# Physical Environment, Diet Quality, and Body Weight in a Group of 12-year-old Children from Four Public Schools in Puerto Rico

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**Objective: Physical environment influences diet and has been proposed as a determinant of childhood obesity. This cross-sectional study explored physical environment and its associations with diet quality and weight status in a sample of 114 12-year-old children from 4 public schools in the metropolitan area of San Juan, PR.**

**Methods: Physical environment was assessed by asking questions regarding the availability and accessibility of healthy and unhealthy foods and food outlets as well as of recreational and sports facilities and equipment. Food intake was determined using a 24-hour diet-recall questionnaire, with the gathered data being used to assess diet quality and calculate the Healthy Eating Index (HEI)-2010. The HEI includes 12 components that are used to determine the compliance of a given diet with federal guidelines. HEI-2010 total score ranges from 0 to100 and is divided into the following classifications: *poor* (≤50), *needs improvement* (51-80), and *good* (>80). Body mass index was computed using measured weight and height and categorized according to the CDC Growth Charts.**

**Results: Thirty-six percent of the participating children were overweight or obese. Nearly 57% had poor diet quality. The lowest HEI-2010 component scores were found for total fruits, whole fruits, total vegetables, whole grains, seafood and plant proteins, and fatty acids. However, diet quality was not associated with weight status or physical environment factors. Compared to the other children in the study, overweight or obese children reported having a significantly ($p<0.05$) lower availability of unhealthy foods and the highest access to recreational and sports facilities at home but also lower utilization of recreational and sports facilities at school and reduced participation in the school breakfast program.**

**Conclusion: This study showed that some home- and school-environment factors influenced body weight in the children in this sample. However, these same factors did not appear to affect diet quality. [*P R Health Sci J 2014;33:14-21*]**

*Key words: Diet quality, Childhood obesity, Physical environment*

Childhood overweight or obesity is a major public health concern worldwide, including in Puerto Rico (PR). Childhood obesity is a risk factor for chronic diseases later in life (1,2). An island-wide study of youths aged 4 to 17 years of age in PR found the prevalences of overweight and obesity to be 17.9% and 21.5%, respectively (3). The highest overweight prevalence has been found in those who are 11 to 12 years old (46.8%) (4). Therefore, the high obesity rates in PR represent a critical situation.

Overweight and obesity are a complex and multidimensional health issues (5). Although studies have investigated the individual determinants of dietary intake and obesity, there is a gap in the knowledge regarding both the environmental determinants of diet quality (DQ) and those of obesity (6,7). In children, DQ and physical activity (PA) may be influenced by environmental factors, such as physical and social surroundings (6,8); therefore, the physical environment (PE) is an important component of the obesogenic environment (5). In this manuscript, we are using PE to specifically refer to the availability and accessibility of healthy and unhealthy foods and food outlets, recreational and sports facilities, and PA programs (at home, school, or both) (6,9,10).

Access to and the availability of healthy foods at home have been associated with better DQ (9,11), while on the contrary, access to unhealthy food outlets, such as fast food restaurants and convenience stores, can lead to high energy, sugar, and saturated-

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fat intakes, which have been linked to increases in the prevalence of obesity (12,13). Since school is the place where children spend most of their day, it exerts great influence in their diet and PA. Food outlets, such as vending machines, street vendors, and fast food restaurants in and around schools have been linked to poor DQ and body weight (14,15). However, participation in school breakfast and lunch programs can positively influence DQ and body weight (16,17).

PE factors are also linked to PA (18). PA can be linked to access to such recreational facilities as parks and playgrounds as well as to sports and exercise facilities in the neighborhood (19). In the school setting, PA has been linked to access to and the availability of recreational and sports facilities, recess periods in which activity-related equipment is available, and physical education programs (20).

The study of these factors is essential if we are to better understand how the environment influences diet and obesity (6,8). Therefore, the aim of this study was to explore PE factors and their association with DQ and weight status in a group of 12-year-old children from PR.

## Methods

### Study design and participants

A cross-sectional design was used to study the association between PE factors, DQ, and weight status among 12-year-old children enrolled in 4 public schools in the metropolitan area of San Juan, PR. The inclusion criteria were that each participant must be 12 years old, must be enrolled in the 2012-2013 school year, and must have a signed parental consent form and participant's assent form. There were no exclusion criteria.

The 4 schools selected were the ones identified in a previous island-wide study of 1,550 12-year-olds with the highest prevalence of overweight or obesity in this area (21). Based on an acceptable error of 0.05, a confidence level of 95%, and a population size of 300, the estimated number of study participants aimed for was 168, distributed equally among the schools. For the purpose of this study, participants were selected by convenience within the schools.

At each school, investigators visited 6$^{th}$- and 7$^{th}$-grade classrooms to explain the study. At a subsequent visit, interested participants with signed forms were invited to a private classroom in order to complete the questionnaire, 24-hour dietary recall interview, and anthropometric measurements. The Institutional Review Board of MSC-UPR and the Department of Education of PR approved the study.

### Questionnaire

A self-administered, short questionnaire was developed to collect data on socio-demographic characteristics, PE, and diet. Participants were asked if they were users of the Nutritional Assistance Program, which was used as an indicator of low socio-economic status (22).

Questions assessing the total time spent on vigorous and moderate PA and sedentary type activities were included using a modified version of the *Team Cool* survey (23). The total time that each participant spent in vigorous and moderate PA was dichotomized as meeting or not meeting the U.S. Department of Health and Human Services recommendation that children get at least 60 minutes of exercise every day (24). Similarly, the total sedentary time for each participant was dichotomized as meeting or not meeting the recommendation of the American Academy of Pediatrics that children remain inactive for fewer than 2 hours daily (25).

PE data were collected using a modified version of the *Active Where*? survey (26). This survey was designed to assess and understand how environment impacts PA and eating behaviors in children. This survey has been previously tested for its validity and reliability in 12- to 19-year-olds, demonstrating satisfactory indicators (27). Several questions of interest were extracted from this survey and translated into Spanish. Experts in child obesity and school health assessed content validity.

Home PE factors included the following: the availability of healthy and unhealthy foods, distance to healthy and unhealthy food outlets, distance to recreational and sports facilities, use of recreational and sports equipment, access to recreational and sports facilities, variety of foods at meals, and frequency of visits to fast food restaurants. The school PE factors included the following: the frequency of visits to unhealthy food outlets, the use of recreational and sports equipment and facilities, participation in breakfast and lunch programs, and physical education class frequency.

### 24-h dietary recall interview

Diet was assessed by 2 nutritionists using a single 24-hour dietary recall. Children were asked to list all of the foods and beverages that they had consumed in the past 24 hours, starting with the most recent meal and going backwards and including meals and snacks consumed both on weekends and weekdays, whichever might be the case; parents were not present in the interview. To aid in the estimation of portion sizes, food models were used (Life/form® food replicas; Nasco, Salida, CA). A fruit and vegetable frequency screener was used to corroborate the information from the recall (Rivera-Soto W, unpublished data, 2012). This screener was designed for adolescents in PR, and it is currently being validated. The results of the screener were adjusted to reflect daily intake. There was a perfect correlation between the results from the 24-hour dietary recall and the screener ($r = 1.0$), which indicates good reliability of the information reported in the recall. Data were analyzed using the Nutrition Data System for Research (NDSR 2011; University of Minnesota).

With information from the 24-hour dietary recall, DQ was assessed using the most recent (at the time of the study) updated version of the USDA's Healthy Eating Index (HEI-2010) (28).

The HEI is a score that assesses compliance with the US Dietary Guidelines for Americans and captures balance among food groups, including foods to encourage and foods to reduce (28). The HEI-2010 has 12 components, 9 of which assess dietary adequacy (total fruits, whole fruits, total vegetables, greens and beans, whole grains, total proteins, seafood and plant proteins, dairy, and fatty acids) and 3 of which assess dietary components that should be consumed in moderation (refined grains, sodium, and empty calories).

Each component is evaluated with a density approach; that is, food and nutrient components are expressed as an amount per 1,000 kcal. This allows the components to be considered independently of an individual's energy requirements so that diet quality can be evaluated regardless of the total amount of food consumed (29).

The components related to total fruits, whole fruits, total vegetables, greens and beans, total proteins, and seafood and plant proteins are scored from 0 to 5 points each. Whole grains, dairy, fatty acids (ratio of poly- and monounsaturated fatty acids to saturated fatty acids), refined grains, and sodium are scored from 0 to 10 points each; and the empty-calorie components are scored from 0 to 20 points. For the 9 adequacy components, participants with intakes at the level of the standard or higher received the maximum number of points. Those with no intake received a score of 0. For the 3 moderation components, participants with diet intakes at the level of the standard or lower were given the maximum number of points (28). Scores for intakes between the minimum and maximum standards were prorated linearly; that is, the reported amount per 1,000 kcal was divided by the standard and multiplied by the total possible number of points (30). The total score was calculated as the sum of all scores (0-100) and categorized as one of the following: good DQ (>80), DQ needs improvement (51-80), or poor DQ (≤50). The HEI has proven to be a reliable and valid measure of DQ in children (30,31) when using the NDSR (32).

### Anthropometric measurements

Trained staff measured weight and height following the NHANES procedures (33), with the participating children wearing their school uniforms without socks, shoes, or accessories. Weight was measured using a calibrated digital weight scale (Seca 882; GMBH & Co., Germany); this was calibrated between each participant (and before the first) using a 2.3 kg weight. Height was measured using a Height Measuring Rod (BM-9071; Charder Electronic Co., LTD, Taiwan, ROC). Measurements were taken in duplicate, rounded to the nearest 0.1, and averaged. Body mass index (BMI) was calculated dividing weight in kilograms by height in meters squared. Using the Centers for Disease Control and Prevention age- and sex-specific percentiles for BMI (34), participants were categorized as being of normal weight or as being overweight or obese.

### Statistical analysis

Normality of continuous variables was assessed using the Shapiro–Wilk test (35). The data were non-normally distributed; therefore, we used non-parametric tests. For descriptive statistics, we used median (25th and 75th percentiles) and frequency distributions. Fisher's exact test was used to compare socio-demographic characteristics by weight status, while the linear-by-linear association chi-squared test was used for the ordinal categorical variables. The Mann–Whitney U test was used to compare the median HEI scores with the continuous home and school PE variables by weight status. To study the association between total HEI and the scores and PE variables, Spearman's correlation and Kruskal–Wallis tests were used. Spearman's correlation was also used to study the association between BMI percentiles, PE, and total HEI variables. All descriptive and inferential statistics were assessed using the SPSS Statistical Package (SPSS version 18.0 for Windows, 2010, SPSS Inc., Chicago, IL). Statistical significance was set at $p<0.05$.

## Results

Of the 165 children who were eligible for the study, 118 (71.5%) were enrolled. Three participants who were underweight and 1 who did not complete the study protocol were excluded from the subsequent analysis. Therefore, 114 participants were included in the analysis; 57% of those participants were females and 43% were males. In terms of weight status classification, 64% were classified as being of normal weight and 36% were classified as being overweight or obese. In addition, 58% reported that they participated in Nutritional Assistance Program (only 63% answered this part). In relation to parental education, 71% of the children reported that their parents (mother and father) had completed at least a high school education, while 29% reported that their parents had completed more than a high school education. This part of the questionnaire was answered by only about 60% of the children.

Table 1 shows median HEI scores by weight status. Total HEI-2010 scores were similar in normal weight and overweight or obese children (48.8 and 49.7, respectively). The lowest median scores (0) for both males and females were found for whole fruits, whole grains, seafood and plant proteins, and fatty acids. However, girls had significantly ($p<0.05$) higher scores for whole fruits and total vegetables than did boys (data not shown). Normal-weight children appeared to have higher scores for total fruits, greens and beans, and empty calories than overweight or obese children did; however, these and other components were not significantly different by weight status ($p>0.05$).

Most children (55.6%) were categorized as having "poor DQ," while none of the children was categorized as having "good

DQ," with no differences by weight status (p>0.05; Table 2). About 30% of the children met the recommended guidelines for moderate and vigorous PA, and less than 10% of the children met the recommended guidelines for sedentary time, with no differences by weight status or gender (p>0.05).

Compared to those of normal weight, overweight or obese children reported significantly (p<0.05) lower availability of unhealthy foods, higher access to recreational and sports facilities at home, less use of recreational and sports facilities at school, and reduced participation in school breakfast programs (Table 3). There was a trend of higher availability of healthy foods and less accessibility to unhealthy food outlets in the homes of children classified as "DQ needs improvement" (p = 0.07; Table 4). Total HEI-2010 and individual component scores did not vary significantly across PE variables (data not shown).

There was a significant negative correlation between BMI and the availability of unhealthy foods at home (r = -0.25, p = 0.01) and a weak positive correlation between BMI and access to recreational and sports facilities at home (r = 0.25, p = 0.01; Table 5). In addition, there was a negative correlation trend between BMI and the use of recreational and sports facilities (p = 0.06).

**Table 1**. Healthy Eating Index-2010 components and total scores by weight status

| HEI-2010 component (maximum score) | Weight status | | *P-value** |
|---|---|---|---|
| | Normal weight (n = 73) | Overweight or obese (n = 41) | |
| | *median ($P_{25}$, $P_{75}$)* | | |
| Total fruit (includes 100% juice) (5) | 1.09 (0.0, 2.5) | 0.79 (0.0, 2.6) | 0.67 |
| Whole fruit (not juice) (5) | 0.0 (0.0, 2.7) | 0.0 (0.0, 3.7) | 0.83 |
| Total vegetables (5) | 0.3 (0.14, 0.9) | 0.41 (0.20, 1.1) | 0.32 |
| Greens and beans (5) | 3.6 (0.6, 5.0) | 2.21 (0.0, 5.0) | 0.14 |
| Whole grains (10) | 0.0 (0.0, 0.7) | 0.0 (0.0, 2.1) | 0.69 |
| Dairy (10) | 6.4 (3.6, 9.3) | 6.4 (3.8, 10.0) | 0.54 |
| Total protein foods (5) | 5.0 (3.3, 5.0) | 5.0 (3.8, 5.0) | 0.96 |
| Seafood and plant proteins (5) | 0.0 | 0.0 | 0.47 |
| Fatty acids† (10) | 0.0 | 0.0 | 0.55 |
| Refined grains (10) | 4.9 (3.9, 5.8) | 5.4 (4.1, 6.7) | 0.20 |
| Sodium (10) | 6.8 (6.0, 7.7) | 7.1 (6.2, 8.1) | 0.18 |
| Empty calories‡ (20) | 20.0 (15.3, 20.0) | 18.4 (13.9, 20.0) | 0.18 |
| Total HEI-2010 score (100) | 48.8 (42.5, 54.5) | 49.7 (41.9, 55.6) | 0.78 |

*P-value assessed by Mann–Whitney U; †Ratio of poly- and monounsaturated fatty acids to saturated fatty acids; ‡Calories from solid fats, alcohol, and added sugars.

**Table 2**. HEI-2010 category and physical activity by weight status

| | Weight status | | | | *P-value** |
|---|---|---|---|---|---|
| | Normal weight | | Overweight or obese | | |
| | n | % | n | % | |
| *Total HEI-2010 Category (n = 114)* | | | | | |
| Good DQ | 0 | 0 | 0 | 0 | 0.55 |
| DQ needs improvement | 31 | 57.5 | 20 | 48.8 | |
| Poor DQ | 42 | 42.5 | 21 | 51.2 | |
| *Moderate to Vigorous Physical Activity (n = 113)* | | | | | |
| <6 hours per week | 51 | 70.8 | 28 | 68.3 | 0.47 |
| ≥6 hour per week | 21 | 29.2 | 13 | 31.7 | |
| *Sedentary Time (n = 106)* | | | | | |
| ≤2 hours per day | 7 | 9.6 | 4 | 9.8 | 0.61 |
| >2 hours per day | 66 | 90.4 | 29 | 90.2 | |

*P-value assessed by linear-by-linear association chi-squared. DQ: diet quality.

## Discussion

Overall DQ in the sample was poor, with the lowest scores found for whole fruits, whole grains, seafood and plant proteins, and fatty acids, and with no differences by weight status. Normal-weight children participated more frequently in school breakfast programs and used recreational and sports facilities at school with greater frequency than did overweight or obese children, while the latter had less availability of unhealthy foods at home and more access to recreational and sports facilities at home. However, PE was not significantly associated with DQ.

The overall HEI-2010 score of our sample was lower than that reported for US Hispanic children (36,37), with scores ranging from 54 to 62. However, consistent with other studies in children (37,38), the lowest scores were found for whole fruits and whole grains. Moreover, scores for seafood and plant proteins and for fatty acids were low, which suggests that children in our sample are consuming too much saturated fat. A study in 633 children in PR ranging in age from 11 to 18 years reported high intakes of fried foods and fast foods, which are high in saturated fats (39). Similarly to other studies (38), we found that girls had significantly better scores for whole fruits and total vegetables than boys had.

In the present study, normal-weight children appeared to have higher scores for total fruits, greens and beans, and empty calories than did their overweight or obese counterparts; however, the differences were not significant. These results are consistent with those of other studies (38). Diet plays an important role in the development of obesity; however, diet varies through time, and overweight or obese participants in this study may have had different diets (which led to fat accumulation) in the years before the study than they did at the time of the study.

Overweight or obese children reported significantly less availability of unhealthy foods at

home than normal-weight children did. In other studies, low BMI has been associated with the highest availability of healthy foods, but not with less availability of unhealthy foods (8,41). Although the foods listed for each category (healthy/unhealthy) consisted of only 5 easy-to-recognize items, it may have been difficult for the participants to recall the frequency of their availability at home. In addition, overweight or obese children are more likely to under-report energy intake (42). Others have reported that parents of overweight or obese children are trying to have more healthy foods at home to help their children be more healthy (43), but the present study did not address this issue, thus it should be further studied.

Access to recreational and sports facilities was higher in overweight or obese children than it was in their normal-weight counterparts. Contrary to a study in 799 US adolescents, access to recreational facilities (which was determined using a geographic information system) was not associated with weight status (19). However, a Canadian study of a sample of 10- to 11-year old children found that those with more access to recreational facilities were less likely to be overweight or obese (44). Differences in these findings may reflect variations in the source of the information and in the measurement techniques used. Complexity in the evaluation of PE has been recognized (6,45,46).

**Table 3**. Physical environmental factors by weight status

| Physical Environmental Factors | Weight status | | *P-value*[a] |
|---|---|---|---|
| | Normal weight (n = 73) | Overweight or obese (n = 41) | |
| | *median ($P_{25}$, $P_{75}$)* | | |
| *Home physical environment (number of items)* | | | |
| Availability of healthy foods (5)[b,c] | 12.0 (9.0, 15.0) | 12.0 (9.7, 15.0) | 0.74 |
| Availability of unhealthy foods (5)[d,c] | 13.0 (11.0, 15.0) | 11.0 (10.0, 13.2) | 0.01 |
| Distance to: | | | |
| Healthy food outlets (3)[e,f] | 10.0 (7.0, 11.0) | 9.0 (6.0, 11.0) | 0.13 |
| Unhealthy food outlets (3)[g,f] | 9.0 (7.0, 13.0) | 9.0 (6.0, 12.0) | 0.55 |
| Recreational and sports facilities (6)[h,f] | 20.0 (15.9, 23.2) | 20.0 (16.0, 23.0) | 0.79 |
| Use of recreational and sports equipment (8)[i,j] | 16.0 (9.0, 20.0) | 16.0 (9.0, 18.0) | 0.83 |
| Access to recreational and sports facilities (4)[k] | 5.0 (5.0, 6.0) | 5.3 (5.0, 6.0) | 0.04 |
| *School physical environment (number of items)* | | | |
| Frequency of visits to unhealthy food outlets (4)[c] | 3.0 (2.0, 6.0) | 3.0 (2.0, 5.5) | 0.65 |
| Use of recreational and sports equipment (3)[c] | 8.0 (5.0, 9.0) | 6.0 (4.0, 9.0) | 0.29 |
| Use of recreational and sports facilities (2)[c] | 7.0 (6.0, 8.0) | 6.0 (4.0, 8.0) | 0.01 |
| *Home physical environment* | *n (%)* | *P-value*[l] | |
| Variety of foods at meals (n = 112) | | | |
| Never/Rarely | 13 (18.1) | 10 (25.0) | 0.46 |
| Sometimes | 31 (43.1) | 16 (40.0) | |
| Frequently/Always | 28 (38.9) | 14 (35.0) | |
| Frequency of visits to fast food restaurants (n = 112) | | | |
| Never/Rarely | 14 (19.2) | 8 (20.5) | 0.58 |
| Sometimes | 48 (65.8) | 27 (69.2) | |
| Frequently/Always | 11 (15.1) | 4 (10.3) | |
| *School physical environment* | | | |
| Participation in school breakfast program (n = 109) | | | |
| ≤1 day a week | 24 (33.8) | 24 (63.2) | 0.01 |
| 2-3 days a week | 7 (9.9) | 0 | |
| ≥4 days a week | 40 (56.3) | 14 (36.8) | |
| Participation in school lunch program (n = 109) | | | |
| ≤1 day a week | 10 (14.1) | 8 (21.1) | 0.60 |
| 2-3 days a week | 8 (11.3) | 2 (5.3) | |
| ≥4 days a week | 53 (74.6) | 28 (73.7) | |
| Physical education class frequency (n = 107) | | | |
| Never | 27 (39.1) | 14 (36.8) | 0.60 |
| 1-4 days a week | 9 (13.0) | 6 (15.8) | |
| 5 days a week | 33 (47.8) | 18 (47.4) | |

[a]*P-value* assessed by Mann-Whitney U test; [b]Includes fruits and vegetables, 100% fruit juice, whole grains, and low fat milk; [c]On a 5-point scale: Never=1, Rarely=2, Sometimes=3, Frequently=4, Always=5. [d]Includes candy, sweet pastries, sweetened beverages, refined grains, and chips; [e]Includes super- and mini-markets and fruit and vegetable markets; [f]On a 5-point scale: 1-5 minutes (min.)=1, 6-10 min.=2, 11-20 min.=3, 21-30 min.=4, >31 min.=5; [g]Includes fast food restaurants and street food vendors; [h]Includes playgrounds, parks, fitness centers, and basketball courts. [i]Includes bicycles, balls, skates, and video games for exercise; [j]On a 5-point scale: Not available=1, Available but never use=2, Use once a month or less=3, Use once every other week=4, Use once a week or more=5; [k]On a 2-point scale: No=1, Yes=2. [l]P-value assessed by linear-by-linear association chi-squared test.

Reduced participation in school breakfast programs was significantly associated with overweight or obese. This is consistent with results from a US national sample of public schools, which showed a significant association between lower BMI and school-breakfast-program participation, but not with similar participation in school lunch programs (17). Regular participation in a school breakfast program influences the prevalence of breakfast consumption (17), which is associated with lower BMI (47). This relationship is unclear, but some theories suggest that it may influence the distribution of daily energy intake, prevent overeating, and promote diet-induced thermogenesis and energy expenditure (17,47).

More than half of the children did not meet the recommended guidelines for PA and sedentary time. Overweight or obese children reported significantly less use of recreational and sports facilities at school than normal-weight children did. Similarly, a study in 410 US schools found that the use and participation in recreational and sports activities at school was associated with lower BMI scores (20). Reduced participation of overweight or obese children in such activities may be influenced by social factors linked to self-esteem, parental or peer support, or perceived peer attitudes about body shape and fitness (48). Therefore,

**Table 4**. Physical Environmental Factors by HEI-2010 category

| Physical Environmental Factors | HEI-2010 category | | *P-value*[a] |
|---|---|---|---|
| | DQ needs improvement | Poor DQ | |
| | median ($P_{25}$, $P_{75}$) | | |
| *Home physical environment (number of items)* | | | |
| Availability of healthy foods (5)[b,c] | 12.0 (11.0, 15.0) | 12.0 (9.0, 14.0) | 0.07 |
| Availability of unhealthy foods (5)[d,c] | 12.0 (10.0, 14.0) | 12.0 (10.0, 15.0) | 0.46 |
| Distance to: | | | |
| Healthy food outlets (3)[e,f] | 9.0 (7.0, 11.0) | 9.0 (7.0, 11.0) | 0.59 |
| Unhealthy food outlets (3)[g,f] | 10.0 (7.0, 14.0) | 9.0 (6.0, 12.0) | 0.07 |
| Recreational and sports facilities (6)[h,f] | 20.0 (18.0, 24.0) | 19.0 (15.4, 23.0) | 0.23 |
| Use of recreational and sports equipment (8)[i,j] | 16.0 (10.0, 20.0) | 16.0 (8.7, 18.2) | 0.84 |
| Access to recreational and sports facilities (4)[k] | 5.0 (5.0, 6.0) | 5.0 (5.0, 6.0) | 0.94 |
| *School physical environment (number of items)* | | | |
| Frequency of visits to unhealthy food outlets (4)[c] | 3.0 (1.2, 5.5) | 4.0 (1.0, 6.0) | 0.80 |
| Use of recreational and sports equipment (3)[c] | 8.0 (5.0, 8.2) | 7.0 (4.5, 9.0) | 0.96 |
| Use of recreational and sports facilities (2)[c] | 7.0 (5.0, 8.0) | 7.0 (5.0, 8.0) | 0.71 |
| *Home physical environment* | *n (%)* | | *P-value*[l] |
| Variety of foods at meals (n = 112) | | | 0.49 |
| Never/Rarely | 10 (20.4) | 13 (20.6) | |
| Sometimes | 18 (36.7) | 29 (46.0) | |
| Frequently/Always | 21 (42.9) | 21 (33.3) | |
| *Frequency of visits to fast food restaurants (n = 112)* | | | 0.96 |
| Never/Rarely | 11 (22.0) | 11 (17.7) | |
| Sometimes | 31 (62.0) | 44 (71.0) | |
| Frequently/Always | 8 (16.0) | 7 (11.3) | |
| *School physical environment* | | | |
| Participation in school breakfast program (n = 109) | | | 0.20 |
| ≤1 day a week | 18 (37.5) | 30 (47.6) | |
| 2-3 days a week | 3 (6.3) | 4 (6.6) | |
| ≥4 days a week | 27 (56.3) | 27 (44.3) | |
| Participation in school lunch program (n = 109) | | | 0.85 |
| ≤1 day a week | 8 (16.7) | 10 (16.4) | |
| 2-3 days a week | 5 (10.4) | 5 (8.2) | |
| ≥4 days a week | 35 (72.9) | 46 (75.4) | |
| Physical education class frequency (n = 107) | | | 0.76 |
| Never | 18 (36.7) | 23 (39.7) | |
| 1-4 days a week | 7 (14.3) | 8 (13.8) | |
| 5 days a week | 24 (49.0) | 27 (46.6) | |

[a]P-value assessed by Mann-Whitney U test; [b]Includes fruits and vegetables, 100% fruit juice, whole grains, and low fat milk; [c]On a 5-point scale: Never=1, Rarely=2, Sometimes=3, Frequently=4, Always=5; [d]Includes candy, sweet pastries, sweetened beverages, refined grains, and chips; [e]Includes super- and mini-markets and fruit and vegetable markets; [f]On a 5-point scale: 1-5 minutes (min.)=1, 6-10 min.=2, 11-20 min.=3, 21-30 min.=4, >31 min.=5; [g]Includes fast food restaurants and street food vendors; [h]Includes playgrounds, parks, fitness centers, and basketball courts; [i]Includes bicycles, balls, skates, and video games for exercise; [j]On a 5-point scale: Not available=1, Available but never use=2, Use once a month or less=3, Use once every other week=4, Use once a week or more=5; [k]On a 2-point scale: No=1, Yes=2; [l]P-value assessed by linear-by-linear association chi-squared test. DQ: Diet quality.

PA programs specifically designed for overweight or obese children are of particular importance (49). A pilot program entitled "Ponte Guillao con Buena Salud" in 8- to 13-year-old obese children from 6 (3 control and 3 intervention) extended-stay elementary schools in PR, which included 13 weeks of nutritional, physical, and self-esteem–building activities, found that obesity was reduced by 5% in the intervention group but underwent a 2% increase in the control group (50).

Children classified as "DQ needs improvement" appeared to report a higher availability of healthy foods and less accessibility to unhealthy food outlets than did children classified as "poor DQ"; however, this was not significant. A US study in 458 adolescents and their parents found that a diet high in fruits and vegetables was positively associated with the availability of healthy foods at home (9). Furthermore, diets high in sugar have been associated (in adolescents) with the residential proximity to unhealthy food outlets (12). Although this was not observed in the present study, PE is complex and can be influenced by several factors not included in this study (e.g., perception socio-cultural factors). Moreover, a larger sample size may help in the detection of associations with PE; parental reports may also be important to confirm the child's answers.

This is the first study to explore the PEs of school children in PR. However, some limitations should be considered. Children were self-selected and may have been more motivated and health conscious than those who did not choose to participate. The sample size was limited and the information on diet and PE was self-reported without parental involvement. In addition, individual reports of parental socioeconomic status were missing for a significant number of the participants. On the other hand, among the strengths of this study is the inclusion of measures that have been previously tested and validated in children. Finally, the response rate was similar to that of other pediatric studies in PR, and nutritionists performed the 24-hour recall dietary interview.

In conclusion, overweight or obese was associated with a low availability of unhealthy foods, high access to recreational and sports facilities at home, reduced participation in school breakfast programs, and low use of the recreational and sports facilities at school. These findings can help in the development of health-promoting public policies and nutritional interventions to improve participation in school breakfast programs as well as in increasing the use of recreational and sports facilities. More research is needed to develop validated tools for measuring PE and to explore other environmental factors influencing diet and PA in children.

**Table 5**. Correlations between BMI percentiles with Physical Environmental Factors and Total HEI-2010 score

| | Correlation coefficient | *P-value** |
|---|---|---|
| *Home physical environment* | | |
| Availability of healthy foods | 0.05 | 0.61 |
| Availability of unhealthy foods | -0.25 | 0.01 |
| Distance to: | | |
| Healthy food outlets | -0.03 | 0.74 |
| Unhealthy food outlets | 0.07 | 0.49 |
| Recreational and sports facilities | 0.04 | 0.64 |
| Use of recreational and sports equipment | -0.08 | 0.39 |
| Access to recreational and sports facilities | 0.25 | 0.01 |
| *School physical environment* | | |
| Visits to unhealthy food outlets | -0.13 | 0.17 |
| Use of recreational and sports equipment | -0.10 | 0.28 |
| Use of recreational and sports facilities | -0.17 | 0.06 |
| *Total HEI-2010 score* | 0.08 | 0.42 |

**P-value* assessed by Spearman's correlation.


## Resumen

Objetivo: El ambiente físico influye la alimentación y ha sido propuesto como un determinante de la obesidad en los niños. Este estudio transversal exploró el ambiente físico y su asociación con la calidad de la dieta y el estatus del peso en una muestra de 114 niños de 12 años de cuatro escuelas públicas del área metropolitana de San Juan. Métodos: El ambiente físico fue evaluado a través de preguntas relacionadas a la disponibilidad y accesibilidad de alimentos y lugares de venta de alimentos saludables y poco saludables, lugares y equipo recreativo y deportivo. La ingesta dietaría fue evaluada utilizando un recordatorio de 24 horas, la cual fue utilizada para calcular el Healthy Eating Index (HEI, por sus siglas en inglés)-2010, el cual incluye 12 componentes que reflejan la conformidad de la alimentación con las guías federales. La puntuación total del HEI-2010 varía de 0-100, y es clasificada como pobre (≤50), necesita mejorar (51-80) y buena (>80). El índice de masa corporal fue calculado utilizando medidas de peso y estatura, y fue categorizado según las tablas de crecimiento del CDC. Resultados: El 36% de los niños estaba en sobrepeso u obesidad. Casi el 57% tenía una calidad de la dieta clasificada como pobre. Los componentes del HEI-2010 con menores puntuaciones fueron total de frutas, frutas enteras, total de vegetales, granos integrales, pescados y mariscos y proteínas de plantas, y ácidos grasos. Sin embargo, la calidad de la dieta no estuvo asociada con el estatus del peso o con los factores del ambiente físico. Los niños en sobrepeso u obesidad reportaron ($p<0.05$) menor disponibilidad de alimentos poco saludables, mayor acceso a facilidades recreativas y deportivas en el hogar, pero también, menor uso de las facilidades recreativas y deportivas en la escuela, y menor participación del comedor escolar para desayunos. Conclusión: Este estudio demostró que algunos factores del ambiente físico en el hogar y en la escuela influyen en el peso corporal, pero no en la calidad de la dieta, en esta muestra.



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