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Baseline dietary patterns of children enrolled in an urban family weight management study: associations with demographic characteristics

Parisa Assassi[a], **Beatrice J. Selwyn**[a], **David Lounsbury**[b], **Wenyaw Chan**[a], **Melissa Harrell**[a], **Judith Wylie-Rosett**[b]

[a]Department of Epidemiology, Human Genetics and Environmental Science, UT-Health School of Public Health, Houston, TX, US

[b]Albert Einstein College of Medicine, Albert Einstein College of Medicine, Bronx, NY, US

Abstract

Objective: To identify dietary patterns (DP) of children enrolled in the Family Weight Management Study (FWMS) and to examine relationship between the identified DP with demographics.

Design: We performed a cross-sectional analysis of baseline data from 332 children (BMI ≥85th percentile for age and sex and 7–12 years old) who were enrolled in the FWMS. The Block Kids Food Frequency Questionnaire was used to assess dietary intake. Principal component analysis was conducted to identify DPs.

Setting: Participants were recruited from Jacobi Medical Center, Bronx, NY from July 2009 – December 2011.

Results: The mean age of the children was 9.3 (±1.7 SD) years; about half were female and 75% self-identified as Hispanic/Latino. The majority of parents/guardians were born outside of the mainland USA and half had less than a high school education. We identified a “pizza-pasta” DP (high loadings of pizza, pasta, red meat, chicken, fries, sweets, processed meat, and sweet breads)

CONTACT Parisa Assassi, passassi@qcc.cuny.edu; assassip@gmail.com, Department of Health, Physical Education and Dance, Queensborough Community College, City University of New York-CUNY.

Authors´ contributions
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Designing Study: PA, JWR, BS, DL, WC, MH.
Analysis the data: PA, JWR, BS, DL, WC, MH.
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Disclosure statement
The authors declared no conflict of interest.

Ethical Standards Disclosure
Human subject protection
All study procedures were approved by the Institutional Review Board of the Albert Einstein College of Medicine (Bronx, NY). Consent and assent forms were signed by parents and children, respectively, who met the eligibility criteria and were willing to participate in the study. All materials and forms were available in English and Spanish, and interviews were conducted in the language preferred by each participant.

and a “snacks-dessert” DP (high loadings of snacks, desserts, soft drinks, and bread and refined grains) but no healthy patterns with high loadings of fruit, vegetables, nuts, and dairy products. The “pizza-pasta” pattern was associated with parents/guardian being born in the mainland USA and having a higher educational level ($p < 0.05$) whereas the “snack-dessert” pattern was not significantly associated with any of the demographic variables.

Conclusion: Our findings suggest that poor DP is common among second-generation immigrant Hispanic/Latino children who are obese/overweight. Future research needs to address how parental education and acculturation status are related to DP to inform future directions for preventing childhood obesity.

Keywords

Dietary pattern; obese and overweight; children; principal component analysis; education; parent country of birth

Introduction

Traditional approaches to nutritional epidemiology have contributed to an understanding of the cause and prevention of individual nutrient deficiency without explicitly linking findings to chronic diseases, such as cancer and cardiovascular disease (Hu 2002; Kant 2004). More recently, nutritional epidemiology has begun to focus on dietary pattern analysis which describes the overall diet, represents a broader picture of food and nutrient intake, and predicts health outcomes more precisely than assessing individual foods or nutrients (Hu 2002; Slattery 2008; Ocke 2013). Dietary pattern represents complex sets of highly correlated dietary exposures, and detects joint effects of foods by considering the entire eating pattern (Jaconson and Stanton 1986; Jacques and Tucker 2001). Dietary patterns can be influenced by acculturation, adherence to traditional eating patterns, and the heterogeneity of populations with diverse socioeconomic, cultural and ethnic backgrounds (Satia et al. 2001; Arredondo et al. 2006; Nettleton et al. 2008; Davis et al. 2013).

Emerging evidence indicates that obesity is common among children in the USA and the prevalence of childhood obesity and overweight has increased since 1980 (Skinner and Skelton 2014; Ogden et al. 2016). The prevalence of obesity in children 6 to11 years of age was 11.5% from 1988 to 1994, but it has increased to 17.5% in the time period from 2011 to 2014 in this age group (Ogden et al. 2016). Childhood obesity has been defined as a body mass index (BMI) ≥ 95^{th} percentile for children of the same age and sex, and overweight as BMI ≥ 85^{th} percentile for children of the same age and sex (Barlow et al. 2007; Ogden and Flegal 2010; Ogden et al. 2016). Data from New York City (NYC) public schools indicate that half of NYC children are overweight for their age and sex, with the highest prevalence among Hispanic students (Centers for Disease Control and Prevention 2011).

Observational studies suggest that dietary patterns with high energy-dense, high in fat, and low in fiber foods increase the risk of obesity and overweight in childhood and later in life (Han et al. 2010; Ambrosini et al. 2012; Ambrosini 2014; Gurnani et al. 2015). Identifying and understanding dietary patterns in the obese and overweight pediatric population and their associations with demographic characteristics can be helpful in developing effective preventive strategies for a target population. Although dietary pattern analysis has become a popular alternative method to traditional methods, few studies have been conducted in the U.S. pediatric population (Ritchie et al. 2007; Li and Wang 2008; Lioret et al. 2008; Cutler et al. 2009, 2012; Cribb et al. 2013; Ambrosini 2014; Shang et al. 2014). None of the existing studies conducted in the USA (Ritchie et al. 2007; Li and Wang 2008; Cutler et al. 2009, 2012; Shang et al. 2014) focused on dietary patterns in obese and overweight children. The present study used baseline data from the Family Weight Management Study to identify dietary patterns in obese and overweight children from the Bronx, New York, and to examine the associations of dietary patterns with demographic characteristics.

Methods

This study involved secondary analysis of baseline data from a randomized-controlled trial (Family Weight Management Study (FWMS) registered at www.clinicaltrials.gov, NCT00851201). The trial was conducted at the Jacobi Medical Center in Bronx, NY. The Jacobi facility provides health services to an underserved community where 31.5% of residents live in poverty (United States Census Bureau 2016).

Eligibility criteria for the current study and the FWMS included children 7 to 12 years of age with a BMI ≥ 85th percentile who enrolled to receive primary care in the North Bronx Health Network. Exclusion criteria included chronic illness such as diabetes and major physical, cognitive, or emotional impairment that would affect ability or safety in following the study protocol, treatment with medications to affect body weight, and enrollment in weight management programs. Enrollment occurred from January 2009 to December 2011.

Of the 360 children who participated in the FWMS, 332 participants completed a food intake assessment questionnaire. Thus, the current dietary analysis is based on the completed data from these 332 children.

A trained research staff interviewed children (with assistance from parents or guardians as needed) using the Block Kids Food Frequency Questionnaire (BKFFQ) (Block et al. 2000; Cullen et al. 2008) to assess their dietary intake. The BKFFQ consists of 77 food and beverage items. Each item includes questions about the frequency of consumption during the past seven days with six choices, ranging from “never eaten” to “eaten every day,” and portion size in one day. The validity and the reliability of the BKFFQ were previously evaluated on children and adolescents age 10–17 years old (Cullen et al. 2008).

Standing height and weight of children were measured using a standardized procedure (Family Weight Management Study Writing Group 2008), and the BMI was calculated and converted to age- and sex-standardized percentiles based on the Centers for Disease Control and Prevention (CDC) 2000 growth charts. Children were classified as being overweight if their BMI was ≥ the 85th percentile and <95th percentile for age and sex (Kuczmarski et al. 2002). A BMI ≥ than the 95th percentile for age and sex was categorized as obese (Kuczmarski et al. 2002). Standing height and weight of the parent who was interviewed was measured by a trained research staff member using a standard procedure (Family Weight Management Study Writing Group 2008). Parents were categorized based on their

BMI levels as being: underweight (BMI < 18 kg/m^2), normal weight (BMI ≥ 18 and BMI < 25 kg/m^2), overweight (BMI ≥ 25 and BMI < 30 kg/m^2), and obese (BMI ≥ 30.0 kg/m^2) (Centers for Disease Control and Prevention 2017).

An interviewer-administered questionnaire was used to collect demographic information from each child and his/her family. Due to a large proportion of Hispanics (74.1%) in the study population, race and ethnicity were collapsed into a single variable (Hispanic/Latino, Non-Hispanic). Black Hispanic Latino participants were included in the Latino category. African-American, Asian, Caucasian, Native Hawaiian, and American-Indian participants were included in the Non-Hispanic category. Parent measures included education of the mother, household income, country of birth (of the parent who was interviewed), and years living in the USA. We included education of the mother since there is evidence showing that maternal education is closely related to the child's nutritional status, and the impact of the maternal education on child health and nutrition is larger than that of paternal education (Reed et al. 1996; Alderman and Headey 2017). Household yearly income was categorized into three categories: less than or equal to 9,999, USD between 10,000 USD to 19,999, USD and more than 20,000 USD per year. Child measures included age and gender.

Household food security was assessed by parents' self-response to six questions from the Short Form of the Household Food Security Scales, which is a validated and reliable instrument (Blumberg et al. 1999; Gulliford et al. 2004; United States Department of Agriculture Economic Research Service 2012). The scale for the household food security measure was calculated as the sum of affirmative responses to the six questions; thus, the total scores ranged from 0 to 6 (United States Department of Agriculture Economic Research Service 2012). The food security status of households with a score of 0 was considered as secure, and a household with a score equal to or greater than 1 was considered as food insecure.

Statistical analysis

We recoded portion size and frequency responses for each food item on the BKFFQ into frequency-per-day indices by multiplying consumption frequency per day by serving size. Seventy-seven food items in the BKFFQ were grouped into 26 food categories based on nutrient profiles or culinary usage (Fung et al. 2001; Nettleton et al. 2006) (appendix 1). The BKFFQ included multiple food groups that were significantly different from existing food categories (e.g., pizza, soups, and multiple cultural foods). We created new categories to represent these items.

We used Principal Component Analysis (PCA) to identify dietary patterns (Hu 2002; Ocke 2013). The 26 investigator-defined food categories were entered into the PCA analysis. The factors were rotated by varimax (orthogonal) transformation to maintain uncorrelated factors and interpretability. To determine the number of factors and item-selection in each factor, we used the criteria of an eigenvalue greater than 1, factor loadings above 0.30, Cronbach's alpha greater than 0.70, and face validity. PCA-defined factor scores were calculated for each participant by summing intake of food categories weighted by factor loading. Each individual received a factor score for each PCA-defined dietary pattern. The factor scores calculated for each dietary pattern represent the level of adherence to that specific dietary pattern, with a higher factor score representing a higher consumption of foods represented by that dietary pattern.

To facilitate comparison of each dietary pattern, we categorized participants to tertiles of “high,” “medium,” or “low” scores, representing “high, medium, or low” intake of the foods in that dietary pattern.

We examined multi-co-linearity among demographic variables using cross-tabulation or Pearson correlation, and considered a Pearson correlation coefficient equal to or higher than 0.65 as the cut-off point for co-linearity. Parent’s country of birth, years of living in the USA, and race/ethnicity were co-linear; thus, we only included parental country of birth in the model. Since Puerto Rico is a territory and not in the mainland USA, we categorized Puerto Rico born parents as an individual category. Mother’s education and household income were correlated; thus, we included only education of the mother in the multivariate model. Demographic variables included in each multivariate model were child age, child BMI, gender, and parent’s country of birth, mother’s educational level, parent BMI, and household food security index.

Univariate analysis of variance was performed to compare mean differences between dietary pattern scores and BMI *Z*-scores. Univariate analysis of variance was also used to compare the mean difference between nutrient intake of participants and the PCA-defined dietary pattern tertiles (“low intake,” “medium intake,” and “high intake”).

We combined the second and third tertiles (“medium intake” and “high intake”) of each dietary pattern in order to generate a binary variable in which the first tertile (“low intake”) denoted the reference group. Logistic regression analysis was conducted to determine the association between demographic variables and dietary tertiles (“low intake” versus “medium intake or high intake”) of each PCA-defined dietary pattern. We reported odds-ratios and their corresponding 95% confidence intervals for each association. A multivariable logistic regression analysis was conducted to assess the demographic variables associated with each PCA-defined dietary pattern. All models were adjusted for BMI *Z*-score.

Results

A total of 332 children with BMI ≥ 85 percentile were enrolled (Mean age: 9.3 ± 1.7 years, Male: 46.7%, Hispanic/Latino: 74.1%, Obese: 76%, Overweight: 23.6%).

Two major patterns were identified by PCA, that explained 16.12% and 7.33% of the variation of food intakes, respectively. Dietary patterns were named according to the food categories that were highly loaded for each dietary pattern. PCA defined pattern 1, “pizza and pasta,” was characterized by high loadings of pizza, pasta, red meat, chicken, fries, sweets, processed meat, and sweet breads (descending order). PCA defined pattern 2, “snacks and dessert,” was characterized by high loadings of snacks, desserts, soft drinks, and bread and refined grains (Table 1). The mean scores of both PCA identified dietary patterns were higher in the “high intake” participants ($P < 0.01$, Table 2).

The mean nutrient intakes by PCA-defined pattern scores are shown in Table 3. Children in the "high intake" of the "pizza and pasta" pattern consumed significantly more calories, fat, saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, carbohydrate, sugar, fiber, protein, and dairy products than children in the "low intake" of the "pizza and pasta" pattern ($P < 0.01$). Similarly, in the "snacks and dessert" pattern, calories, total fat, saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol, protein, sugar, fiber, and dairy mean intake was significantly higher in the "high intake" category ($P < 0.01$ for all). Although a child in the "high intake" category of the "snacks and dessert" pattern consumed more protein than a child in the "low intake" category, the percentage of calories from protein was less in a child in the "high intake" category than in a child in "low intake" category (15.15 vs. 13.45, $P < 0.01$). The intakes of vegetables and fruits were not significantly different between participants in the "low intake" and "high intake" categories in either dietary pattern.

Pizza and pasta pattern

There was a significant association between parents' place of birth and "pizza and pasta" pattern. Children with higher intake (second and third tertiles) of the "pizza and pasta" pattern were more likely to have parents/guardians born in the mainland USA (OR = 3.79, 95% CI: 1.66–8.26). Children with a parent/guardian born in Mexico or Dominican Republic were less likely to consume foods from "pizza and pasta" pattern compared to children with parents born in the mainland USA (OR = 0.30, 95% CI: 0.16–0.76, and OR = 0.20, 95% CI: 0.07–0.52, respectively). There was a significant association between maternal education and "pizza and pasta" dietary pattern. Children, whose mothers had high school or post-secondary education, were more likely to consume foods from the "pizza and pasta" dietary pattern compared to children whose mothers had less than a high school education (OR = 1.81, 95% CI: 1.03–3.22; OR = 2.39, 95% CI: 1.08–2.29, respectively) (Table 4).

Snacks and dessert pattern

Children in the higher intake category of the "snacks and dessert" pattern were more likely to have a parent born in the mainland USA or a parent/guardian that lived in the USA for more than 10 years (OR = 2.16, 95% CI: 1.02–4.55). Children with a parent/guardian born in Mexico were less likely to consume foods from "snack and dessert" dietary patterns compared to children with parents/guardians born in mainland USA (OR = 0.47, 95% CI: 0.23–0.64) (Table 5).

We included gender, child age, parent's/guardian's country of birth, mother education, parent BMI, child BMI, and household food security in the multivariate logistic regression analysis (Table 6). The "pizza and pasta" pattern was significantly associated with child age, parents' country of birth, and mother's education. Children aged 10–12 were less likely to consume foods from the "pizza and pasta" pattern than children 7–9 year-old (OR = 0.44, 95% CI: 0.23–0.84). Children with parents born in Mexico or the Dominican Republic were less likely to consume from the "pizza and pasta" pattern as compared to children with the parents born in the mainland USA (OR = 0.18, 95% CI: 0.07–0.52; OR = 0.13, 95% CI: 0.39–0.43, respectively). Children whose mothers had postsecondary education were more likely to consume from "pizza and pasta" pattern compared to children with mothers with high school education or less (OR = 3.18, 95% CI: 1.23–8.16).

Discussion

In our study of overweight or obese children from Bronx with predominantly Hispanic and low-income backgrounds, we identified two major dietary patterns. The "pizza and pasta" pattern was loaded with energy-dense, mostly processed, convenience foods such as fries, processed meats, fried chicken, and red meats. The "snacks and dessert" pattern was high in sugar and/or fat, salty snacks, sweets, and soft drinks, and sugary beverages. The analysis of demographic factors and dietary patterns indicated that the parents' place of birth and maternal education were associated with the "pizza and pasta" pattern.

Comparison of dietary patterns across studies is complicated by differences in dietary assessment methods, definitions, and distribution of the food groups, the number of food groups identified for analysis, the number of patterns retained for analysis, and statistical techniques used for dietary pattern analysis. However, we found some commonalities and differences in our PCA-identified dietary patterns and other studies that examined dietary patterns in children and adolescents (Northstone and Emmett 2005; Ritchie et al. 2007; Cutler et al. 2009). The earlier published studies (Aranceta et al. 2003; Northstone and Emmett 2005; Lioret et al. 2008; Ambrosini et al. 2009; Shang et al. 2014; Pinho et al. 2014) identified at least one healthy dietary pattern characterized by high loadings of fruit, vegetables, nuts, and dairy products. We did not observe a comparable pattern indicating a healthy diet in our study population. Dietary patterns similar to our "pasta and pizza" pattern and/or "snacks and dessert" pattern have been identified in other pediatric and adolescent populations (Aranceta et al. 2003; Northstone and Emmett 2005; Lioret et al. 2008). Our "snacks and dessert" dietary pattern was similar to the "snacky" pattern reported by Aranceta et al. (Aranceta et al. 2003) and "sweet/salty snack" reported by Cutler et al. (Cutler et al. 2009) which were characterized by high loadings of confectionery, sweets, salted snacks, and soft drinks. Other studies have reported dietary patterns comparable to our "pizza and pasta" pattern, or the combination of the "pizza and pasta" and "snacks and dessert" patterns. For instance, a study from the USA (Ritchie et al. 2007) identified a "fast food" pattern with high loading of burgers, fried potatoes, processed meat sandwiches, chips, legumes, and baked desserts. A Canadian study (Shang et al. 2014) identified a "fast food" pattern with high loadings of sugary beverages, fried food, convenience foods such as processed meat, and salty snacks. An Australian study (Ambrosini et al. 2009) characterized a "Western food" pattern containing convenience foods, soft drinks, confectionery, French fries, refined grains, and processed meats. A study from the UK (Northstone and Emmett 2005) described a "junk food" pattern that consisted of high-in-fat, processed foods with sugary and/or salty snacks. Four of the above-mentioned studies (Northstone and Emmett 2005; Lioret et al. 2008; Ambrosini et al. 2009; Shang et al. 2014) assessed the association of the identified dietary patterns and BMI status. These studies reported higher consumption of foods with a high loading of processed foods, fast foods, snacks, and sugary beverages in overweight children. The Canadian (Shang et al. 2014) and Brazilian (Pinho et al. 2014) studies also reported that overweight and obese children were less likely to consume foods from the "healthy" dietary pattern.

The logistic regression analysis confirmed significant association between parents' place of birth and the "pizza and pasta" pattern in our study population. Children with a parent born in the mainland USA were more likely to have higher scores on the "pizza and pasta" and "snacks and dessert" patterns. Wiley et al. (Wiley et al. 2014) suggested that immigrant children with more acculturated families or neighborhoods consumed significantly more Westernized diet. They found that children of mothers with greater acculturation to the USA culture tended to fall into higher BMI percentiles and consume more processed, energy-dense, snacky foods. Among immigrants of Mexican descent, it has also been shown that a greater degree of acculturation is associated with lower intakes of healthy traditional Mexican foods that include vegetables, fruits, and whole grains (Wiley et al. 2014). American acculturation in children of Mexican immigrants is found to be associated with a higher consumption of refined grains, food with added sugars, sugar-sweetened beverages, and nutrient-poor, energy-dense foods (Akresh 2007; Ayala et al. 2008; Batis et al. 2011). Results of a study by Montez and Eschbach (Montez and Eschbach 2008) reported that mainland USA-born women were significantly more likely to consume processed meats and French fries, and were less likely to consume fruits, vegetables, and whole grains than Mexican-born women (Montez and Eschbach 2008). We identified a significant association between higher maternal education and increased intake of the "pizza and pasta" dietary pattern. A previously published study by Northstone et al. (Northstone and Emmett 2005) reported an inverse association between maternal education and a "junk-type" food dietary pattern characterized by high loading of convenience and high fat foods. However, we observed a positive but not significant association between increased intake of the "snack and dessert" dietary pattern and higher maternal education. This may be explained by the mostly low income, and immigrant population of Bronx, NY, where our study took place.

We observed an inverse but not significant association between lower household income and higher intake of the "pizza and pasta" dietary pattern. A similar trend with significant associations have been reported in previously published studies (Aranceta et al. 2003; Ambrosini et al. 2009).

Our study suggests that the dietary intake of children with parents born in the mainland USA differs from children with an immigrant parent or guardian. Level of acculturation and the dietary patterns may be associated and different between born in the mainland USA and foreign-born parents (Wiley et al. 2014). This highlights the important role that the family plays in children's acculturation and dietary behavior, and aligns well with findings of other studies about acculturation and diet (Arredondo et al. 2006; Northstone et al. 2014; Conlon et al. 2015). Parents who immigrated to the mainland USA may bring their original dietary culture to their new environment and may continue to reinforce their original dietary cultures in the family (Zane and Mark 2003) for some time, while second generation ethnic minorities (the USA-born ethnic minorities) might adopt a more Americanized dietary culture. Thus, the parental acculturation process might play an important role in shaping the dietary intake and choices of families.

We did not identify major dietary patterns with high loadings of healthy foods in our population. The possible explanation for this discrepancy is that all children in our study were obese and overweight, while other studies recruited participants that represented the general pediatric or adolescent populations, (Aranceta et al. 2003; Northstone and Emmett 2005; Lioret et al. 2008; Ambrosini et al. 2009; Shang et al. 2014; Pinho et al. 2014) with the exception of the Canadian study (Shang et al. 2014) which recruited children (8–10 years old) with at least one parent who was obese (BMI ≥ 30).

We observed a negative but not significant association between lower family income and increased intake of the "pizza and pasta" dietary pattern. The lack of a significant association in our study could be due to the predominantly low income and economic status of families from Bronx, that are known to have the highest poverty rate in New York City, with 38% of the residents being below the federal poverty level (Rodriguez 2017).

A dietary pattern with high fat/sugar and low fiber foods has been associated with childhood obesity (Johnson et al. 2008). Childhood obesity is considered to be a risk factor for chronic diseases including high blood pressure, hyperlipidemia, insulin resistance, type 2 diabetes and fatty liver disorder (Hampl and Campbell 2015).

Our study focuses on the dietary patterns of children who are obese and overweight and live in the Bronx, NY, one of the poorest and most underserved communities in the USA. This study may provide important enabling information to conceptualize targeted guidelines and effective preventive strategies for this population. We present a case for tailoring custom dietary advice for first-generation immigrant parents to promote healthy cultural foods. This may encourage the second generation to adopt healthier dietary patterns. Dietary counseling should focus on promoting healthier main dishes and reducing the consumption of unhealthy snacks and desserts.

Our findings should be interpreted in the context of the following limitations. There were inherent biases with the use of Food Frequency Questionnaires (FFQs) to assess dietary intake. The research staff interviewed children with assistance from parents or guardians which could have influenced children to provide socially desirable responses. Although visual representations of serving sizes, on plates or in bowls, were used during the interview sessions to aid portion size estimations, the FFQs are still subject to recall bias and individual measurement error (Cullen et al. 2008). However, the FFQ remains one of the most practical dietary assessment methods in epidemiological and nutritional studies (Cullen et al. 2008; Shim et al. 2014).

We should also consider limitations of the cross-sectional study design when interpreting our results. This study cannot provide information about the temporal relationship between dietary patterns and obesity among children (Börnhorst et al. 2013; Bel-Serrat et al. 2016).

The higher proportion of children who were obese versus overweight limited our ability to compare the dietary patterns in these two groups.

Few studies have used dietary pattern analysis in pediatric populations (Aranceta et al. 2003; Ritchie et al. 2007; Lioret et al. 2008; Cutler et al. 2009; Pala et al. 2013; Turyashemererwa et al. 2013; Shang et al. 2014; Pinho et al. 2014; Northstone et al. 2014; Kehoe et al. 2014; Tavares et al. 2014). Our literature search yielded no study examining the dietary pattern analysis of overweight or obese children. Employing PCA, we successfully identified two distinct "unhealthy" dietary patterns while failing to identify a "healthier" pattern among our study population. That is, children in our study who are overweight or obese, often consume nutrient-poor and energy-dense foods while intake of fruits, vegetables, and dairy products (which constitute a "healthy" dietary pattern) is not a prominent pattern in this population (United States Department of Agriculture 2018).

Our study highlights potential targets for interventions that may aim to improve dietary intake of high-risk communities, particularly obese and overweight children. Promoting fruit and vegetable intake among children in low-income, urban communities may be prioritized for preventing obesity and overweight. The poor dietary intake among children is a public health concern given the high prevalence of obesity and other health-related outcomes associated with nutrient-poor diet.

Conclusions

Our examination of the dietary patterns was obtained from predominately Hispanic/Latino children, who are overweight or obese in one of the poorest communities in the USA (United States Census Bureau 2016). Our findings suggest that dietary patterns may reflect cultural background, and wide-ranging personal and socio-cultural influences. The dietary intake in children with parents born in the mainland USA was different from children with parents born elsewhere. This finding highlights the role of family in shaping dietary behavior of the future generations. Study findings can help facilitate developing culturally sensitive and demographically tailored approaches to improve eating behavior in pediatric populations with diverse ethnic backgrounds.

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Appendix 1.: Food frequency questionnaire items by food group used in the principal component analysis from the family weight management study data.

Food Groups	Items included in group
Fruit	Bananas, apples or pears, oranges or tangerines, strawberries or other berries, apple sauce, fruit cocktail or pineapple slices, any other fruit like grapes, peaches, watermelon, cantaloupe, fruit roll-ups
Real fruit juice	Real orange juice, any other real fruit juices such as apple juice or grape juice

Food Groups	Items included in group
Vegetables	Salad with lettuce, green salad, green beans, string beans or peas, collards, mustard greens or spinach, broccoli, carrots, carrot sticks or cooked carrots, cooked green pepper, chile rellenos, green chili stew, any other vegetables like squash, cauliflower, asparagus, eggplant, nopales
Potato and starchy vegetables	Sweet potatoes, sweet potato or pumpkin pie, other starchy vegetables like yucca, yautia, plantain, corn or corn-on-the-cob, any kind of potatoes like mashed, baked or boiled
Processed meat	Bacon or sausage, hot dogs or corn dogs, lunch meats, ham, Lunch-ables
Poultry	Fried chicken, including nuggets, other chicken, roasted, stewed
Red meat and eggs	Hamburger or cheeseburger, roast beef or steak, pork chops, cooked ham, Hot Pockets, meat ball subs or Sloppy Joes, eggs or breakfast sandwiches
Fish	Any fish, fish sticks, shrimp, tuna
Legumes	Pinto beans, chili with beans, refried beans, beans in enchiladas
Nuts and seeds	Sunflower seeds, peanuts or other nuts, peanut butter sandwiches
Whole grain bread, rice and pasta	Whole wheat bread or rolls, multigrain bread, corn tortillas, whole wheat Tortillas
Refined bread and rice	White bread or rolls, white rice, rice including fried rice, Spanish rice, rice with beans, bagels, flour tortillas, biscuits
Cereals	Cooked cereals like oatmeal or grifts, cold cereals like corn
Pasta	Macaroni and cheese, spaghetti, pasta, other noodles
Sweet breads and bars	Pancakes, waffles, pop tarts, other sweet muffins, French toast Granola bars and breakfast bars
Pizza	Pizza or pizza pockets
Dairy and cheese	Reduced fat 2% milk, low-fat 1% milk, non-fat skim milk, low-fat yogurt, Lactaid milk, milk added to cereals, whole milk and whole milk yoghurt, cheese and cheese in sandwiches or quesadillas
Chocolate milk	Chocolate milk, hot chocolate or other flavored milks
Fries	French fries, tater tots, hash browns or home fries
Desserts	Puddings, ice cream, frozen yogurt, cookies, doughnuts, cake, pies
Sweets	Candies, chocolate candy like candy bars, other candy, jams and honey
Snacks	Crackers, snack chips like potato chips, tortilla chips, Doritos, popcorn, Bugles, Cheetos
Fats and oils	Mayonnaise or sandwich spread, margarine or butter, salad dressing
Soft drinks and Sugary drinks	Sodas like coke, Dr. Pepper, 7 Up, Sprite, Sunkist, orange, Slurpees, snow cones, popsicles, Hawaiian punch, Kool-Aid, Hi-C, Tang, Mr. Juicy
Soups	Vegetable soup, vegetable beef soup, tomato soup, chicken noodles, menudo and posole
Cultural foods	Tacos, burritos, tamales, Frito pie, tamale pie, enchiladas, chalupas or nachos with cheese, avocado or guacamole

References

Akresh I 2007. Dietary assimilation and health among hispanic immigrants to the United States. J Health Soc Behav. 48(4):404–417. doi:10.1177/002214650704800405. [PubMed: 18198687]

Alderman H, Headey D. 2017. How Important is parental education for child nutrition? World Dev. 94:448–464. doi:10.1016/j.worlddev.2017.02.007. [PubMed: 28579669]

Ambrosini G, Emmett P, Northstone K, Howe LD, Tilling K, Jebb SA. 2012. Identification of a dietary pattern prospectively associated with increased adiposity during childhood and adolescence. Int J Obes. 36(10):1299–1305. Lond. doi:10.1038/ijo.2012.127.

Ambrosini G, Oddy W, Robinson M, O'Sullivan TA, Hands BP, de Klerk NH, Silburn SR, Zubrick SR, Kendall GE, Stanley FJ, et al. 2009. Adolescent dietary patterns are associated with lifestyle and family psycho-social factors. Public Health Nutr. 12(10):1807–1815. doi:10.1017/S1368980008004618 [PubMed: 19161648]

Ambrosini GL. 2014. Childhood dietary patterns and later obesity: a review of the evidence. Proc Nutr Soc. 73(1):137–147. doi:10.1017/S0029665113003765. [PubMed: 24280165]

Aranceta J, Pérez-Rodrigo C, Ribas L, Serra-Majem L. 2003. Sociodemographic and lifestyle determinants of food patterns in Spanish children and adolescents: the enKid study. Eur J Clin Nutr. 57(Suppl 1):S40–4. doi:10.1038/sj.ejcn.1601813. [PubMed: 12947451]

Arredondo EM, Elder J, Ayala G, Campbell N, Baquero B, Duerksen S. 2006. Is parenting style related to children's healthy eating and physical activity in Latino families? Health Educ Res. 21(6):862–871. doi:10.1093/her/cyl110. [PubMed: 17032706]

Ayala G, Baquero B, Klinger S. 2008. A systematic review of the relationship between acculturation and diet among Latinos in the United States: implications for future research. J Am Diet Assoc. 108(8):1330–1344. doi:10.1016/j.jada.2008.05.009. [PubMed: 18656573]

Barlow S, Richert M, Baker E. 2007. Putting context in the statistics: paediatricians' experiences discussing obesity during office visits. Child Care Health Dev. 33(4):416–423. doi:10.1111/j.1365-2214.2006.00716.x. [PubMed: 17584397]

Batis C, Hernandez-Barrera L, Barquera S, Rivera J, Popkin B. 2011. Food acculturation drives dietary differences among Mexicans, Mexican Americans, and Non-Hispanic Whites. J Nutr. 141(10):1898–1906. doi:10.3945/jn.111.141473 [PubMed: 21880951]

Bel-Serrat S, Julián-Almárcegui C, González-Gross M, Mouratidou T, Börnhorst C, Grammatikaki E, Kersting M, Cuenca-Garcia M, Gottrand F, Molnar D, et al. 2016. Correlates of dietary energy misreporting among European adolescents: the healthy lifestyle in europe by nutrition in adolescence (HELENA) study. Br J Nutr. 115(8):1439–1452. doi:10.1017/S0007114516000283 [PubMed: 26888046]

Block G, Murphy M, Roulett J, Wakimoto P, Crawford P, Block T. (2000) Pilot validation of a FFQ for children 8–10 years. Abstract presented at Fourth International Conference on dietary Assessment Methods, Arizona.

Blumberg SJ, Bialostosky K, Hamilton WL, Briefel R. 1999. The effectiveness of a short form of the household food security scale. Am J Public Health. 89(8):1231–1234. doi:10.2105/AJPH.89.8.1231 [PubMed: 10432912]

Börnhorst C, Huybrechts I, Ahrens W, Eiben G, Michels N, Pala V. 2013. Prevalence and determinants of misreporting among European children in proxy-reported 24 h dietary recalls. Br J Nutr. 109(7):1257–1265. doi:10.1017/S0007114512003194 [PubMed: 22863030]

Centers for Disease Control and Prevention. 2011. Obesity in K-8 students - New York city, 2006–07 to 2010–11 school years. MMWR. 2016 60(49):1673–1678.

Centers for Disease Control and Prevention. (2017). How is BMI interpreted for adults? Available from: https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/. (accessed June 2018)

Conlon B, McGinn A, Lounsbury D, Diamantis PM, Groisman-Perelstein AE, Wylie-Rosett J, Isasi CR. 2015. The role of parenting practices in the home environment among underserved youth. Childhood Obes. 11(4):394–405. doi:10.1089/chi.2014.0093.

Cribb V, Emmett P, Northstone K. 2013. Dietary patterns throughout childhood and associations with nutrient intakes. Public Health Nutr. 16(10):1801–1809. doi:10.1017/S1368980012004132. [PubMed: 22974523]

Cullen K, Watson K, Zakeri I. 2008. Relative reliability and validity of the Block Kids questionnaire among youth aged 10 to 17 years. J Am Diet Assoc. 108(5):862–866. doi:10.1016/j.jada.2008.02.015. [PubMed: 18442512]

Cutler G, Flood A, Hannan P, Neumark-Sztainer D. 2009. Major patterns of dietary intake in adolescents and their stability over time. J Nutr. 139(2):323–328. doi:10.3945/jn.108.090928. [PubMed: 19091799]

Cutler GJ, Flood A, Hannan P, Slavin JL, Neumark-Sztainer D. 2012. Association between major patterns of dietary intake and weight status in adolescents. Br J Nutr. 108(2):349–356. doi:10.1017/S0007114511005435. [PubMed: 22017879]

Davis NJ, Schechter CB, Ortega F, Rosen R, Wylie-Rosett J, Walker EA. 2013. Dietary patterns in Blacks and Hispanics with diagnosed diabetes in New York city's South Bronx. Am J Clin Nutr. 97(4):878–885. doi:10.3945/ajcn.112.051185. [PubMed: 23446901]

Family Weight Management Study Writing Group (2008). Standard procedure for measuring height and weight in the family weight management study. standard procedures for the family weight management study.

Fung TT, Willett WC, Stampfer MJ, Manson JE, Hu FB. 2001. Dietary patterns and the risk of coronary heart disease in women. Arch Intern Med. 161(15):1857–1862. doi:10.1001/archinte.161.15.1857. [PubMed: 11493127]

Gulliford M, Mahabir D, Rocke B. 2004. Reliability and validity of a short form household food security scale in a Caribbean community. BMC Public Health. 16(4):22.

Gurnani M, Briken C, Hamilton J. 2015. Childhood obesity causes, consequences, and management. Pediatr Clin North Am. 62(4):821–840. doi:10.1016/j.pcl.2015.04.001. [PubMed: 26210619]

Hampl S, Campbell A. 2015. Recognizing obesity and its complications: the story of score 1 for health. NASN Sch Nurse. 30(1):46–52. doi:10.1177/1942602X14559749. [PubMed: 25626243]

Han J, Lawlor D, Kimm S. 2010. Childhood obesity – 2010: progress and challenges. Lancet. 375(9727):1737–1748. doi:10.1016/S0140-6736(10)60171-7. [PubMed: 20451244]

Hu FB. 2002. Dietary pattern analysis: a new direction in nutritional epidemiology. Curr Opin Lipidol. 13(1):3–9. doi:10.1097/00041433-200202000-00002. [PubMed: 11790957]

Jaconson HN, Stanton JL. 1986. Pattern analysis in nutrition. Clin Nutr. 5:249–253.

Jacques PF, Tucker KL. 2001. Are dietary patterns useful for understanding the role of diet in chronic disease? Am J Clin Nutr. 73(1):1–2. doi:10.1093/ajcn/73.1.1. [PubMed: 11124739]

Johnson L, Mander AP, Jones LR, Emmett PM, Jebb SA. 2008. Energy-dense, low-fiber, high-fat dietary pattern is associated with increased fatness in childhood. Am J Clin Nutr. 87(4):846–854. doi:10.1093/ajcn/87.4.846. [PubMed: 18400706]

Kant AK. 1996. Indexes of overall diet quality: a review. J Am Diet Assoc. 96:785–791. doi:10.1016/S0002-8223(96)00217-9. [PubMed: 8683010]

Kant AK. 2004. Dietary patterns and health outcomes. J Am Diet Assoc. 104(4):615–635. doi:10.1016/j.jada.2004.01.010. [PubMed: 15054348]

Kehoe SH, Krishnaveni GV, Veena SR, Guntupalli AM, Margetts BM, Fall CHD, Robinson SM. 2014. Diet patterns are associated with demographic factors and nutritional status in South Indian children. Matern Child Nutr. 10(1):145–158. doi:10.1111/mcn.12046. [PubMed: 23819872]

Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z. 2002. 2000 CDC growth charts for the United States: methods and development. Vital Health Stat. 246:1–190.

Li J, Wang Y. 2008. Tracking of dietary intake patterns is associated with baseline characteristics of urban low-income African-American adolescents. J Nutr. 138(1):94–100. doi:10.1093/jn/138.1.94. [PubMed: 18156410]

Lioret S, Touvier M, Lafay L, Volatier J-L, Maire B. 2008. Dietary and physical activity patterns in French children are related to overweight and socioeconomic status. J Nutr. 138(1):101–107. doi:10.1093/jn/138.1.101. [PubMed: 18156411]

Montez J, Eschbach K. 2008. Country of birth and language are uniquely associated with intakes of fat, fiber, and fruits and vegetables among Mexican-American women in the United States. J Am Diet Assoc. 108(3):473–480. doi:10.1016/j.jada.2007.12.008. [PubMed: 18313430]

Nettleton J, Steffen L, Mayer-Davis EJ, Jenny N, Jiang R, Herrington D. 2006. Dietary patterns are associated with biochemical markers of inflammation and endothelial activation in the multi-ethnic study of atherosclerosis (MESA). Am J Clin Nutr. 83(6):1369–1379. doi:10.1093/ajcn/83.6.1369 [PubMed: 16762949]

Nettleton JA, Schulze MB, Jiang R, Jenny NS, Burke GL, Jacobs DR. 2008. A priori-defined dietary patterns and markers of cardiovascular disease risk in the multi-ethnic study of atherosclerosis (MESA). Am J Clin Nutr. 88(1):185–194. doi:10.1093/ajcn/88.1.185. [PubMed: 18614740]

Northstone K, Emmett P. 2005. Multivariate analysis of diet in children at four and seven years of age and associations with socio-demographic characteristics. Eur J Clin Nutr. 59(6):751–760. doi:10.1038/sj.ejcn.1602136. [PubMed: 15841093]

Northstone K, Smith AD, Cribb VL, Emmett PM. 2014. Dietary patterns in UK adolescents obtained from a dual-source FFQ and their associations with socio-economic position, nutrient intake and modes of eating. Public Health Nutr. 17(7):1476–1485. doi:10.1017/S1368980013001547. [PubMed: 23782861]

Ocke MC. 2013. Evaluation of methodologies for assessing the overall diet: dietary quality scores and dietary pattern analysis. Proc Nutr Soc. 72(2):191–199. doi:10.1017/S0029665113000013. [PubMed: 23360896]

Ogden C, Carroll M, Lawman H, Fryar CD, Kruszon-Moran D, Kit BK, Flegal KM. 2016. Trends in obesity prevalence among children and adolescents in the United States, 1988-1994 through 2013-2014. JAMA. 315(21):2292–2299. doi:10.1001/jama.2016.6361. [PubMed: 27272581]

Ogden C, Flegal K. 2010. Changes in terminology for childhood overweight and obesity. Natl Health Stat Report. 25(25):1–5.

Pala V, Lissner L, Hebestreit A, Lanfer A, Sieri S, Siani A 2013. Dietary patterns and longitudinal change in body mass in European children: a follow-up study on the IDEFICS multicenter cohort. Eur J Clin Nutr. 67(10):1042–1049. doi:10.1038/ejcn.2013.145 [PubMed: 23942180]

Pinho L, Silveira MF, Botelho AC, Caldeira AP. 2014. Identification of dietary patterns of adolescents attending public schools. J Pediatr (Rio J). 90(3):267–272. doi:10.1016/j.jped.2013.04.006. [PubMed: 24548916]

Reed B, Habicht J, Niameogo C. 1996. The effects of maternal education on child nutritional status depend on socio-environmental conditions. Int J Epidemiol. 25(3):585–592. doi:10.1093/ije/25.3.585. [PubMed: 8671560]

Ritchie LD, Spector P, Stevens MJ, Schmidt MM, Schreiber GB, Striegel-Moore RH, Wang M-C, Crawford PB. 2007. Dietary patterns in adolescence are related to adiposity in young adulthood in black and white females. J Nutr. 137(2):399–406. doi:10.1093/jn/137.2.399. [PubMed: 17237318]

Rodriguez C NYC's poverty rate goes up for third straight year (2012). [cited 2017]; Available from: http://www.wnyc.org/story/238573-new-york-city-poverty-rate-third-year-row/

Satia J, Patterson R, Kristal A, Hislop TG, Yasui Y, Taylor VM. 2001. Development of scales to measure dietary acculturation among Chinese-Americans and Chinese-Canadians. Am Diet Assoc. 101(5):548–553. doi:10.1016/S0002-8223(01)00137-7.

Shang L, O'Loughlin J, Tremblay A, Gray-Donald K. 2014. The association between food patterns and adiposity among Canadian children at risk of overweight. Appl Physiol Nutr Metab. 39(2):195–201. doi:10.1139/apnm-2012-0392. [PubMed: 24476475]

Shim J, Oh K, Kim H. 2014. Dietary assessment methods in epidemiologic studies. Epidemiol Health. 36:e2014009. doi:10.4178/epih/e2014009. [PubMed: 25078382]

Skinner A, Skelton J. 2014. Prevalence and trends in obesity and severe obesity among children in the United States, 1999-2012. JAMA Pediatr. 168(6):561–566. doi:10.1001/jamapediatrics.2014.21. [PubMed: 24710576]

Slattery ML. 2008. Defining dietary consumption: is the sum greater than its parts? Am J Clin Nutr. 88(1):14–15. doi:10.1093/ajcn/88.1.14. [PubMed: 18614718]

Tavares L, de Castro I, Levy R, Cardoso LDO, Claro RM. 2014. Dietary patterns of Brazilian adolescents: results of the Brazilian National School-based health survey. Cad Saude Publica. 30(12):2679–2690. doi:10.1590/0102-311x00016814. [PubMed: 26247996]

Turyashemererwa FM, Kikafunda J, Annan R, Tumuhimbise GA. 2013. Dietary patterns, anthropometric status, prevalence and risk factors for anaemia among school children aged 5-11 years in Central Uganda. J Hum Nutr Diet. 26(Suppl 1):73–81. doi:10.1111/jhn.12069. [PubMed: 23782401]

United States Census Bureau (2016) QuickFacts. Available from: http://www.census.gov/quickfacts/table/PST045215/36005 00.

United States Department of Agriculture. Kids. (2018) [cited 2018]; Available from: http://www.choosemyplate.gov/myplate/

United States Department of Agriculture Economic Research Service(2012) USDA economic research service-survey tools. [updated 2015 September 08; cited 2017].

Wiley J, Cloutier M, Wakefield D, Grant A, Beaulieu A. 2014. Acculturation determines BMI percentile and noncore food intake in Hispanic children. J Nutr. 144(3):305–310. doi:10.3945/jn.113.182592 [PubMed: 24453127]

Zane N, Mark W. 2003. Major approaches to the measurement of acculturation among ethnic minority populations: A content analysis and an alternative empirical strategy. In: Chun K, Organista P, Marin G, editors. Acculturation, advances in theory, measurement, and applied research (Vol. 3). Washington (DC, US): American Psychological Association; p. 9–60.

Table 1.

Factor loadings and summary statistics describing two dietary patterns derived from a principal components analysis of 26 dietary food categories in a sample of overweight and obese children (*n* 332).

Food category	Factor1	Factor 2
Pizza	**0.68**	0.09
Pasta	**0.66**	0.02
Red meat	**0.61**	0.27
Chicken	**0.53**	0.13
Fries	**0.52**	0.19
Sweets	**0.33**	0.20
Snacks	0.02	**0.83**
Desserts	0.25	**0.80**
Soft drinks	0.27	**0.64**
Cereals	0.19	0.04
Dairy	−0.07	0.15
Fruits	0.181	−0.10
Legumes	−0.01	−0.14
Processed meats	**0.33**	0.09
Bread and refined grains	0.27	**0.31**
Starchy vegetables	0.19	0.13
Vegetables	−0.15	−0.03
Nuts	0.13	−0.05
Fish	0.13	−0.08
Fat	−0.04	0.16
Soups	0.05	0.11
Real fruit juice	−0.04	0.11
Sweet breads	**0.34**	0.04
Cultural foods	0.22	0.10
Whole grains	−0.10	−0.11
Chocolate milk	−0.01	−0.01
Summary Statistics	**Factor 1**	**Factor 2**
Cronbach´s alpha	0.72	0.71
Eigenvalue	4.19	1.91
Proportion of variance (%)	16.12	7.33

Table 2.

Comparison of mean scores[a] by intake categories[b] for two dietary patterns: "pizza and pasta" and "snacks and dessert" in a sample of obese and overweight children (*n* 332).

	Dietary pattern 1: 'pizza and pasta'[c]			Dietary pattern 2: 'snacks and dessert'[d]		
	Low intake (*n* 110)	**Medium intake (*n* 111)**	**High intake (*n* 111)**	**Low intake (*n* 110)**	**Medium intake (*n* 111)**	**High intake (*n* 111)**
Dietary pattern scales *Mean (SD)*	0.36 (0.16)	0.90 (0.17) *	2.44 (1.55) *	0.40 (0.22)	1.18 (0.24) *	3.71 (0.33) *
BMI *Z*-score *Mean (SD)*	1.98 (0.42)	1.93 (0.42)	2.04 (0.37)	2.00 (0.42)	1.92 (0.39)	2.03 (0.40)

SD, standard deviation.

BMI, Body Mass Index

[a]The "medium intake" category (second tertile) and "high intake" (third tertile) category were individually compared with the "low intake" (first tertile) category.

[b]Intake categories are based on tertiles of each dietary pattern score: "low intake" category represents the first tertile of the dietary pattern scores, "medium intake" category represents the second tertile of the dietary pattern scores, and "high intake" category represents the third tertile of the dietary pattern scores.

[c]"pizza and pasta" was characterized by high loadings of pizza, pasta, red meat, chicken, fries, sweets, processed meat, and sweet breads.

[d]"snacks and dessert" was characterized by high loadings of snacks, desserts, soft drinks, and bread and refined grains.

*P value < 0. 01.

Table 3.

Univariate analysis[a] of average daily intake of nutrients, fruits, vegetables, and dairy products by dietary pattern scales[b] in a sample of overweight and obese children (*n* 332).

	Dietary pattern 1: "pizza and pasta" [c]			Dietary pattern 2: "snacks and dessert" [d]		
Nutrients	**Low intake (*n* 110)**	**Medium intake (*n* 111)**	**High intake (*n* 111)**	**Low intake (*n* 110)**	**Medium intake (*n* 111)**	**High intake (*n* 111)**
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Calories (kcal/d)	796.53 (301.87)	1056.36 (367.99) **	1842.39 (908.74) **	796.49 (319.47)	1108.76 (400.86) **	1790.03 (931.23) **
Total fat (g)	26.69 (12.15)	36.27 (13.36) **	67.35 (34.78) **	27.36 (12.95)	39.17 (16.72) **	63.80 (36.10) **
Fat (% of calories)	29.99 (6.10)	31.30 (5.35)	33.08 (4.90) **	30.71 (6.07)	31.73 (5.37)	31.93 (5.31)
Total saturated fat (g)	8.57 (3.99)	11.98 (4.31) **	22.16 (11.12) **	8.89 (4.08)	12.74 (5.37) **	21.08 (11.62) **
Monounsaturated fat intake (g)	9.58 (4.38)	13.40 (5.03) **	25.83 (14.02) **	9.89 (4.79)	14.51 (6.27) **	24.41 (14.62) **
Polyunsaturated fat intake (g)	6.38 (3.80)	7.90 (3.79) *	13.81 (7.92) **	6.22 (3.85)	8.71 (4.90) **	13.16 (7.67) **
Dietary cholesterol (mg)	87.29 (47.97)	127.90 (56.39) **	231.11 (113.71) **	96.91 (52.35)	144.71 (79.87) **	204.78 (120.35) **
Total carbohydrate (g)	117.48 (46.89)	149.57 (60.32) *	250.35 (135.31) **	112.47 (46.59)	153.29 (56.97) *	251.59 (134.59) **
Carbohydrate (% of calories)	58.93 (8.18)	55.98 (6.77) **	53.59 (6.83) **	56.74 (8.46)	55.43 (6.90)	56.32 (7.36)
Total dietary sugar (g/d)	57.37 (26.97)	70.94 (34.91) *	123.60 (81.20) **	52.80 (23.55)	71.88 (32.56) **	127.19 (79.89) **
Fiber (g/d)	9.88 (5.12)	11.36 (6.11)	15.50 (8.16) **	10.17 (5.58)	11.24 (5.64)	15.34 (8.32) **
Total protein intake (g)	27.13 (10.96)	38.52 (14.18) **	65.67 (28.90) **	30.34 (13.58)	41.01 (17.05) **	60.01 (31.88) **
Protein (% of calorie)	13.79 (3.01)	14.74 (2.53) **	14.75 (2.52) **	15.15 (3.12)	14.70 (2.32)	13.45 (2.42) **
Fruit (serving/d)	1.34 (0.98)	1.42 (1.18)	1.65 (1.21)	1.42 (1.02)	1.39 (1.10)	1.61 (1.25)
Vegetables (serving/d)	1.45 (1.24)	1.36 (1.22)	1.68 (1.68)	1.46 (1.18)	1.22 (1.17)	1.82 (1.72) **
Dairy (serving/d)	0.81 (0.65)	0.98 (0.68)	1.26 (0.87) **	0.84 (0.67)	1.00 (0.72)	1.21 (0.85)

[a]We used univariate analysis of variance. The "medium intake" category (second tertile) and "high intake" (third tertile) category were individually compared with the "low intake" (first tertile) category.

[b]Intake categories are based on tertiles of each dietary pattern scores: "low intake" category represents the first tertile of the dietary pattern scores, "medium intake" category represents the second tertile of the dietary pattern scores, and "high intake" category represents the third tertile of the dietary pattern scores.

[c]"pizza and pasta" dietary pattern was characterized by high loadings of pizza, pasta, red meat, chicken, fries, sweets, processed meat, and sweet breads.

[d]"snacks and dessert" dietary pattern was characterized by high loadings of snacks, desserts, soft drinks, and bread and refined grains.

*The mean differences are significant at 0.05 level.

**The mean differences are significant at 0.001 level.

Table 4.

Association of demographic characteristics with "pizza and pasta" dietary pattern scales[a] in a sample of obese and overweight children (*n* 332).

Demographic variable	Characteristic	Low intake	Medium& high intake	OR (95% CI)	p value
Child age, n (%)	7–9 years	51 (46.36)	127 (57.21)	Reference	0.06
	10–12 years	59 (53.64)	95 (42.79)	0.65 (0.41–1.02)	
Gender, n (%)	Male	47 (43.93)	107 (49.76)	Reference	0.32
	Female	56 (56.07)	108 (50.54)	0.79 (0.50–1.26)	
Race/ethnicity, n (%)	Hispanic	80 (72.73)	166 (74.73)	Reference	0.68
	Non-Hispanic **	30 (27.20)	56 (25.23)	0.91 (0.54–1.51)	
Child BMI category, n (%)	Overweight; 85th–95th %	27 (24.55)	52 (23.42)	Reference	0.82
	Obese ≥ 95th %	83 (75.45)	170 (76.58)	1.06 (0.62–1.81)	
Parent weight category (BMI; kg/m^2, n (%)	Normal weight ≤ 25	8 (7.27)	19 (8.60)	Reference	0.74
	Overweight (25–29.9)	30 (27.27)	66 (30.13)	0.93 (0.36–2.35)	
	Obese ≥ 30	72 (65.45)	134 (61.18)	0.78 (0.33–1.89)	
Parent place of birth, n (%)	Mainland United States[b]	10 (10.75)	53 (26.50)	Reference	0.025
	Puerto Rico	4 (4.30)	14 (7.00)	0.49 (0.16–0.66)	
	Dominican Republic	17 (18.28)	18 (9.00)	0.20 (0.07–0.52)	
	Jamaica	7 (7.53)	15 (7.50)	0.40 (0.13–1.20)	
	Mexico	38 (40.86)	70 (35.00)	0.30 (0.16–0.76)	
	Other [c]	17 (18.28)	30 (15.00)	0.31 (0.41–0.82)	
Parent years living in the Mainland United States[b] n (%)	0–10	30 (32.26)	42 (21.00)	Reference	0.017
	11–15	18 (19.35)	37 (18.50)	1.47 (0.70–3.05)	
	> 15	35 (37.63)	68 (34.00)	1.39 (0.74–2.58)	
	Mainland United States[b]-born	10 (10.75)	53 (26.50)	3.79 (1.66–8.26)	
Mother Education ***	Less than high School	37 (44.05)	52 (28.72)	Reference	0.04
	High school or GED	36 (42.86)	92 (50.83)	1.81 (1.03–3.22)	
	Postsecondary education[d]	11(13.10)	37 (20.44)	2.39 (1.08–2.29)	
Household income, n (%)	≤ $9,999	33 (30.00)	95(42.79)	Reference	0.13
	$10,000–$19,999	28 (25.45)	49 (22.07)	0.61 (0.33–1.12)	
	≥ $20,000	25 (22.73)	45 (20.27)	0.62 (0.33–1.73)	
	Do not know	24 (21.82)	33 (14.86)	0.48 (0.25–0.92)	
Household food security, n (%)	Secure	37 (38.95)	76 (37.62)	Reference	0.82
	Not secure	58 (61.05)	128 (62.38)	0.94 (0.57–1.56)	

OR: odds ratio, CI: confidence interval, GED: General Education Diploma, BMI: Body Mass Index

"pizza and pasta" was characterized by high loadings of pizza, pasta, red meat, chicken, fries, sweets, processed meat, and sweet breads.

Each category was compared to the other categories for each variable separately.

[a]Intake categories are based on tertiles of each dietary pattern score: "low intake" category represents the first tertile of the dietary pattern scores, "medium intake" category represents the second tertile of the dietary pattern scores. and "high intake" category represents the third tertile of the dietary pattern scores

[b] Does not include Puerto Rico.

[c] Includes other Caribbean countries, Africa, Central America, South America, Europe, and South Asia.

[d] Postsecondary education includes college degree, some college but not receiving diploma, technical school, associate′s degree, bachelor′s degree, or professional school.

[*] Logistic regression analysis were run to assess crude odds ratio between each dietary pattern scores (dichotomized as 1 = "low intake" (first tertile) as a reference group; 2 = medium and "high intake" (second tertile and third tertile) as a comparison group, and each demographic factor.

[**] Non-Hispanic includes black (20%), white (4%), Asian and others (2%).

[***] Total number of mothers: 265

There were no underweight parents in the study population.

Table 5.

The association of demographic factors with "snack and dessert" pattern scores[a] in a of sample of obese and overweight children (*n* 332).

Demographic Variable	Characteristic	Low intake	Medium and high intake	OR (95%CI)	p-value ★
Child age, n (%)	7–9 years	61 (55.45)	117 (52.70)	Reference	0.63
	10–12 years	49 (44.55)	105 (47.30)	1.12 (0.71–1.12)	
Gender, n (%)	Male	46 (42.99)	108 (50.23)	Reference	0.89
	Female	61 (57.01)	107 (49.76)	0.75 (0.47–1.19)	
Race/ethnicity, n (%)	Hispanic	82 (74.55)	160 (72.39)	Reference	0.89
	Non-Hispanic[b]	28 (25.45)	61 (27.61)	1.04 (0.61–1.74)	
Child BMI category, n (%)	85^{th}–95^{th} % (overweight)	28 (25.45)	51(22.97)	Reference	0.62
	≥ 95^{th} % (obese)	82 (74.55)	171 (77.03)	1.14 (0.67–1.95)	
Parent weight category (BMI; kg/m^2), n (%)	Normal weight ≤ 25	9 (8.18)	18 (8.21)	Reference	0.18
	Overweight (25–29.9)	25 (22.73)	71 (32.42)	1.42 (0.56–3.75)	
	Obese ≥ 30	76 (69.09)	130(59.36)	0.86 (0.37–2.00)	
Parent place of birth, n (%)	Mainland United States[c]	15 (15.62)	48 (24.36)	Reference	0.36
	Puerto Rico	7 (7.29)	11 (5.58)	0.49 (0.16–1.50)	
	Dominican Republic	10 (10.42)	25 (12.69)	0.78 (0.31–1.99)	
	Jamaica	7 (7.29)	15 (7.61)	0.67 (0.23–1.95)	
	Mexico	43 (44.79)	65 (32.99)	0.47 (0.23–0.64)	
	Other [d]	14 (14.58)	33 (16.75)	0.74 (0.31–1.73)	
Parent years living in the mainland United States[c] n (%)	0–10	29 (30.21)	43 (21.82)	Reference	0.25
	11–15	18 (18.75)	37 (18.78)	1.39 (0.66–2.88)	
	> 15	34 (35.42)	69 (35.02)	1.36 (0.73–2.56)	
	Mainland United States[c]-born	15 (15.62)	48 (24.36)	2.16 (1.02–4.55)	
Mother Education[**]	Less than high School	28 (34.10)	61 (33.33)	Reference	0.22
	High school or GED	44 (53.70)	84 (45.90)	0.87 (0.49–1.56)	
	Postsecondary education[e]	10 (12.20)	38 (20.85)	1.74 (0.76–3.99)	
Household income, n (%)	≤ $9,999	44 (40.00)	84 (37.83)	Reference	0.81
	$10,000–$19,999	22 (20.00)	55 (24.77)	1.31 (0.71–2.42)	
	≥ $20,000	20 (18.18)	50 (22.52)	1.31 (0.70–2.70)	
	Do not know	24 (21.82)	33 (14.86)	0.72 (0.38–1.37)	
Household food security, n (%)	Secure	36 (37.11)	77 (38.50)	Reference	0.81
	Not secure	61 (62.89)	123 (61.50)	1.06 (0.64–1.75)	

OR: odds ratio, CI: confidence interval, GED: General Education Diploma, BMI: Body Mass Index Each category was compared to the other categories for each variable separately.

[a]Intake categories are based on tertiles of each dietary pattern score: "low intake" category represents the first tertile of the dietary pattern scores, "medium intake" category represents the second tertile of the dietary pattern scores, and "high intake" category represents the third tertile of the dietary pattern scores "snacks and dessert", was characterized by high loadings of snacks, desserts, soft drinks, and bread and refined grains.

[b]Non-Hispanic includes black (20%), white (4%), Asian and others (2%).

[c] Does not include Puerto Rico.

[d] Includes other Caribbean countries, Africa, Central America, South America, Europe, and South Asia.

[e] Postsecondary education includes college degree, some college but not receiving diploma, technical school, associate′s degree, bachelor′s degree or professional school.

[★] p-value test the significance of the variable

[*] Logistic regression analysis were run to assess crude odds ratio between each dietary pattern scores (dichotomized as 1 = "low intake" (first tertile) as a reference group; 2 = medium and "high intake" (second tertile and third tertile) as a comparison group, and each demographic factor.

[**] Total number of mothers: 265

Table 6.

Multivariate logistic regression [a] model with reference group as the "low intake" (first tertile) category of each dietary pattern in a sample of overweight and obese children (n = 224 (of 332, after removing rows with missing value)).

	Dietary pattern 1: 'pizza and pasta'[b]			Dietary pattern 2: 'snacks and dessert"[c]		
	Adjusted OR	**95% CI**	**p value ★**	**Adjusted OR**	**95% CI**	**p value ★**
Gender	Reference		0.28	Reference		0.48
Male						
Female	0.70	0.36–1.34		0.80	0.44–1.49	
Child age						
(7–9 years)	Reference		0.009	Reference		0.52
(10–12 years)	0.44	0.23–0.84		0.82	0.46–1.55	
Mother education						
Less than high school	Reference		0.042	Reference		0.33
High school or GED*	1.78	0.91–3.52		0.95	0.49–1.84	
Postsecondary education[d]	3.18	1.23–8.16		1.77	0.72–4.33	
Parent place of birth						
Mainland United States[e]	Reference		0.017	Reference		0.72
Puerto Rico	0.39	0.08–1.76		0.51	0.13–1.92	
Dominican Republic	0.13	0.39–0.43		0.70	0.23–2.02	
Jamaica	0.24	0.06–0.93		0.60	0.18–2.00	
Mexico	0.18	0.07–0.52		0.51	0.22–1.19	
Others[f]	0.30	0.09–0.97		0.75	0.26–2.08	
Parent BMI						
BMI < 25 kg/m^2 (normal weight)	Reference		0.33	Reference		0.11
BMI > 25 and BMI < 29.9 kg/m^2 (overweight)	2.05	0.66–6.39		3.01	1.01–8.99	
BMI ≥ 30 kg/m^2	1.42	0.49–4.15		1.75	0.63–4.82	
Household Security Index						
Food secure	Reference		0.60	Reference		0.89
Food unsecure	0.83	0.43–1.60		1.04	0.56–1.90	
Child BMI Z-score	0.63	0.27–1.41	0.26	0.86	0.40–1.87	0.74

GED: General Education Diploma, OR: Odds ratio, BMI: Body Mass Index

[a]Multivariate logistic regression models were run to assess associations between dietary pattern scores (dichotomized as 1 = “low intake” (first tertile) as a reference; 2 = medium and “high intake” (second tertile and third tertile) and all demographic variables. All demographic variables in the table were entered into the model.

[b]“pizza and pasta” pattern, was characterized by high loadings of pizza, pasta, red meat, chicken, fries, sweets, processed meat, and sweet breads.

[c]Snacks and dessert′ pattern, was characterized by high loadings of snacks, desserts, soft drinks, and bread and refined grains.

[d]Postsecondary education includes college degree, some college but not receiving diploma, technical school, associate′s degree, bachelor′s degree or professional school

[e]Limited to the 50 states and does not include Puerto Rico

[f]Includes other Caribbean, Africa, Central America, South America, Europe and South Asia