Prevalence of Overweight among Inner City Hispanic-American Children and Adolescents

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Abstract

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Objective: National surveys have pointed to a particularly high risk of pediatric overweight among U.S. Hispanics. However, the data have been primarily from the Mexican-American community. We studied the prevalence of overweight and clinical comorbidities in children and youth of predominantly El Salvadoran ancestry.

Research Methods and Procedures: A sample of 309 Hispanic youth, 6–18 years was surveyed from two inner city Washington, DC, clinics. BMI; triceps skinfold (TSF) and subscapular skinfold thickness (SSSF); bioelectrical impedance analysis (BIA); and blood pressure measures were obtained, along with information regarding physical activity, sedentary behavior, dietary history, family, and personal medical history.

Results: Thirty-eight percent were overweight (BMI $\geq$ 95th percentile) and 22% at risk for overweight (BMI 85–94th percentile). Thirty-four percent had TSF $\geq$ 90th percentile and 29% had SSSF $\geq$ 90th percentile. Fifty-one percent of males and 70% of females had body fat > 30%. Compared to their nonoverweight counterparts, overweight youth had significantly higher systolic blood pressure (111.4 $\pm$ 1.3 vs. 104.5 $\pm$ 0.9 mm Hg, $p < 0.0001$). Among children younger than 11 years, overweight was associated with onset of adrenarche (23% vs. 10%, $p = 0.01$). Participation in one or more sports teams was negatively correlated with overweight) $p = 0.04$).

Discussion: The prevalence of overweight and at risk for overweight in this sample was twice the national average for U.S. children and 1.7 times greater than that of Mexican-American children in national surveys. Overweight was associated with advanced pubertal development, high body fat, elevated blood pressure, and decreased sports participation.

Key words: overweight, Hispanic-American children and adolescents, clinical comorbidities, physical activity, dietary patterns

Introduction

Overweight in children and adolescents is on the rise in the United States (1). The most current National Health and Nutrition Examination Study (NHANES)[1] survey (1999 to 2000) found that the prevalence of BMI $\geq$ 95th percentile was 15% for children 6 to 19 years old, representing an almost 4-fold increase for children 6 to 11 years old and a 3-fold increase for children 12 to 19 years old since the 1960s (2). The complications of obesity in children and adolescents (1,3–8) also seem to be increasingly prevalent in children (9–12). Some (13,14) but not all (15) studies find that high body weight in adolescence is an independent factor predicting obesity, elevated health risks, and increased mortality in adulthood. Therefore, it is important to identify subgroups of children who are more likely to develop obesity, so that treatment and prevention efforts can be directed toward them.

The prevalence of obesity has been found to be higher among both Hispanic- and African-American youth than

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[1] Nonstandard abbreviations: NHANES, National Health and Nutrition Examination Study; TSF, triceps skinfold thickness; SSSF, subscapular skinfold thickness; BP, blood pressure; BIA, bioelectrical impedance analysis.

among non-Hispanic white children (2). Although data for African-American children have been obtained from many U.S. regions, the prevalence rates quoted for Hispanics reflect data obtained primarily in Mexican-American children and youth from the West and Southwest U.S., areas that have the highest concentration of Hispanics (16). There is a paucity of information on the prevalence rates for non-Mexican-American Hispanics, who constitute 41.6% of Hispanics in the U.S. (16).

Somewhat unique among cities in the U.S. with large numbers of Hispanic-American residents, the District of Columbia's Hispanic population is predominantly of El Salvadoran ancestry (17). Washington, DC has the second largest population of Salvadorans outside El Salvador (18). The growth in the Hispanic population in DC is due mainly to immigration rather than fertility (19). In the mid-1980s, DC experienced a large influx of Central American immigrants fleeing their war-torn countries (19). Anecdotal reports suggest that the prevalence of overweight is extraordinarily high among children of this immigrant community. Therefore, the purpose of this study was to conduct a cross-sectional survey in two community clinics with the objectives of determining the prevalence of overweight among inner city Hispanic children and youth of predominantly El Salvadoran ancestry and examining the correlation between the clinical comorbidities of obesity and the BMI of such children.

Research Methods and Procedures

We conducted a cross-sectional survey of Hispanic children and adolescents at two community clinics in inner city Washington, DC from February to July 2002. The clinics serve a low socioeconomic minority population, predominantly Hispanics (85%). Over 80% of the clinic population has medical assistance insurance. It is estimated that 22.2% of the population in Ward 1, where the clinics are located, is uninsured, and 41.2% is <200% of the Federal Poverty Level (20). In 1999, the per capita income for Ward 1 was $23,760 (21), whereas the per capita income for Hispanics was $12,525 (19). Although the official DC Hispanic population is estimated at 45,000, the Immigration and Naturalization Service estimates that in 1996, there were 30,000 undocumented immigrants in the District (19). Almost one-half (46.3%) of the Hispanics in DC live in Ward 1. A majority of the Hispanics in this area are from El Salvador. Most families are new immigrants, whereas others have been in the U.S. for several generations.

Every other child 6 to 18 years old who was registered to be seen at the clinic and whose parents were both identified as Hispanic was eligible for the study. Children who were being seen for illness-related visits were also recruited if they were not ill-appearing and had no history of disorders expected to alter body weight, such as fever, diarrhea, vomiting, or decreased oral intake. To assure independence among children, only one child per family was recruited. In families with more than one eligible child at the time of recruitment, one child was selected at random. In families where one child had been recruited previously, the rest of the siblings in the family were considered ineligible for the study.

Parents and children were presented with questionnaires (generally administered in Spanish) that inquired about birth history, past and current medical history, family medical history, migration history, sociodemographics, socioeconomic status, feeding history during infancy, acculturation, parental body perception, physical activity, and sedentary behavior pattern. Only one set of questionnaires was completed by the parent-child dyad. An additional questionnaire was administered directly to children 10 years and older, inquiring about physical activity, sedentary behavior, self-esteem, social coping skills, and dietary behavior. The questions were derived from validated surveys [2001 Youth Risk Behavior Survey (22), World Health Organization Study of Health Behavior of School Children Survey (23), Eating Disorder Inventory (24), Short Acculturation Scale for Hispanic Youth (25), and the Bicultural Involvement Questionnaire (26)].

Physical assessments included height measured with a wall-mounted stadiometer and weight measured on a digital scale that was calibrated weekly. Triceps skinfold thickness (TSF) and subscapular skinfold thickness (SSSF) were measured to the nearest millimeter on the right side of the body using Lange skinfold calipers. Three measurements were taken at each site, and the average of the three measurements was used for analyses. Waist circumference was measured at the umbilicus using a nonelastic tape measure to the nearest 0.1 cm. Two measurements were taken, and the average of the two measurements was used for analysis. Blood pressure (BP) was measured by Dinamap (Critikon, Inc., Denver, CO). Anthropometric measurements were done by trained research assistants using standardized procedures (27,28). The research assistants underwent training until their circumference measurements were replicable to within 0.5 cm, and their skinfold thickness measurements were replicable within 2 mm of the trainer's measurements. Their measurement techniques were supervised once a week by an experienced dietitian from the Pediatric Clinical Research Center.

Bioelectrical impedance analysis (BIA) was used to estimate body fat mass. For this measurement, resistance and reactance were measured using a single frequency BIA analyzer (Model BIM 4G; SEAC for Impedimed P/L, Capalaba, Australia), as recommended by the manufacturer. Bioelectrical resistance was measured after induction of a 50-kHz electrical signal with a maximum current of 500 μA. Because no BIA body fat formula for Hispanic children is available, a formula for white children was used (29).

Clinic health care providers performed sexual maturation staging of study subjects. These health care providers were given a form with the Tanner classification in a pictorial format and were requested to record the picture that best corresponded to the study subjects' puberty stage. Health care providers attended a training program for Tanner classification before the onset of the study that included discussion of the need to perform palpation to adequately determine breast Tanner stage. Over 85% of the assessments were done by three consistent providers. Inter-rater reliability agreement among these providers was not measured.

The study was approved by the Institutional Review Board at Children's National Medical Center (Washington, DC). Written consent was obtained from the parents or guardians of the children, and assent was obtained from children 7 years and older. Consent and assent forms were available in Spanish and English and were administered in the language of preference for parent and child.

Variable Definitions

The outcome variable BMI was calculated as weight in kilograms divided by height in meters squared. Using the 85th and 95th percentile cut-off points for age and sex from the Centers for Disease Control and Prevention Growth Charts, United States (3), children with BMI ≥ 95th percentile for age and sex were categorized as overweight, and those with BMI between 85th and 94th percentile for age and sex were categorized as at risk for overweight. BMI SD score for age and sex (BMI z score) were similarly calculated. Age was calculated from date of birth and date of visit. Using NHANES criteria, TSF and SSSF ≥ 90th percentile for age and sex were used to indicate overfatness (30,31). Body fat mass and percentage body fat were calculated from the BIA readings using Kushner et al.'s equations for children 6 to 9 years of age and Houtkooper et al.'s equations for children 10 to 18 years old (29). Percentage body fat ≥ 30% was used to indicate overfatness. Cardiovascular risk was estimated using both skinfolds and BIA using the criteria proposed by Higgins et al., where high risk is defined as waist circumference ≥ 71 cm or body fat > 33% (32). These cardiovascular risk cut-off points were developed from a sample of 87 prepubertal African-American and white boys and girls 4 to 11 years old (32).

Analyses

Frequency distributions of independent variables were calculated, and information was analyzed by BMI category (BMI < 95th and ≥95th percentile). Bivariate associations between BMI and categorical variables were examined using χ^2 test, and Student's t test was used to examine associations between BMI and continuous variables. Cochran-Armitage trend test was performed for all ordered variables with more than two categories. Multiple logistic regression was used to examine the independent effects of dietary, physical activity, and sedentary behavior variables on BMI (<95th vs. ≥95th percentile) adjusting for potential confounders (age, sex, and household income). Separate regressions were performed for diet and physical activity. Variables that had significant associations in these two models were then included in the final combined model. Statistical analyses were performed with SAS version 8.1 software (SAS Institute Inc., Cary, NC).

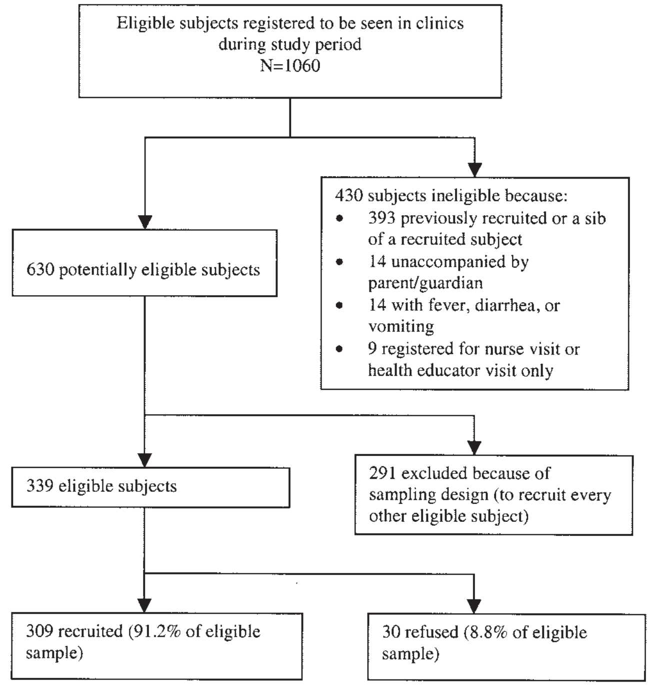

Figure 1: Schematic representation of study recruitment process.

Results

Characteristics of the Population

A schematic representation of the sampling process is shown in Figure 1. Ninety-one percent of eligible children agreed to participate in the survey. Fifty-four percent of study subjects were women, and 70% were between 6 and 11 years old. Over 80% of the subjects were of El Salvadoran origin, ~6% of Guatemalan origin, and the remainder from Mexico (4%), Dominican Republic (4%), Nicaragua (2%), Peru (2%), Puerto Rico (<1%), Honduras (<1%), Bolivia (<1%), and Ecuador (<1%). A majority of the children (84%) were second generation Americans, and only 15% were first generation Americans. First generation refers to an individual who arrived as an adult or child to the U.S. Second generation refers to an individual who was born in the U.S. of immigrant parents.

Ninety-three percent of the children were born at full-term gestation, and the average birth weight was 3363 grams. Six percent had a birth weight < 2500 grams, and 12% had a birth weight > 4000 grams. There were no significant associations between study children's overweight status and their age, gender, birth weight, birth order, generation in the U.S., or maternal education (Table 1).

Table 1. Distribution of the demographic characteristics of the study population

	Child's BMI < 95th percentile Freq %	Child's BMI ≥ 95th percentile Freq %	*p**
All subjects	(n = 193)	(n = 116)	
	62	38	
Gender distribution (%)	(n = 193)	(n = 116)	
Men	46	46	0.9
Women	54	54	
Age distribution (%)	(n = 193)	(n = 116)	
6 to 8 years	40	42	0.9
9 to 11 years	29	29	
12 to 18 years	31	29	
Birth weight (g, mean ± SD)	(n = 176)	(n = 104)	
	3341 ± 537	3400 ± 618	0.4†
Birth order (%)	(n = 114)	(n = 79)	
1st born	47	38	
2nd born	30	33	0.6
3rd born	12	18	
≥4th born	11	11	
Child's generation in the U.S. (%)	(n = 193)	(n = 116)	
1st generation	18	11	0.1
2nd or more generations	82	89	
Maternal BMI (%)	(n = 140)	(n = 76)	
BMI < 30	63	39	0.001
BMI ≥ 30	37	61	
Positive family history of obesity	(n = 193)	(n = 116)	
	19	30	0.03
Maternal education	(n = 189)	(n = 115)	
Some primary education	7	4	
Did complete high school	37	44	0.33
Graduated from high school	26	33	
Some education after high school	30	19	
Annual household income	(n = 178)	(n = 108)	
<$10,000	6	17	
$10 to $20,000	39	31	0.3
$20 to $40,000	49	43	
>$40,000	6	9	

* χ^2 (for variables with 2 levels) or Cochran-Armitage Trend Test (for variables with >two ordered levels).
† Student's t value (Student's t test).

A positive but nonsignificant trend between increasing BMI and duration of residency in the United States was observed (Table 1, generation in the U.S.). Over 45% of the study participants lived in households with an annual income of $20,000 or less. A higher proportion of overweight children was found in both extremes of income categories compared with the middle of the income distribution.

Prevalence of Overweight and Variation between Measures

Fifty-nine percent of the children and adolescents were either overweight or at risk for overweight (BMI ≥ 85th percentile), 38% were overweight (BMI ≥ 95th percentile), and 13% had a BMI ≥ 99th percentile for age and gender (Table 2). There were no significant differences in the

Table 2. Distribution of BMI, weight for age, height for age centiles, skinfold thickness, and percentage body fat mass by age and gender

	All subjects			Age categories: 6 to 8 years old		9 to 11 years old		12 to 18 years old	
	Both sexes ($n = 309$) %	Men ($n = 142$) %	Women ($n = 167$) %	Men ($n = 57$) %	Women ($n = 70$) %	Men ($n = 46$) %	Women ($n = 42$) %	Men ($n = 39$) %	Women ($n = 55$) %
BMI									
<50th percentile	13	14	11	18	8	6	17	18	11
50th to 84th percentile	28	30	26	28	23	37	14	26	40
85th to 94th percentile	22	18	25	17	29	24	26	13	18
95th to 99th percentile	24	25	25	23	23	26	26	25	26
≥99th percentile	13	13	13	14	17	7	17	18	5
Weight for age									
<50th percentile	23	23	23	26	16	18	24	26	33
50th to 84th percentile	33	35	30	32	33	41	24	33	31
85th to 94th percentile	17	15	18	14	21	20	16	10	16
95th to 99th percentile	16	17	16	16	17	17	17	18	13
≥99th percentile	11	10	13	12	13	4	19	13	7
Height for age*									
<50th percentile	63	65	62	56	53	68	48	77	84
50th to 84th percentile	28	25	30	28	37	26	40	18	14
85th to 94th percentile	6	6	6	11	9	4	7	0	2
95th to 99th percentile	3	4	2	5	1	2	5	5	0
≥99th percentile	0	0	0	0	0	0	0	0	0
Skinfold thickness									
TSF ≥ 90th percentile	34	32	35	32	34	30	43	36	29
SSSF ≥ 90th percentile†	29	32	27	39	34	22	27	33	18
BIA body fat mass (%)									
>30%‡	61	51	70	53	74	56	68	41	65

* $\chi^2 = 19.06$, $p = 0.004$ for females for increasingly shorter stature with age.
† Decreasing prevalence of overfatness with age in females for SSSF (trend test, $p = 0.04$).
‡ $\chi^2 = 11.8$, $p = 0.0006$ for the overall difference in percentage body fat mass between men and women.

prevalence of overweight or at risk for overweight between men and women or among the different age categories. The mean and median BMI z scores for the entire sample were 1.21 and 1.31, respectively, with a range from −2.15 to 3.19.

The children in the study were relatively short for age, with over 90% being less than the 85th percentile and 63% being less than the 50th percentile for height for age compared with the U.S. national reference population (Table 2). Stature was negatively correlated with age, with the older children being much shorter relative to the U.S. national reference than the younger children ($r = 0.3$; $p < 0.0001$; data not shown). Stature was significantly associated with generations in the U.S. ($p = 0.01$) but not with socioeconomic status ($p = 0.1$) or maternal education ($p = 0.9$) (data not shown). First generation Hispanic-American children were significantly shorter (height for age mean z score = −0.69, SE 0.15) than second or more generation Hispanic-American children (height for age mean z score = −0.27, SE 0.06; $p = 0.01$) (data not shown).

Body fat percentage measured using BIA suggested that 51% of the men and 70% of the women had >30% body fat. Using skinfold thicknesses as measures of adiposity, 34% of the children were overfat by TSF, and 29% were overfat by SSSF criteria (Table 2). There were no significant differences in SSSF or TSF measures between men and women or among the different age categories for TSF. However, for SSSF, there were significant differences among the different age categories, with the older women having a lower prevalence of high adiposity. The correlation among the different measures of adiposity are shown in Table 3.

Table 3. Correlation coefficients among measures of fatness

	BMI	TSF	SSF	BIA body fat mass (%)	Waist circumference
BMI	**1.00**	0.51	0.46	0.67	0.48
TSF	0.52	**1.00**	0.86	0.52	0.74
SSF	0.54	0.86	**1.00**	0.50	0.81
BIA body fat mass (%)	0.67	0.40	0.44	**1.00**	0.44
Waist circumference	0.52	0.76	0.79	0.36	**1.00**

Above the diagonal (values of 1.00) men ($n = 142$); below the diagonal women ($n = 167$). All correlations are significant at $p < 0.001$.

Variables Associated with Overweight

Family History of Obesity. There was a significant association between maternal BMI and the child's BMI (Table 1), even though most mothers were overweight or obese: 83% of mothers had a BMI $\geq$ 25 kg/m^2 and 45% had a BMI $\geq$ 30 kg/m^2. There was a significant association between the child's BMI and family history of obesity (Table 1). The relationship of the obese family members to the index child included mothers (39%), fathers (16%), siblings (14%), grandparents (11%), aunts (9%), uncles (4%), and more distant family members (7%).

Dietary and Activity History. These are summarized in Tables 4 and 5. Overall regular consumption of fruit juices and sweetened beverages was highly prevalent, and both the overweight and nonoverweight children reported a relatively low frequency of vegetable consumption. In general, the children surveyed were not very active, with over one-quarter of them reporting that they never played outside their homes after school, and one-quarter reporting that they rarely participated in physical education classes in school. Fourteen percent of overweight and 8% of nonoverweight adolescents described themselves as being inactive, and ~70% of each group described themselves as "standing and walking quite a lot" (Table 5). Ninety-one percent of the entire cohort rarely participated in club activities such as scouts or 4-H clubs (data not shown).

Bivariate analysis of self-reported (for adolescents) or parent-reported (for children age 6 to 9 years old) dietary intake and physical activity among participants showed significant associations between BMI and type of milk consumed (Tables 4 and 5). When multivariate logistic regression analysis was run, with BMI categories (<95th and ≥95th percentile) as the response variable and physical activity and dietary variables as the independent variables, significant associations were found between BMI and participation in sports teams and type of milk consumed (Table 6). Adolescents who participated in one or more sports teams in a year were 61% less likely to be overweight than those who did not play in any sports team. Adolescents who consumed 1% to 2% milk were 3.9 times more likely to be overweight than adolescents who reported consumption of whole milk in the last 7 days.

Clinical Manifestations of Overweight That Increase Risk for Morbidity

Bivariate analyses showed statistically significant associations between the child's BMI and Tanner puberty stage (Table 7). Overweight children 6 to 11 years old were also more likely to have initiated pubertal hair development than their nonoverweight counterparts.

Mean systolic BP was significantly higher in overweight children (Table 7). There was positive correlation between systolic ($r = 0.2$; $p < 0.0001$) and diastolic ($r = 0.1$; $p = 0.069$) BP with BMI z score. Using the criteria proposed by Higgins et al. (32), a high cardiovascular risk profile, assessed either by waist circumference or by body fat percentage, was found in 45% to 49% of all study subjects, respectively, and was significantly more likely to be found in overweight children.

There were no significant associations between BMI and history of asthma, attention deficit hyperactive disorder, snoring, obstructive sleep apnea, or daytime somnolence (data not shown). None of the study children or adolescents had been diagnosed with type 2 diabetes.

Discussion

The prevalence of overweight and at risk for overweight among children and adolescents in this inner city Hispanic community of predominantly El Salvadoran origin was extremely high. Among the 6- to 11-year-old children in this study population, overweight was 3.4 times the reported national prevalence of non-Hispanic white children and 1.7 times the national prevalence for Mexican-American children (2). The prevalence of overweight in adolescents 11 to 18 years old in this study population was 2.7 times the national prevalence of overweight among non-Hispanic

Table 4. Food consumption patterns among normal weight and overweight adolescents (10 to 18 years old)

	Child's BMI < 95th %	Child's BMI ≥ 95th %	p*
No. of times consumed 100% fruit juice in the last 7 days	(n = 88)	(n = 47)	
None	4	11	
1 to 3 times in 7 days	23	23	0.21
About once or more a day	73	66	
No. of times consumed sodas or other sweetened beverages in the last 7 days	(n = 90)	(n = 47)	
None	5	13	
1 to 3 times in 7 days	30	28	0.25
About once or more times a day	65	59	
No. of glasses of milk consumed in the last 7 days	(n = 90)	(n = 47)	
None	9	15	
1 to 3 glasses in 7 days	24	23	0.19
About 1 glass a day	28	34	
2 or more glasses a day	39	28	
Type of milk usually consumed	(n = 85)	(n = 44)	
Whole milk	74	43	
1% to 2% milk	26	57	0.0005
No. of times consumed fruits in the last 7 days	(n = 90)	(n = 47)	
None	6	17	
1 to 3 times in 7 days	38	43	0.12
4 to 6 times in 7 days	32	15	
Once or more times a day	24	25	
No. of times consumed green salad in the last 7 days	(n = 90)	(n = 47)	
None	40	32	
1 to 3 times in 7 days	42	53	
4 to 6 times in 7 days	9	6	0.76
Once or more times a day	9	9	
No. of times consumed potatoes in the last 7 days, excluding fries, potato chips or fried potatoes	(n = 90)	(n = 47)	
None	71	68	
1 to 3 times or more in 7 days	29	32	0.7
No. of times consumed carrots in the last 7 days	(n = 90)	(n = 47)	
None	68	64	
1 to 3 times or more in 7 days	32	36	0.6
No. of times consumed other vegetables in the last 7 days	(n = 90)	(n = 47)	
None	30	21	
1 to 3 times or more in 7 days	51	47	0.09
About once or more times a day	19	32	
No. of times consumed meals prepared in restaurant (eat-in, carry out, or delivered to home)	(n = 90)	(n = 47)	
Never	10	15	
Less than once a week	48	55	0.14
Two times or more per week	42	30	

* χ^2 (for variables with two levels) or Cochran-Armitage Trend Test (for variables with >two ordered levels).

Table 5. Distribution of physical activity and sedentary behavior characteristics among normal weight and overweight children and adolescents

	Child's BMI < 95th %	Child's BMI ≥ 95th %	*p**
Hours spent watching TV or playing TV games	(*n* = 192)	(*n* = 115)	
≤1 hour per day	33	36	
2 to 3 hours per day	50	42	0.96
4 or more hours per day	17	22	
Child/adolescent has a TV in his/her bedroom (%)	(*n* = 192)	(*n* = 115)	
	57	55	0.7
Hours spent playing computer games	(*n* = 190)	(*n* = 115)	
<1 hour per week	61	56	
1 to 3 hours per week	28	28	0.30
4 or more hours per week	11	16	
Frequency of playing nonorganized sports	(*n* = 191)	(*n* = 115)	
Rarely or about once a month	58	61	
About once a week	9	17	0.31
2 to 3 times a week or more	33	22	
Frequency of participation in physical education classes in school	(*n* = 191)	115)	
Rarely or about once a month	21	20	
About once a week	44	47	0.91
2 to 3 times a week or more	35	33	
Frequency of moderate activity outside school hours	(*n* = 192)	(*n* = 115)	
Rarely or about once a month	52	43	
About once a week	14	20	
2 to 3 times a week	11	13	0.26
Almost daily	23	24	
Frequency of play outside the house with other children	(*n* = 192)	(*n* = 115)	
Rarely or about once a month	35	31	
About once a week	12	15	0.70
2 to 3 times a week	27	31	
Almost daily	26	23	
No. of sports teams on which adolescents played in the last 12 months†	(*n* = 90)	(*n* = 47)	
None	57	72	0.07
1 or more teams	43	28	
Adolescents' own self description of their daily activities†	(*n* = 90)	(*n* = 46)	
Mainly sit and do not walk much	8	13	0.72
Stand or walk quite a lot, but do not carry or lift things often	72	65	
Work or carry heavy loads	20	22	

* χ^2 (for variables with 2 levels) or Cochran-Armitage Trend Test (for variables with >two ordered levels).
† Data obtained from adolescents (10 to 18 years old) only.

white adolescents and 1.4 times the national average for Mexican-American adolescents. Similar to the NHANES data, we found no significant gender differences in the prevalence of overweight or at risk for overweight (2). Although the higher prevalence of overweight in our study population compared with the national average for Hispanic children could be due to differences in the population studied (clinic based vs. population sample), it seems more

Table 6. Logistic regression model for associations with overweight (BMI ≥ 95th % versus BMI < 95th %)*

Variables	Odds ratio (95% confidence interval)	p	Model likelihood ratio χ^2 (p)
Model 1 (control variables only)			$\chi^2 = 1.57$ ($p = 0.67$)
Age in years	0.98 (0.91 to 1.05)	0.54	
Boys	1.09 (0.67 to 1.77)	0.71	
Girls	1.00	(reference)	
Income	0.83 (0.61 to 1.14)	0.26	
Model 2 (control variables + risk factor variables)			$\chi^2 = 18.85$ ($p = 0.004$)
No. of sports teams that adolescents played in the last 12 months			
None	1.0	(reference)	
1 or more teams	0.39 (0.16 to 0.94)	0.04	
No. of times consumed fruits in the last 7 days†	0.88 (0.75 to 1.04)	0.13	
Type of milk usually consumed			
Whole milk	1.0	(reference)	
1% to 2% milk	3.87 (1.66 to 9.04)	0.002	

* Controlled for age, sex, and household income.
† Analyzed as an ordinal variable, with 0 = none, 2 = 1 to 3 times a week, 5 = 4 to 6 times a week, and 8 = once or more a day.

likely to be related to differences in the ethnic composition of the two samples. Some prior studies have found differences in the prevalence of overweight based on country of origin. The Hispanic Health and Nutrition Examination Study found that overweight was more prevalent in Puerto Rican adolescents than in Mexican Americans and Cubans, although data from the National Longitudinal Study of Adolescent Health (Add Health Study) found a similar prevalence in these three groups of Hispanic adolescents (33). One possible explanation for the greater prevalence of overweight among the children studied relative to Mexican Americans is their shortness. Over 60% had height for age less than the 50th percentile. Mexican-American children are significantly taller than poor children from rural areas of Mexico and other Central American countries (34). Because BMI is calculated as weight for height squared, shorter children have higher absolute BMI measurements at the same body weight. Their short stature could also partly explain the high percentage body fat measured by BIA because height is one of the parameters included in the prediction equations (29). However, short stature does not fully account for the high prevalence of excessive BMI because even though study children were shorter than the national U.S. average, 28% of them had weight for age greater than the 95th percentile. This short and plump physique has been described earlier in Mexican-American children (34).

In the present study, there was a trend for an effect of the number of generations living in the U.S. on BMI, with children whose families had been in the U.S. for 2 or more generations having a higher prevalence of being overweight. However, this association was not statistically significant, perhaps because of the relatively small sample of children whose families had been residents in the U.S. for 2 or more generations (<1% of the families in this sample). In the Add Health Study, significant generational differences were noted, with 26% of first generation Hispanic adolescents having a BMI ≥ 85th percentile compared with 33% of second and third generation Hispanics (35).

Overweight children younger than 11 years of age were more likely to have initiated their pubic hair development compared with their nonoverweight counterparts. The association between pubic hair development and BMI has been observed in other studies (36). Pubic hair development is a reflection of increased secretion of adrenal androgens (adrenarche) and gonadal steroids. Although the factors regulating adrenarche are not well understood, it has been suggested that nutritional status may have an influence (37). It has also been suggested that hyperinsulinism may play a role in early androgen secretion by direct and indirect stimulation of ovarian and adrenal steroidogenesis (38). Hyperinsulinism has

Table 7. Distribution of the clinical characteristics of the study population

	Child's BMI < 95th % Freq %	Child's BMI ≥95th % Freq %	*p**
Pubertal staging: testicular volume in boys and breast size in girls			
All children 6 to 11 years (%)	(*n* = 110)	(*n* = 72)	
Stage 1	64	56	0.2
Stage 2	36	44	
Boys 6 to 11 years (%)	(*n* = 53)	(*n* = 29)	
Stage 1	53	34	0.1
Stage 2	47	66	
Girls 6 to 11 years (%)	(*n* = 57)	(*n* = 43)	
Stage 1	75	70	0.5
Stage 2	25	30	
Pubertal staging: pubic hair in boys and girls (adrenarche)			
All children 6 to 11 years (%)	(*n* = 115)	(*n* = 77)	
Stage 1	90	77	0.01
Stage 2	10	23	
Boys 6 to 11 years (%)	(*n* = 58)	(*n* = 33)	
Stage 1	91	79	0.09
Stage 2	9	21	
Girls 6 to 11 years (%)	(*n* = 57)	(*n* = 44)	
Stage 1	88	75	0.09
Stage 2	12	25	
BP (mm Hg, mean ± SD)			
Systolic	(*n* = 190)	(*n* = 112)	
	104.5 (11.8)	111.4 (14.1)	<0.0001‡
Diastolic	(*n* = 185)	(*n* = 110)	
	61.8 (8.2)	62.7 (8.2)	0.34‡
Cardiovascular risk profile by waist circumference† (%)	(*n* = 193)	(*n* = 116)	
Low-risk profile	37	4	
Medium-risk profile	38	18	<0.0001
High-risk profile	25	78	
Cardiovascular risk profile by BIA body fat† (%)	(*n* = 192)	(*n* = 116)	
Low-risk profile	10	0.0	
Medium-risk profile	63	13	<0.0001
High-risk profile	27	87	

* χ^2 (for variables with two levels) or Cochran-Armitage Trend Test (for variables with >two ordered levels).
† Definition of cardiovascular risk factors, derived from Higgins et al. (32). Low risk includes children with waist circumference less than 61 cm or percentage body fat less than 20%. High-risk included children with waist circumference greater or equal to 71 cm or body fat greater than 33%. Medium-risk includes children with waist circumference between 61 and 71 cm or percentage body fat between 20% and 33%.
‡ Student's *t* values (Student's *t* test).

been associated with obesity, especially among minority children (38,39). However, we do not have data on these parameters in our study.

We found that overweight Hispanic children and adolescents had significantly higher systolic BP than their non-overweight counterparts. As previously described in other pediatric populations (12), the risk of hypertension increased across the entire range of BMI values, without a threshold effect. In addition, overweight children and youth in the study had a significantly higher cardiovascular risk profile than nonoverweight participants based on waist circumference or percentage body fat. A larger waist circumference is a proxy for both the overall level of fat and centrally distributed fat, which has been associated with a higher risk of morbidity and mortality (40,41). Cardiovascular risk in young adulthood is highly related to the degree of adiposity as early as age 13 years (41), and in adults, an increased risk of death from cardiovascular disease has been found for individuals whose BMI was greater than the 75th percentile when they were adolescents (42). It is reported that ~60% of children and adolescents with BMI ≥ 95th percentile have at least one risk factor for future cardiovascular disease (elevated BP, abnormal lipids, or high insulin), and over 25% have two or more risk factors (10). Because we did not obtain blood samples, we cannot determine whether this relationship holds true for the study's Hispanic children.

Although we did not find significant associations between consumption of sweetened beverages or fruit juices and BMI, the overall consumption of these foods was high compared with consumption of whole fruits, vegetables, and salads. Thus, although we could not confirm previously reported findings linking consumption of sugared beverages to a greater risk of obesity in childhood (43), it is possible that the use of such foods predisposes Hispanic children to obesity. The association between low-fat milk consumption and higher likelihood of overweight is contrary to what is expected; however, this association could be due to reverse causality, with children who were overweight being more likely to consume lower fat products in an attempt to control their weight. Further research is needed to determine dietary patterns of non-Mexican Hispanic children and adolescents.

In general, the Hispanic children and adolescents in this inner city community were not very physically active. However, we found that adolescents who were more active (those playing nonorganized sports or participating in a larger number of sports teams) had a lower likelihood of being overweight. The trend of declining physical activity in children and adolescents is not limited to this community but has been shown nationally (44,45). In a survey of children 6 to 9 years old, only 53% said that they played outside after school and on Saturdays (33). Both Hispanic and African-American children and youth have been reported in other studies to participate in fewer vigorous activities and to be more sedentary compared with white children and youth (33).

One limitation of this study is possible sample selection bias. Because our study sample was drawn from a clinic population of Hispanic children and adolescents, our findings may not be generalizable to the general population of Hispanic children and youth. However, we believe that because this sample was drawn from community clinics, and not tertiary or referral centers, it is less likely to be biased. The health clinics from which we drew our sample provide bilingual health services and accept all patients, including the noninsured; hence, the samples seen at the clinics are fairly representative of the residents in Ward 1. As such, these clinics are the primary sources of health care for this inner city Hispanic community. The similarity in distribution of annual household income and country of origin of the Hispanics seen at the two clinics and that reported in the DC census provides some reassurance that a fairly representative sample of the Hispanic residents in the neighborhood is seen in these community clinics (18,21). However, by excluding sick children, we may have underestimated the prevalence of children with acute or chronic disorders such as asthma. The strengths of the study are that it examines a unique population and the surveys were conducted by fluently bilingual research assistants, eliminating the exclusion of subjects because of language or literacy barriers.

In summary, the prevalence of overweight and at risk for overweight is extraordinarily high among this inner city Hispanic community of predominantly El Salvadoran origin and is significantly related to decreased physical activity. Given the fact that childhood obesity is associated both with comorbidities during childhood and with later sequelae, it is important that priority be given to the development of prevention strategies and intervention programs for the children in such communities. Further studies are needed in other Hispanic populations of non-Mexican-American ancestry to determine whether these populations have a similarly high prevalence of overweight.

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