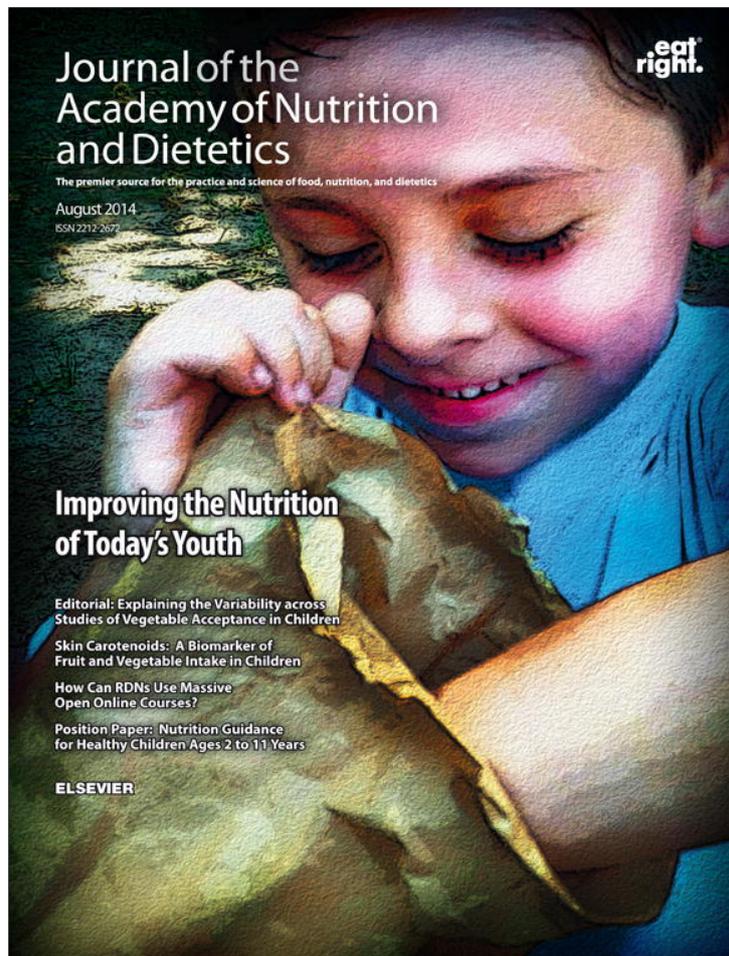


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## RESEARCH

## Research and Professional Briefs

# Diet Quality, Social Determinants, and Weight Status in Puerto Rican Children Aged 12 Years

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## ABSTRACT

Diet quality may be influenced by social determinants and weight status. This has not been studied in Puerto Rico; therefore, our cross-sectional study examined whether diet quality, assessed by the Healthy Eating Index-2005 (HEI-2005), differs by social determinants (sex, school type, and region) and weight status in children in Puerto Rico. As part of an island-wide study to evaluate oral health in 1,550 children aged 12 years, dietary intake was assessed in a representative subset ( $n=796$ ) using a 24-hour diet recall. Diet quality was evaluated from the diet recall results using the HEI-2005. Overall mean HEI-2005 score was 40.9, out of a total maximum score of 100. Girls had significantly higher scores for whole fruit, total vegetables, whole grains, and sodium but lower scores for total grains and milk compared with boys ( $P<0.05$ ). Children from public schools had higher scores for total fruit, whole fruit, and dark green and orange vegetables and legumes, but lower scores for whole grains and milk compared with those from private schools ( $P<0.05$ ). Children from the central mountains had higher scores for the dark green and orange vegetables and legumes and for whole fruit compared with the other regions ( $P<0.05$ ). Overweight children had significantly higher scores for total vegetables and milk, but lower scores for total fruit and sodium compared with non-overweight children ( $P<0.01$ ). Some components of diet quality were associated with the social determinants studied and with weight status in our sample. Overall diet quality needs improvement in Puerto Rican children so that it is better aligned with dietary recommendations.

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**O**VERWEIGHT AND OBESITY ARE SERIOUS PUBLIC health issues in the United States and in Puerto Rico. Overweight and obesity during childhood and adolescence can lead to serious chronic diseases during adulthood<sup>1,2</sup> such as cardiovascular diseases, diabetes, and certain cancers,<sup>3-5</sup> three conditions that are among the primary mortality and morbidity causes in the United States and Puerto Rico.<sup>6,7</sup>

In Puerto Rico, data from the Behavioral Risk Factor Surveillance System Survey in 2009 showed that 38% of adults were overweight and 28% were obese.<sup>8</sup> In children, an island-wide study of second graders conducted by the Puerto Rico Department of Health found 16% prevalence for overweight and 26% for obesity.<sup>9</sup> Another study in a mountain region of Puerto Rico that included elementary school children found the highest prevalence of obesity (47%) in those in fifth and sixth grade (aged 10 to 12 years).<sup>10</sup>

Among the social determinants influencing children's diet are availability and accessibility of foods and parental socioeconomic status.<sup>11</sup> Recent evidence indicates an association between neighborhood food environment with diet and obesity in children and adolescents.<sup>12,13</sup> For example, those living in neighborhoods with greater access to fast food and convenience stores have lower diet quality, although the findings are inconsistent.<sup>14</sup> Likewise, low socioeconomic

status has also been related to poor diet quality.<sup>15,16</sup> This is important to study in Puerto Rico, a small, urbanized island with high availability of fast food, US-based supermarkets, and numerous convenience stores, particularly in the San Juan area. In addition, there is a distinct difference among children attending public and private schools—most children from low socioeconomic status go to public schools, whereas children from higher socioeconomic status go to private schools. However, unlike private schools, public schools have the National School Lunch Program (NSLP), which could affect diet quality in these children. This has not been properly evaluated in Puerto Rico. Therefore, our study examined whether diet quality, assessed by the Healthy Eating Index (HEI-2005),<sup>17</sup> differs by social determinants such as sex, socioeconomic status, and region, and by weight status in children aged 12 years in Puerto Rico.

## METHODS

## Study Design and Participants

Data for our study were drawn from an island-wide, cross-sectional study in Puerto Rico designed to examine oral health, dietary practices, and weight status in a sample of 1,550 children aged 12 years enrolled in the academic year 2010-2011. A probabilistic random sample of all public and

private schools (n=133) from the 11 health administrative regions of Puerto Rico, covering the entire island, was used in the main study, stratified by sex. For our analysis, regions were regrouped into coast, metropolitan, and central mountain. From this sample, a representative and similar subset sample was chosen to complete the 24-hour dietary recall by randomly selecting 50% of participants within each school (n=800). Parents or guardians signed a written informed consent and children provided written assent. The study was approved by the Institutional Review Board of the Medical Sciences Campus of the University of Puerto Rico.

### Sociodemographic and Anthropometric Measurements

Sex was self-reported. Socioeconomic level was obtained indirectly from the type of school attended, which was used as a proxy. In Puerto Rico, being in public school is indicative of low or middle socioeconomic status, whereas being in private school is indicative of high socioeconomic status.<sup>18</sup> This was confirmed in a subset sample (n=122) of participants who completed information on income. Most parents with children in public schools reported a total annual family income of \$0 to \$10,000 (51%) and \$10,000 to \$20,000 (23%); most parents with children in private schools reported an income of >\$40,000 (77%) and \$30,000 to \$40,000 (23%). The overlap was minimal; only 4.6% of parents with children in public schools had an income >\$40,000 and 8.3% had an income of \$30,000 to \$40,000.

Trained staff measured children's weight and height following the National Health and Nutrition Examination Survey procedures.<sup>19</sup> Body mass index (BMI) was calculated by dividing weight in kilograms by height in meters squared. Participants were categorized into non-overweight (BMI <85th percentile) and overweight (BMI ≥85th percentile) categories, using the Centers for Disease Control and Prevention age- and sex-specific growth charts.<sup>20,21</sup>

### Dietary Assessment

Dietary intake was obtained by trained interviewers using a single 24-hour dietary recall. The interview was performed at school; children were asked to list all foods and beverages consumed for the past 24 hours, starting with the most recent meal. It included intakes from weekdays and weekends (with no significant differences in energy intake between days); parents were not present during the interview. For estimation of portion sizes, a booklet with drawings of actual serving portions and images of serving sizes of commonly eaten foods and beverages was used.<sup>22</sup> Energy intake and food group intake was analyzed using the Nutrition Data System for Research (database version 2011, Nutrition Coordinating Center, University of Minnesota). Of 800 children who completed the recall, three participants whose energy intakes were <500 kcal/day were excluded because only one meal was reported and one participant whose energy intake was >6,000 kcal/day was excluded because of overestimation (a total of 14 cans of soda were reported).

### Diet Quality Assessment

Food group and nutrient intake data obtained from the recall were used to assess diet quality using the US Department of

Agriculture's HEI-2005.<sup>23</sup> The HEI is a measure of diet quality that assesses compliance with the 2005 Dietary Guidelines for Americans.<sup>24</sup> It has 12 components (total fruit; whole fruit; total vegetables; dark green and orange vegetables and legumes; total grains; whole grains; milk; meat and beans; oil; saturated fat; sodium; and energy from solid fats, alcoholic beverages, and added sugars [SoFAAS]), and each one is evaluated with a density approach; that is, food and nutrient intakes and scoring standards are expressed as the amount per 1,000 kcal. This allows the quality of the diet to be assessed independent of an individual's energy requirement, which is very difficult to determine.<sup>25</sup>

The components related to total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, and whole grains are scored from 0 to 5 points each. Milk, meat and beans, oil, saturated fat, and sodium are scored from 0 to 10 points each; energy from SoFAAS are scored from 0 to 20 points. Participants with intake at the suggested level received the maximum score. The further intakes were from the standards, the lower the score. The total HEI-2005 score was calculated as the sum of all components scores and the score range was from 0 to 100.

### Statistical Analyses

For descriptive statistics, means±standard error were computed for continuous variables and frequencies were computed for categorical values. Because only a single 24-hour dietary recall was used, the HEI-2005 component and total scores were estimated using the population ratio method.<sup>25</sup> This method is computed by calculating the population's total intake of food groups or nutrients (relevant to the HEI) and the population's total energy intake and taking the ratio of these. The subpopulation HEI-2005 components and total scores were estimated using the Microsoft Excel spreadsheet (2007, Microsoft Corp) created by the Center for Nutrition Policy and Promotion. To test for significant differences between HEI-2005 scores by sex, school type, region, and weight status, a two-tailed *t* test was performed using Stata Statistical Software (version 12, 2011, StataCorp). One-way analysis of variance with Bonferroni post hoc test was used, as appropriate, using GraphPad InStat (version 3.1a, 2009, GraphPad Software). Statistical tests were not performed on component scores in cases where the maximum total point value was assigned and the standard error is not shown. Statistical significance was set at  $P < 0.05$ .

## RESULTS AND DISCUSSION

The total sample consisted of 796 children. Just over half of participants (54.5%) were girls and most were from public schools (77.9%) (Table 1). Overweight was found in 40.2% of children (43.1% in boys and 37.8% in girls; 39.5% in public schools and 42.6% in private schools). No significant difference in weight status was seen by sex, school type, and region (data not shown).

Table 2 describes the daily intake of energy and nutrients and number of food group servings. Fruit, vegetables, dairy products, and dietary fiber mean intakes were lower than reported in other studies in Puerto Rican children<sup>26,27</sup> and in Hispanic children living in the United States.<sup>16</sup> Such differences could be attributed to differences in dietary assessment methods used and/or the population studied.

## RESEARCH

**Table 1.** Demographic characteristics of Puerto Rican children aged 12 years enrolled in the academic year 2010-2011 (n=796)

Attribute	n	%
<b>Sex</b>		
Male	362	45.5
Female	434	54.5
<b>School type</b>		
Private	176	22.1
Public	620	77.9
<b>Region<sup>a</sup></b>		
Coast	356	44.0
Metropolitan	350	44.7
Central mountain	90	11.3
<b>Weight status<sup>b</sup></b>		
Non-overweight	476	59.8
Overweight/obese	320	40.2

<sup>a</sup>Region was divided into coast, which includes all municipalities around the perimeters of the island in the north, northwest, northeast, east, southeast, southwest, and west, not including the metropolitan area; metropolitan region, which includes the metro area, including San Juan, the capital of Puerto Rico; and the central mountain region, which includes the mountainous center of Puerto Rico.

<sup>b</sup>Children were classified into these 2 categories based on measured body mass index and the Centers for Disease Control and Prevention growth charts.<sup>20</sup>

However, similar to those studies, we found that consumption of sugary beverages, meats, and sodium were high when compared with current dietary recommendations.

Table 3 shows the mean±standard error for HEI-2005 total and component scores by the social determinants studied and weight status. Children's mean scores met the maximum level for meat and beans, and were close to meeting standards for total grains; both food groups are among the most popular staple foods in Puerto Rico; that is, rice and beans. The lowest component scores for all subgroups were found for whole fruit, vegetables, and whole grains. Low scores in these components are consistent with findings reported in other studies of Hispanic children living in the United States.<sup>28,29</sup> A study of 993 Hispanic children found that low intakes of fruit, vegetables, and fiber decreased diet quality.<sup>16</sup> The reasons for such low scores have been related to the home environment, such as parents' eating habits, feeding styles, and socioeconomic status.<sup>11</sup> Scores from saturated fat, sodium, and energy from SoFAAS were below half of the maximum score, which means higher intake. These nutrients are found in fried foods and fast food, which are commonly consumed by children in Puerto Rico.<sup>27</sup> Currently, there are more than 15 fast-food chains in Puerto Rico, with more than 1,000 establishments on the island, with about 50% in the metropolitan region. In addition, it is estimated that more than 70% of foods consumed in the island are imported, mostly from the United States.<sup>30</sup> Therefore, an Americanized diet has replaced the traditional Puerto Rican diet, which traditionally has consisted of rice, beans, starchy tubers, meats, sugar, lard, and coffee, but also of some seasonal

**Table 2.** Mean intake of daily total energy, nutrients, and food groups as determined by a single 24-h dietary recall of Puerto Rican children aged 12 years enrolled in the academic year 2010-2011 (n=796)

Intake group	Mean±standard error
<b>Energy and nutrients</b>	
Energy (kcal/d)	1,633±21
Protein (g)	59.4±1.0
Carbohydrate (g)	212.3±3.0
Dietary fiber (g)	8.5±0.2
Total fat (g)	61.7±1.0
Saturated fat (g)	21.9±0.4
Sodium (g)	2.6±0.0
<b>Food groups (servings)<sup>a</sup></b>	
Refined grains	4.6±0.1
Whole grains	0.4±0.0
Fruits	1.2±0.1
Vegetables	1.2±0.0
Meats, poultry, fish, and eggs	4.7±0.1
Dairy products	1.4±0.0
Oils	2.4±0.1
Sweetened beverages	2.7±0.1

<sup>a</sup>Serving size of each group: grains=1/2 cup if cooked, 1 slice bread, 1 oz crackers/ready-to-eat cereal; fruits=1/2 cup if fresh/frozen/cooked/canned, 1/4 cup if dried, or 4 fl oz if 100% fruit juice; vegetables (includes dark-green and orange vegetables and legumes)=1/2 cup if raw/cooked/canned/frozen; meats and others=1 oz if cooked meats, 1 egg, 1 tbslp if peanut butter or 1/2 oz nuts/seeds; dairy=1 cup if milk/yogurt, 2 oz cheese; oils=1 tsp if oil/margarine-butter/shortening, 15 g mayonnaise; sweetened beverages (includes sweetened fruit drink, soft drinks, tea, and energy drinks)=8 fl oz.

tropical fruits and vegetables.<sup>31</sup> A more recent study in a representative sample of children aged 11 to 18 years (n=633) in Puerto Rico confirmed this pattern of low intakes of fruit and vegetables and high intakes of sweetened beverages and fried foods using a cross-culturally validated food behavior checklist.<sup>27</sup> However, overall diet quality was not assessed.

We found sex differences in diet quality; namely, girls had significantly higher scores for whole fruit, total vegetables, whole grains, and sodium but lower scores for total grains and milk compared with boys ( $P<0.05$ ). This is similar to other studies in which girls had highest scores for fruit, vegetables, and whole grains.<sup>28</sup> Sex differences in diet may be related to weight issues that may arise during preadolescence.<sup>32</sup> Also, a recent study evaluating nutrient intakes in 321 children from the San Juan metropolitan area in Puerto Rico<sup>26</sup> found that girls had apparently higher participation in the NSLP and this in turn was found to be related to a better diet in girls compared with boys, because this program provides meals with all the recommended food groups.

Children from public schools had higher scores for total fruit, whole fruit, and dark green and orange vegetables and legumes, but lower scores for whole grains and milk compared with children from private schools ( $P<0.05$ ).

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We speculate that these differences could be related to socioeconomic status, because parents with low and middle incomes send their children to public schools<sup>18</sup> that have NSLP availability this is not available in private schools. This nutritionally balanced meal may be the only meal with all food groups that these children receive. NSLP meals include a fruit and a vegetable at every meal; however, they traditionally did not include whole grains. Children from private schools typically purchase their foods at the school cafeteria, which usually offers burgers, hot dogs, and sandwiches and is limited in fruits and vegetables; or, they bring lunchboxes from home. Similarly, higher scores have been found for vegetables, but also for milk, meat, and grains in US children participating in the NSLP.<sup>33</sup> The previously mentioned study in Puerto Rican children<sup>26</sup> found higher intakes of fiber, energy, calcium, potassium, and sodium but lower intakes of the other micronutrients in those participating in the NSLP compared with nonparticipants, but diet quality was not assessed. Recently, the NSLP improved its menu standards and is now requiring more whole grains, which may help improve the diet quality in this group; this warrants further research.

Children residing in the rural central mountain region had higher scores for the dark green and orange vegetables and legumes and whole fruit compared with children residing in the other regions ( $P < 0.05$ ). However, those in the metropolitan region had the highest scores for total fruit and whole grains, whereas those in the coast region had the highest score for total vegetables. A US study of 8,000 individuals found that those from rural areas consume less fruit compared with those from urban areas, a fact that was related to accessibility,<sup>34</sup> but this is not the case in Puerto Rico. This rural region has plenty of naturally grown tropical fruit and vegetable sources, but is also relatively close to urban supermarkets and other food stores. Therefore, the context of the rural environment in Puerto Rico favors a higher intake of fruit and vegetables, whereas it may not be the case on the mainland United States.

In our study, overweight children had significantly higher scores for the total vegetables and milk components compared with non-overweight children ( $P < 0.01$ ), whereas non-overweight children had the highest scores for total fruit and sodium. Similarly, the aforagh.

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## STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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