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.

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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 eating behaviors 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.

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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...
A 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

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 |
|----------------------|----------------------|--------------------------|----------------------|-----------|
| **Gender**           |                      |                          |                      | 0.843     |
| boys                 | 660 (2.3)            | 436 (2.9)                | 136 (5.2)            | 53.2      |
| Girls                | 655 (2.3)            | 379 (2.9)                | 105 (5.2)            | 46.8      |
| **Age**              |                      |                          |                      | 0.000     |
| 12–23.9 months       | 600 (1.8)            | 256 (2.2)                | 61 (2.9)             | 17.7      |
| 24–35.9 months       | 395 (1.9)            | 268 (2.5)                | 70 (5.1)             | 37.3      |
| 36–47.9 months       | 320 (1.6)            | 291 (2.7)                | 110 (4.8)            | 45.0      |
| **Birth order**      |                      |                          |                      | 0.003     |
| First child          | 422 (2.1)            | 355 (3.0)                | 106 (4.9)            | 39.4      |
| Not first child      | 835 (2.1)            | 455 (3.0)                | 127 (4.9)            | 60.6      |
| **Breastfeeding**    |                      |                          |                      | 0.005     |
| Ever breastfed       | 1068 (1.4)           | 641 (2.5)                | 179 (4.8)            | 71.3      |
| Not ever breastfed   | 233 (1.4)            | 164 (2.5)                | 60 (4.8)             | 28.7      |
| **Weight-for-age-percentile** |       |                          |                      | 0.853     |
| 1st Weight-for-age quartile | 264 (2.0) | 147 (2.3) | 48 (4.4) | 24.6      |
| 2nd Weight-for-age quartile | 334 (2.1) | 194 (3.1) | 73 (4.5) | 26.1      |
| 3rd Weight-for-age quartile | 266 (2.1) | 186 (2.7) | 49 (4.1) | 20.7      |
| 4th Weight-for-age quartile | 325 (2.2) | 187 (2.7) | 51 (5.5) | 28.6      |
| **Ethnicity**        |                      |                          |                      | 0.041     |
| Non-Hispanic White   | 991 (2.1)            | 644 (3.0)                | 168 (4.8)            | 45.7      |
| Non-Hispanic Black   | 85 (1.5)             | 65 (2.5)                 | 19 (3.7)             | 16.2      |
| Other                | 97 (1.2)             | 53 (1.3)                 | 23 (1.8)             | 7.2       |
| Hispanic             | 142 (2.1)            | 53 (2.8)                 | 31 (5.5)             | 31.0      |
| **Mother’s education** |                      |                          |                      | 0.006     |
| 9th grade or less    | 19 (0.8)             | 8 (1.6)                  | 7 (1.7)              | 3.6       |
| 10th to 11th grade   | 32 (0.7)             | 20 (0.7)                 | 8 (4.9)              | 10.9      |
| Completed high school| 216 (1.8)            | 146 (1.8)                | 60 (4.6)             | 27.5      |
| Some post-secondary  | 403 (2.1)            | 248 (2.8)                | 70 (3.7)             | 23.6      |
| Completed college    | 404 (1.9)            | 243 (2.7)                | 55 (4.2)             | 21.3      |
| Some graduate work/degree | 240 (1.8) | 150 (2.4) | 39 (2.8) | 13.2      |
| **Household income** |                      |                          |                      | 0.262     |
| Under 10,000         | 42 (1.0)             | 32 (1.0)                 | 13 (2.9)             | 7.8       |
| 10,000 to 19,999     | 64 (1.3)             | 47 (2.7)                 | 13 (4.3)             | 13.3      |
| 20,000 to 34,999     | 151 (1.6)            | 87 (2.5)                 | 26 (3.6)             | 14.5      |
| 35,000 to 49,999     | 189 (1.6)            | 112 (2.0)                | 40 (5.0)             | 18.5      |
| 50,000 to 74,999     | 289 (1.7)            | 187 (2.4)                | 58 (4.0)             | 21.6      |
| 75,000 to 99,999     | 221 (2.0)            | 132 (2.1)                | 35 (3.7)             | 13.5      |
| 100,000 to 149,999   | 163 (1.7)            | 91 (1.8)                 | 23 (0.7)             | 9.2       |
| 150,000 and over     | 78 (1.4)             | 48 (1.8)                 | 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)             | 26 (1.3)                 | 8 (1.1)              | 2.5       |
| Twice                | 146 (1.7)            | 101 (2.4)                | 24 (3.6)             | 12.2      |
| Three to five times  | 537 (2.3)            | 408 (3.0)                | 116 (5.0)            | 44.7      |
| Six to ten times     | 103 (0.8)            | 94 (1.7)                 | 40 (3.3)             | 16.1      |
| More than ten times  | 164 (1.4)            | 162 (1.7)                | 43 (5.0)             | 18.1      |
| Child likes everything | 307 (1.9) | 15 (0.8) | 7 (3.1) | 6.6       |
| **How does child react to new foods** |       |                          |                      | 0.000     |
| Willing to try new foods | 1010 (1.8) | 297 (2.9) | 47 (4.7) | 25.9      |
| Have to be convinced to try new foods, but generally accepts them | 272 (1.8) | 370 (3.0) | 62 (5.3) | 29.0      |
| Does child generally resist new foods? | 22 (0.4) | 134 (1.8) | 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) | 471 (3.0) | 59 (4.0) | 23.9      |
| Resists eating certain food textures | 184 (1.8) | 261 (2.9) | 99 (5.1) | 42.4      |
| Refuses to eat certain food textures | 34 (0.8) | 70 (2.1) | 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)            | 493 (2.8)                | 198 (4.3)            | 79.5      |
| No                   | 918 (2.2)            | 320 (2.8)                | 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.
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, 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 tough texture that is 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 tough texture that is difficult to eat for them.
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 2 | Multiple logistic regression analyses between demographics, child eating characteristics and picky eater status of preschoolers. |
|---------|---------------------------------------------------------------------------------------------------------------|
| Predictors | OR | 95% Wald Confidence Limits | P-value |
| Gender (boy) | 0.87 | 0.61 | 1.25 | 0.453 |
| Birth order (not first child) | 0.58 | 0.40 | 0.84 | 0.004 |
| Breastfeeding (never breastfed) | 1.88 | 1.22 | 2.89 | 0.004 |
| Birth order (not first child) | 1.05 | 0.63 | 1.75 | 0.956 |
| Birth order (not first child) | 1.00 | 0.62 | 1.62 | 0.567 |
| Birth order (not first child) | 0.91 | 0.56 | 1.46 | 0.347 |
| Ethnicity | 1.00 | | | |
| Non-Hispanic White | 1.37 | 0.76 | 2.47 | 0.044 |
| Non-Hispanic Black | 2.90 | 1.31 | 6.40 | 0.024 |
| Other | 1.02 | 0.43 | 2.41 | 0.903 |
| Hispanic | 1.00 | | | |
| Mother’s education | 1.00 | | | |
| 9th grade or less | 1.35 | 0.17 | 10.48 | 0.015 |
| 10th to 11th grade | 5.33 | 1.68 | 16.93 | 0.001 |
| Completed high school | 1.86 | 0.93 | 3.75 | 0.048 |
| Some post-secondary | 2.49 | 1.37 | 4.53 | 0.001 |
| Completed college | 1.40 | 0.79 | 2.51 | 0.856 |
| Some graduate work/degree | 1.00 | | | |
| Household income | 1.00 | | | |
| Under 10,000 | 0.64 | 0.22 | 1.90 | 0.172 |
| 10,000 to 19,999 | 1.77 | 0.58 | 5.40 | 0.023 |
| 20,000 to 34,999 | 1.87 | 0.72 | 4.85 | 0.001 |
| 35,000 to 49,999 | 1.24 | 0.51 | 2.99 | 0.001 |
| 50,000 to 74,999 | 1.13 | 0.50 | 2.56 | 0.001 |
| 75,000 to 99,999 | 1.11 | 0.48 | 2.56 | 0.001 |
| 100,000 to 149,999 | 0.67 | 0.26 | 1.71 | 0.001 |
| 150,000 and over | 1.00 | | | |

How many times do you offer new food before you decide the child does not like it?

- Child likes everything: 1.00
- 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?

- 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: 1.91 (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

Table 3

Main food group consumption by picky eater status (grams and Kcal)².

| 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) | 0.783 |
| Supplements          | 10.2 (4.2)      | 10.0 (2.7) | 0.973 | 5.9 (2.2) | 8.8 (2.5) | 0.385 |

² 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.
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 more specific measures. Various recent reviews address a similar need for more specific measures.

Table 4

| Vegetable type | Not picky (n = 1315) | Picky (n = 1056) | P-value | Not picky (n = 1315) | Picky (n = 1056) | P-value |
|----------------|----------------------|-----------------|---------|----------------------|-----------------|---------|
| Gram (SE)      | Kcal (SE)            | Gram (SE)       | Kcal (SE) |                     |                 |         |
| 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 | 15.0 (1.9) | 18.1 (3.1)      | 0.508    | 28.0 (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   |
| **Soup**       | 13.4 (1.6)           | 8.0 (1.3)       | 0.012    | 39.0 (4.8)           | 22.9 (3.6)      | 0.009   |
| Spaghetti, ravioli, lasagna | 19.5 (3.1) | 22.5 (4.6)      | 0.588    | 11.0 (2.1)           | 9.8 (1.8)       | 0.705   |
| Vegetable preparation method | 27.1 (3.0) | 21.5 (2.7)      | 0.180    | 31.2 (3.5)           | 23.6 (3.1)      | 0.121   |

* 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.

**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.

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 Child'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

Neophelia, 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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