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Association between blood pressure and waist-to-height ratio in schoolchildren aged 6 to 8 years in the Valparaíso Region, Chile

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Keywords

Hypertension • Blood pressure • Obesity • Nutritional status • Waist circumference

Summary

Background. *Hypertension is a serious obesity-related disease that affects the paediatric population. Objective: To examine the positive association between systolic and diastolic blood pressure and waist-to-height ratio in schoolchildren Methods: Cross-sectional study. Convenience sample of 300 schoolchildren aged 6 to 8 years from Valparaíso. Blood pressure, waist circumference and height were evaluated. Data were collected in non-consecutive years (2015, 2018, 2019, 2022) due to logistical constraints. Blood pressure was assessed according to the criteria of the American Academy of Pediatrics (2017). Statistical analysis: Results were expressed as mean, 95% confidence interval (95% CI) for quantitative variables and qualitative variables were expressed in absolute (n) and relative (%) frequencies. Normality was verified with the Shapiro Wilk test (p > 0.05). Associations were made between altered blood pressure and anthropometric variables (BMI, waist circumference, nutritional status) using the Proportion test and Chi Square test. Three different models were developed to determine the association between altered BP with WHR, WC and NS, adjusting for age in all models.*
Results. *A significant positive association was found between systolic blood pressure and waist-to-height ratio (p = 0.0073).*
Conclusion. *Higher WHR is associated with increased blood pressure, highlighting its potential as a screening tool for metabolic risk.*

Introduction

Over the past two decades, the prevalence of arterial hypertension (AHT) has risen significantly in both adults and children [1]. AHT is a serious disease that poses a risk for various pathologies and is a cause of premature death. It affects more than one in three adults worldwide, representing a high burden of disease, especially in low- and middle-income countries [2]. The World Health Organization (WHO) has shown that from 1990 to 2019 the worldwide prevalence of AHT has doubled [3].
It is estimated that 1.28 billion adults aged 30-79 years suffer from AHT, and about two-thirds are unaware of their condition [4]. In the Region of the Americas, it affects between 20% and 40% of the adult population and is the main risk factor for cardiovascular disease. In total, this condition causes the death of 1.6 million people, of which more than half a million are premature deaths in people under 70 years of age [5].
In Chile, the latest National Health Survey (Encuesta Nacional de Salud, ENS) conducted in the population over 15 years of age indicated that suspected AHT reached 27.6% between 2016 and 2017, representing an increase of 1.1% over the previous period (2009-2010) [6].
The prevalence of paediatric hypertension is increasing worldwide, driven by rising rates of childhood obesity [7, 8]. Globally, it is estimated that the prevalence of hypertension in children and adolescents ranges from 3.5% to 5% [9]. In Latin America, recent studies have reported rates of altered blood pressure (ABP) that vary between 0.7% and 40.5% in children and adolescents [10]. In Chile, a prevalence of 20.8% has been observed in the child population. Other studies examining AHT in the Chilean school population have found rates of 13.6% in children aged 6-14 years, and 3.4% in children whose average age was 10.6 years, associated with obesity and other parameters related to metabolic syndrome [11, 12].
In this context, one of the most relevant risk factors for AHT and metabolic syndrome is obesity, which affects 2 billion people worldwide [13]. Obesity is defined as an energy imbalance between caloric intake and expenditure, resulting in excess energy stored in adipose cells [14].
In 2022, 43% of adults aged 18 years and older were overweight and 16% were obese. In addition, more than 390 million children and adolescents aged 5-19 years were overweight, of whom 160 million were obese [15, 16]. In the case of Latin America and the Caribbean, a recent UNICEF study has reported that more than 4 million children under 5 years of age are overweight, as well as almost 50 million of the population between 5 and 19 years of age, with this rate being higher than the world average [17]. The World Obesity Atlas indicates that in the Region of the Americas (North, Central and South America) the prevalence of obesity will increase

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between 20% and 33% between 2020 and 2035 [18].

In Chile, data from the nutritional map of the National School and Scholarship Board (JUNJI) for the year 2023 showed that 49.3% of children entering the first year of elementary school in public schools are overweight and obese, and of these, 25.8% are severely obese, that is, 3 out of every 5 schoolchildren in Chile already have weight problems at an early age [19]. This situation, if maintained over time, will prematurely confront them with cardiovascular risks, high blood pressure, metabolic alterations, diabetes and metabolic syndrome in adolescence, which will possibly extend into adulthood [20].

In this sense, it is worth noting the rise in the rates of metabolic syndrome (MS) in young age and the importance of early diagnosis. MS is defined as a cluster of risk factors that include central obesity, hypertension, insulin resistance, and dyslipidaemia, that determine an increased risk for cardiovascular disease and diabetes mellitus (DM), and which incidence has increased among paediatric population [21]. Body Mass Index (BMI) measurement has been traditionally used to assess obesity and, therefore, to evaluate its impact on cardiovascular and metabolic risk factors. However, waist circumference WC measurement has gained relevance when it comes to assessment of central adiposity, which is closely linked to the risk of developing cardiovascular conditions [22].

In this context, recent studies have shown that waist-to-height ratio (WHR) is a better predictor of mortality and cardiovascular risk factors than BMI, both in adults and children [23]. WHR measures abdominal circumference adjusted for height, improving its predictive ability for cardiovascular risk. This results in an improved ability to predict cardiovascular risk factors related to body fat distribution, thus replacing the BMI measurement [24].

In adults, it has been observed that an increase in WHR above 0.5% is associated with an increased risk of AHT [25]. However, the application of these anthropometric measurements as predictors of AHT in the paediatric population is a developing area of study [26].

Prevention and early diagnosis are key strategies to prevent serious diseases such as myocardial infarction, heart failure, aneurysms, stroke, renal failure, blindness, blood vessel rupture, and cognitive impairment [27].

This background underscores the need to enhance early identification and management of risk factors at an early age to prevent future diseases that begin in childhood [28].

In this context, the aim of this study is to associate systolic and diastolic blood pressure with waist-to-height ratio in a public elementary school population in the region of Valparaíso, Chile.

Methods

Design and subjects: Cross-sectional study. Convenience sample. Please change wording to "Of 399 eligible schoolchildren from 7 educational institutions in the Valparaíso region, Chile, 300 were included after applying inclusion criteria (*e.g.* incomplete measurements or lack of consent), from 7 educational institutions in the Valparaíso region, Chile. Schoolchildren (males aged 6 to 8 years, 11 months and 29 days; females aged 6 to 7 years, 1 month and 29 days) who agreed to participate on the day of data collection and whose parents, guardians and/ or tutors signed the informed consent form were included. Those who were physically unable to participate in the measurements on the day of the evaluation were excluded. After applying inclusion and exclusion criteria, the final sample consisted of 300 schoolchildren aged 6 to 8 years, 11 months, and 29 days.

Dependent variables: Systolic blood pressure (SBP) and diastolic blood pressure (DBP), classified according to the diagnostic criteria of the AAP 2017 guidelines: normal BP, high BP, stage 1 AHT, and stage 2 AHT [29].

Independent variables: Waist circumference and height.

Data collection: Data were gathered between 2015, 2018, 2019, and 2022 in specific non-consecutive months by fifth-year students of the Nutrition and Dietetics undergraduate program of the Universidad de Playa Ancha, who had been previously trained on the standardization of measurement protocols. This process was supervised by a nutritionist from the Faculty of Health Sciences of the aforementioned institution. The evaluations and data recording were carried out in a space provided by the educational institutions, previously prepared and adapted to ensure the privacy of each participant.

BP was measured in millimetres of mercury (mm Hg); height and waist circumference were measured in centimetres (cm). Measurements were directly tabulated on the record sheet.

An OMRON brand digital pressure monitor, Model number HEM- 7114 with adapter input to OMRON brand paediatric cuff, Model number H- 003DS, was used in the 2015 sample. A BOKANG paediatric aneroid sphygmomanometer, with a BOKANG brand paediatric cuff; and a LITTMANN phonendoscope were used in the 2018, 2019 and 2022 samples. Instrument variation was minimized through standardized training and calibration. The technique considered that each participant took a 10-minute rest before the performance of the measurements, remaining seated in the room set up for the study. Subsequently, two BP measurements were taken, 30 seconds apart, on the right arm; this was done with the student seated with the legs uncrossed and the cuff at the level of the heart.

Data recording was performed by automatic BP measurement in 2015 and 2018. In 2019 and 2022 it was performed by the paediatric cuff insufflation through the sphygmomanometer and BP was recorded by means of Korotkoff sounds in phase I and phase V, as systolic and diastolic measurements, respectively.

BP classification parameters: BP classification corresponded to “normal” BP (< p90), high BP (> p90 to < p95 or 120/80 mm Hg to < p90; whichever is lower), stage 1 AHT (≥ p95 to < p95 + 12 mm Hg or 130/80 to 139/89 mm Hg, whichever is lower), and stage 2 AHT

(≥ p95 + 12 mm Hg or 140/90 mm Hg, whichever is lower). The above, using as reference the "Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents" by the AAP, 2017 [29]. The reference is included since it was used as a guideline for the anthropometric measurement of height for BP assessment and classification.

In this study, BP measurement was performed on one day without follow-up, thus identifying suspicion of high BP and suspicion of AHT.

Anthropometric measurement of height and classification parameters: Height measurement. A TANITA brand portable wall-mounted mechanical measuring rod was used in 2015; a SECA portable measuring rod, Model 213, was used in 2018, 2019, 2022. The technique employed was based on the 2014 MINSAL regulations [30], that is, the schoolchild standing barefoot on a flat, horizontal surface with their back against the instrument, feet parallel or with toes slightly apart. The heels, buttocks, shoulders and head were in contact with the posterior plane, the head comfortably upright. An imaginary horizontal line should pass through the external angle of the eye and the external auditory canal, arms hanging at the sides of the body in a natural way, the child not wearing hair accessories. The upper attachment of the rod is lowered at a right angle gently flattening the hair and making contact with the vertex of the head [31]. Height was used to calculate waist-to-height ratio (WHR).

Anthropometric weight measurement and nutritional status classification parameters according to Body Mass Index (BMI): Weight measurement. An OMRON brand body composition analyser was used in 2015, and a TANITA IRONMAN digital scale was used in 2018 and 2019. The technique used consisted of the child barefoot, with minimal clothing (no vest or sweatshirt and no pants). The scale was placed on a smooth surface with no foreign objects under it. The child was placed with the feet in the centre of the calibrated scale platform, where it was observed that between one patient and another the instrument will indicate zero. Weight was recorded in kilograms, to the nearest 100 grams [31]. With the above data, BMI calculation was performed, this corresponding to the ratio between weight (expressed in kg) and height squared (expressed in meters): BMI = weight/height^2.

Classification parameters of nutritional status according to BMI: BMI-for-age (BMI/A) was assessed and classified as undernutrition (≤ -2SD), risk of undernutrition (≤ -1SD and > -2SD), normal (> -1SD and < +1SD), overweight (≥ +1SD and < +2SD), obesity (≥ +2SD and < +3SD) and severe obesity (≥ +3SD) [32]: Anthropometric measurements. Waist circumference was measured according to 2014 MINSAL regulations [30]. A SECA Model 201 measuring tape was used every year. The child was required to remain with the least amount of clothing possible. In a standing posture, the measuring tape was placed around the waist and then positioned above the iliac crest, passing above the navel, asking the infant to take a breath and exhale, the measurement being taken post exhalation, with the abdomen relaxed. This procedure was done twice, recording the average of both measurements [30].

Classification parameters (cm) of waist circumference according to WHR: Waist circumference was assessed by calculating WHR, both measured in centimetres (waist/height). A cut-off point of 0.5 was used to differentiate low WHR index (< 0.5) and high WHR index (≥ 0.5) [33].

Statistical analysis

Results were expressed as mean, 95% confidence interval (95% CI) for quantitative variables and qualitative variables were expressed as absolute (n) and relative (%) frequencies. Normality was verified with the Shapiro Wilk test ($p > 0.05$). Associations were made between altered blood pressure and anthropometric variables (BMI, WC, nutritional status) using the Proportion test and the Chi square test. Three different models were developed to determine the association between altered BP with WHR, WC and NS, adjusting all models for age. Logistic regression models adjusted for age assumed linearity and no multicollinearity.

Data were analysed using the Statistical Package for Social Sciences (SPSS) software, version 13.0 (SPSS Inc. Chicago, IL, USA).

Ethical aspects: The study was validated by the Bioethics Committee of the Universidad de Playa Ancha (RES: 13/2015; 21/2018; 19/2019; 40/2022).

Results

General Background: The sample consisted of 300 subjects (males 50.6% and females 49.3%). P-values have been added for each variable in Table I in order to specify which differences are significant.

Suspected arterial hypertension. For systolic blood pressure (SBP), 81.7% had normal SBP, 6.3% had high BP, 8.7% had stage 1 hypertension and 3.3% had stage 2 hypertension. In the case of DBP, 75.7% had normal BP, 10.0% had high BP, 9.0% had stage 1 AHT, and 5.3% had stage 2 AHT (Tab. II).

Regarding the association between anthropometric variables (high WHR, obesity WC, nutritional status) and sex, it was observed that the waist-to-height ratio and obesity according to WC did not differ according to sex, and a significant association was found between nutritional status and sex (p=0.043) (Tab. III).

Altered BP (high BP, stage 1 or 2 AHT) was associated with anthropometric variables (WHR, obesity WC and nutritional status (normal weight, overweight and obesity)). It was observed that: i) WHR was significantly higher in children whose BP was altered (39.2%); ii) obesity according to WC is significantly higher in children with altered BP (41.2%); and iii) there is a significant association between nutritional status and altered BP in children with normal nutritional status (58.8%), overweight children (11.3%), and obese children (29.9%) (Tab. IV).

In turn, three different models were generated for the

Tab. I. Sample characterization by sex.

Variables	Males n = 152 (50.6%)	Females n = 148 (49.3%)	Total n = 300 (100%)	*p* -value
Age - yearsƗ	6.8 ± 0.6	6.7 ± 0.5	6.8 ± 0.6	0.0129
95% CI	(6.7 - 6.9)	(6.6 - 6.8)	(6.7 - 6.8)	
SBP mm Hg^2	96.7 ± 13.2	97.2 ± 13.0	97.0 ± 13.1	0.7359
95% CI	(94.6 - 98.8)	(95.1 - 99.3)	(95.5 - 98.4)	
DBP mm HgƗ	62.8 ± 9.5	65.2 ± 11.1	64.0 ± 10.4	0.0411
95% CI	(61.3 - 64.3)	(63.4 - 67.0)	(62.8 - 65.2)	
Weight kgƗ	28.9 ± 6.6	27.1 ± 5.9	28.0 ± 6.3	0.0128
95% CI	(27.8 - 30.0)	(26.1 - 28.0)	(27.3 - 28.7)	
Height cmƗ	125.4 ± 6.3	123.5 ± 6.0	124.4 ± 6.2	0.0097
95% CI	(124.3 - 126.4)	(122.5 - 124.5)	(123.7 - 125.1)	
WC cmƗ	60.7 ± 7.3	58.6 ± 7.2	59.6 ± 7.30	0.0126
95% CI	(59.5 - 61.9)	(57.4 - 59.7)	(58.8 - 60.5)	
BMIƗ kg/m^2	18.1 ± 3.0	17.3 ± 2.7	17.7 ± 2.9	0.0210
95% CI	(17.6 - 18.6)	(16.9 - 17.8)	(17.4 - 18.0)	
WHR	0.48 ± 0.05	0.47 ± 0.06	0.48 ± 0.05	0.1306
95% CI	(0.48 - 0.49)	(0.47 - 0.48)	(0.47 - 0.49)	

Results expressed as Mean ± Standard Deviation (SD) and Confidence Interval. Ɨ: T Test. *p*-value < 0.05.

Tab. II. Blood pressure classification (2017 AAP guidelines).

	Systolic Blood Pressure (SBP)	Diastolic Blood Pressure (DBP)
Normal	245 (81.7%)	227 (75.7%)
High BP	19 (6.3%)	30 (10.0%)
Stage 1 AHT	26 (8.7%)	27 (9.0%)
Stage 2 AHT	10 (3.3%)	16 (5.3%)

Results expressed in number of subjects (percentage).

Tab. III. Association between anthropometric variables and sex.

	M	F	*p*-value
High WHR*	48 (31.6%)	39 (26.4%)	0.3185Ɨ
Obesity WC	96 (36.8%)	105 (29.1%)	0.1515Ɨ
Nutritional Status Normal weight Overweight Obesity	 81 (53.3%) 32 (21.1%) 39 (25.7%)	 97 (65.5%) 29 (19.6%) 22 (14.9%)	0.043¥

*> 0.05 weight-to-height ratio. Ɨ: Proportion test. ¥: Chi square test

Tab. IV. Association between altered blood pressure and anthropometric variables.

	Normal BP	Altered BP	*p*-value
High WHR*	49 (24.1%)	38 (39.2%)	0.0073Ɨ
Obesity WC	59 (29.1%)	40 (41.2%)	0.0360Ɨ
Nutritional Status Normal weight Overweight Obesity	 121 (59.6%) 50 (24.6%) 32 (15.8%)	 57 (58.8%) 11 (11.3%) 29 (29.9%)	0.002¥

*> 0.05 weight-to-height ratio. Ɨ: Proportion test. ¥: Chi square test.

association of altered BP with WHR, WC and age-adjusted NS in all models. In Model 1 it was observed that a child has 2.2 times more chance of having high BP compared to children with normal WHR; in Model 2 it was observed that a child with high WC has 1.7 times more chance of having high BP compared to children with normal WHR. In Model 3, nutritional status was not significantly associated with altered BP (p = 0.901) (Tab. V). It was concluded that the WHR variable has more weight than the WC variable and that the NS variable does not have greater weight with respect to high BP.

Tab. V. Association between altered BP with WHR, WC and NS, adjusted for age.

Model 1			
Variables	OR	CI	*p* value
High WHR	2.2	(1.3 - 3.7)	0.005Ɨ
Females	1.3	(0.8 - 2.2)	0.315
Hosmer - Lemeshow	0.7754		
Model 2			
Variables	OR	CI	
High WC	1.7	(1.0 - 2.9)	0.040Ɨ
Females	1.3	(0.8 - 2.2)	0.325
Hosmer - Lemeshow	0.7013		
Model 3			
Variables	OR	CI	
NS Over+ob	1.0	(0.6 - 1.7)	0.901
Females	1.2	(0.7 - 2.1)	0.409
Hosmer - Lemeshow	0.8718		

A logistic regression was conducted, and reference values are: WHR normal; sex: male; normal WC; NS normal weight.

Discussion

BMI has traditionally been the primary anthropometric measurement to evaluate obesity and to associate it with metabolic and cardiovascular risks in children and adults. In an epidemiological context that includes a high prevalence of obesity from an early age, waist-to-height ratio is proposed for the early detection of central obesity and its associated risks, since it combines the measurement of WC and corrects it for height, exhibiting a greater ability to diagnose cardiovascular risk factors in obese populations as well as in those with normal BMI and in children with chronic kidney disease and hyperinsulinemia, among others [34, 35, 36].

Different studies on waist-to-height ratio, such as one conducted in Brazil in children aged 8-10 years, determined that the WC variable was better correlated with the increase in blood pressure, since an increase of 1.22 times in the probability of children to become hypertensive was observed for each centimetre of increased waist circumference [37]. Our study has also found similar evidence, since it has observed that WHR is 2.2 times higher in children with altered BP ($p < 0.005$) and 1.7 times higher in those with high central obesity compared to children with normal central obesity ($p < 0.040$). 005), and 1.7 times higher in those with high central obesity compared to children with normal WHR.

Similar results on the importance of controlling WC were found in China, concluding that within each BMI category (normal weight, overweight, and obese), children with a WC ≥ P 90 had higher blood pressure levels than those with a WC < P 90 [38]. It was also observed that 43.6% of students with high waist-to-height ratio had alterations in one or more of their blood pressures [33]. At the same time, it has been shown that compared with BMI and WC, waist-to-height ratio was the anthropometric measurement with the highest area under the curve in both sexes for hypertension. Our study also showed that 39.2% of children with altered BP had a high waist-to-height ratio ($p < 0.0073$) and 41.2% with altered BP had central adiposity ($p < 0.0360$). Other studies conducted in Mexico and in the Dominican Republic, which purpose was to detect metabolic risks in school population using the waist-to-height index, showed that this index is a better predictor to detect metabolic alterations early in school age and noted the need to study risk factors for metabolic syndrome [39-42]. Our study has shown similar results, since the models to assess the associations between altered BP with WHR, WC and age-adjusted nutritional status showed that children with high WHR had 2.2 times higher odds of altered BP compared to children whose WHR is normal, and that an individual with high WC is 1.7 times more likely to have altered BP compared to those with normal WHR.

Although age groups studied differ, similar findings were reported in a study conducted in Spain including 1,511 schoolchildren aged 6-16 years, which examined weight, height, waist circumference, adiposity and blood pressure. It was found that 3.17% of boys and 3.05% of girls had high blood pressure and the risk increased 10.56 times in boys and 7.87 times in girls with a high waist-to-height index [43]. These results were also observed in our study, noting that children with a high waist-to-height ratio are 2.2 times more likely to have altered BP than those with a normal waist-to-height ratio.

In Iran, two studies have shown the importance of waist-to-height ratio; one observed that waist-to-height ratio, unlike BMI and waist-to-hip ratio, was significantly associated with an increased risk of developing hypertension, considering that the distribution of adipose tissue is an important factor in the development of cardiovascular diseases [26]. Researchers concluded that after waist-to-height control, the correlations that remained significant were WC and systolic blood pressure, and between WC and diastolic blood pressure in individuals with type 2 diabetes [26]. The other research, in the context of the Mashhad Stroke and Heart Atherosclerotic Disorder (MASHAD) study [44], evaluated 9,704 participants aged 35-65 years. Logistic regression including data mining algorithms was applied, showing that the most important indicators for discriminating hypertensive patients from normotensive patients were body roundness index (BRI), body mass index (BMI) and visceral adiposity index (VAI), which were significantly associated with AHT in both sexes ($p < 0.0001$). BRI showed the strongest association with AHT (OR = 1.276, 95% CI = (1.224, 1.330)). For BMI we had OR = 1.063, 95% CI = (1.047, 1.080), for VAI we had OR = 1.029, 95% CI = (1.020, 1.038), *i.e.* one of the most significant anthropometric indices for discriminating hypertensive patients from normotensive patients was BRI which is an indicator of body adiposity [44].

Studies conducted in Chile in both children and adults have noted the increase in cardiometabolic diseases and the importance of gathering more evidence and measurement instruments that contribute to their early detection, in order to reduce their current and future prevalence [45, 46]. A study carried out in Chile in the adult population on the three National Health Surveys (ENS) that are applied to the population from 15 years of age compared the predictive capacity of cardiometabolic risk, AHT and diabetes between BMI, WC, and WHR and concluded that WHR has greater sensitivity as a predictor of cardiometabolic risk [47].

Studies on children and adolescents suffering from chronic kidney disease (CKD) and insulinemia, respectively, have shown that cardiovascular risk is high among children with CKD as well as in those with hyperinsulinemia, with no measurements available to assess cardiovascular risk in these populations, which emphasizes the importance of using the waist-to-height ratio as a better predictor of CVR in these patients [35, 36].

The increase in the prevalence of childhood obesity and cardiometabolic alterations associated with central adiposity require the availability of indicators for the evaluation of cardiovascular risk in both obese and normal-weight populations, in order to allow early diagnosis of metabolic syndrome and risk factors for which evidence is being generated, both for the indicator to be used and the cut-off points, which is in line with studies that have been conducted in Chile and other countries [48, 49].

Conclusion

The waist-to-height ratio abdominal obesity index is a useful predictor of hypertension and cardiovascular and metabolic risks, since it allows the detection of central adiposity in the paediatric population. BMI is less effective than WHR for early detection of metabolic disorders. Detecting BP alterations and risk factors in early stages of life may facilitate the implementation of corrective measures in order to decrease the burden of cardiovascular and metabolic diseases in the population and to decrease CVR in adulthood. The results of this study provide evidence for the use of waist-to-height ratio in the paediatric population.

Recommendation

According to the latest studies, BMI is less effective than WHR for early detection of metabolic disorders. WHR should be integrated into routine paediatric screenings to identify children at risk of hypertension. It is a predictor and an early-warning index for the possibility of developing cardiovascular diseases in childhood, such as hypertension. One of the last studies conducted in Chile regarding hypertension in schoolchildren concluded that, currently, it is necessary to update the regulations for the evaluation of hypertension in the country. The guidelines of the AAP (2017) introduced a more rigorous instrument that achieves sensitivity to identify more cases of hypertension, which may be found in the onset of the disease, thus eventually contributing to decrease the present and future disease burden in the country.
Additionally, the measurement of waist and height is easy to apply, the calculation of its index is simple and of great relevance for the early detection of central obesity as a cardiometabolic risk factor, and for the implementation of policy actions in the context of primary public health care.

Limitations

Participation in 2022 was limited by COVID-19 protocols, potentially affecting data collection. Although the measurements were obtained using different instruments, the individuals who performed the measurements were previously trained; however, all measurements were performed under the supervision of the same researcher.
Convenience sampling prevents the establishment of causality.
Researchers did not include a question on the consumption of drugs and/or medicines that may have been prescribed to some of the schoolchildren at the time the measurements were collected.

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Conflict of Interests Statement

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Authors' Contribution

MC: Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Data curation, Writing-Original draft preparation, Writing-Reviewing and Editing. KC: Conceptualization, Methodology, Validation, Data curation.

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