in older children, first born children and never breastfed children. Most parents of infants indicated that they offer a new food up to three to five times before deciding that the child does not like it, with percentages ranging between 41% and 53% in the three categories of picky eating. The percentage of parents who report to offer a new food 6 times or more to their child, was higher for parents of very picky eaters (34%) and somewhat picky eaters (26%) than non-picky eaters (18%). Child picky eating characteristics were more prevalent in very picky eaters compared to non-picky eaters. Neophobia was reported in 45% of the very picky eaters versus 1.5% in non-picky eaters. Texture refusal was reported in 34% of very picky eaters versus 3% in non-picky eaters. Periods of only eating favorite foods was reported in 80% of very picky eaters versus 32% in non-picky eaters.

The logistic regression analysis, showed inverse associations between age, not being the first child, and being ever breastfed with picky eating (Table 2). Ethnicity was found to be significantly associated with picky eating, showing children of non-Hispanic black ethnicity to be more likely to be picky. A lower education status of the mother was also found to be associated with higher likelihood of picky eating. All child eating characteristics: neophobia, texture acceptance and eats-only-favorite-foods were significantly associated with picky eater status. Neophobic and texture resistant children, and children who showed periods where they would only eat favorite foods were more likely to be picky eaters. The parents of picky eaters offer a new food a greater number of times than those of non-picky eaters before deciding that the child does not like it.

3.3. Food groups

Table 3 shows the amount consumed in grams and kilocalories of the various food groups picky and non-picky eaters based on the 24-h recall data. Picky eaters had a lower intake of meats and other protein sources ($d = 16$ g, $p = 0.002$) and a lower intake of vegetables ($d = 11.8$ g, $p = 0.041$) than non-picky eaters. Picky eaters also had a lower energy intake from mixed dishes than non-picky eaters ($d = 38.6$ Kcal, $p = 0.008$).

To further explore the differences between picky and non-picky eaters aged 12–47.9 months, the sub-categories of the food groups with significant differences in intake were analyzed (Table 4). Within the meats and other proteins food group, picky eaters had a significantly lower intake of eggs than non-picky eaters ($d = 6.5$ g, $p = 0.004$). Within the mixed dishes food group, picky eaters had a significant lower intake of the burritos, tacos, enchiladas and nachos group ($d = 3.0$ g, $p = 0.03$) and sandwiches ($d = 5.4$ g, $p = 0.01$). Within the vegetables food group, picky eaters consumed less raw vegetables and vegetables from the other vegetables (artichoke, asparagus, beets, Brussels sprouts, cabbage, cauliflower, celery, cucumber, eggplant, green beans, lettuce, mushrooms, okra, onions, pea pods, peppers, tomatoes/tomato sauce, wax/yellow beans, zucchini, summer squash) than non-picky eaters. Analysis of the other vegetables category showed that picky eaters had a significantly lower intake of other raw vegetables (4.5 g) compared to non-picky eaters (8.6 g) (Table not shown). To ensure that combining somewhat and very picky eaters did not lead to underestimation of the results, analyses were repeated for the group of very picky eaters which confirmed that and no findings were missed.

4. Discussion

This study aimed to explore the characteristics of picky eating behavior and the associations between picky eating and food group intake in toddlers. The results showed that in addition to the typical reported characteristics of picky eating such as neophobia and favorite food consumption (Carruth & Skinner, 2000; Carruth et al., 2004; Dovey, Staples, Gibson, & Halford, 2008), texture resistance is also significantly associated with picky eating. The current study, using a 24-h recall in a large representative sample of US toddlers showed that picky eaters consumed less meat and other protein sources, less vegetables, and consumed less energy from mixed dishes than non-picky children. Exploring the sub food categories highlighted significant differences in the consumption of eggs, sandwiches, burritos/tacos/enchiladas/nachos, other vegetables and raw vegetables.

The association between texture resistance and pickiness reported in the current study, confirms the results from qualitative and quantitative studies in which was shown that tactile sensitivity may play a role in food acceptance among picky eaters (Boquin, Moskowitz, et al., 2014; Nederkoorn et al., 2015). These findings indicate that food texture is an important factor for food rejection in picky eaters. The on average lower intake of raw vegetables and eggs in picky eaters might also indicate difficulty with the texture of foods. In the current study, raw vegetable intake was shown to be low for all toddlers, but this was more pronounced in picky eating toddlers. Slimy or mushy textures (Boquin, Moskowitz, et al., 2014; Russell & Worsley, 2013) and tough foods that require chewing can be especially unappealing for the child (Russell & Worsley, 2013). Raw foods might be more difficult to eat for picky eaters as they might have more tactile sensitivity than the non-picky eaters (Nederkoorn et al., 2015). A higher sensitivity to touch could cause children to dislike the feel of a particular food in their mouth, which could be a reason for the lower consumption of eggs that was found for picky eaters. Eggs, depending on the preparation, have a rubbery texture and/or a specific flavor that might be difficult for picky eaters. Other factors, such as a bitter taste might also influence picky eaters' food intake. No evidence was found as indicated by the no significant difference in the intake of dark green vegetables (Negri et al., 2012). The difference found in the consumption of mixed dishes might relate to specific vegetables or foods that are

Table 2
Multiple logistic regression analyses between demographics, child eating characteristics and picky eater status of preschoolers.[a]

Predictors	OR	95% Wald Confidence Limits		*P*-value
Gender (boy)	0.87	0.61	1.25	0.453
Age				
12–23.9 months	0.49	0.32	0.77	0.007
24–35.9 months	0.65	0.41	1.01	
36–47.9 months	1.00			
Birth order (not first child)	0.58	0.40	0.84	0.004
Breastfeeding (never breastfed)	1.88	1.22	2.89	0.004
Weight-for-age-percentile				
1st Weight-for-age quartile	1.05	0.63	1.75	0.956
2nd Weight-for-age quartile	1.00	0.62	1.62	
3rd Weight-for-age quartile	0.91	0.56	1.46	
4th Weight-for-age quartile	1.00			
Ethnicity				
Non-Hispanic White	1.37	0.76	2.47	0.044
Non-Hispanic Black	2.90	1.31	6.40	
Other	1.02	0.43	2.41	
Hispanic	1.00			
Mother's education				
9th grade or less	1.35	0.17	10.48	0.015
10th to 11th grade	5.33	1.68	16.93	
Completed high school	1.86	0.93	3.75	
Some post-secondary	2.49	1.37	4.53	
Completed college	1.40	0.79	2.51	
Some graduate work/degree	1.00			
Household income				
Under 10,000	0.64	0.22	1.90	0.172
10,000 to 19,999	1.77	0.58	5.40	
20,000 to 34,999	1.87	0.72	4.85	
35,000 to 49,999	1.24	0.51	2.99	
50,000 to 74,999	1.13	0.50	2.56	
75,000 to 99,999	1.11	0.48	2.56	
100,000 to 149,999	0.67	0.26	1.71	
150,000 and over	1.00			
How many times do you offer new food before you decide the child does not like it?[b]				
Child likes everything	1.00			0.000
Once to five times	8.49	3.46	20.85	
Six times and more	11.70	4.59	29.85	
How does your child react to new foods?				
Willingly tries new foods	1.00			0.000
Has to be convinced to try new foods, but generally accepts them	4.72	1.24	2.96	
Resists new food	17.45	3.77	14.56	
Which best describes your child's acceptance of different textures?				
Willingly eats a number of different food textures	1.00			0.000
Resists eating certain food textures	1.91	1.24	2.96	
Refuses to eat certain food textures	7.41	3.77	14.56	
Within the last month, has your child gone through periods where he/she will only eat favorite foods? (no)	0.38	0.26	0.54	0.000

[a] All factors listed in the Table were included in the regression model.
[b] This question was assessed with 6 answering categories: child likes everything, once, twice, three to five times, six to ten times and more than ten times, and categorized in the three reported groups.

Table 3
Main food group consumption by picky eater status (grams and Kcal)[a].

	Not picky (n = 1315)	Picky (n = 1056)	*P*-value	Not picky (n = 1315)	Picky (n = 1056)	*P*-value
	Gram (SE)	Gram (SE)		Kcal (SE)	Kcal (SE)	
Fruit	262.9 (9.0)	253.7 (12.5)	0.557	143.8 (4.8)	138.7 (6.2)	0.525
Grains and grain products	100.1 (4.2)	101.0 (4.3)	0.883	213.8 (7.2)	223.9 (7.3)	0.337
Meats and other protein sources	**76.9 (3.9)**	**60.9 (3.2)**	**0.002**	**172.4 (8.3)**	**145.7 (7.8)**	**0.021**
Milk and milk products	457.6 (13.0)	470.0 (14.9)	0.536	293.3 (8.7)	300.3 (9.1)	0.582
Mixed dishes	110.3 (5.8)	95.3 (6.0)	0.085	**172.5 (10.4)**	**133.9 (9.0)**	**0.008**
Other foods and beverages	248.0 (12.2)	234.1 (13.4)	0.457	41.0 (3.0)	37.1 (3.2)	0.396
Sweets, sweetened beverages, and desserts	140.5 (7.8)	161.4 (10.1)	0.109	158.3 (6.2)	177.4 (8.7)	0.075
Vegetables	**69.7 (4.1)**	**57.9 (3.8)**	**0.041**	55.3 (3.4)	53.7 (4.5)	0.785
Supplements	10.2 (4.2)	10.0 (2.7)	0.973	5.9 (2.2)	8.8 (2.5)	0.385

[a] Analysis of Variance between picky eaters and non-picky eaters, with age in days as covariate. Significant values ($p < 0.05$) are indicated in bold.

in the mixed dish that are rejected by the picky eater. A previous study found that a disliked food can act as a contaminant to liked food during childhood (Brown, Harris, Bell, & Lines, 2012).

Based on the results of various studies, the texture resistance characteristic of picky eating should be taken into account when conducting future studies on picky eating behaviors by

Table 4
Consumption of meats and other protein sources, sweets, sweetened beverages, desserts and vegetables by picky eater status[a].

	Not picky (n = 1315)	Picky (n = 1056)	*P*-value	Not picky (n = 1315)	Picky (n = 1056)	*P*-value
	Gram (SE)	Gram (SE)		Kcal (SE)	Kcal (SE)	
Meats and other protein sources						
Babyfood meats	0.2 (0.1)	0.2 (0.1)	0.695	0.3 (0.1)	0.2 (0.1)	0.596
Dried beans and peas	6.7 (1.1)	4.7 (1.0)	0.165	8.7 (1.5)	6.2 (1.4)	0.191
Eggs	**16.0 (1.7)**	**9.5 (1.3)**	**0.004**	**26.5 (2.7)**	**16.9 (2.5)**	**0.010**
Non-babyfood meats	50.8 (2.9)	43.0 (2.8)	0.059	120.1 (7.1)	105.7 (7.4)	0.163
Peanut butter, nuts and seeds	2.8 (0.4)	2.6 (0.4)	0.669	16.0 (2.4)	15.1 (2.2)	0.795
Vegetarian meat substitutes	0.5 (0.2)	0.9 (0.4)	0.396	0.8 (0.4)	1.5 (0.7)	0.351
Mixed dishes						
Beans and rice, other bean mixtures	0.0 (0.0)	0.0 (0.0)	0.318	0.0 (0.0)	0.0 (0.0)	0.318
Beef with vegetables and/or rice/pasta	5.1 (1.3)	4.0 (1.2)	0.561	5.7 (1.3)	5.1 (1.7)	0.762
Burrito, taco, enchilada, nachos	**4.5 (1.0)**	**1.5 (0.6)**	**0.031**	**11.3 (3.0)**	**2.9 (1.4)**	**0.028**
Chicken or turkey with vegetables and/or rice/pasta	10.0 (1.9)	8.1 (1.8)	0.457	11.9 (2.6)	8.8 (2.1)	0.322
Chili	0.4 (0.2)	0.4 (0.2)	0.798	0.4 (0.2)	0.3 (0.2)	0.663
Fish or shellfish with vegetables and/or rice/pasta	0.4 (0.2)	1.2 (0.6)	0.181	0.5 (0.3)	1.5 (0.7)	0.169
Macaroni and cheese	15.6 (1.9)	18.1 (3.1)	0.508	28.6 (3.5)	34.0 (6.4)	0.465
Pizza	11.1 (2.0)	8.6 (1.4)	0.351	27.8 (5.0)	22.1 (3.7	0.396
Pork/ham with vegetables and/or rice/pasta	1.7 (0.9)	0.6 (0.3)	0.184	2.4 (1.3)	0.8 (0.4)	0.253
Pot pie/hot pocket	1.4 (0.5)	0.7 (0.5)	0.352	2.5 (0.8)	2.1 (1.4)	0.782
Sandwich	**13.4 (1.6)**	**8.0 (1.3)**	**0.012**	**39.0 (4.8)**	**22.9 (3.6)**	**0.009**
Soup	19.5 (3.1)	22.5 (4.6)	0.588	11.0 (2.1)	9.8 (1.8)	0.705
Spaghetti, ravioli, lasagna	27.1 (3.0)	21.5 (2.7)	0.180	31.2 (3.5)	23.6 (3.1)	0.121
Vegetable type[b]						
Yellow/orange	11.0 (2.4)	9.6 (2.2)	0.695	5.0 (1.0)	5.3 (1.5)	0.866
Dark green	6.8 (1.4)	5.5 (1.1)	0.448	2.7 (0.6)	2.2 (0.5)	0.526
White potatoes	19.1 (2.1)	18.9 (1.8)	0.937	30.2 (2.9)	32.4 (3.9)	0.645
Other starchy	8.7 (1.0)	8.3 (1.1)	0.829	8.4 (1.1)	7.7 (1.1)	0.656
Other vegetables	**24.0 (2.1)**	**15.6 (1.6)**	**0.002**	**9.0 (0.9)**	**6.1 (0.7)**	**0.010**
Vegetable preparation method						
Cooked	51.8 (3.1)	48.1 (3.6)	0.447	48.7 (3.3)	50.3 (4.5)	0.778
Raw	**11.6 (1.5)**	**5.0 (0.8)**	**0.000**	**3.9 (0.6)**	**1.6 (0.3)**	**0.000**
Babyfood Vegetable	4.0 (1.0)	4.5 (1.2)	0.762	1.8 (0.5)	1.7 (0.5)	0.954

[a] Analysis of Variance between picky eaters and non-picky eaters with age in days as covariate. Significant values ($p < 0.05$) are indicated in bold.
[b] Yellow/orange (carrots, sweet potatoes, winter squash, pumpkin), Dark green (broccoli, spinach, other greens, Romaine lettuce), White potatoes (French fries and other fried potatoes, mashed, baked, boiled), Other starchy vegetables (corn, green peas, lima beans, black-eyed peas), Other vegetables (artichoke, asparagus, beets, Brussels sprouts, cabbage, cauliflower, celery, cucumber, eggplant, green beans, lettuce, mushrooms, okra, onions, pea pods, peppers, tomatoes/tomato sauce, wax/yellow beans, zucchini, summer squash). The "Other vegetables food group was created based on the relatively low frequency of consumption of each reported vegetable.

incorporating this characteristic in questionnaires or by developing a new picky eating questionnaire that tries to cover the eating characteristics of picky eating more broadly than the existing measures. Various recent reviews address a similar need for consensus on the definition of picky eating and improvement of assessment tools as this had led to the wide variation in the definition of picky eating in studies with limited comparability (Lafraire, Rioux, Giboreau, & Picard, 2015; Taylor et al., 2015). Another area of research that still need to be addressed is the effect of picky eating on food intake, with better quality data (Taylor et al., 2015).

It may be possible to whittle down picky eating by relatively simple actions, such as not allowing grazing and presenting rejected foods for tasting at least six times or more (Caton et al., 2013; Caton et al., 2014). In the current study, the parents of picky eaters offered a new food a greater number of times than those of non-picky eaters before deciding that the child did not like it. It might be because the parents consider their child as a picky eater, so they are treating them as such by putting more effort in having the children tasting new foods. It can also be that parents of picky eaters, due to their concerns about their child's nutrition status might be more active in seeking and implementing feeding advice from professionals (Ong, Phuah, Salazar, & How, 2014). Parent use and the effectiveness of these recommended feeding strategies for picky eaters need to be a future topic of research to enable appropriate intervention strategies and advice for parents (Taylor et al., 2015). Advice on how to deal with the picky eater texture difficulties should also be part of the recommendations to parents. Appropriate texture introduction from weaning to early childhood is important in order to progress to lumpier and more difficult foods in the first year of life and to raw foods and vegetables in toddlerhood (Coulthard et al., 2009; Northstone, Emmett, Nethersole, & Alspac Study Team, 2001).

The limitations of this study include the untrained parental report of picky eater status and limited measurement of picky eating and other child eating characteristics. The use of a more extensive measure on picky eating, for example the Children's Eating Behavior Questionnaire (Wardle et al., 2001), would have given a more in-depth analyses of children's eating behaviors as it also measures acceptance of new foods, acceptance of a variety of foods and if the child is difficult to please with meals. However, texture acceptance is not covered in this questionnaire. The cross-sectional nature of the study also has to be taken into account. Even though various age groups were analyzed, what causes or is an effect of picky eating cannot be concluded. Longitudinal studies on picky eating behaviors are scarce but necessary to confirm findings on the effects on dietary intake (Taylor et al., 2015). Even though this study included a well-recognized measure of food intake, the 24-h recall has its own limitations. A single 24-h recall is not considered to be representative of habitual diet at an individual level due to day by day variability and the methodology is adequate for surveying intake in a large group and estimating group mean intakes of diet. Errors in memory and conceptualization of food portion sizes can cause bias. Even though significant, differences in intake were small ranging between 12 g for vegetables and 16 g for meat and other protein sources. Differences could have been

influenced by the reported portion sizes and biased by parents' perception of the picky eaters' intake. However it would be less likely that parents of picky eaters consistently underreport the consumption of the very specific foods that were found significant in this study such as eggs.

4.1. Conclusion & future research

Neophobia, eating only favorite foods and difficulties with texture are all important characteristics of picky eaters which need to be integrated in studies measuring picky eating behavior. With the increasing clarity about the main characteristics of picky eating, a validated measure is needed to advance research in the field of picky eating. The current study confirmed that on average food intake of picky eaters differs only slightly from non-picky eaters, which seems to reflect a behavior that can be considered part of normal development. However, because picky eating and child food intake is a major parental concern, feeding strategies and advice related to the relevant characteristics of picky eating behavior need to be developed and assessed for their effectiveness. Furthermore, future studies could link individual foods with their sensory properties to explore why picky eaters refuse certain foods.

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