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Prevalence of Hypertension among School-Aged Children and Adolescents in Luanda, Angola

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Abstract: ***Background: Knowledge of the prevalence, diagnosis, and treatment of hypertension (HTN) in children and adolescents is essential to prevent cardiovascular disease in adulthood, particularly in sub-Saharan Africa, a region with limited data. Objective: This study investigated the prevalence of hypertension among school-aged children and adolescents in Luanda, Angola, an area where pediatric cardiovascular data remain scarce. Methodology: Using a cross-sectional design, 616 students aged 6 to 16 years from public and non-public schools in the Maianga District were evaluated. Blood pressure measurements were taken weekly over three weeks using auscultatory methods and interpreted according to the 2017 American Academy of Pediatrics. Results: The prevalence of hypertension was 26.1%, with a higher occurrence among older adolescents and students from non-public schools Conclusion: Findings underscore the need for routine blood pressure screening after age 3 and lifestyle-focused interventions involving schools.***

Keywords:.Hypertension, Children, Adolescents, Prevalence, Luanda

1. Introduction

The recognition that elevated blood pressure begins in childhood and is a predictor of high blood pressure in adults has led to renewed interest in investigating blood pressure in childhood and adolescence [1-3].

In developed countries, the prevalence of high blood pressure (HTN) in childhood and adolescence ranges from 1% to 5% [4-10]. In low- and middle-income countries, particularly African countries, there is a wide variation in estimated prevalence, with significant heterogeneity across studies, ranging from 5% to over 20% [11-18]. In many sub-Saharan African countries, hypertension remains underdiagnosed, and when diagnosed, it is often delayed, with complications already occurring [12].

According to the current guidelines for the diagnosis of hypertension in children and adolescents, no published data were found for Angola, but a study conducted at a school in Luanda on cardiovascular risk factors in prepubertal schoolchildren aged 7 to 11 years revealed a frequency of 14.6% of children with high blood pressure [19]. This result caught our attention, and we defined the objective of this study to determine the prevalence of hypertension in children and adolescents in schools in Luanda. These findings are essential for guiding early screening initiatives and informing school-based health interventions in Angola and similar contexts.

2. Methodology

Study Design, Setting, and Participants

A cross-sectional study was conducted across six schools, including primary, elementary, and secondary levels (three public and three non-public) in the Maianga District, Maianga Municipality, Luanda Province, Angola. Data collection took place from October 2023 to September 2024. Study participants were children and adolescents aged 6 to 16. A random cluster sample of six schools was selected in four stages (from the Province of Luanda, the municipality of Maianga was selected, from which the district of Maianga was randomly selected, which was stratified into primary, first, and second cycle schools). Six schools (three public and three non-public) were selected proportionally to the size of each stratum. All students aged 6 to 16 from the selected schools were invited to participate in the study. Initially, 800 children were recruited with prior parental consent and the adolescents' assent. Due to refusal, a 23% loss was recorded, resulting in a final sample of 616 participants.

Data Collection Procedure

A pre-tested form approved by the Scientific Committee of the Doctorate in The questionnaire was prepared by the Department of Public Health of the Agostinho Neto University School of Medicine, with items on identification (name, age (date of birth), school, case number, telephone number) and family history of hypertension. The information was obtained either by the child or adolescent at school if they were able to do so, or by the child or adolescent's parents or guardians, by completing a form or by telephone. The anthropometric assessment (weight, height) was performed by the work team, composed of the principal investigator and three other members (one cardiopulmonary specialist, one cardiopulmonary specialist, and one medical student) who were properly trained to reduce intra- and inter-rater error. A SECA® anthropometric scale was used, properly calibrated to 100 g accuracy and a stadiometer fixed to the scale with 0.1 cm accuracy. For the measurement, participants were asked to remove their shoes and wear light clothing, with an empty bladder, and to stand in the center of the scale platform, with their upper limbs extended along the torso to promote equitable weight distribution. For the evaluation From the height, the participant kept their head up, looking at the

horizon, and maintaining a position under the Frankfurt plane. Blood pressure was measured with a RIESTER® aneroid sphygmomanometer and a cuff appropriate for the arm size, covering 40% of the width and 80% of the length. The cuff was placed 2 to 3 cm above the cubital fossa, with the compressive part over the brachial artery. Measurements were taken in a calm environment, in a seated position, preceded by 5 minutes of rest, legs uncrossed and feet flat on the floor, back resting on the chair with the right arm at heart level, supported on a horizontal plane, with the palm facing upwards. Measurements were taken weekly, three times a day, separated by 2-3 minutes, over a three-week period. The average of the last two measurements of each day (mean systolic blood pressure (MSBP), mean diastolic blood pressure (DMBP)) and then the average of the pressures of the previous two days were considered. In this study, any child whose average SBP or DBP readings for the last two days were equal to or greater than the 90th percentile was considered hypertensive, and any child whose average SBP or DBP readings were below the 90th percentile was considered non-hypertensive. Any child with stage 1 hypertension (mean systolic or diastolic blood pressure) equal to or above the 95th percentile at the end of the three-day measurement period underwent ambulatory blood pressure monitoring (ABPM) at the David Bernardino Pediatric Hospital in Luanda, with follow-up instructions.

Statistical Analysis

SPSS (Statistical Package for the Social Sciences) version 26 was used for data entry and analysis. Descriptive statistics (absolute and relative frequencies, mean, standard deviation, and median) were used to describe the participants' general characteristics. The chi-square test was used to test the association between pediatric blood pressure (dependent variable) and the independent variables. (gender, age group, and schools).

Ethical considerations

Ethical authorization for this study was requested from the ethics committee of the Faculty of Medicine of Agostinho Neto University (FMUAN) and granted under resolution No. 09/01-PAR/CE/FMUAN/2023. Permission to conduct the study in the selected schools was requested from the Luanda Municipal Education Directorate and the heads of the selected schools. Informed consent to participate in the study was requested from parents/guardians and assent from children and adolescents aged 12 to 16 years.

3. Results

Of the 616 children and adolescents participating in the study, 383 (62.2%) were female. The sample had a mean age of 13.25 (±0.098) years, with a median age of 14 years (interquartile range: 12–15). The 14–16 age group accounted for 320 (52%) participants. The majority of the children, 318 (51.6%), attended non-public schools. It was observed that 455 (73.9%) children and adolescents did not have hypertension. At the first visit after the three measurements and the average of the last two measurements (SBP and DBP) was calculated, 35.2% of the children and adolescents had hypertension, at the second visit 28.2%, and at the third visit 26.8%. The difference between the first and third visits was an 8.4% decrease in the prevalence of hypertension among children and adolescents. After calculating SBP and MDBP, 7.7% had systolic hypertension, 5.4% diastolic hypertension, and 14.6% had both (systolic and diastolic). Of the 161 (26.1%) children with hypertension, 70 (11.4%) had persistently high blood pressure equal to or greater than the 95th percentile (P≥95 = stage 1 hypertension) and underwent ambulatory blood pressure measurement (ABPM). It was found that 1.1% had systolic hypertension, 2.3% diastolic hypertension, and 8.0% both. The overall mean blood pressure was 80 (± 9.79), with a minimum value of 60 and a maximum of 116.6 mmHg. The mean systolic blood pressure was 107.17 (± 12.1), with a minimum value of 80 and a maximum of 150, and the mean diastolic blood pressure was 66.9 (± 9.9), with a minimum value of 50 and a maximum of 104 mmHg, as shown in Table 1.

Table 1: Frequency distribution of general characteristics of children and adolescents in schools in the Maianga District (Luanda): December 2023 – July 2024

Variable		Number (n)	Percentage (%)
Sex	Female	383	62.2
	Male	233	37.8
Age Group	6 – 9 years	47	7.6
	10 – 13 years	249	40.4
	14 – 16 years	320	52
Schools	Public	298	48.4
	Non-public	318	51.6
Blood Pressure – Mean 1st Visit (mmHg)	No hypertension	399	64.8
	Systolic hypertension	70	11.4
	Diastolic hypertension	44	7.1
	Both	103	16.7
Mean 2nd Visit (mmHg)	No hypertension	442	71.8
	Systolic hypertension	54	8.8
	Diastolic hypertension	32	5.2
	Both	88	14.2
Mean 3rd Visit (mmHg)	No hypertension	451	73.2
	Systolic hypertension	40	6.5
	Diastolic hypertension	34	5.5
	Both	91	14.8
Blood Pressure	No hypertension (P < 90)	455	73.9

	With hypertension (P ≥ 90)	161	26.1
MAP	Systolic hypertension	7	1.1
	Diastolic hypertension	14	2.3
	Both	49	8
		Mean (Standard Deviation)	(minimum/maximum)
Mean blood pressure (mmHg)		80 (9,79)	(60 / 116,6)
Mean systolic blood pressure (mm/Hg)		107,17 (12,1)	(80 /150)
Mean diastolic blood pressure (mm/Hg)		66,9 (9,9)	(50 / 104)

Abbreviations nº = number; % = percentage; P = percentile; ABPM = ambulatory blood pressure measurement

Table 2 summarizes the prevalence of high blood pressure in children and adolescents by sex and age group in schools in the Maianga District.

Of the 161 children and adolescents with high blood pressure, 73.3% were female. Among those with high blood pressure, the 14-16 age group accounted for 55.3% of cases. Non-public schools accounted for 57.1% of cases among all hypertensive individuals, and public schools accounted for 42.9%. There was a significant association between sex (P = 0.001), schools (P = 0.032), and high blood pressure.

Table 2: Prevalence of high blood pressure (HBP) in children and adolescents by sex and age group in schools in the Maianga District (Luanda): December 2023 – July 2024

Variable	n (%)	Com HTA (%)	Sem HTA (%)	P
Sex				
Female	383 (62,2)	118 (73,3)	265 (58,2)	**0,001**
Male	233 (37,8)	43 (26,7)	190 (41,8)	
Age group				
6 - 9 years	47 (7,6)	15 (9,3)	32 (7,0)	**0,268**
10 – 13 years	249 (40,4)	57 (35,4)	192 (42,2)	
14 - 16 years	320 (51,9)	89 (55,3)	231 (50,8)	
Schools				
Publics	298 (48,4)	69 (42,9)	229 (50,3)	**0,032**
Non públics	318 (51,6)	92 (57,1)	226 (49,7)	

Abbreviations: nº = number; % = percentage; P = P value

4. Discussion

The study reports the prevalence of high blood pressure in children and adolescents in schools in Luanda. The prevalence was 26.1% (based on the definition of hypertension (P ≥90). Of these children and adolescents, 11.4% had persistent systolic or diastolic blood pressure equal to or greater than the 95th percentile, which corresponds to stage 1 hypertension (P ≥95). In the present study, the prevalence was higher compared to that of other studies carried out in some sub-Saharan African countries [1,2,11,12,13,14,17,20,21,30,32] where the prevalence of arterial hypertension ranged from 11 to 24.8%, with the variation of stage 1 hypertension (P ≥95) from 6.3 to 10.8%. In some developed countries [4,8,10,13,22-24] the variation in the prevalence of stage 1 hypertension (P ≥95) was 1 to 5%. These differences may stem from multiple factors, including the heterogeneity in blood pressure measurement methods. blood pressure, number of screening visits, and population factors. In some studies [1,2], despite repeated measurements every 3 days, electronic devices were used, without confirmation of hypertension by aneroid or mercury sphygmomanometers. 10.8%. On the other hand, in the study conducted in Angola (Luanda), the prevalence of arterial hypertension (P≥90) was 26.1% and stage 1 hypertension (P≥95) was 11.4%, which was lower, compared to the Bhimma study in South Africa (P≥90) was 29.7% and (P≥95) was 13.7% [17].

Females were the most affected, corroborating studies conducted in Saudi Arabia, Ghana, and Tanzania [18,21,26], which supports the statement that female children aged 7 to 12 have higher blood pressure than males, but from the age of 12 onwards 13 years of age is lower [29] due to the protective influence of sex hormones (estradiol). Despite this statement, in the present study, 73.3% of female children and adolescents had arterial hypertension and of these, 55.3% were adolescents aged 14 to 16 years, perhaps because the sample was mostly female (62.2%) and because adolescents have a greater tendency to be overweight or obese [26], which are significant determinants of hypertension [12]. In contrast, other studies have indicated that males were the most affected [27-30,32]. Regarding age, the 14 to 16 age group had a higher proportion of hypertensive individuals (55.3%). This fact may be related to weight gain with age and changes in arterial and arteriolar stiffness [26]. The proportion of children in non-public schools with arterial hypertension was higher (57.1%) compared to those in public schools (42.9%) and may be due, on the one hand, to the greater number of participants from non-public schools. Unhealthy lifestyles (lack of fruits and vegetables in the diet, excess sugar, fried and ultra-processed foods, and little physical activity) were equally observed in all schools. This result corroborates that of other studies, which found that the highest proportion of hypertensive children and adolescents attended private schools [1,26].

There was a difference in blood pressure during measurements between the first and third visits, with an 8.4% reduction in the number of children and adolescents with hypertension. This difference may be due to fear and anxiety during the first visit, as it was the first time they had their blood pressure measured. After measurements at the three visits, 14.6% of the children and adolescents had elevated blood pressure (systolic and diastolic). In isolation, there was a predominance of mean systolic blood pressure (7.7%) over mean diastolic blood pressure (5.4%), which corroborates some studies that state that systolic hypertension is more common than diastolic hypertension in children and adolescents [21, 29]. Ambulatory blood pressure measurement (ABPM) revealed a predominance of diastolic blood pressure (2.3%) over systolic blood pressure (1.1%), and 8.0% had both. This finding is concerning, as an increase in diastolic blood pressure alone contributes to early death (before age 50) [31,33,34].

Limitations

There was some difficulty convincing parents of younger children (6–9 years old) to allow their participation in the

study, especially those in non-public schools. Some children and adolescents refused, even with parental consent. On the other hand, there were children and adolescents who wanted to participate in the study without parental consent, but for ethical reasons, their inclusion was not possible, contributing to the underestimation of the prevalence found.

5. Conclusions

The prevalence of hypertension in children and adolescents in Luanda is high. Considering the result in this study, aproximately 26 out of every 100 apparently healthy children and adolescents were found to have hypertension. This constitutes a major public health problem and requires the immediate inclusion of blood pressure measurements as a routine part of children's physical examinations after age 3, intensified education about childhood hypertension in school health programs through lifestyle changes, and the development of health policies and prevention strategies.

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Conflicts of Interest
None

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