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Prevalence of high blood pressure and their association with body mass index in children between 5 and 11 years of Nahbalam, Yucatan

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Abstract

Objective: *To determine the prevalence of high blood pressure in children aged between 5-11 years in the community of Nahbalam, Yucatan, and its association with the body mass index.* **Material and Methods:** *A transversal study with children of the primary school "Lazaro Cardenas del Rio" was performed, measuring blood pressure, height, and weight of 259 girls and boys; systolic and/or diastolic blood pressure equal or greater than percentile 95 for gender, age, and height at three measures was considered as hypertension; prehypertension was considered as blood pressure equal or greater than percentile 90 but lower than percentile 95.* **Results:** *A prevalence of 11.9% prehypertension and 6.1% hypertension was found. There is an association between hypertension and overweight and obesity ($p \leq 0.001$).* **Conclusions:** *The prevalence of high blood pressure in children of the community of Nahbalam, Yucatan, is 18%. The children with overweight and obesity have an almost tenfold greater risk of hypertension than the eutrophic children (OR: 9.896; 95% CI: 2.738-35.764).* (Gac Med Mex. 2016;152:574-8)

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Introduction

Currently, high blood pressure is the chronic condition more commonly seen in primary care outpatient clinics, and it is associated with more than 12% of deaths every year[1,2]. In 2001, the World Health Organization (WHO) conducted a study on the training for the management of high blood pressure, and the results showed that 61% of 167 participating countries had no guidelines for the management of hypertension available; in 47% of them, healthcare professionals were not trained on the management of high blood pressure; in 25%, the population could not afford antihypertensive drugs, and in 12%, neither the equipment, nor the medications required were available at primary care centers[13].

In spite of not having a world-wide estimate on the prevalence of high blood pressure in children, multiple recent studies have demonstrated a higher-than-expected incidence. In the USA, studies show pre-hypertension prevalences ranging from 10% to 34%, with the figures for hypertension ranging from 4.7% to up to 20.6%[4-6]. In Latin American countries such as Cuba, Argentina, Uruguay and Chile, studies show pre-hypertension prevalences ranging from 4.2% to 8.6%, whereas arterial hypertension prevalence ranges from 6.1% to 13.6%[7-11].

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In Mexico, there are few recent studies on high blood pressure values prevalence in children; some of them show prevalences between 3.2% and 16.2% for pre-hypertension, and arterial hypertension shows a prevalence between 4.2% and 10%[12-15]. One study conducted in 2009 showed that children with overweight and obesity had a 7.35-fold higher risk for high blood pressure than eutrophic children[15].

As with adults, high blood pressure in children can be classified as primary or essential and secondary, with differences in causes and frequency[16-18]:

- Primary or essential hypertension: in comparison with adults, where it is the cause of 85%-90% of cases, it has a lower prevalence (10%-15%), and is more common in adolescents than in children. As in adults, it is usually multifactorial and is largely associated with overweight and obesity.
- Secondary hypertension: it is more common in infants and small children. The three more common causes of secondary hypertension are aortic coarctation, renal artery disease and renal parenchymal disease, with the latter being the cause of 60%-80% of all secondary hypertensions in children and young people. Other causes children share with adults are pheochromocytoma, Cushing syndrome, hyperthyroidism, systemic lupus erythematosus, Turner syndrome, etc.

Health institutions at the national level still do not give this condition in children the crucial importance they should, since screening campaigns, plans of action, training of personnel and availability of the material required for detection are practically inexistent. Even the weekly epidemiologic reports delivered by rural health centers only allow for patients diagnosed with high blood pressure to be reported if they are older than 15 years, and the required medications for their treatment are not available, even when, on the long-term, primary prevention and opportune treatment can lead to the saving of millions of pesos in medications and treatments required for the management of chronic complications.

Material and methods

A cross-sectional, descriptive-type study was carried out in the community of Nahbalam, in Yucatán, to initially determine the prevalence of high blood pressure values in children between 5 and 11 years of age and, with the obtained data, being able to determine the prevalence of arterial pre-hypertension and hypertension, as well as the existence of a relationship between high blood pressure and gender, age and body mass index (BMI).

The community, with 1,962 inhabitants according to the census carried out in the year 2015, has one primary school, the Lázaro Cárdenas del Río Bilingual Primary School. The decision was made to work with a sample population and, therefore, the entire student population of the community's primary school, i.e., 310 schoolchildren, was established as the study subject.

Prior to the conduction of the study, a meeting was held with the school's authorities, who were briefed on its importance and its performance, and doubts were clarified. Similarly, a previous meeting was carried out with the parents of the schoolchildren, where the procedure and the measurements to be practiced on their children were explained, and informed consent had to be verbally obtained; all parents agreed on their children taking part in the study.

For the conduction of the study, arterial hypertension was defined as blood pressure at the 95th percentile or above the values for age, gender and height recorded on 3 or more occasions according to the tables of the Task Force[16], issued in its fourth report on assessment, diagnosis and treatment of high blood pressure in children and young people of 2005; arterial pre-hypertension was defined as mean systolic or diastolic blood pressure at the 90th percentile or above the values for age, gender and height, but below the 95th percentile, or blood pressure equal or higher than 120/80 not reaching percentile 95 for age, gender and height. Similarly, low weight was defined as a body mass index (BMI) below the Z-Score -2 in the WHO tables of BMI for age and gender[19]; normal weight as a BMI for age and gender between Z-Scores -2 and +1; overweight as BMI between Z-Scores +1 and +2; and obesity as a BMI above Z-Score +2.

Measurements were made using a scale with stadiometer to obtain the weight in kilograms and height in meters, with the study subject wearing light clothing and no shoes and placed at the center of the scale. With these measurements, the BMI of each study subject was obtained. Blood pressure was obtained with a calibrated aneroid sphygmomanometer (Wech Allyn), after at least 120 min without having performed any physical activity, with size 10, 11 and 12 cuffs, using the size that covered 2/3 of the arm, and by personnel trained for adequate blood pressure measurement.

The data collection phase took place at the Lázaro Cárdenas del Río Bilingual Primary School facilities and was divided in three stages. The first one involved the entire student population, and weight, height and

Table 1. Characteristics of the studied children (n = 259)

	Frequency	Mean	Median	Standard deviation
Males	134 (51.73%)			
Age		9.03	9	1.61
Height		1.26	1.27	0.10
Weight		30.72	29.75	8.76
BMI		18.25	18.00	3.03
Females	125 (48.26%)			
Age		8.48	8.00	1.80
Height		1.23	1.23	0.12
Weight		28.22	26.70	8.89
BMI		17.46	17.00	2.95

blood pressure measurements were taken in all of them. The second measurement stage was carried out one week after the first one, it involved only the study subjects that had shown systolic and/or diastolic blood pressure above the 95th percentile for the corresponding height, age and gender on the first measurement, and it involved a second blood pressure measurement. The third measurement stage took place 3-4 days after the second and involved only study subjects that had participated in the second measurement and in whom systolic and/or diastolic pressure above the 95th percentile for height, age and gender was obtained, and a third blood pressure measurement was performed, thus concluding the data collection phase.

The statistical analysis was conducted aided by the Statistical Package for the Social Sciences program (SPSS) (SPSS 22 for Windows). Descriptive statistics measures were obtained, as well as percentages for variables requiring it. Pearson's chi-square test (χ^2) was used to determine associations.

Results

Of the 310 study subjects that were initially considered, 51 were excluded for the following reasons: failed to meet the pre-established age criteria (26 subjects), failed to attend the day they were required for any of the measurements (11 subjects) and withdrawal from school (14 subjects); hence, the analysis was performed with the results of the 259 children who met all requirements and had all measurements they were required to.

When the descriptive statistics were analyzed, out of the 259 students who participated in the study, 125 (48.2%) belonged to the female gender, and 134 (51.7%), to the male gender, with ages ranging from 5 to 11 years (11 years was the age with the highest number of study subjects [61 children], and 5 years, the age with the lower number of subjects [3 children]. Mean height of the boys was 1.26 m; mean weight was 30.72 kg, and mean BMI was 18.25; as for the girls, mean height was 1.23 m, mean weight 28.22 kg and mean BMI was 17.46 (Table 1).

When the analysis of results was carried out, we could observe that 212 out of the 259 analyzed students (accounting for 81.8% of study subjects) had normal blood pressure; 31 subjects (11.9%) had a diagnosis of arterial pre-hypertension and 16 subjects (6.1%) were diagnosed with arterial hypertension (Table 2). Once the children's BMI was obtained, 1 student (0.4% of study subjects) was established as being undernourished; 169 (65.3%) had normal weight, 57 (22%) had overweight and 32 (12.4%) had obesity (Table 2).

When the analysis with the χ^2 test was performed to obtain the association between overweight or obesity and high blood pressure in the children, a p-value < 0.001 was found, which reflected a positive association. When the relative risk was analyzed in children with overweight or obesity, it was found to be nearly 10-fold higher than in children with normal weight or undernourishment according to their BMI (OR: 9.896; CI: 2.738-35.764). As for the relationship between high blood pressure and gender, females were found to have an arterial hypertension prevalence of 5.6%, with males showing a prevalence of 6.7% (Table 2), with a Pearson's χ^2-value of p > 0.05 being obtained, which reflected there was no association between gender and arterial hypertension. With regard to the relationship between high blood pressure values and age, the incidence of arterial hypertension in the different age groups ranged from 2.3% to 9.1%, without taking into account 5-year old children, since none of the 3 study

Table 2. Blood pressure figures as related to gender, BMI and age

	Normal	Pre-hypertension	Hypertension	Total
Total	212 (81.8%)	31 (11.9%)	16 (6.1%)	259
Gender				
Male	110 (82.1%)	15 (11.2%)	9 (6.7%)	134
Female	102 (81.6%)	16 (12.8%)	7 (5.6%)	125
BMI				
Undernourishment	(100%)	0	0	1 (0.4%)
Normal	144 (85.2%)	22 (13%)	3 (1.8%)	169 (65.3%)
Overweight	45 (78.9%)	5 (8.8%)	7 (12.3%)	57 (22%)
Obesity	22 (68.8%)	4 (12.5%)	6 (18.8%)	32 (12.4%)
Age				
5	3 (100%)	0	0	3 (1.15%)
6	21 (75%)	5 (17.9%)	2 (7.1%)	28 (10.81%)
7	41 (93.2%)	2 (4.5%)	1 (2.3%)	44 (16.98%)
8	41 (95.3%)	1 (2.3%)	1 (2.3%)	43 (16.60%)
9	33 (75%)	7 (15.9%)	4 (9.1%)	44 (16.98%)

subjects had hypertension (Table 2). This yielded a Pearson's χ^2 value of $p > 0.05$, again showing there was no association between age and high blood pressure in this study group.

Discussion

The results of this thesis show an arterial pre-hypertension prevalence of 11.9% in children aged from 5 to 11 years, a figure within the range found in studies from other countries such as the USA, Iran, Cuba and Argentina[4,10,20,21], but below the values found in other studies carried out in our country. Likewise, an arterial hypertension prevalence of 6.1% was found, similar to findings in studies conducted in the USA, Cuba, Argentina and Mexico[4,8-10,12]. It is important highlighting that public health institutions in our country lack the equipment and training required to establish an arterial hypertension diagnosis in children in primary care units, as well as adequate medications for its treatment, and this why the existence of 6.2% of children with this condition in a rural community is more relevant.

In the past few years, some studies on the relationship between overweight and obesity in children and the risk for high blood pressure have been carried out. In 2009, Aregullin-Eligio et al. found that children with overweight or obesity from the community of Sabinas Hidalgo, in Nuevo León, had a 7.35-fold higher risk for high blood pressure than eutrophic and undernourished patients[15]. In 2011, Bancalari et al. found that Chilean obese schoolchildren had a 3.6-fold higher risk for the development of arterial hypertension than eutrophic patients[11]. The results of this study showed the existence of an association between the children's BMI and the presence of high blood pressure. When the risk analysis was performed, children with overweight or obesity were found to have a 9.9-fold higher risk for suffering from high blood pressure than eutrophic and undernourished patients, a number higher than that recorded in previous studies. Of note, 81.2% of arterial hypertension-diagnosed patients had overweight or obesity. These data acquire more relevance if we take into account that overweight and obesity are conditions that increase their prevalence every year, due to the lifestyle and inadequate nutrition boys and girls are exposed to these days, which results in a probable increase in the prevalence of arterial hypertension in children and young individuals.

Some studies have looked into the existing relationship between gender and the development of high blood pressure, such as those carried out in 2009 in Sabinas Hidalgo (Nuevo León) by Aregullin-Eligio et al.[15], in 2006 in the USA by Urrutia-Rojas et al.[5] and in 2013 in Iran by Hakim et al.[21]. All these studies agree that there is no relationship between gender and suffering from high blood pressure, which is consistent with the results found in the present study.

This study had a rather reduced number of test subjects available, which precludes adequately establishing the relationship between the age and having arterial hypertension; therefore, in order to enable for more

categorical results to be obtained a larger number of study subjects would be required.

Conclusions

- The prevalence of high blood pressure values in children from the community of Nahbalam, in Yucatan, is 18% (11.9% of pre-hypertensive and 6.1% of hypertensive subjects).
- There is an association between BMI and arterial hypertension (Pearson's χ^2: 17,364; $p \leq 0.001$).
- Relative risk for high blood pressure in children with overweight and obesity is 9.8.
- There is no association between arterial hypertension and gender (Pearson's χ^2: 0.139; $p \geq 0.05$) or age (Pearson's χ^2: 3.963; $p \geq 0.05$.

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