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HIGH BLOOD PRESSURE IN OVERWEIGHT CHILDREN AND ADOLESCENTS

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Abstract

Objective: to evaluate the prevalence of high blood pressure in fat or overweight children and adolescents and its associated factors. **Methods:** Cross-sectional study including 200 children and adolescents between two and 18 years old. It was measured the abdominal circumference, blood pressure, weight and height. The systolic and diastolic blood pressure were considered high when equal or higher than 90th percentile. The value of the blood pressure in the 25th, 50th and 75th percentiles were described according to age groups, sex, nutritional state and abdominal circumference. To check the association between high blood pressure and clinical variables it was used qui-square tests and a significant level of 5%. **Results:** The majority of children and adolescents (70.5 %) had high blood pressure: 6% showed an increase only in the systolic blood pressure, 33% in diastolic blood pressure and 31.5 % in both. Systolic blood pressure values were higher observed in individuals with severe obesity and increased waist circumference, as well as those of the male sex and in the group of adolescents. Among those who had high blood pressure, the normal maximum limit of the systolic blood pressure was observed in the 50th percentile and for the diastolic in the 75th percentile. The high systolic blood pressure was associated with adolescents with severe obesity. **Conclusion:** The high prevalence of high blood pressure observed in this study indicates the need to implement policies and actions oriented towards the prevention and control of obesity and its co-morbidities, as the case of high blood pressure.

Key words: obesity; blood pressure; child; adolescent.

INTRODUCTION

Obesity is considered the epidemic of the XXI century by the World Health Organization (WHO). The increase in its prevalence has been observed in all age groups, especially in developing countries, which characterizes it as a serious public health problem[1]. In Brazil, the Family Budget Survey (POF)[2] held in 2008-2009, found that overweight and obesity are increasing, reaching respectively 21.7% and 5.9% of adolescents and 34.8% and 16.6% of children in the years surveyed.

Since childhood, excess weight can predispose individuals to chronic noncommunicable diseases (NCDs) such as dyslipidemia, type-2 diabetes mellitus (DM2) and high blood pressure (HBP)[3]. According to a recent publication by Lancet (2011), NCDs have become a health priority in Brazil, among other reasons, for being responsible for 72% of deaths in 2007. Of the total deaths, hypertension and other cardiovascular diseases stand out, accounting for 30% of deaths and representing high costs, direct or indirect, to the public health system[4]. About one billion adults worldwide had hypertension in 2000, and this number will increase to 1,560 billion in 2025[5].

When present in overweight children and adolescents, high blood pressure (BP) may have values from two to six times higher than those found in eutrophic children and adolescents, with variations between 28.7% and 46.4%, respectively, for overweight and obesity[6,7].

Blood hypertension, although treatable and easy to be clinically measured and assessed, is a silent disease, whose degenerative and cumulative effect is greater for younger individuals due to their longer exposure. Thus, the aim of this study was to evaluate the prevalence of high blood pressure and

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associated factors in overweight children and adolescents.

METHODS

This is a cross-sectional study based on a longitudinal study that followed overweight children and adolescents at the Center for Childhood Obesity (COI), Elpidio de Almeida Health Institute (ISEA) between April 2009 and March 2010 in Campina Grande-PB.

The recruitment of participants was done through the disclosure of the research in Basic Health Units, in collaboration with the City Hall Department of Health, including overweight or obese children and adolescents from 2 to 18 years of age. Patients with chronic diseases or making use of drugs that would interfere with lipid or glucose metabolism and those with the presence of disease or disabilities which would impair physical mobility were excluded.

Considering that the study population was composed of individuals from Basic Health Units, the sample calculation took into consideration the population from this age group registered in the Primary Care Information System (SIAB) in 2008. An overweight and obesity prevalence of 25% [8] was considered, and the proportion of 37.5% of HBP was applied [7]. For a sampling error of 5%, a convenience sample of 160 individuals was obtained, and this number was increased by approximately 25% due to cases being followed at COI during the study period. Three individuals were also excluded, one for making use of corticosteroid, one for being diabetic and the other for being with hepatitis at the time of recruitment, making a final sample of 200 children and adolescents.

The participation in the study was authorized by signing the informed consent form (ICF) by parents or guardians. Information on the child / adolescent (age, sex and skin color) and family (maternal education, family income and family history for blood hypertension) were collected. Then, anthropometric measurements were performed (height, weight, waist circumference) and blood pressure was assessed.

Anthropometric measurements were collected in duplicate, according to recommendations from WHO [9]. To obtain weight, a platform-type Welmy ® digital balance with capacity of 150 kg and accuracy of 0.1 kg was used; height was measured using a Toneli ®stadiometer with accuracy of 0.1 cm. Waist circumference (WC) was obtained with a Cardiomed ® tape measure with accuracy of 0.1 cm.

The nutritional status was evaluated according to recommendations from the Centers for Disease Control and Prevention (CDC) through Body Mass Index (BMI), using percentiles to determine categories as follows: overweight ($85 \leq BMI < 95$), obesity ($95 \leq BMI < 97$) and severe obesity ($BMI \geq 97$)[10]. WC values were considered increased above the 90th percentile, with a maximum limit of 88 cm for girls and 102 cm for boys[11].

Blood pressure was measured in triplicate according to recommendations from the V Brazilian Guidelines of Blood Hypertension[12]. The result was defined by the average of the last two measures. In the first assessment, measurements were obtained from both arms, and in case of difference, the arm with the highest value was adopted as reference for subsequent measurements. Aneroid sphygmomanometer was used, with cuffs of appropriate sizes. Systolic (SBP) or diastolic (DBP) blood pressure was considered normal below the 90th percentile and high when equal to or above this percentile according to sex, age and height.

Data were described through absolute and relative frequency, mean and standard deviation, and the distribution of SBP and DBP values into 25th, 50th and 75th percentiles according to age group, sex, nutritional status, waist circumference and classification of normal and high BP. In the statistic analysis, chi-square test was used to compare the prevalence of high and normal BP between groups, and the variables were categorized as follows: nutritional status: overweight/obese ($85 \leq BMI < 97$) and severe obesity ($BMI \geq 97$), age group: pre-school/school (2-9 years) and adolescent (10-18 years); WC: normal ($\leq$ 90th percentile for sex, height and age) and high ($\geq$ 90th percentile); BP: normal (< 90th percentile for sex, height and age) and high ($\geq$ 90th percentile). Data were analyzed using the SPSS software version 17, considering a significance level of 5%.

The study was approved by the Ethics Committee of the State University of Paraiba, under No. 0523.0.133.000-09, according to criteria established by resolution 196/96 of the National Health Agency.

RESULTS

The description of the study population indicates that the majority were adolescents (61.5%) and females (64%). It is noteworthy that 66% had severe obesity, 79.5% had increased WC and 96% had family history for cardiovascular diseases (CVD), and of these, 85% had family history for blood hypertension.

The socio-economic characteristics indicate that the study population is mainly composed of low-income families, with family income of up to two minimum wages (53%) and low maternal education, where 46% had incomplete secondary education.

High systolic / diastolic blood pressure ($\geq$ 90th percentile) was observed in 141 (70.5%) subjects, 12 (6%) had only increased SBP, 66 (33%) had increased DBP and 63 (31.5%) had both.

The bivariate analysis between BP, SBP and DBP outcomes and associated factors showed no

statistical significance (Table 1). An approximation of the significance level was observed between the association of high SBP (P = 0.062) and severe obesity, and the data were stratified by age group, being significant for adolescents (p = 0.025).

Table 1: Mean values and standard deviation of SBP, DBP, age, BMI and WC according to sex in overweight children and adolescents. Campina Grande - PB, 2009-2010 (n = 200).

	Sex		
	Male Mean (± SD)	Female Mean (± SD)	*p*
SBP (mm Hg)	109,3 (±13,07)	107,4 (±11,3)	0,278
DBP (mm Hg)	73,5 (±9,68)	71,9 (±10,13)	0,288
Age (years)	10,6 (±3,24)	11,4 (±4,03)	0,132
BMI (kg/m²)	27,4 (±4,57)	27,3 (±4,73)	0,896
WC (cm)	87,2 (±14,09)	85,4 (±13,55)	0,372

SBP: systolic blood pressure, DBP: diastolic blood pressure, BMI: body mass index; WC: waist circumference.

Table 2 shows that systolic blood pressure levels ≥ 120mmHG are observed in males and in those with increased WC, severely obese and in adolescents from the 75th percentile. This distribution is not observed in DBP (Table 3).

In the BP distribution of those with high BP, it was found that the maximum limit of normal SBP was observed in the 50th percentile, but for DBP, the maximum limit was in the 75th percentile. Among those with normal BP, these values were not observed at any time (Table 4).

In the distribution of means according to sex, higher but not significant mean SBP and DBP values were observed among males (Table 5).

Table 2: Mean values and standard deviation of SBP, DBP, age, BMI and WC according to sex in overweight children and adolescents. Campina Grande - PB, 2009-2010 (n = 200).

		Descriptive measures					
		n	P25*	P50*	P75*	Minimum	Maximum
Sex	**Male**	72	100	110	120	90	137
	Female	128	100	110	117	90	128
Age group	**2 - 9 years**	77	97	100	110	90	120
	10 - 18 years	123	100	110	120	90	130
WC	**WC < P90**	41	100	105	115	90	120
	WC ≥ P90	159	100	110	120	90	130
BMI	**BMI < P97**	68	100	105	117	90	128
	BMI ≥ P97	132	100	110	120	90	130

* P25, P50 and P75 are respectively 25th, 50th (median) and 75th percentiles. WC: waist circumference, BMI: body mass index.

Table 3: Diastolic blood pressure values distributed in percentiles by sex, age group, WC and BMI of overweight children and adolescents. Campina Grande - PB, 2009-2010 (n = 200)

		Descriptive measures					
		n	P25*	P50*	P75*	Minimum	Máximum
Sex	**Male**	72	68,5	70	80	60	90
	Female	128	65	70	80	60	90
Age group	**2 - 9 years**	77	60	70	75	60	90
	10 - 18 years	123	70	70	80	60	90
WC	**WC < P90**	41	66,6	70	80	60	90
	WC ≥ P90	159	65	70	80	60	90
BMI	**BMI < P97**	68	65	70	80	60	90
	BMI ≥ P97	72	68,5	70	80	60	90

* P25, P50 and P75 are respectively 25th, 50th (median) and 75th percentiles. WC: waist circumference, BMI: body mass index.

Table 4: BP values distributed into percentiles, according to the blood pressure classification of overweight children and adolescents. Campina Grande - PB, 2009-2010 (n = 200)

		Descriptive measures					
		n	P25	P50	P75	Minimum	Maximum
SBP (mmHg)	Hight	75	115	120	120	100	140
	Normal	125	100	100	110	90	110
DBP (mmHg)	Hight	129	70	75	80	60	90
	Normal	71	60	65	70	60	70

SBP: systolic blood pressure, DBP: diastolic blood pressure. * P25, P50 and P75 are respectively 25th, 50th (median) and 75th percentiles

Table 5: Bivariate analysis of normal and high blood pressure according to sex, age, nutritional state, WC and skin color of overweight children and adolescents. Campina Grande – PB 2009-2010 (n = 200)

	N	BP ≥ P90	BP < 90	*p*	SBP ≥ 90	SBP < 90	*p*	DBP ≥ 90	DBP < 90	*p*
Sex										
Male	72	73,6%	26,4%	0,469	27 (37,5%)	45 (62,5%)	1,00	52 (72,2%)	20 (27,8%)	0,087
Female	128	68,8%	31,3%		48 (37,5%)	80 (62,5%)		77 (60,2%)	51 (39,8%)	
Age group										
2 - 9 years	77	52 (67,5%)	25 (32,5%)		24 (31,2%)	53 (68,8%)		51 (66,2%)	26 (33,8%)	
10 - 18 years	123	89 (72,4%)	34 (276,6%)	0,467	51 (41,5%)	72 (58,5%)	0,143	78 (63,4%)	45 (36,6%)	0,685
Nutritional State										
BMI ≥ P97	169	122 (72,2%)	47 (27,8%)	0,221	68 (40,2%)	101 (59,8%)	0,062	112 (66,3%)	57 (33,7%)	0,221
BMI < P97	31	19 (61,3%)	12 (38,7%)		7 (22,6%)	24 (77,4%)		17 (54,8%)	14 (45,2%)	
WC										
CA ≥ P90	159	113 (71,1%)	46 (28,9%)	0,728	63 (39,6%)	96 (60,4%)	0,222	104 (65,4%)	55 (34,6%)	0,597
CA < P90	41	28 (68,3%)	13 (31,7%)		12 (39,6%)	29 (70,7%)		25 (61%)	16 (39%)	
Skin color										
Non-white	124	83 (66,9%)	41 (33,1%)	0,158	45 (36,3%)	79 (63,7%)	0,652	77 (62,1%)	47 (37,9%)	0,364
White	76	58 (76,3%)	18 (23,7%)		30 (39,55)	46 (60,5%)		52 (68,4%)	24 (31,6%)	

BMI: body mass index; WC: waist circumference.

DISCUSSION

Obesity and blood hypertension, which until recently were restricted to the adult population, now also affect children and adolescents. The prevalence of high BP in the population studied is worrisome, since it is a condition commonly associated with cardiovascular disease in adults, and when affecting younger individuals, has a greater impact on health due to the longer exposure to this risk factor[13,14].

The prevalences of high BP among children and adolescents found in various studies can vary according to the population, nutritional status, age group, and criterion adopted to the definition of this condition[6].

The prevalence of high BP found here was much higher that that found in a similar study carried out by Ferreira and Aydos (2010)[13], which was 21.7% in obese children between 7 and 14 years of age followed at a specialized service of the

Regional Hospital of Mato Grosso do Sul. Similar results were observed in a study conducted in Nigeria, whose prevalence of high BP was 37.2% in obese adolescents[15]. One explanation for this finding may be attributed to the criteria used by these authors to define hypertension, who adopted as high BP value equal to or above the 95th percentile, whereas in this study, the cutoff point was the 90th percentile, based on a study that found that children with blood pressure values above this percentile often become hypertensive adults[14]. Another possible explanation for this divergence is the nutritional status of the population of this study, which is mostly composed by severe obese individuals.

Another survey, carried out in Paraiba, the same state of the present study, found a prevalence of 30.1% of high BP [4]. Although both studies have adopted the same cutoff point, in the aforementioned study, only 10.1% of adolescents were overweight, in contrast to this study, where the entire population had overweight/obesity, stressing the importance of the nutritional status as a risk factor for high blood pressure[16]. In this sense, studies carried out in Belo Horizonte with 672 children aged from 2 to 10 years and 11 months found association between higher mean SBP and DBP with high BMI among children[17].

In this study, when SBP and DBP were evaluated and distributed into percentiles, it was found that when SBP is 120 mmHg, it already appeared in the 50th percentile, and when DBP is 80 mmHg, it appeared in the last percentile, which are maximum values that regardless of age, are considered as borderline for the diagnosis of blood hypertension in childhood[18].

The DBP value in percentiles both for males and females was higher in this study compared to that developed by Ferreira and Aydes (2010), who evaluated obese children aged from 7 to 14 years. This can be explained by the fact that these authors worked with a younger age group, and also because half of the population in this study is composed of severe obese individuals.

Although with no statistically significant difference, the frequency of high BP was higher in males, a fact observed by other authors[19,20]. The distinction between sexes can be attributed to timing differences in which biological changes occur (sexual maturation, body composition and testosterone production)[19] or because boys are considered more active than girls[20].

Regarding age, a higher prevalence of high BP was observed among adolescents. Stratification by nutritional status made this difference statistically significant; a fact also observed in other studies that worked with children and adolescents[19,20]. The risk of BP reaching high values varies according to the obesity duration and intensity[14]. Due to the design of this study, where there was no longitudinal follow-up of patients, it is not possible to state that high BP increased with aging; however, higher prevalence was observed in the higher age group. This can be due to the presence of significantly higher body fat in these subjects compared to younger age groups, as well to the increased exposure time to excessive fatty tissue[13].

Among the factors that can interfere with blood pressure values, literature shows that white children have a greater chance of having higher BP [21] than non-white children, since they tend to have higher fat percentage[6]. Although no association between BP and skin color was found in this study, high BP was present in most white individuals.

Excess fat plays a role in the blood hypertension pathogenesis, either directly associated with the metabolic characteristics of adipocytes located mainly in the abdominal region, or indirectly by means of hyperinsulinemia resulting from the insulin resistance and consequent disorder in glucose metabolism cellular mechanism[22].

The variation in the body fat distribution is important morphological indicator, related to endocrine and metabolic complications, which are predisposing to the development of cardiovascular diseases. Individuals with centripetal disposition of body fat tend to have higher incidence of blood hypertension[23].

Increased WC has been related to higher blood pressure levels. A cross-sectional study with obese and eutrophic children aged from 7 to 12 years found that individuals with increased WC were 2.8 times more likely to have high blood pressure than those with adequate waist circumference[6]. A study with eutrophic and obese adolescents showed that the elevation of SBP and DBP were 3.9 and 3.4 times more frequent among children with increased WC and 2.2 to 2.0 times among girls under the same condition[24]. This relationship was not observed in the present study, since there was no association between increased WC and high DBP and / or SBP values. This finding could be attributed to the fact that the study population is composed of obese and overweight children and adolescents, and therefore with increased waist circumference.

Excess weight causes abnormalities in blood pressure, and therefore predisposes to cardiovascular diseases. Pre-hypertensive and hypertensive individuals have higher heart rate, increased cardiac output, thicker interventricular septum and left ventricle walls, and larger diameter of the left ventricular chamber when compared to normotensive individuals. The prevalence of left ventricular hypertrophy (LVH) is three times higher in hypertensive individuals and two times higher in pre-hypertensive individuals compared to normotensive individuals[25]. Although the process of atherosclerosis and left ventricular hypertrophy (LVH) starts early in childhood, the extent of these lesions seems be lower than in adults. Many of the alterations that occur in this age group are reversible if there is early detection and intervention to combat the risk factors for CVD such as hypertension, since

the process of atherosclerosis and LVH may be reversed or minimized by reducing weight[26].

One of the limitations of this study was that BP was measured in a single visit, which does not allow being used to characterize blood hypertension. However, this measurement method can be used as an indicator of risk of blood hypertension for cross-sectional comparisons in epidemiological studies with children and adolescents[19].

Another limitation was the difficulty found to compare the results found here with other published in literature due to different criteria adopted for the diagnosis of high BP or blood hypertension, as well as to the different populations studied. However, it is noteworthy that no study was found in literature involving overweight children and adolescents with the number of cases and the wide age groups as focused in this study.

The adverse impact of excess weight on the multiple cardiovascular risk factors, such as high blood pressure requires primary prevention at early ages, since studies indicate that excess weight in childhood and adolescence tends to persist into adulthood[27].

Thus, the prevalence of high BP identified in the study population, especially among adolescents with severe obesity, strengthens the importance of preventing obesity and its co-morbidities.

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