Association Between Anthropometry and High Blood Pressure in a Representative Sample of Preschoolers in Madrid

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Keywords: Obesity, Body composition, Blood pressure, Health promotion, Children

Abstract

Introduction and objectives: Program S1! is a multi-level, school-based intervention for the promotion of cardiovascular health from early childhood. The aim of this paper is to characterize the prevalence of obesity and high blood pressure in the preschoolers enrolled in the study, and to compare various criteria for classifying obesity.

Methods: The study was a cluster-randomized controlled intervention trial including 24 state schools in Madrid (Spain). Weight, height, triceps and subscapular skinfold thicknesses, waist circumference, and systolic and diastolic blood pressure were measured in 2011 children (1009 boys and 1002 girls) aged 3 to 5 years (3.7 ± 0.9). Body mass index and blood pressure were classified by corresponding task force criteria. Obesity was studied by 6 different criteria. Associations of body mass index, body weight, body fat, and waist circumference on blood pressure were examined, and the risk of high blood pressure in relation to tertiles of body mass index was calculated.

Results: The prevalence of obesity according to the International Obesity Task Force varied from 2% at age 3 to 8% at age 5, and the overall prevalence of high blood pressure (≥ 90th percentile) was 20%. Sex- and age-specific criteria for obesity showed better agreement with the reference than a single generalized cutoff. The risk of high blood pressure was higher for the highest tertile of body mass index distribution.

Conclusions: The highest prevalence of obesity and high blood pressure was found among older children. The classification of obesity in children was more accurate using sex- and age-specific cutoffs.

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Asociación entre antropometría y presión arterial alta en una muestra representativa de preescolares de Madrid

Resumen

Introducción y objetivos: El Programa S1! es una intervención escolar de promoción de salud cardiovascular en la infancia. El objetivo de este artículo es caracterizar la prevalencia de obesidad y presión arterial alta entre los preescolares del estudio del Programa S1! y comparar distintos criterios de clasificación de obesidad.

Métodos: El diseño es una intervención controlada y aleatorizada por grupos en 24 colegios públicos de Madrid. Se midió peso, talla, pliegues tricipital y subescapular, circunferencia de la cintura y presión arterial en 2011 preescolares (1.009 niños y 1.002 niñas) de 3 a 5 (3,7 ± 0,9) años. El índice de masa corporal y la presión arterial se clasificaron siguiendo criterios internacionales. Se estudiaron seis criterios diferentes de obesidad, los efectos del índice de masa corporal, peso, porcentaje de grasa y circunferencia de la cintura en la presión arterial y el riesgo de presión arterial alta por terciles de índice de masa corporal.

Resultados: La prevalencia de obesidad osciló del 2% (niños de 3 años) al 8% (niños de 5) y la de presión arterial alta fue del 20%. Se ha encontrado mejor concordancia con la referencia internacional para los criterias de obesidad específicos para sexo y edad que con puntos de corte únicos. El riesgo de presión arterial alta aumentó en cada tercil de índice de masa corporal.

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The objective of this study was to characterize the Program SII population of preschoolers in terms of anthropometric measurements and its association with the prevalence of high blood pressure, and to determine the prevalence of obesity according to various criteria.

METHODS

Participants

The study was a cluster-randomized, controlled intervention trial including 24 state schools in Madrid (clinical trial registry number NCT01579708). A detailed description of Program SII was published recently. During the 2010-2011 academic year there were 787 state schools in the Madrid area. To ensure a homogeneous sample, selection was restricted to schools located in the city of Madrid with a canteen service and a minimum of two classes per preschool level. A total of 174 schools satisfied these criteria. We further excluded schools representing extremes according to quartiles of socioeconomic variables, resulting in a sample with these characteristics: 10% to 32% immigrant families, 36% to 54% families receiving state subsidies for books, and 13% to 20% families receiving state subsidies for canteen meals. The remaining 73 schools were invited to a 1-day meeting at which Program SII was presented; 35 schools agreed to participate, and the final 24 were selected by excluding larger schools with more than 2 classes per level, to yield a sample of medium-sized schools. All children at preschool level in these 24 schools were eligible for participation and were recruited through written consent from their parents in both the control and the intervention schools, resulting in a response rate of 59.1%. Sample distribution by school level was 801 (51.3% girls) from 1st grade (“age 3”), 623 (44.3% girls) from 2nd grade (“age 4”) and 587 (53.7% girls) from 3rd grade (“age 5”). Data are treated according to Spanish Law 15/1999 for the Protection of Personal Data, and were processed with a data encryption system to guarantee confidentiality of the information provided. The study protocol was approved by the Madrid Clinical Research Ethics Committee.

Anthropometry and Blood Pressure Assessment

All measurements were made by trained nutritionists according to a standardized protocol. Body weight was measured to the nearest 0.1 kg (Seca 803 electronic scale; Hamburg, Germany) and height to the nearest 0.1 cm (Seca 213 portable stadiometer) with children wearing light clothes and no shoes. Waist circumference was measured to the nearest 0.1 cm directly on the skin at the end of a gentle expiration; measurements were made halfway between the lower costal border and the iliac crest, using a flexible, nonelastic Holtain tape (Crymych, United Kingdom). Triceps skinfold thickness and subscapular skinfold thickness were measured to the nearest 0.2 mm with a Holtain T/W Skinfold Caliper (Crymych, United kingdom). Triceps skinfold thickness was measured at the midpoint between the acromion and the olecranon processes on the posterior surface of the right arm, and subscapular skinfold thickness was measured 2 cm below the inferior angle of the right scapula. BMI was calculated using the standard formula of weight (in kilograms)
divided by the square of height (in meters).\textsuperscript{21} Percentage BF was
determined from triceps and subscapular skinfold thicknesses
using the Slaughter prepubescent equation.\textsuperscript{22} Obesity and
overweight were defined according to the International Obesity
Task Force (IOTF) BMI categories.\textsuperscript{23,24} Obesity was also defined
according to other methods to study differences from the IOTF
criteria: Spanish BMI 97th percentile,\textsuperscript{25} Taylor’s BF age- and sex-
specific cutoffs,\textsuperscript{19} Williams’ BF sex-specific cutoffs,\textsuperscript{20} Dwyer and
Blizzard’s BF sex-specific cutoffs,\textsuperscript{12,13,26} and Fredriks’ waist
circumference criteria, specific for age and sex.\textsuperscript{7}

Blood pressure was measured after children had been relaxing
for 5 to 10 min and were comfortable with the nutritionists and
familiarized with the device. Three measurements were taken at
2 to 3 min intervals, and the lowest value was used in the analysis.
Such repeated readings are recommended to improve measure-
ment accuracy, since previous studies on very young children
have demonstrated that high readings are commonly a stress-
response to the measuring procedure, even in a familiar, nonclinical
setting such as the child’s school.\textsuperscript{27,28} We used an automatic
monitor with a special cuff for children (OMRON M6, cuff CS2, Omron; Kyoto, Japan) on the right arm resting on a support, at the level of the heart. Blood pressure was classified as
normal or high: normal blood pressure was defined as systolic
blood pressure (SBP) and diastolic blood pressure (DBP) < 90th
percentile for age, sex and height; and high blood pressure was
defined as SBP or DBP ≥ 90th percentile or ≥ 120/80 mmHg,
according to the criteria of the National High Blood Pressure
Education Program Working Group on High Blood Pressure in
Children and Adolescents.\textsuperscript{29}

### Data Analysis

Anthropometric and blood pressure data were analyzed by
descriptive statistics stratified by school level. Continuous vari-
bables are presented as mean (standard deviation) and categorical
variables are presented as sample size in the category (percentage).
Sex differences in BMI categories, obesity classification, and blood
pressure category were analyzed in each preschool level by chi-
square tests. Student t test was used to compare sex differences
and a P for trend was tested across the three preschool levels.
Agreement between obesity criteria was examined using the
Cohen’s kappa coefficient. Scattergrams were used to explore
the relationship between BMI, BF and waist-circumference cutoffs
for obesity definition. Linear regression analysis adjusted for sex
and age was used to examine the association of cardiovascular risk
indicators (BMI, body weight, BF, and waist circumference by
tertiles) with SBP and DBP. We calculated odds ratios (OR) and 95%
confidence intervals (95%CI) for high blood pressure in relation to
BMI tertiles. All statistical analyses were performed with SPSS
statistical software, version 21.0 (SPSS Inc.; Chicago, Illinois,
United States).

### RESULTS

Direct anthropometric measurements (waist circumference and
skinfold thicknesses), blood pressure, and derived measure-
ments (BMI and BF) are listed in Table 1. Waist circumference and
blood pressure (SBP and DBP) increased significantly with age

### Table 1

Baseline Characteristics of Boys and Girls by Age

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Age 3</th>
<th>Age 4</th>
<th>Age 5</th>
<th>P-trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI, kg/m²</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Boys, n = 1009</td>
<td>16.2 (1.6)</td>
<td>16.3 (1.4)</td>
<td>16.2 (1.5)</td>
<td>16.3 (1.8)</td>
<td>.801</td>
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<tr>
<td>Girls, n = 1002</td>
<td>16.2 (1.6)</td>
<td>16.1 (1.6)</td>
<td>16.1 (1.7)</td>
<td>16.2 (1.7)</td>
<td>.439</td>
</tr>
<tr>
<td><strong>Overweight (IOTF)</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Boys</td>
<td>94 (9.6)</td>
<td>37 (9.5)</td>
<td>35 (10.1)</td>
<td>22 (9.0)</td>
<td>.329</td>
</tr>
<tr>
<td>Girls</td>
<td>142 (14.6)</td>
<td>50 (12.1)</td>
<td>42 (15.3)</td>
<td>50 (17.6)</td>
<td>&lt; .01</td>
</tr>
<tr>
<td><strong>Obesity (IOTF)</strong></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Boys</td>
<td>41 (4.2)</td>
<td>8 (2.1)</td>
<td>13 (3.7)</td>
<td>20 (8.2)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Girls</td>
<td>42 (4.3)</td>
<td>15 (3.6)</td>
<td>10 (3.6)</td>
<td>17 (6.0)</td>
<td>&lt; .05</td>
</tr>
<tr>
<td><strong>Waist, cm</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys, n = 1009</td>
<td>52.2 (4.0)</td>
<td>50.6 (3.2)</td>
<td>52.3 (3.5)</td>
<td>54.2 (4.5)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Girls, n = 1002</td>
<td>51.6 (4.1)</td>
<td>50.2 (3.6)</td>
<td>52.0 (4.0)</td>
<td>53.1 (4.2)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td><strong>Triceps skinfold, mm</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Boys, n = 1003</td>
<td>9.0 (2.4)</td>
<td>8.9 (2.0)</td>
<td>8.9 (2.4)</td>
<td>9.2 (3.0)</td>
<td>.063</td>
</tr>
<tr>
<td>Girls, n = 997</td>
<td>10.0 (2.5)</td>
<td>9.6 (2.3)</td>
<td>10.0 (2.6)</td>
<td>10.3 (2.6)</td>
<td>&lt; .01</td>
</tr>
<tr>
<td><strong>Subscapular skinfold, mm</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys, n = 1001</td>
<td>5.9 (1.8)</td>
<td>5.9 (1.6)</td>
<td>5.8 (1.7)</td>
<td>6.1 (2.2)</td>
<td>.490</td>
</tr>
<tr>
<td>Girls, n = 996</td>
<td>6.7 (2.1)</td>
<td>6.6 (1.9)</td>
<td>6.7 (2.4)</td>
<td>6.6 (2.2)</td>
<td>.885</td>
</tr>
<tr>
<td><strong>Percentage of body fat (Slaughter’s equation)</strong></td>
<td></td>
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<tr>
<td>Boys, n = 1001</td>
<td>14.5 (3.6)</td>
<td>14.4 (3.1)</td>
<td>14.3 (3.5)</td>
<td>14.8 (4.4)</td>
<td>.281</td>
</tr>
<tr>
<td>Girls, n = 995</td>
<td>15.8 (3.5)</td>
<td>15.5 (3.3)</td>
<td>15.9 (3.8)</td>
<td>16.0 (3.9)</td>
<td>.105</td>
</tr>
<tr>
<td><strong>Systolic blood pressure, mmHg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys, n = 992</td>
<td>96.2 (8.3)</td>
<td>93.7 (8.3)</td>
<td>96.1 (7.2)</td>
<td>99.6 (8.5)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Girls, n = 988</td>
<td>95.4 (8.4)</td>
<td>93.1 (8.3)</td>
<td>96.1 (8.2)</td>
<td>97.9 (8.0)</td>
<td>&lt; .001</td>
</tr>
<tr>
<td><strong>Diastolic blood pressure, mmHg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys, n = 992</td>
<td>56.9 (7.1)</td>
<td>56.4 (7.5)</td>
<td>56.4 (6.5)</td>
<td>58.2 (7.1)</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Girls, n = 988</td>
<td>58.1 (7.3)</td>
<td>57.4 (6.9)</td>
<td>58.3 (7.8)</td>
<td>58.9 (7.1)</td>
<td>&lt; .01</td>
</tr>
</tbody>
</table>

BMI, body mass index; IOTF: International Obesity Task Force.
* Children in the category (percentage).
(P for trend < .01 to P for trend < .001). Although girls and boys showed no differences in BMI, there were marked differences in adiposity measurements (skinfold thicknesses and BF; P for trend < .01 to P for trend < .001). The prevalence of overweight and obesity was calculated using IOTF criteria.23,24 (Table 1). The prevalence of obesity increased with age: 2.1% (95%CI, 0.8-3.6) at age 3; 3.7% (95%CI, 1.7-5.7) at age 4, and 8.2% (95%CI, 5.3-11.5) at age 5 for boys (P for trend < .01); and 3.6% (95%CI, 1.9-5.8) at age 3; 3.6% (95%CI, 1.9-5.8) at age 4, and 6.0% (95%CI, 3.5-8.8) at age 5 for girls (P-trend < .05).

The extent of agreement between different methods for estimating obesity was evaluated using Cohen kappa coefficients and scattergrams for BMI vs BF (Figure 1) and BMI vs waist circumference (Figure 2). The IOTF BMI classification reference showed the highest agreement with Spanish BMI standards (κ = 0.837) and with classification according to waist circumference (κ = 0.670). The lowest agreement was found when we classified by BF, especially using the generalized cutoffs (Taylor, κ = 0.555; Williams κ = 0.429; Dwyer and Blizzard, κ = 0.489). The cutoffs for BF proposed by Taylor (Figure 1, BF-a) and by Williams...

**Figure 1.** Obesity by body mass index and body fat cutoffs for boys and girls by age. Body fat criteria (a: Taylor; b: Williams; c: Dwyer and Blizzard). BF, body fat; BMI, body mass index; IOTF, International Obesity Task Force.
(Figure 1, BF-b) underestimated obesity in all ages compared with the reference (IOTF BMI-criteria), and only the cutoffs for boys proposed by Dwyer and Blizzard (Figure 1, BF-c) overestimated obesity.

According to the IOTF criteria, high blood pressure (SBP or DBP $\geq 90$th percentile for age, sex and height or $\geq 120/80$ mmHg) was found in 96 boys at age 3 (25.7%), 44 (12.9%) at age 4, and 42 (15.4%) at age 5. High blood pressure was found in 100 girls at age 3 (24.8%), 50 (18.6%) at age 4, and 56 (17.9%) at age 5. The age trend was significant ($P$ for trend < .01 for boys and $P$ for trend < .05 for girls). The association between SBP and DBP and CVD-risk markers (tertiles of body weight, BMI, BF, and waist circumference) obtained by age and sex-adjusted linear regression analysis is shown in Table 2. The highest tertiles for all CVD-risk markers (body weight, BMI, BF, and waist circumference) were associated with higher SBP and DBP readings ($P < .001$). Accordingly, high blood pressure was associated with a high BMI.

Taking the lowest BMI tertile as the reference, we found a greater risk of high blood pressure in the highest BMI tertile (OR = 2.0, 95%CI, 1.5-2.7). The same outcome was obtained by analyzing girls and boys separately at age 3 (OR = 1.8; 95%CI, 1.0-3.2 for boys; OR = 2.1; 95%CI, 1.2-3.6 for girls), age 4 (OR = 1.8; 95%CI, 0.8-4.1 for boys; OR = 1.9; 95%CI, 0.9-3.6 for girls), age 5 (OR = 1.8; 95%CI, 1.0-3.6 for boys; OR = 2.1; 95%CI, 1.2-3.6 for girls).
Table 2

Association Between Systolic and Diastolic Blood Pressure and Cardiovascular Risk Indicators

<table>
<thead>
<tr>
<th></th>
<th>SBP</th>
<th>(R^2)</th>
<th>DBP</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>97.2 (7.7)</td>
<td>0.149</td>
<td>60.1 (7.3)</td>
<td>0.012</td>
</tr>
<tr>
<td>Medium</td>
<td>97.8 (7.7)</td>
<td></td>
<td>59.8 (7.0)</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>102.0 (8.6)*</td>
<td></td>
<td>62.0 (7.5)*</td>
<td></td>
</tr>
<tr>
<td>Body weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>96.1 (7.8)</td>
<td>0.193</td>
<td>59.8 (7.5)</td>
<td>0.039</td>
</tr>
<tr>
<td>Medium</td>
<td>98.2 (7.0)*</td>
<td></td>
<td>60.1 (6.6)</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>102.9 (8.4)*</td>
<td></td>
<td>62.0 (7.5)*</td>
<td></td>
</tr>
<tr>
<td>Body fat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>97.6 (7.3)</td>
<td>0.137</td>
<td>59.6 (6.9)</td>
<td>0.021</td>
</tr>
<tr>
<td>Medium</td>
<td>98.1 (7.5)</td>
<td></td>
<td>60.5 (7.1)*</td>
<td>0.012</td>
</tr>
<tr>
<td>High</td>
<td>101.4 (9.3)*</td>
<td></td>
<td>61.7 (7.7)*</td>
<td></td>
</tr>
<tr>
<td>Waist circumference</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>96.5 (7.6)</td>
<td>0.159</td>
<td>60.2 (7.1)</td>
<td>0.035</td>
</tr>
<tr>
<td>Medium</td>
<td>98.0 (7.7)*</td>
<td></td>
<td>59.7 (7.3)</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>102.6 (8.4)*</td>
<td></td>
<td>61.9 (7.3)*</td>
<td></td>
</tr>
</tbody>
</table>

BMI, body mass index; DBP, diastolic blood pressure; SBP, systolic blood pressure. \(R^2\) determined by linear regression analysis adjusted by sex and age. *Significantly different from the lowest tertile (Bonferroni test; \(P < .001\); \(P < .05\), \(P < .01\)).

0.9–4.0 for girls), and age 5 (OR = 2.2; 95%CI, 1.0–4.8 for boys; OR = 2.4; 95%CI, 1.2–4.8 for girls). The BMI-associated risk of high blood pressure was especially high at age 5, showing marked differences with the lowest tertile for girls and boys (Figure 3).

DISCUSSION

The prevalence of obesity in our study population was similar to that detected in children of the same age group in northern and central Europe countries, but lower than that reported in Spanish preschoolers in the enKid study (8.3% in boys and 12.7% in girls; IOTF criteria). The most up-to-date study on Spanish preschoolers is IDEFICS, which examined a population from eight European countries: Spain, Cyprus, Italy, Hungary, Germany, Belgium, Estonia and Sweden. The prevalence of obesity in the Spanish subpopulation in IDEFICS was 6.9% (boys) and 5.8% (girls), according to the IOTF criteria. This is slightly higher than in our sample, although the available data cover a wider age range (2–10 years old). The proportion of overweight and obesity in the Program SI! population increased with increasing preschool level, and is expected to increase progressively until adolescence, as shown in recent studies of Spanish children (11% at 6–9 years old; 8.6% at 8–17 years old). The previous Program SI! study, carried out in Colombia on a sample with the same age range (3–5 years), found an obesity prevalence of 2.9% in the intervention group and 2.2% in the control group, but in that study the reference values were the United States Centers for Disease Control growth charts.

The mean values for waist circumference (boys = 52.2; girls = 51.6) and the sum of both skinfolds (boys = 14.9; girls = 16.6) in our sample were very similar to those obtained in the IDEFICS study (2–6 years old) (waist circumference, boys = 51.0; girls = 50.4; sum of skinfolds, boys = 15.9; girls = 17.9). Our waist circumference values were also similar to other European studies in this age range and slightly lower than studies in the United States. In the Program SI! sample, waist circumference was higher in boys than girls at all three preschool levels, and skinfold thickness were significantly lower in boys, reflecting sexual dimorphism.

There are very few studies reporting percentages of BF in children of this age range. Our values calculated with the Slaughter prepubescent equation (14.5% girls, 15.8% boys) are similar to those obtained by DEXA (dual-energy X-ray absorptiometry) in 3- to 6-year-old children in New Zealand (13.7% girls, 17.8% boys) and are lower than BF values obtained in a wider age range of children (3–8 years) in the United States by DEXA (22.6% boys, 27.36% for girls) or by Slaughter equation (17%). The percentage BF values we obtained can be used to estimate obesity as an excess of fat according to defined cutoffs. Taylor's classification by BF showed higher agreement because it has been validated by DEXA in children aged 3–18 and uses the IOTF BMI reference. A single generalized BF cutoff, as in the classification of Williams (20% BF) or Dwyer and Blizzard (25% BF), showed a lower agreement with the reference (Figure 1). The cutoff for boys proposed by Dwyer and Blizzard (Figure 1; BF-c) is lower than that proposed by Williams (Figure 1; BF-b), and both result in higher estimates of obesity among boys than the reference. It can be therefore concluded that the excess of adiposity in boys aged 3 to 5 years is close to 20% and below 25% BF. Both criteria have a cutoff for girls of 30% BF that noticeably underestimates obesity compared with the reference. The excess of fat in girls over this age range seems to be < 30%, close to Taylor's cutoff for this age in girls (26%). Using waist circumference to define obesity according to

Figure 3. Age-specific odds ratio of high blood pressure by tertiles of body mass index for boys and girls. High blood pressure: systolic blood pressure or diastolic blood pressure ≥ 90th percentile for age, sex, and height or ≥ 120/80 mmHg. BP, blood pressure; OR, odds ratio. *\(P < .01\); **\(P < .05\).
abdominal adiposity, prevalence was slightly lower than the reference. This method showed good agreement (k = 0.670), confirming once more that sex- and age-specific cutoffs give more accurate estimates than a single generalized cutoff.

As seen in our study, blood pressure increases with age and body size, hence the accuracy of blood-pressure classification in children is increased by including information on height, in addition to age and sex. Most blood pressure studies in Spain included populations aged ≥ 6 years, so our data on Spanish preschoolers may add valuable information for establishing reference values. In our sample, around 25% of boys and girls aged 3 years had SBP or DBP ≥ 90th percentile or ≥ 120/80 mmHg, and the figure for children aged 4 and 5 years was around 15%. This suggests that the youngest children (aged 3, 1st preschool level) may be more affected by the “white coat phenomenon,” being more nervous than the older children, and it may also be significant that data collection coincided with the start of their school life, before they are fully familiarized with the school environment.

Conclusions

Preschool children participating in Program SI of the Spanish kindergartens with the highest BMI had higher SBP and DBP and therefore an increased risk of high blood pressure, and this association was especially strong in 5-year-old group. In the context of the increase in childhood obesity and the consequences this implies for CVD, studies of cardiovascular risk indicators in very young children are an important source of information.

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Conflicts of Interest

None declared.

References


