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Relationship between nutritional status, perinatal and family history and blood pressure levels in adolescents

Relación del estado nutricional, antecedentes perinatales, y familiares con cifras de tensión arterial en adolescentes

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ABSTRACT

Introduction: arterial hypertension and its risk factors go unnoticed in adolescence, so it is vital to carry out an active search in this population to improve its evolution and prognosis.
Objective: to determine the possible relationship between nutritional status, perinatal and family history and blood pressure in adolescents in the 8th grade of the Secondary School Carlos Ulloa.
Methods: an observational, analytical and cross-sectional study was carried out in 72 adolescents belonging to this institution. A questionnaire was administered to the guardians, which collected family and perinatal pathological antecedents. The adolescents were measured for weight, height, waist circumference, hip circumference, arm circumference, tricipital fold, systolic and diastolic blood pressure. Mean, standard deviation, absolute and relative frequencies were used, as well as mean, chi-square and Spearman correlation comparisons, all at 95 % confidence.
Results: 36,1 % showed elevated blood pressure, prehypertension (23,6 %) or arterial hypertension (8,3 % stage I and 4,2 % stage II). The patient's history of The most important factors associated with the presence of elevated blood pressure were obesity and gestational diabetes (p<0,05). High waist circumference and waist-to-height ratio showed a statistically significant association (p<0,05) with elevated blood pressure. Systolic and diastolic blood pressure were positively and significantly correlated with weight, body mass index, waist circumference, hip and waist-height index.

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Conclusions: the frequency of elevated blood pressure was present in one third of the population studied and associations with pregnancy history and excess malnutrition were identified.

Keywords: Arterial Hypertension; Adolescent; Risk Factors; Obesity.

RESUMEN

Introducción: la hipertensión arterial y sus factores de riesgo pasan inadvertidas en la adolescencia, por lo que es vital realizar una búsqueda activa en esta población para mejorar su evolución y pronóstico.
Objetivo: determinar la posible relación del estado nutricional, los antecedentes perinatales y familiares con las cifras de tensión arterial en adolescentes del 8vo grado de la ESBU Carlos Ulloa.
Métodos: se realizó un estudio observacional, analítico y transversal en 72 adolescentes pertenecientes a esta institución. Se aplicó a los tutores un cuestionario que recogió antecedentes patológicos familiares y perinatales. A los adolescentes se les midió peso, talla, circunferencia de la cintura, cadera, del brazo, pliegue tricipital, tensión arterial sistólica y diastólica. Se emplearon media, desviación estándar, frecuencias absolutas y relativas además de comparaciones de media, chi-cuadrado y correlación de Spearman todas al 95 % de confianza.
Resultados: el 36,1 % mostró cifras tensionales elevadas, prehipertensión (23,6 %) o hipertensión arterial (8,3 % estadio I y 4,2 % en estadio II). Los antecedentes del embarazo asociados a la presencia de cifras tensionales elevadas fueron la obesidad y diabetes gestacional (p<0,05). La circunferencia de la cintura e índice cintura-talla elevados mostraron una asociación estadísticamente significativa (p<0,05) con la presión elevada. La tensión arterial sistólica y diastólica se correlacionaron positiva y significativamente con el peso, índice de masa corporal, circunferencia de la cintura, cadera y el índice cintura-talla.
Conclusiones: la frecuencia de cifras tensionales elevadas se presentó en un tercio de la población estudiada y se identifican asociaciones con antecedentes del embarazo y malnutrición por exceso.

Palabras clave: Hipertensión Arterial; Adolescentes; Factores de Riesgo; Obesidad.

INTRODUCTION

Arterial hypertension is the main risk factor for the development of cardiovascular diseases, constituting the first cause of death worldwide; it is responsible for at least 45 % of deaths due to heart disease and 51 % due to stroke.[1] It was considered a disease of adult life, which only in some cases occurred in children, when they had some underlying disease that conditioned it, which has been called secondary arterial hypertension. Today it is known that essential or primary arterial hypertension in adults often begins in childhood.[2]

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Epidemiological studies of children and adolescents in the last 20 years reveal an increase in the prevalence of hypertension and prehypertension, explained in part by the increase in obesity, thus; prehypertension progresses to hypertension at a rate of approximately 7 % per year. In adolescence, this increase is between 4,7 to 13 % in the population under 18 years of age, a worrisome fact, since the increase in blood pressure levels in adolescence remains throughout life and leads to a series of early complications in adulthood.[3]

In Cuba, as in the rest of the world, AHT is not a very frequent problem in pediatrics compared to adults; however, when it occurs, the consequences can be very serious. According to reports its frequency is around 30% in adolescence. In 2015 in Cuba, a rate of arterial hypertension of 0,2 per thousand inhabitants, between 10 and 14 years of age, was recorded. However, according to reports of a study conducted in 1026 high school students of both sexes in Havana the prevalence of primary HT resulted in 4,7 % and prehypertensive of 9,7 %.[4]

International and national studies such as the one conducted in Yunnan, China among the school-aged population aged 9 to 17 years between 2017 to 2019 the total prevalence of hypertension was 13,72 %, 12,49 % and 13,45 % respectively.[5]

In Chiquimula, Guatemala a study on Arterial hypertension and obesity in school children aged 6 to 15 years, recorded 8,38 % with arterial hypertension (AHT) and 22,7 % prehypertension. Of the children with hypertension, 83.9% were overweight; 58,3 % of the overweight children had prehypertension, which demonstrates the association of excess malnutrition with a risk factor for hypertension.[6]

In Villa Clara, Cuba, a study on arterial hypertension in childhood found a high incidence of prehypertensive and hypertensive infants (37,.3 %), demonstrating that the alteration of blood pressure figures at an early age has become a problem to be addressed worldwide.[7]

Several studies have shown that arterial hypertension has its origins in early stages of life, with evidence showing the frequency of hypertension in members of some families, studies on pro-hypertensive genes, experiments in sodium sensitive rats, the high incidence associated with lipid and carbohydrate dysmetabolism, association with obesity, systematic alcohol intake, smoking, and steroid intake.[8]

This entity has been clinically observed in young individuals, confirming a certain genetic predisposition, which interacts with phenotypic phenomena and depends on environmental influences.[9]

Arterial hypertension in children and adolescents has increased as a clinical entity in association with other risk factors for cardiovascular disease, including obesity, insulin resistance and dyslipidemia. The prevalence of lipid abnormalities in children is increasing and is associated with the obesity epidemic, as well as the metabolic syndrome that includes HT. Obesity and overweight have been widely recognized in different studies as a conditioning factor, and one that needs to be modified, with respect to the development and prevention of HT and other cardiovascular diseases.[10]

The identification of risk factors is the main measure to control cardiovascular disease. Modifiable factors are those that can be changed to reduce or eliminate the probability of having the problem and enjoying a productive life.[11]

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The factors associated with HT can be summarized as age, gender, ethnicity and heredity (non-modifiable), smoking, alcohol, sedentary lifestyle, diet, sociological and social (behavioral modifiable) and overweight, obesity, dyslipidemia, diabetes mellitus (metabolic modifiable). Non-modifiable or non-preventable factors are inherent to the individual. However, the modifiable ones are associated with lifestyle, so they can be prevented, minimized or, better yet, eliminated.[12]

In the province of Pinar del Río in 2018, a study entitled "Factors associated with arterial hypertension in adolescents in San Juan y Martínez, 2018,[12]" was conducted in which epidemiological elements related to the presence of high blood pressure in adolescents are provided.

The morbidity of arterial hypertension is increasing in pediatric ages. The recognition of its presence at this stage would allow the modification of lifestyles and also the implementation of therapeutic measures to minimize its impact on adult life. In the province of Pinar del Rio, few studies have been reported on the frequency of arterial hypertension or prehypertension in adolescents, its relationship with perinatal and family antecedents and nutritional status. Taking into account the great importance of this subject, and the essential need to control this disease especially at early ages, the present work is conducted in this province to provide more evidence in relation to this health problem. The present research aims to determine the possible relationship of nutritional status, perinatal and family history with blood pressure figures in adolescents of the 8th grade of the ESBU Carlos Ulloa.

METHODS

An observational, analytical and cross-sectional research was carried out in adolescents belonging to the 8th grade of the Carlos Ulloa ESBU in the city of Pinar del Río. The universe was constituted by the totality of 8th grade students of the ESBU Carlos Ulloa (n=346), it was possible to include in the sample 72 students due to the epidemiological situation of COVID-19 which met the following inclusion criteria: Adolescents of the 8th grade of the ESBU Carlos Ulloa to whom it was possible to perform all the anthropometric and blood pressure measurements prior consent of their parents or guardians to participate in the study and whose guardians answered the questionnaire of perinatal and family history.

Prior coordination was made with the management of the Carlos Ulloa ESBU to obtain authorization to carry out the study. The authorization was accepted and coordination was made with the person in charge of the eighth grade to organize the different times when all the determinations of the present study would be made according to the possibilities of the teaching schedule.

In addition, a meeting was arranged with the guardians of these adolescents to inform them of the objectives and conditions of the study in an attempt to obtain their consent for the inclusion of their children in the research and to apply the perinatal and family history questionnaire to parents or guardians. This meeting took place and subsequently the questionnaire was applied in each of their children's classrooms in a school for parents or guardians held at the school.

A room with adequate conditions was set up in which the following anthropometric determinations were made: Weight, Height, Waist circumference (CCi), hip circumference (CC) and tricipital fold (PT) with which it was possible to calculate the indicators body mass index (BMI), waist-height index (WHI) and waist-hip index (WHI) and systolic and diastolic blood pressure were measured.

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Body height and weight were measured according to internationally standardized protocols,[13] using an electronic digital scale (KERN, United States) with a resolution of 0,100 kg and an attached stadiometer. BMI was calculated according to the formula weight(kg)/height2(m) and was considered obese if the BMI was >percentile (pc) 97 according to age and sex in the curves for Cuban children and adolescents, overweight if the BMI was > pc 90 and ≤ pc 97, normal weight if the BMI was between pc 10 and 90, and underweight if the BMI was <pc 10. The Cci was measured at the end of a smooth expiration, with the subject in a standing position, at the midpoint between the lower costal border and the iliac crest at the level of the mid-axillary line, and parallel to the standing plane. Abdominal obesity was considered when the Cci was higher than the 90th percentile. The percentile table used was the one proposed by Esquivel and colls,[14] in Havana, Cuba in the absence of reference tables for this indicator in the Cuban population.

Hip circumference was measured at the level of the gluteal prominence and the ICC was calculated as the ratio between waist and hip circumference. The 90th percentile was taken as the cut-off point indicative of cardiovascular risk due to CHF, as described by Mederico et al,[15] in Venezuela, in the absence of reference tables of CHF percentiles, the tables offered in this study were taken as a reference.

The CCI was calculated from the current values of the subject's CCi and height as previously described.[16] The obtained ICT value was stratified as follows: Acceptable: ICT < 0,50 vs. Elevated: ICT ≥0,50; respectively.

In addition, the circumference of the arm was measured using a tape measure which was placed in the middle part of the arm taking as reference the length between the tip of the shoulder (acromion) and the head of the radius (olecranon).

The tricipital crease was measured using a metallic Holtain plicometer calibrated in millimeters and the midpoint of the arm was carefully chosen, which is none other than the midpoint between the acromion at its most superior and external point and the head of the radius at its lateral and external point. The measurement was taken with the arm relaxed and hanging laterally, with the shoulder joint in slight external rotation and the elbow extended. The crease formed parallel to the longitudinal axis, with the thumb and index finger of the left hand separated from the underlying muscle and measured at that point, placing the plicometer perpendicular to the crease. was taken on the posterior aspect of the arm, over the triceps muscle, midway between the lateral projection of the acromion process of the scapula and the inferior margin of the olecranon process of the ulna.

Determination of blood pressure:

To measure the adolescent's blood pressure, in addition to meeting the same requirements as the adult, the size of the cuff should be taken into account, which should cover approximately 2/3 of the arm and the inflatable bag inside should cover the entire circumference of the arm or at least 80 %. If the cuff is smaller it will yield higher blood pressures and if it is larger it will be lower. The arm was supported and at the level of the heart, without rounding the figures. The systolic and diastolic blood pressures were taken as reference for the first and fifth Korotkoff noises, respectively, as in the adult, and the measurements were taken in triplicate.[17]

The criteria for arterial hypertension in children are based on the tables of percentile values according to age, sex and height of the SecondTaskForceonBloodPressure of 1996 and its most recent update in 2004 (Fourth Report of Children) by the WorkingGroup collected in the Cuban Guide for the prevention, diagnosis and treatment of arterial hypertension.[18,19]

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- Normal: systolic and/or diastolic BP less than the 90th percentile for age, sex and height.
- Prehypertensive: equal to or greater than the 90th percentile and less than the 95th percentile, as well as all those with blood pressure figures equal to or greater than 120/80.

The basic descriptive parameters were estimated: mean and standard deviation for quantitative variables and absolute frequencies (No.) and relative percentages (%) for qualitative variables. Box and whisker plots, scatter plots and histograms were used to characterize the distribution of the variables, detect aberrant points and check the assumptions of normality for the tests that required it.

A mean comparison test was used for quantitative variables (Mann Whitney U) and the chi-square test for comparison of proportions by group and for the determination of the association between categorical variables. A 95 % confidence level was used for all tests. The results were expressed in tables to facilitate a quicker understanding. The data were processed using SPSS,[21] for Windows.

This research was carried out with the previous authorization of the Research Ethics Committee of the Faculty of Medical Sciences Dr. "Ernesto Che Guevara de la Serna". All data obtained will be used for strictly scientific purposes and will only be disclosed in events and published in prestigious journals.

RESULTS

Table 1 shows the diagnosis made according to systolic and diastolic blood pressure figures by sex.

Table 1. Diagnosis according to systolic and diastolic blood pressure figures by sex.

Overall diagnosis according to BP figures	Sex					
	Female		Male		Total	
	No.	%	No.	%	No.	%
Normal	27	58,7	19	41,3	46	63,9
Normal-high	9	52,9	8	47,1	17	23,6
HTA EI	2	33,3	4	66,7	6	8,3
HTA EII	2	66,7	1	33,3	3	4,2
Total	**40**	**55,6**	**32**	**44,4**	**72**	**100,0**

$X2=1.581$ p=0.064
Legend:
BP: blood pressure. AHT IE: Arterial Hypertension Stage I. AHT IBD: Arterial Hypertension Stage II.

Table 1 shows that females predominated in the population of adolescents studied, with 55,6 %.

Of the sample, 63,9 % had normal blood pressure figures and 36.1% showed blood pressure levels considered normal-high (23,6 %) or arterial hypertension in any of its stages (8,3 % stage I and 4,2 % in stage II).

The test for comparison of proportions by group showed that there was no difference in the frequency of different blood pressure levels between the two sexes (p>0,05).

Table 2 below shows the family pathological history and during maternal pregnancy and its relationship with the presence or not of elevated blood pressure figures in the adolescents studied.

Table 2. Family and pregnancy pathological history and its relationship with the presence or not of elevated blood pressure in the adolescents studied.

Family and pregnancy history		Presence or absence of elevated blood pressure levels						X^2	p
		YES		No		Total			
		No.	%	No.	%	No.	%		
APF de HTA	Yes	7	9,7	15	20,8	22	30,6	0,250	0,615
	No	19	26,4	31	43,1	50	69,4		
Obesity	Yes	2	2,8	3	4,2	5	6,9	0,035	0,851
	No	24	33,3	43	59,7	67	93,1		
Gestational AHT	Yes	4	5,6	5	6,9	9	12,5	0,310	0,578
	No	22	30,6	41	56,9	63	87,5		
Gestational Diabetes	Yes	1	1,4	2	2,8	3	4,2	0,010	0,919
	No	25	34,7	44	61,1	69	95,8		
Excessive weight gain	Yes	2	2,8	7	9,7	9	12,5	0,860	0,354
	No	24	33,3	39	54,2	63	87,5		
Insufficient weight gain	Yes	1	1,4	1	1,4	2	2,8	0,172	0, 678
	No	25	34,7	45	62,5	70	97,2		

Legend: FPA: Family Pathological History. HTA: Hypertension.

Table 2 shows that no association was found between maternal or paternal family history of hypertension and the presence of high blood pressure in the adolescents included in the study. In the case of maternal pregnancy history, a statistically significant association was found between maternal obesity during pregnancy and having had gestational diabetes and the presence of high blood pressure during adolescence in these patients (p<0,05), and no association was found with any of the other antecedents evaluated (p>0,05).

Table 3. performs a similar analysis but now taking into account the child's perinatal history.

Child's history		Perinatal history and relationship with the presence of elevated blood pressure.						X^2	p
		Yes		**No**		**Total**			
		No.	**%**	**No.**	**%**	**No.**	**%**		
Nutritional status of the child at birth	Low weight	2	28,6	5	71,4	7	9,7	2,870	0,238
	Normal weight	21	34,4	40	65,6	61	84,7		
	Macrosomic	3	75,0	1	25,0	4	5,6		
Breastfed	Yes	22	35,5	40	64,5	62	86,1	0,076	0,783
	No	4	40,0	6	60,0	10	13,9		
Weight gain in the first year of life	Insuficient	0	0	2	100,0	2	2,8	1,467	0,480
	Normal	24	36,4	42	63,6	66	91,7		
	Acelerated	2	50,0	2	50,0	4	5,6		

As can be seen, when considering the birth weight factor, no association was found between the presence of low or high birth weight and the presence of high blood pressure. Nor was there any association between high blood pressure and not having received breastfeeding or inadequate weight gain during the first year of life (p>0,05).

Table 4 shows the relationship between the presence of excess malnutrition as assessed according to different anthropometric indicators and the presence or absence of high blood pressure.

Table 4. Relationship between the presence of excess malnutrition as assessed according to different anthropometric indicators and the presence or absence of high blood pressure.

Cut-off point for diagnosis of malnutrition due to excess	With high blood pressure		Normotensive		Total		X^2	p
	No.	**%**	**No.**	**%**	**No.**	**%**		
Cci ≥ P90	12	63,2	7	36,8	40	55,6	8,18	0,000
ICC ≥ P90	5	55,6	4	44,4	9	12,5	1,69	0,194
ICT≥0,5	7	87,5	1	12,5	8	11,1	10,3	0,001
IMC≥ P90	12	48,0	13	52,0	25	34,7	2,35	0,125

Legend: Cci: Waist circumference. ICC: Waist Hip Index. WHI: Waist-to-height ratio. BMI: Body Mass Index.

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A statistically significant association was found between the presence of abdominal obesity as assessed by waist circumference values (CCi>P90) and the presence of high blood pressure in the sample studied (p<0,05). Similarly, the waist-to-height ratio ≥0,5 was also found to be significantly associated (p<0,05) with elevated blood pressure. No statistically significant association (p>0,05) was found between waist-hip index ≥ P90 or body mass index ≥ P90 and the presence of elevated blood pressure figures.

Table 5 shows the mean values and standard deviation of the different anthropometric indicators evaluated, taking into account the presence or absence of elevated blood pressure among the adolescents studied. In addition, the mean comparison test and its significance are shown.

Table 5. Mean values and standard deviation of the different anthropometric indicators evaluated taking into account the presence or absence of high blood pressure among the adolescents studied.

Anthropometric indicators	Presence or absence of elevated blood pressure figures			
	No		**YES**	
	Mean	**Standard deviation**	**Mean**	**Standard deviation**
Weight at birth	7_a	1,10	7_a	1,36
Current weight	$49,9_a$	10,1	$58,2_b$	11,9
Height	$1,61_a$	,07	$1,63_a$	,07
BMI	$19,2_a$	3,0	$21,9_b$	4,7
Cci	$64,8_a$	6,5	$72,0_b$	10,9
Cc	$83,6_a$	6,8	$87,8_b$	8,6
ICC	$0,7758_a$	0,0577	$0,8173_b$	0,000629
ICT	$0,4024_a$	0,0343	$0,4421_b$	0,0690
CB	21,14	3,97	23,64	3,58
Tricipital fold	$15,9_a$	6,5	$21,0_b$	9,0

Legend: BMI: Body Mass Index. Cci: Waist circumference.
Cc: Hip circumference. HCW: Waist Hip Index. ICT: Waist Height Index.
CB: Circumference of the Arm.

Note: Values in the same row and subtable that do not share the same subscript are significantly different at p<0.05 in the two-sided test of equality for column means.

As can be seen with the exception of birth weight and arm circumference the rest of the anthropometric parameters evaluated showed higher mean values among adolescents with elevated blood pressure figures with statistically significant differences with those who had normal blood pressure figures (p<0,05).

DISCUSSION

There is evidence that cardiovascular disease begins at an increasingly younger age. The prevalence of arterial hypertension in pediatric ages reported in epidemiological data from developed countries is between 4,7 and 13 %.[20]

In the present study, 36.1 % showed elevated blood pressure, prehypertension (23,6 %) and arterial hypertension (8,3 % stage I and 4,2 % in stage II), a higher frequency than that recorded in another study carried out in Pinar del Rio, Sandino municipality by Troche Valdés and collaborators,[21] where the prevalence of prehypertensive patients was 3,57 % and 5,87 % of hypertensive patients.

In a similar study carried out in Paraguay by Real Delor and collaborators, [21] lower figures were also obtained, with only 1,5 % of all adolescents studied having arterial hypertension. The difference could be due to the fact that the samples are not similar, as they were made in different social and geographic contexts, in addition to the small sample size, the main limitation of this study as a consequence of the Covid-19 pandemic.

The study found no association between maternal or paternal family history of hypertension and the presence of high blood pressure in the adolescents included, which shows that the genetic component does not determine the presence of high blood pressure in this sample but that other associated factors are present; however, according to Mata Wong,[2] in a study of 203 adolescents, 33 (16,2 %) were hypertensive and of these, 60,6 % had a family history of hypertension and (57,5 %) of obesity.

In the case of maternal pregnancy history, a statistically significant association was found between maternal obesity during pregnancy and having had gestational diabetes and high blood pressure during adolescence in these patients (p<0,05), and no association was found with any of the other antecedents evaluated (p>0,05). No similar results were found in other national or international studies for comparison.

Systolic and diastolic blood pressure were positively and significantly correlated with weight, body mass index, waist circumference, hip circumference and waist-height index. A statistically significant association was found between the presence of abdominal obesity as assessed by waist circumference values (CCi>P90) and the presence of high blood pressure in the sample studied (p<0,05).

Similarly, the waist-to-height ratio ≥0,5 was also found to be significantly associated (p<0,05) with elevated blood pressure. No statistically significant association (p>0,05) was found between waist-hip index ≥ P90 or body mass index ≥ P90 and the presence of elevated blood pressure figures.

For many years, BMI has been the anthropometric indicator of choice for the prediction of cardiovascular damage or other health risks due to the ease of obtaining the primary variables, and its calculation and interpretation. However, it is clear to many that BMI can be affected by the muscularity of the subject as well as by the presence of water distribution disorders.[21]

On the other hand, waist circumference (WC) is a useful anthropometric measure for the identification of abdominal obesity and has been rated as a better tool for assessing cardiovascular and metabolic risk than body mass index (BMI).[12]

Similar results to this study were obtained by Rojas Concepción and collaborators,[10] who reported a relationship between excess malnutrition and the presence of arterial hypertension. Other studies also agree with this research, such is the case of the one carried out by Amor Micaela and collaborators,[22] in the city of Buenos Aires, Argentina, who found a 6,6 % prevalence of HT in the adolescents studied, mainly associated with obesity and overweight (10,9 %) and with an increased waist circumference (13,4 %). These authors also coincide in finding no statistically significant association between the waist-hip index and the presence of high blood pressure.

With similar results, Cabal Giner and collaborators,[23] in a study carried out in Havana reported that 0,7 % of the school children in their study series presented elevated blood pressure figures, of which 5,0 % were obese. This was corroborated when CC and CTI were used as predictors. Thus, schoolchildren with increased CC and/or CTI values were also those with increased BP values.

Garí Llanes,[7] in his research determined that weight, height and body mass index, in isolation, are not good predictors of blood pressure; however, among the anthropometric markers studied, the waist circumference variable shows a continuously increasing mean (among the variables, it is the best predictor of blood pressure), which coincides with the findings of the present study.

It is worth highlighting the importance and obligatory nature of measuring BP and assessing nutritional status in consultations with adolescents. Taking into account the positive and significant correlation between blood pressure and weight, body mass index, waist circumference, hip circumference and waist-to-height ratio, an appropriate nutritional assessment should be made of adolescents in consultations, measuring all anthropometric markers, as well as detecting risk factors for hypertension and implementing an action plan to favorably address modifiable factors.[24,25]

It is concluded that the frequency of high blood pressure was present in one third of the population studied and associations with pregnancy history and excess malnutrition were identified.

Conflict of interest
The authors declare that there is no conflict of interest.

Authorship contribution
KGC: conceptualization, research, project management, supervision, visualization, writing - original draft, writing - revision and editing.
YHR: conceptualization, research, visualization, writing - original draft, writing - review and editing.
ATC and YCD: conceptualization, research, writing - original draft.
MGF and YCR: conceptualization, writing - original draft.

Additional material
Additional material to this article can be consulted in its electronic version available at: www.revcmpinar.sld.cu/index.php/publicaciones/rt/suppFiles/5711

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