



Prevalence of high blood pressure in children and adolescents from the city of Maceió, Brazil

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Abstract

Objectives: To define the prevalence of high blood pressure in a representative sample of children and adolescents from the city of Maceió, state of Alagoas, Brazil, and to investigate the association of high blood pressure with age, sex and nutritional status.

Methods: This cross-sectional study was carried out from May 2000 to September 2002. Individuals between 7 and 17 years of age were selected among all the 185,702 students from public and private schools. The size of the sample was defined based on the expected prevalence of hypertension for the age group. After randomization, data were collected through a questionnaire. Blood pressure was measured twice. Weight and height were also measured. High blood pressure was defined as systolic and/or diastolic blood pressure over the 95th percentile in one or in both measures.

Results: The final sample included 1,253 students (706 females). One hundred and eighteen students had high blood pressure (mean age 13 years; 44% males). Risk of being overweight and excess weight were identified, respectively, in 9.3 and 4.5% of the students. These variables were significantly associated with high blood pressure.

Conclusions: The prevalence of high blood pressure was 9.4%. High blood pressure was significantly more frequent among overweight students and among those at risk for being overweight.

J Pediatr (Rio J). 2004;80(1):35-40: Blood pressure, prevalence, children, adolescents.

Introduction

Hypertension is a persistent elevation of arterial blood pressure (BP) above levels arbitrarily defined as normal.¹ It is the most common cardiovascular disease, and a public health challenge for societies in socioeconomic and epidemiological transition, and one of the most important risk factors for cardiovascular death, accounting for 20-50% of all deaths.² In Brazil, it affects 14 to 18% of the adult population.³

Hypertension is uncommon in infants, and if present, it often indicates an underlying pathological process. Children (seven years or older), especially adolescents, may present essential hypertension, which is usually detected by regular BP monitoring. Currently, this is the main cause of arterial hypertension in this age group.⁴⁻⁸

Several studies have provided ample evidence that hypertension in adults has its onset in childhood^{4-6,9,10} which has caused growing concern with monitoring arterial BP in children in the last few decades.

In 1977, the first Report of the Task Force on Blood Pressure Control in Children⁴ was published in the United States, with the aim of standardizing the measuring method and the distribution curves of arterial BP in healthy children, organized into percentile graphs according to age and sex. In this study, the 95th percentile was established as normotensive level and the recommendation that "All children 3 years of age or older should have their

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Financial support: FAPEAL – Fundação de Amparo à Pesquisa do Estado de Alagoas.

Manuscript received Apr 16 2003, accepted for publication Nov 03 2003.

blood pressures recorded during health maintenance visits and emergent visits” is still valid today.

Since then, a wide series of nationwide and international studies have been undertaken and new concepts have been elaborated. In 1987, the second Report of the Task Force on Blood Pressure Control in Children was released.⁵ In 1993, Rosner *et al.* published a meta-analysis with reference values for normal arterial BP (below the 90th percentile), normal-high BP (between the 90th and 95th percentiles) and high BP (above the 95th percentile), according to age and sex, subdivided into height percentiles, based on 76,018 blood pressure screenings.¹⁰ In addition, they also used and recommended the fifth phase Korotkoff sound (K5) as reference for diastolic blood pressure (DBP) for all age groups. In 1996, the *Update on the 1987 Task Force Report on High Blood Pressure in Children and Adolescents* was published.⁹

In Brazil, Alves *et al.* investigated the frequency of arterial hypertension in a group of 989 infants and children in Recife, all of whom had a good socioeconomic status, and found a rate of 2.12% of hypertensive children, using the 1987 Task Force reference values.¹¹ In 1995, Oliveira assessed 1,005 schoolchildren randomly selected among the students regularly enrolled in public and private schools of Belo Horizonte, by carrying out an anthropometric assessment and two BP screenings. The author observed systolic and diastolic BP values slightly lower than the 1987 Task Force reference values.¹²

The aims of the present study are to: 1. define the prevalence of elevated blood pressure in school-aged children and adolescents from Maceió; 2. investigate the association of elevated blood pressure using variables such as age, gender and nutritional status.

Patients and methods

An observational, descriptive, cross-sectional epidemiological study was conducted between May 2000 and September 2002. The sample consisted of male and female children and adolescents aged between 7 and 17 years enrolled in elementary and high schools in Maceió, state of Alagoas.

In order to define the prevalence of elevated BP among children and adolescents in Maceió in such a way that the observed values were representative of the study population, the sample was calculated using an estimated prevalence of hypertension for the analyzed age group, according to the III Consensus on Arterial Hypertension of the Brazilian Society of Cardiology in 1998: 7%.¹³ A 95%CI and a precision of 2% were used. The final sample included 1,253 individuals.

A cluster randomization trial was used, in which each school was regarded as a cluster. For improved accuracy of prevalence estimates and better demographic distribution of students, we decided to include 40 schools in our study.

After random selection, the schools were distributed as follows: federal (1), state (20), municipal (8), and private schools (11).

As the size of the randomly selected schools was different, we selected (at random) 2.7% of the students enrolled in these schools so that the final sample could proportionally represent each of the schools, which resulted in a sample of 1,253 individuals.

The selected schools and students' parents gave their consent as to the inclusion of the students in the study.

The data were collected by means of a questionnaire and measurement of arterial BP, weight and height. The screening of BP was performed by a medical researcher, who was properly trained for the procedure.

The students who refused to participate in the study were replaced. In this case, the same randomization process was used in order to keep the same sample size.

The parameters used were the following: Elevated blood pressure: systolic and/or diastolic BP equal to or greater than the 95th percentile according to the reference values of the *Update on the 1987 Task Force Report on High Blood Pressure in Children and Adolescents* (Task Force, 1996), for corresponding age and sex, adjusted for the height percentile of the assessed individual. To define the height percentile we used the National Center for Health Statistics (NCHS) growth charts.¹⁴ Arterial blood pressure was measured on two occasions, with an interval of two minutes between them. A BP equal to or greater than the 95th percentile in either two occasions was used to define the prevalence of elevated blood pressure. A Hg sphygmomanometer, whose reliability was tested by the Brazilian Institute of Metrology (INMETRO), with different-sized cuffs (25 x 12 cm and 18 x 9 cm), and a pediatric stethoscope were used. The methodological recommendations of the 1998 Brazilian Consensus on Hypertension¹³ and of the 1996 Task Force were used for the screening of BP (Table 1). For assessment of the nutritional status, we used the classification of CDC (*Centers for Disease and Control and Prevention*) - Atlanta, 2001, which is based on body mass index (BMI): underweight: BMI below the 5th percentile, normal weight: BMI above the 5th percentile and below the 85th percentile, overweight risk: BMI equal to or greater than the 85th percentile, overweight: BMI equal to or greater than the 95th percentile.¹⁵ Weight was measured with a digital scales with a capacity for 150 kg calibrated and tested by INMETRO. Height was measured with a wooden stadiometer and cursor with a precision of 0.1 cm.

The collected data were stored in a database (Microsoft® Excel 2000) and analyzed with Epi Info 2000.¹⁷ Simple analysis of variance was used to compare the mean differences of systolic or diastolic BP between groups, according to sex, age and nutritional status. The chi-square test (χ^2) and Fisher's exact test were used to compare prevalence differences in normal-high or high BP between the groups. A p value < 0.05 or of 5% was considered to be statistically significant for all tests.

The study was approved by the research ethics committee of Hospital Universitário da Universidade Federal de Alagoas.

Results

The final sample consisted of 1,253 children and adolescents between 7 and 17 years old (mean = 12.4±2.9 years), 547 males and 706 females.

Elevated blood pressure was observed in 9.41% of the students when separate measures were assessed (confidence interval: 7.8–11.02). When only the mean of the two screenings was taken into account, a prevalence of 7.7% was noted (confidence interval: 6.5–9.5).

By analyzing the questionnaires, we noted that students whose BP was elevated had not been using drugs that could increase BP, and had not been diagnosed with diseases that can occur concomitantly with arterial hypertension.

No statistically significant differences were observed between males and females with regard to the prevalence of elevated blood pressure, which was 9.5% (52) for males and 9.3% (66) for females ($p = 0.95$). Also, no statistically significant differences were seen when individuals of different genders but in the same age group were compared. When not subdivided according to sex, the students showed significant difference when the 11–14 and 7–10 age groups were compared with the 15–17 age group (Table 2).

The nutritional status of the study population was as follows: normal weight – 86.3% (1,081), overweight risk – 9.3% (116) and overweight – 4.5% (56).

The prevalence of elevated blood pressure showed an extremely significant difference when the normal weight and overweight groups were compared, a significant difference when the overweight and overweight risk groups were compared, and no statistically significant difference when the normal weight and overweight risk groups were compared (Table 3).

Discussion

Since hypertension is a disease with high morbidity and mortality that affects adults but whose roots extend back to childhood and adolescence, it has been one of the most widely investigated disorders. Epidemiological surveys are quite important in this case, as they may provide information on how this entity develops with age and which the risk factors are for the development and persistence of elevated blood pressure, as well as on how persistently high blood pressure results in morbid states. Genetic factors, nutrition and lifestyle have been increasingly implicated and correlated with elevated blood pressure;¹⁸ therefore, parents, teachers, and pediatricians should invest in the aspects related to the prevention and routine follow-up of annual BP screenings already suggested in cardiology and pediatric consensus.

In children, the levels that define elevated blood pressure are based on statistical limits, that is, arbitrary thresholds.⁹ Therefore, separate measures are useful only for assessment in specific moments. It is necessary to assess blood pressure during child development to find out which blood pressure percentile correlates with these levels.⁹

Table 1 - Methodologic recommendations of the III Brazilian Consensus on Hypertension of 1998,¹³ and the Task Force of 1996,⁹ used in this study

Item	Recommendation
Width of the cuff	40% of the arm circumference in the mean point between the elbow and the acromion
Length of the cuff	80 to 100% of the arm length
Manometer	Mercury column
Stethoscope	On the brachial artery pulse, 2 cm above the cubital fossa
Patient	Calm, seated, arm at the level of the heart; taken after 3 to 5 minutes of rest
Number of measures	Two, with 1 to 2-minute interval between the successive measures
Sistolic	First Korotkoff sound
Diastolic	Fifth Korotkoff sound

Adapted from Koch.²⁸

Table 2 - Prevalence of elevated blood pressure in students of different age groups of Maceió in both genders

Age (n)	Prevalence according to gender		Global prevalence
	Male	Female	
7-10 years (355)	4.2% (7)*	8.4% (16)	6.5% (23)
11-14 years (552)	7.9% (18)†	9.5% (31)	8.9% (49)
15-17 years (346)	17.6% (27)‡	9.9% (19)	13.3% (46)

* Elevated blood pressure male x female, two-tailed Fisher's exact test, $p = 0.1324$, uncorrected χ^2 , $p = 0.1679$
 † Elevated blood pressure male x female, two-tailed Fisher's exact test, $p = 0.5464$, uncorrected χ^2 , $p = 0.6125$
 ‡ Elevated blood pressure male x female, two-tailed Fisher's exact test, $p = 0.0396$, uncorrected χ^2 , $p = 0.0541$
 † Elevated blood pressure (7-10 x 11-14 years), two-tailed Fisher's exact test, $p = 0.2104$, uncorrected χ^2 , $p = 0.2449$
 ‡ Elevated blood pressure (11-14 x 15-17 years), two-tailed Fisher's exact test, $p = 0.0336$, uncorrected χ^2 , $p = 0.0376$
 † Elevated blood pressure (7-10 x 15-17 years), two-tailed Fisher's exact test, $p = 0.0023$, uncorrected χ^2 , $p = 0.0034$

Prevalence of elevated blood pressure in school-aged children and adolescents in the City of Maceió

Nationwide and international studies have revealed varying prevalence rates— between 1.2 and 13%. Methodological differences, number of measurements used, and distinct reference criteria are the main causes for such variation.

In the Muscatine Study,¹⁹ the prevalence decreased from 13% to less than 1% during the study period. In the United States, in 1966, Londe found 12.6% of hypertensive children among 1,805 children assessed at a private practice. After follow-up, this value decreased to 1.9%.²⁰ Adrogué & Sinaiko, in 2001, assessed 19,452 children aged between 10 and 15 years according to the 1996 TASK FORCE reference values, and found 2.7% of systolic hypertension and 2% of diastolic hypertension. By reassessing all the children whose BP was above the

70th percentile, they found 0.8% of systolic hypertension and 0.4% of diastolic hypertension.²¹

Brazilian studies also have demonstrated a great variation in prevalence rates. However, it should be noted that three screenings of BP above the 95th percentile corresponding to the height percentile for age and sex are necessary in order to characterize a child as hypertensive. These three measures should be performed on different occasions (on different days).⁹

The results of the present study show prevalence of elevated blood pressure in 9.4% of individuals assessed on a single occasion. These are the children that will be reassessed in two more screenings in order to define the presence or absence of hypertension. Once hypertension is detected, the individual should be submitted to an exhaustive investigation of its secondary causes, especially the youngest individuals.

Table 3 - Prevalence of elevated blood pressure in students from 7 to 17 years from Maceió according to their nutritional status

Nutritional status (n)	Prevalence of elevated arterial pressure	
	Yes	No
Normal (1,081)	8.1% (88)	91.9% (993)
Overweight (56)	28.6% (16)	71.4% (40)
Overweight risk (OWR) (116)	12.1% (14)	87.9% (102)

Elevated blood pressure normal weight x OWR, two-tailed Fisher's exact test, $p = 0.1606$, uncorrected χ^2 , $p = 0.2070$
 Elevated blood pressure overweight x OWR, two-tailed Fisher's exact test, $p = 0.0174$, uncorrected χ^2 , $p = 0.0164$
 Elevated blood pressure normal weight x overweight, two-tailed Fisher's exact test, $p < 0.0001$, uncorrected χ^2 , $p < 0.0001$

Blood pressure differences between different age groups

The increase in the prevalence of elevated blood pressure in older age groups, observed in the present study, is expected as essential hypertension is more common and tends to be more prevalent in preadolescents, adolescents, and adults.^{19,22,23}

Blood pressure differences between students according to nutritional status

The higher prevalence of elevated blood pressure among overweight students is similar to that reported in numerous epidemiological studies conducted in Brazil and overseas, which investigated the relationship between obesity and blood pressure in adults, children, and adolescents, having unanimously confirmed that obesity has a great impact on blood pressure.^{21,24-28}

The present study, the first epidemiological study carried out in Maceió, points to the necessity of including blood pressure control in pediatric clinical examination so that children and adolescents with elevated blood pressure can be identified and assessed as soon as possible, which will allow for the detection and treatment of secondary causes of hypertension, of factors that predispose to high blood pressure such as obesity, and specific intervention in cases of essential arterial hypertension. Only in this way may we help prevent the epidemics of cardiovascular diseases predicted by the World Health Organization for countries in epidemiological transition.

Our conclusion is that the prevalence of elevated blood pressure was 9.4% in the present study; no statistically significant differences were noted between the prevalences of elevated blood pressure between genders; the difference between the prevalences of elevated blood pressure was significant when the groups of children and preadolescents were compared with the group of adolescents, and extremely significant when the normal weight and overweight groups were compared.

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