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Relationships of neophobia and pickiness with dietary variety, dietary quality and diabetes management adherence in youth with type 1 diabetes

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Abstract

BACKGROUND/OBJECTIVES—Neophobia, pickiness and diet variety are associated with diet quality and health outcomes in young children. Limited research has examined these associations among youth with type 1 diabetes (T1D), a population at risk for poor health outcomes when dietary quality is inadequate.

SUBJECTS/METHODS—Youth (n = 252, age 13.2±2.8 years, 92% white, diabetes duration 6.3±3.4 years) with T1D and their parents completed 3-day youth diet records; parents completed questionnaires regarding youth neophobia, pickiness and diabetes management adherence. Medical records provided biomedical data. Dietary quality indicators included Nutrient-Rich Foods Index 9.3 (NRF9.3), Healthy Eating Index-2005 (HEI-2005), Whole Plant Food Density (WPFD) and key single nutrients. Dietary variety was operationalized as a count of 20 recommended food groups consumed. Relationships of dietary quality and diabetes management adherence with neophobia, pickiness and dietary variety as independent variables were examined using multiple linear regression analyses adjusted for total energy intake, age, height and weight.

RESULTS—In multiple linear regression analyses, NRF9.3 and HEI-2005 were each inversely associated with neophobia and pickiness, and positively associated with dietary variety. WPF and potassium were each positively associated and saturated fat was inversely associated with dietary variety. However, in models simultaneously including neophobia, pickiness and dietary variety as independent correlates of dietary quality, only relationships with dietary variety remained significant. Diabetes management adherence was negatively associated with both neophobia and pickiness and positively associated with dietary variety.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

CONCLUSIONS—Findings suggest that increasing dietary variety may contribute toward improved dietary quality among youth with T1D, despite potentially adverse influences of neophobia and pickiness.

Keywords

dietary variety; dietary quality; neophobia; pickiness; type 1 diabetes; youth

INTRODUCTION

To improve dietary quality and overall health, the 2010 Dietary Guidelines for Americans issued by the US Department of Agriculture and the Department of Health and Human Services encourage individuals to eat a variety of foods while also having a well-balanced eating pattern that is within energy needs.[1] Following these dietary guidelines by eating a variety of healthful foods allows individuals to achieve adequate calorie, micronutrient and phytonutrient needs for optimal growth and development.[2] Dietary variety and quality are particularly important in early childhood and throughout adolescence as this is a key developmental period where adequate nutrient intake is crucial for proper growth and development and establishing healthful eating patterns for life.[3]

Among youth in the general population, food likes and dislikes are common and have a demonstrated impact on overall dietary quality.[4] Food neophobia, defined as the avoidance of new foods, is common in children under 5 years of age,[4] and is associated with lower consumption of vegetables, fruit and meat in preschool children (2–6 years of age).[5] In school-aged children (4th and 5th graders), food neophobia has been associated with increased saturated fat intake and decreased food variety and dietary quality (as measured by the Healthy Eating Index 2000).[6] Pickiness is a related, although conceptually different, construct[7] referring to the tendency to reject certain types of foods or groups of foods that are both familiar and unfamiliar. Among toddlers and young children, food pickiness has been associated with a less varied diet, especially with regard to vegetable intake.[8–10] Neophobia and pickiness at young ages may lead to persistent food dislikes and reduced diet variety later in life, adversely influencing overall dietary quality[11] and health outcomes.[12] However, little research has examined the impact of neophobia and pickiness on diet variety or quality in preadolescents and adolescents[13,14] nor in populations of youth, such as those with diabetes, who receive medical nutrition therapy as a part of their disease management.

For youth with type 1 diabetes (T1D), the American Diabetes Association recommends a diet consistent with guidelines for the general population, including choosing a variety of foods as part of a healthy diet, to maintain good metabolic control and long-term diabetes health outcomes.[15] However, youth with T1D fall short of meeting guidelines for intake of fruits, vegetables and fiber, and consume excessive total fat and saturated fat.[16,17] These eating behaviors may contribute to risk for excess body weight and of adverse health outcomes such as hypertension and cardiovascular disease.[18] Given the intense burden of T1D management for youth and their parents, including monitoring blood glucose, estimating carbohydrate intake, administering insulin and responding to blood glucose fluctuations, families may find recommendations for healthful eating to be less salient.[19] At

a time when all youth struggle with physical, personal and social changes, adherence to dietary recommendations can be especially difficult for youth with T1D.[15] Food neophobia and pickiness may further complicate adherence to overall diabetes management, potentially impacting glycemic control; however, no research has examined these associations. The objectives of this study were to examine associations of neophobia and pickiness with dietary variety among youth with T1D, and to explore the relationships of neophobia, pickiness and dietary variety with dietary quality, diabetes management adherence and glycemic control. It was hypothesized that greater food neophobia and pickiness would be associated with lower dietary variety and poorer diet quality, as well as lower diabetes management adherence and poorer glycemic control.

MATERIALS AND METHODS

Sample and study design

Data were collected from youth and their parents participating in a cross-sectional study of diabetes management and lifestyle behaviors from July 2008 through February 2009 at a single diabetes clinic in Boston, Massachusetts. Eligibility for youth participants included 8–18 years of age, diabetes duration ≥1 year, daily insulin dose ≥0.5 U/kg, absence of additional chronic illness that would interfere with diabetes or nutrition management and the ability to communicate in English. Study procedures were approved by the institutional review board. Written informed consent for parent and youth ≥18 years and assent for children <18 years were obtained. Of the 455 approached, 302 (66%) participants from 291 families were enrolled. The primary reason for non-participation was a lack of time. In families with multiple siblings enrolled, data from the sibling with the longest diabetes duration was retained. After eliminating sibling pairs and families with missing diet information, the total analytical sample included 252 families. There were no significant differences in neophobia or pickiness between participants included and excluded from this analysis.

Data collection methods included medical record review and self-report surveys administered to youth and parents at the clinic. Three-day food records assessed the child's usual dietary intake. Families received detailed instructions by trained study staff on how to measure and report food and beverage intake. Families kept records on 3 days in 1 week, including 2 weekdays and 1 weekend day, and reported specific details for each food item (e.g., including brands names and restaurant sources). Trained research staff reviewed the completed records upon receipt from the family to ensure completeness, and solicited missing information when possible. The Nutrition Data System for Research software (Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, USA) was used to analyze the diet records.

Measures

Youth pickiness and food neophobia—Pickiness and neophobia were assessed using previously validated parent-report survey measures. Pickiness was assessed using the pickiness (three items, Cronbach's $\alpha = 0.85$) subscale from the Child Feeding Questionnaire,[7] using a 5-point Likert-type scale with responses ranging from 'strongly

disagree' to 'strongly agree'; higher scores indicate greater pickiness. A mean score of all items was used to calculate a total pickiness score (possible score range 1–5).

Food neophobia was assessed using the validated,[20] abbreviated Child Food Neophobia scale (four items, Cronbach's α =0.92). Responses were based on a 4-point Likert-type scale ranging from 'strongly disagree' to 'strongly agree'; higher scores indicate greater food neophobia. The overall neophobia score was calculated using the mean of the individual item scores, standardized to have a mean of 0 and standard deviation of 1, consistent with scoring instructions for the measure.[20]

Dietary variety—A modified version of the measure developed by Murphy and co-workers[21] was used to assess dietary variety (i.e., variability in foods chosen from across food groups), operationalized as a count of the number of food groups consumed. The original measure, which included 22 food groups,[21] was modified in accordance with the recently published 2010 Dietary Guidelines for Americans,[1] which include specific recommendations to reduce intake of processed meat and non-whole grains, and to emphasize low-fat versus high-fat dairy products. Thus, the modified measure excluded counts of foods from the 'franks, lunchmeat' and 'non-whole grains' food groups. In addition, foods from dairy food groups (milk, yogurt and cheese) were counted only if classified as low or reduced fat. Food mixtures were disaggregated before food group servings were calculated. A score of one point was assigned for intake of at least one-half serving of each food group over the 3-day period (i.e., average intake of 0.17 serving per day). Overall scores have a possible range of 0–20; higher counts reflected greater dietary variety.

Dietary quality—Although dietary variety measures variability in foods chosen across food groups, dietary quality assesses optimal dietary intake. To capture a broad representation of overall dietary quality, three previously developed indices were calculated: Healthy Eating Index-2005 (HEI-2005), Nutrient-Rich Foods Index (NRF9.3) and Whole Plant Food Density (WPFD). The HEI-2005 was developed to measure conformance to the 2005 United States Department of Agriculture Dietary Guidelines.[22] The measure comprises 12 component scores (for total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, milk, meat and beans, oils, saturated fat, sodium, and calories from solid fats, alcoholic beverages and added sugars) that contribute to a maximum total score of 100.[23,24] Higher scores represent greater conformance to dietary guidelines. Scores are standardized to 1000 kcal in order to enable comparisons of dietary quality between individuals with differing energy requirements.

The NRF9.3 measures dietary nutrient density of foods and beverages consumed (excluding intakes from dietary supplements).[25] It is a continuous measure calculated from the ratio of intake to daily values of nine nutrients to encourage (i.e., protein, fiber, calcium, iron, magnesium, potassium and vitamins A, C and E) and three nutrients to limit (i.e., saturated fat, added sugar and sodium), relative to energy intake. Higher scores indicate greater dietary nutrient density.

WPFD is a continuous measure of the number of servings of whole plant foods (whole grains, whole fruit, vegetables, legumes, nuts and seeds) per 1000 kcal consumed.[26] This measure was selected because higher levels of a plant-based food consumption have been associated with lower risk of cardiovascular disease,[27] a major complication associated with T1D.[28]

Potassium, sodium, added sugars and saturated fat were examined as additional indicators of dietary quality owing to demonstrated associations with a variety of health outcomes such as hypertension and cardiovascular disease.[29–31]

Diabetes management adherence—Parents completed the Diabetes Management Questionnaire (20 items), which measures multiple aspects of adherence (e.g., response to high and low blood sugars, insulin management during exercise and at mealtimes and blood sugar checking). Response options for this 5-point scale range from ‘almost never’ to ‘almost always’; higher scores indicate greater adherence (possible score range 0–100). This instrument has good psychometric properties and is associated with hemoglobin A1c (HbA1c) and other relevant diabetes management behaviors.[32]

Participant characteristics and biomedical information—Parents reported race/ethnicity, household income, household composition and education level. The household poverty income ratio was calculated using self-reported income, household size and the 2008 federal poverty thresholds (US Census Bureau, 2010). Lower scores represent lower incomes relative to poverty (adjusted for household size and composition, and inflation). Youth age, sex, height, weight, HbA1c, date of diabetes diagnosis, Tanner stage, insulin regimen (pump versus multiple daily injections) and frequency of blood glucose monitoring (checks per day) were extracted from medical records.

Statistical analysis

Participant characteristics and variables of interest were summarized using means and standard deviations for continuous variables and frequencies for categorical variables. Associations of neophobia, pickiness and dietary variety with youth age, sex, SES and parent education were examined using *t*-tests, analysis of variance and simple linear regression analysis. Associations among neophobia, pickiness and dietary variety were assessed using Pearson’s correlation analysis with Sidak adjustment for multiple comparisons. In addition, associations of neophobia, pickiness and dietary variety as independent variables with diabetes management adherence and HbA1c were examined using linear regression adjusted for diabetes-related covariates (age, Tanner stage, insulin regimen, diabetes duration and blood glucose monitoring frequency).

Multiple linear regression analysis was used to examine associations of diet quality indicators (HEI-2005, NRF9.3, WPF and daily intake of potassium, sodium, added sugar and saturated fat) with neophobia, pickiness and dietary variety, adjusting for total energy intake, age, height and weight. Neophobia, pickiness and dietary variety were examined as predictors of each dietary quality indicator in separate models. In addition, the independent contributions of each predictor to dietary quality indicators were evaluated by simultaneously including all three predictors in the same model. STATA version 12

(College Station, TX, USA) was used for all analyses. A *P*-value of <0.05 was used to indicate statistical significance.

RESULTS

Participants were mostly white (92%), with a mean age of 13.2±2.8 years, and a mean diabetes duration of 6.3±3.4 years (Table 1). On average, participants consumed food from approximately 8 (±2.5) of the 20 food groups, comprising the diet variety measure. Examination of bivariate associations of neophobia, pickiness and dietary variety with sociodemographic variables (youth age and sex, socioeconomic status, parent education) indicated no statistically significant relations. The most commonly consumed food groups included whole grain products, low-fat milk and non-citrus fruit (Table 2).

Neophobia and pickiness were highly positively correlated (r =0.78, P<0.001). Neophobia and pickiness were also each negatively correlated with dietary variety (r = −0.28 and −0.31, respectively, both P<0.001). In addition, neophobia (β = −1.81, P =0.001) and pickiness (β = −2.07, P<0.001) individually were negatively associated with diabetes management adherence, and dietary variety (β =0.70, P =0.002) was positively associated with diabetes management adherence in regression models adjusted for age, Tanner stage, diabetes duration, insulin regimen and frequency of blood glucose monitoring. However, neither neophobia, pickiness nor dietary variety was individually significantly associated with HbA1c in adjusted models.

In multiple regression analyses predicting diet quality indicators adjusted for total energy intake, age, height and weight (Table 3), food neophobia was negatively associated with NRF9.3, HEI-2005 and potassium; pickiness was negatively associated with NRF9.3 HEI-2005 and sodium; and dietary variety was positively associated with NRF9.3, HEI-2005, WPF and potassium, and negatively associated with saturated fat. In the extended model simultaneously including neophobia, pickiness and dietary variety as predictors, neither neophobia nor pickiness was significantly associated with any indicator of diet quality, with the exception that pickiness was negatively associated with sodium intake. However, dietary variety was positively associated with NRF9.3, HEI-2005, WPF and potassium and negatively associated with saturated fat intake.

DISCUSSION

Consistent with the stated hypotheses, findings from this study suggest that among youth with T1D, food neophobia and pickiness are related to lower dietary variety and poorer diet quality, as well as lower diabetes management adherence. However, glycemic control as measured by HbA1c was not significantly associated with neophobia, pickiness or dietary variety.

Consistent with findings among younger children in the general population,[8–10,33,34] dietary quality was negatively related to neophobia and pickiness and positively related to dietary variety among this sample of children and adolescents with T1D. Findings suggest the relevance of neophobia and pickiness among this population, even for older children and adolescents, who would equally benefit from improved dietary quality. As youth with T1D

have elevated risk for cardiovascular disease,[28] these findings underscore the importance of addressing food neophobia and pickiness among youth with T1D in the efforts to improve their overall diet.

Participants in the sample consumed an average of approximately 8 of the 20 food groups over a 3-day recording period, indicating fairly low dietary variety. Consistent with previous findings in youth with T1D,[16] they consumed diets of poor quality as indicated by low HEI-2005 scores. Participants on average consumed excessive saturated fat and almost double the recommended amount of added sugars.[1] Whole plant food consumption (2.0±1.0 servings), which is protective for multiple health outcomes,[27] was also inadequate relative to recommended intake for these combined food groups.[1] Although dietary intake is an integral part of diabetes management,[35] previous research suggests that families of youth with T1D may not prioritize healthful eating, given the multiple demands of diabetes management, as well as barriers to healthy eating such as the widespread availability of unhealthy foods, lack of food preparation time and desire for intakes consistent with friends given the already substantial differences placed upon the youth with diabetes compared with their peer group.[19,36] In addition, some families may focus on a food's postprandial glycemic response, emphasizing both the amount of carbohydrate and ease of carbohydrate estimation, which may limit the foods children with T1D choose to eat.[36]

When neophobia, pickiness and dietary variety were simultaneously included in regression models, only dietary variety was significantly associated with diet quality indicators (HEI-2005, NRF9.3, whole plant food density, potassium, saturated fat), suggesting that dietary variety is an independent contributor to the variance in diet quality. These findings suggest that improving dietary variety may contribute toward improved dietary quality, despite potentially adverse influences of neophobia and pickiness.

Promoting dietary variety can be challenging for parents, especially when youth demonstrate characteristics of neophobia and pickiness. Parents may be able to improve dietary variety by continued exposure to a variety of foods in non-coercive settings.[4] Experimental studies in children have shown that regular and repeated opportunities to sample small amounts of unfamiliar foods increase both liking and consumption of those exposed foods.[37,38] New foods may need to be offered to children 10 or more times before acceptance occurs.[39,40] The effectiveness of such guidance in increasing vegetable acceptance was demonstrated in a randomized trial.[41] In addition, peer and parent modeling of healthy eating in a supportive environment has been shown to positively impact a child's acceptance of a variety of foods that in turn may help to reduce neophobia and pickiness.[42–44] Other strategies for improving diet quality may include pairing new foods with already-accepted tastes,[45,46] including vegetable purees in familiar foods,[43] changing how the food is presented in altering palatability, offering calm, pleasant mealtimes[40] and promoting greater intake of already-accepted healthful foods. Health-care providers can assist parents by providing nutrition education and strategies for families that will help them to adopt healthy eating behaviors. For instance, registered dietitians trained in T1D management can provide families with guidance on carbohydrate estimation as well as overall healthful eating behaviors with provision of multiple available resources (e.g., Internet, mobile apps, 'smart' food scales) that offer approaches for carbohydrate counting across a broad variety of foods. Future

research examining strategies for improving diet variety and quality in youth with T1D is warranted, especially within the family unit.

Higher scores for diabetes management adherence were positively associated with greater dietary variety and lower neophobia and pickiness; however, glycemic control as measured by HbA1c was not associated with neophobia, pickiness or dietary variety. It was anticipated that youth with lower food neophobia and pickiness may achieve greater adherence to diet-related diabetes management tasks, although we did not measure diet-specific diabetes management adherence, which would be an important area for future research. However, a multitude of factors impact glycemic control; hence, the association of neophobia and pickiness with adherence may not be large enough to influence HbA1c. Further research into these relationships would be informative for health care practitioners and researchers in better understanding the impact of food neophobia and pickiness in this population where diet has an integral role in diabetes-related health outcomes. In addition, pickiness has been found to be a risk factor for disordered eating.[47] Given the potential concerns regarding increased risk of disordered eating among youth with T1D,[48,49] investigation into potential relations of pickiness and neophobia with disordered eating may be warranted.

Findings should be interpreted in the light of study limitations. The cross-sectional design does not allow for interpretation of the causality of the observed associations. In additionally, as the study population was a convenience sample obtained from one pediatric diabetes center, findings may not be generalizable to all youth with T1D. Also, we were unable to ascertain a specific measure of diabetes dietary adherence. Despite these limitations, this is the first study to examine neophobia, pickiness and dietary variety with dietary quality, diabetes management adherence and glycemic control among youth with T1D, and thus will enhance understanding of these relationships in a population with elevated diet-related health risks.

In conclusion, these findings indicate that greater food neophobia and pickiness and lower dietary variety are associated with poorer diet quality and diabetes management adherence. Food neophobia and pickiness in youth with T1D may present a challenge for parents trying to encourage adherence to dietary guidelines and diabetes management. However, evidence from previous studies suggest effective approaches for promoting acceptance of new and diverse healthful foods.[4,39] Health-care providers should be aware of the dietary challenges families of youth with T1D encounter and provide nutrition education and strategies for their families that endorse food variety and acceptance.

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Table 1

Sample characteristics of youth neophobia, pickiness, dietary variety and quality (N = 252)

Characteristic	Mean (s.d.)	*n* (%)
Age (years)	13.2 (2.8)	
Gender		
Female		122 (48)
Male		130 (52)
Duration of diabetes (years)	6.3 (3.4)	
Hemoglobin A1c (%)	8.5 (1.3)	
Insulin regimen		
Injections		79 (31.4)
Pump		171 (67.9)
Both		2 (0.8)
Blood glucose monitoring (times per day)	5.5 (2.2)	
Poverty–income ratio*	4.9 (2.7)	
Parent education		
High school or less		22 (8.7)
Junior college/technical school		9 (3.6)
Some college		34 (13.5)
4-Year college		112 (44.4)
Graduate or professional degree		75 (29.8)
Neophobia[a]	2.3 (1.0)	
Pickiness[b]	2.2 (1.0)	
Dietary variety[c]	8.0 (2.5)	
Dietary quality indicators		
Nutrient-Rich Foods 9.3[d]	20.8 (10.4)	
Healthy Eating Index-2005[e]	53.4 (11.0)	
Whole Plant Food Density[f]	2.0 (1.0)	
Potassium (mg)	2334.6 (747.1)	
Added sugar (g)	59.7 (30.8)	
Saturated fat (g)	28.4 (10.3)	
Sodium (mg)	3442.4 (1015.5)	

Abbreviations: HEI-2005, Healthy Eating Index-2005; NRF9.3, Nutrient-Rich Foods Index 9.3.

*Poverty–income ratio based on household poverty income ratio calculated using self-reported income, household size and the 2008 federal poverty thresholds. Lower scores represent lower incomes relative to poverty (adjusted for household size and composition, and inflation).

[a]Neophobia is the mean of the individual item scores (four items from Child Feeding Questionnaire), unstandardized score (score range 1–5).

[b]Pickiness subscale (three items) from Child Feeding Questionnaire; higher scores indicate increased pickiness (score range 1–5).

[c]Measures dietary variety based on counts of 20 food groups (score range 0–20).

[d] NRF9.3 is based on nine nutrients that encourage (i.e., protein, fiber, calcium, iron, magnesium, potassium and vitamins A, C and E) and three nutrients to limit (i.e., saturated fat, added sugar and sodium), and is calculated from dietary intakes of food (not including dietary supplements) relative to energy intake.

[e] HEI-2005 measures conformance to the 2005 dietary guidelines; higher scores indicate greater conformance to guidelines (possible score range 0–100).

[f] Number of daily servings of whole plant foods (whole grains, whole fruit, vegetables, legumes, nuts and seeds) per 1000 kcal consumed.

Table 2

Frequency of intake of 20 food groups comprising the diet variety score in youth (*N* =252)

Food indicator	***Consumption of ≥0.5 servings over 3 days***	
	N	***%***
Dairy		
Low-fat milk	218	87
Low-fat yogurt	48	19
Low-fat cheese	126	50
Fruit		
Citrus type	39	16
Other non-citrus	186	74
Vegetables		
Dark-green	89	35
Deep-yellow	52	21
White potato	102	41
Other starch	47	19
Tomato	137	54
Other	170	68
Grain		
Whole	234	93
Meat		
Red meat	34	14
Organ	0	0
Poultry	156	62
Fish	45	18
Eggs	96	38
Soy products	4	2
Nuts/seeds	118	47
Beans/peas	25	10

Table 3

Coefficient estimates from multiple linear regression analyses examining associations of dietary quality indicators with dietary variety, neophobia and pickiness (N = 252)

	Dependent variables													
Independent variables	***NRF9.3***[a]		***HEI-2005***[b]		***Whole plant food density***[c]		***Potassium (mg)***		***Added sugar (g)***		***Saturated fat (g)***		***Sodium (mg)***	
	β	***s.e.***	**β**	***s.e.***	**β**	***s.e.***	**β**	***s.e.***	**β**	***s.e.***	***β***	***s.e.***	***β***	***s.e.***
Base Models[d]														
Neophobia	−1.81†	0.6	−2.23†	0.7	−0.12	0.1	−75.8*	31.33	2.40	1.7	0.36	0.4	−41.27	39.1
Pickiness	−1.89†	0.7	−2.17†	0.7	−0.06	0.1	−62.3	32.9	3.17	1.7	0.52	0.4	−118.0†	40.3
Dietary variety	2.03‡	0.2	2.07‡	0.3	0.15‡	0.03	94.9‡	11.7	−0.16	0.7	−0.46†	0.2	−5.79	16.2
Extended Models[e]														
Neophobia	−0.28	0.9	−1.06	1.0	−0.15	0.1	−40.1	45.5	0.16	2.7	−0.24	0.6	113.5	61.7
Pickiness	−0.10	1.0	0.25	1.0	0.19	0.1	46.0	47.7	3.25	2.8	0.37	0.6	−226.3‡	64.7
Dietary variety	1.98‡	0.3	1.97‡	0.3	0.16‡	0.03	95.5‡	12.4	0.26	0.7	−0.45†	0.2	−19.6	16.8

Abbreviations: HEI-2005, Healthy Eating Index-2005; NRF9.3, Nutrient-Rich Foods Index 9.3.

*P-value $p \leq .05$.

†P-value $p \leq .01$.

‡P-value $p \leq .001$.

[a] NRF9.3: measure of overall dietary nutrient density.

[b] HEI-2005: measure of conformance to the 2005 USDA Dietary Guidelines.

[c] Whole Plant Foods Density: indicates number of servings of whole plant foods (whole grains, whole fruit, vegetables, legumes, nuts and seeds) per 1000 kcal consumed.

[d] Base models were run separately for each independent variable; covariates include total energy intake, age, height and weight.

[e] Extended model includes neophobia, pickiness and dietary variety and all base model covariates.