

Prevalence of high blood pressure in Brazilian adolescents and quality of the employed methodological procedures: systematic review

Prevalência de pressão arterial elevada em adolescentes brasileiros e qualidade dos procedimentos metodológicos empregados: revisão sistemática

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Abstract

Objective: To review the literature on studies that estimated the prevalence of high blood pressure (HBP) or systemic arterial hypertension (SAH) in Brazilian adolescents, considering the employed methodological procedures. **Methods:** Bibliographical research of prevalence studies of HBP/SAH in adolescents from 1995 to 2010. The search was conducted in the electronic databases PubMed/Medline, Lilacs, SciELO, and Isi Adolec. The descriptors “hypertension”, “BP”, “teen”, “students”, “cross-sectional”, “prevalence” and “Brazil” were used in Portuguese and English. Furthermore, a score ranging from 0 to 18 based on Recommendations for Blood Pressure Measurement in Humans and Experimental Animals and the VI Brazilian Guidelines of Hypertension was elaborated, in order to analyze the procedures used to measure BP in studies. **Results:** Twenty-one articles were identified, mostly published in the last 10 years, and 90.5% were performed in school-based and regions of the Southeast, Northeast and South. The prevalence of HBP/SAH ranged from 2.5 to 30.9%. The score of the studies ranged from 0 to 16. A significant negative correlation ($\rho = -0.504$; $p = 0.020$) was observed between the prevalence of HBP/SAH and the score of BP measurement quality. **Conclusion:** The great variability of PAE/SAH estimates appears to be influenced by methodological procedures used in the studies.

Keywords: Adolescent. Hypertension. Arterial pressure. Students. Review. Brazil.

Resumo

Objetivo: Revisar a literatura sobre estudos que estimaram a prevalência de pressão arterial elevada (PAE) ou hipertensão arterial sistêmica (HAS) em adolescentes brasileiros, considerando os procedimentos metodológicos empregados. **Métodos:** Pesquisa bibliográfica de estudos de prevalência de PAE/HAS em adolescentes de 1995 a 2010. A busca foi realizada nas bases de dados eletrônicos PubMed/Medline, Lilacs, SciELO, Isi e Adolec. Foram utilizados os descritores: “hipertensão”, “pressão arterial”, “adolescente”, “estudantes”, “estudos transversais”, “prevalência” e “Brasil”, nas línguas portuguesa e inglesa. Além disso, foi elaborado um escore, baseado nas *Recommendations for Blood Pressure Measurement in Humans and Experimental Animals* e nas VI Diretrizes Brasileiras de Hipertensão, para a análise dos procedimentos utilizados para medida da PA nos estudos variando de 0 a 18. **Resultados:** Foram identificados 21 artigos, a maioria publicada nos últimos 10 anos, sendo 90,5% realizados em base escolar e nas regiões sudeste, nordeste e sul do país. As prevalências de PAE/HAS variaram de 2,5 a 30,9%. A pontuação dos estudos variou de 0 a 16. Foi observada uma correlação negativa significativa ($\rho = -0,504$; $p = 0,020$) entre a prevalência de PAE/HAS e o escore da qualidade da medida da PA. **Conclusão:** A grande variabilidade das estimativas da PAE/HAS parece ser influenciada pelos procedimentos metodológicos utilizados nos estudos.

Palavras-chave: Adolescente. Hipertensão. Pressão arterial. Estudantes. Revisão. Brasil.

Introduction

Cardiovascular diseases are currently responsible for approximately 40% of the world mortality¹. Systemic arterial hypertension (SAH) represents the main risk factor for cardiovascular diseases, and its early diagnosis has been pointed out as an important public health strategy.

In Brazil, studies indicate prevalence of SAH ranging from 22 to 44% in the adult population². Even though most of the SAH diagnoses are established at the adult age, it is known that this disease can appear during childhood³. Therefore, measuring blood pressure (BP) has been recommended by the VI Brazilian Guidelines of Hypertension⁴, as well as by the Second Task Force on Blood Pressure Control in Children, since 1987⁵, as an important component of pediatric routine⁶, thus enabling its early diagnosis.

Throughout the past years, several studies have investigated the prevalence of SAH among children and adolescents in Brazil; however, the prevalence estimates provided by the studies present wide variation. For instance, in the study conducted by Rezende et al.⁷, the prevalence was 2.4%, while in the analysis by Sakamoto et al.⁸, the prevalence was 30.9%. These variable results concerning the estimates can be a result of different methodological procedures, especially with regard to the procedures adopted to measure BP. Therefore, it is necessary to synthesize the studies in order to better understand the data that are available in literature, which can subsidize public policies of prevention and treatment of SAH among Brazilian adolescents.

Thus, the objective of this study was to systematically review the studies that estimate the prevalence of high BP in Brazilian adolescents, according to sample characteristics and the employed methodological procedures.

Methods

A bibliographic research of descriptive epidemiological studies analyzing the prevalence

of high BP in adolescents until 2010 was conducted. The research was performed in the electronic data bases PubMed/Medline (National Library of Medicine), Lilacs (*Literatura Latino-Americana e do Caribe em Ciências da Saúde*), SciELO (Scientific Electronic Library Online), Isi Web of Knowledge and Adolec. Descriptors were selected based on consultations to MeSH (Medical Subject Headings) and DeCS (*Descritores em Ciências da Saúde*). The following descriptors were considered, in English and in Portuguese: "hypertension", "blood pressure", "teen", "students", "cross-sectional", "prevalence" and "Brazil" (in order to locate articles with national samples). Besides, the logical operators "and" and "or" were used to combine the terms. All of the search, selection and assessment processes were performed by pairs, who fully and independently analyzed all of the studies that met the inclusion criteria. The results obtained by the evaluators were compared in order to check for the concordance between pairs. In case of divergences, the article was revised again by a third member of the research team.

From the bibliographic research, 479 publications were identified (PubMed = 262; Lilacs = 83; SciELO = 13; Isi = 28 and, Adolec = 93). Only studies investigating adolescents were included (10 to 19 years old)⁹, even those which approached other age groups and that collected data in Brazil; review articles, theses, dissertations, and monographs were not included, as well as studies with specific population, such as people with asthma, obese participants or children of hypertensive patients.

After reading the titles of the articles, 92 remained for the analysis of abstracts. From this analysis, the articles that met the inclusion criteria were fully read by the two evaluators, who fully and independently analyzed all of the studies that met the inclusion criteria. The results obtained by the evaluators were compared in order to verify concordance between pairs. In the case of divergences, the article was revised by a third researcher. It was also observed if studies had proper sample size, involving random selection, besides

the mention of ethical aspects. At the end of these procedures, 19 manuscripts were identified. After reading the manuscripts, two other studies cited in the reference list that had not been identified in the research were identified^{10,11}, therefore being included afterwards, accounting for 21 articles, as presented in Figure 1.

For the analysis of articles, the following aspects were observed: year and region in which the study was carried out, age group, sample size, type of survey, criteria used to diagnose high BP and/or SAH, criteria employed to measure BP (placement, previous rest and calibration), type of used device (aneroid, mercury column or electronic), dimension of the sphygmomanometer cuff, number of measurements, the choice of the value used to determine the prevalence of high BP and/or SAH by gender and total prevalence of high BP and/or SAH.

In order to assess the adopted methodology to verify BP in children and adolescents, a score was elaborated based on the Recommendations for Blood Pressure Measurement in Humans and Experimental Animals¹² and in the VI Brazilian Guidelines of Hypertension⁴ (Chart 1), whose scores ranged from one to three points according to the level of importance of recommendations. Based on the established criteria, the maximum possible score was 18 points, when all of the items of the recommendations were fulfilled.

For statistical analysis, the software SPSS for Windows was used, version 10.0. Normality and homogeneity of data variance were analyzed, and data did not show normal distribution. Therefore, Spearman's correlation was employed to analyze the correlation between the prevalence found and the obtained scores, using a 5% significance level.

Results

Twenty-one articles published between 1998 and 2010 were identified. Table 1 demonstrates general information about the studies, the recommendations used to measure BP, the used terminology and the observed prevalence. Concerning terminology, 55.1%^{7,8,13-22} of the

articles used the descriptor SAH, 38.1%^{10-11,23-28} used the term HBP (high blood pressure) and 4.8%²⁹ referred to borderline BPE. Concerning the criteria used to classify high BP, 4.8%¹⁰ did not provide information as to the adopted criteria, 4.8%¹³ used the BP criterion 140 x 90 mmHG, 23.8%^{8,17,24,26,28} adopted the 90 percentile, and 66.7%^{7,11,14-16,18-23,25,27,29} employed the 95 percentile.

All of the articles included male and female adolescents, however, only 52% presented high BP prevalence stratified by gender^{7,8,13-15,18,20-22,25,28}. Out of these, 18.1%^{14,20} did not present significant differences of high

BP between men and women, 36.4%^{8,13,15,21} pointed out to the higher prevalence among male participants and in 45.5%^{7,18,22,25,28} the female gender had more prevalence of high BP.

The compiled studies were conducted in the Southeast (38%)^{7,13-15,19-21,29}, Northeast (28.5%)^{11,16,17,22-23,25}, South (24%)^{8,10,24,26,27} and Center-West regions (9.5%)^{18,28}. No studies were verified in the North region. The sample size of the studies ranged from 55⁸ to 3,169 individuals¹⁸. Only one analysis was regional¹⁶, and the others were restricted

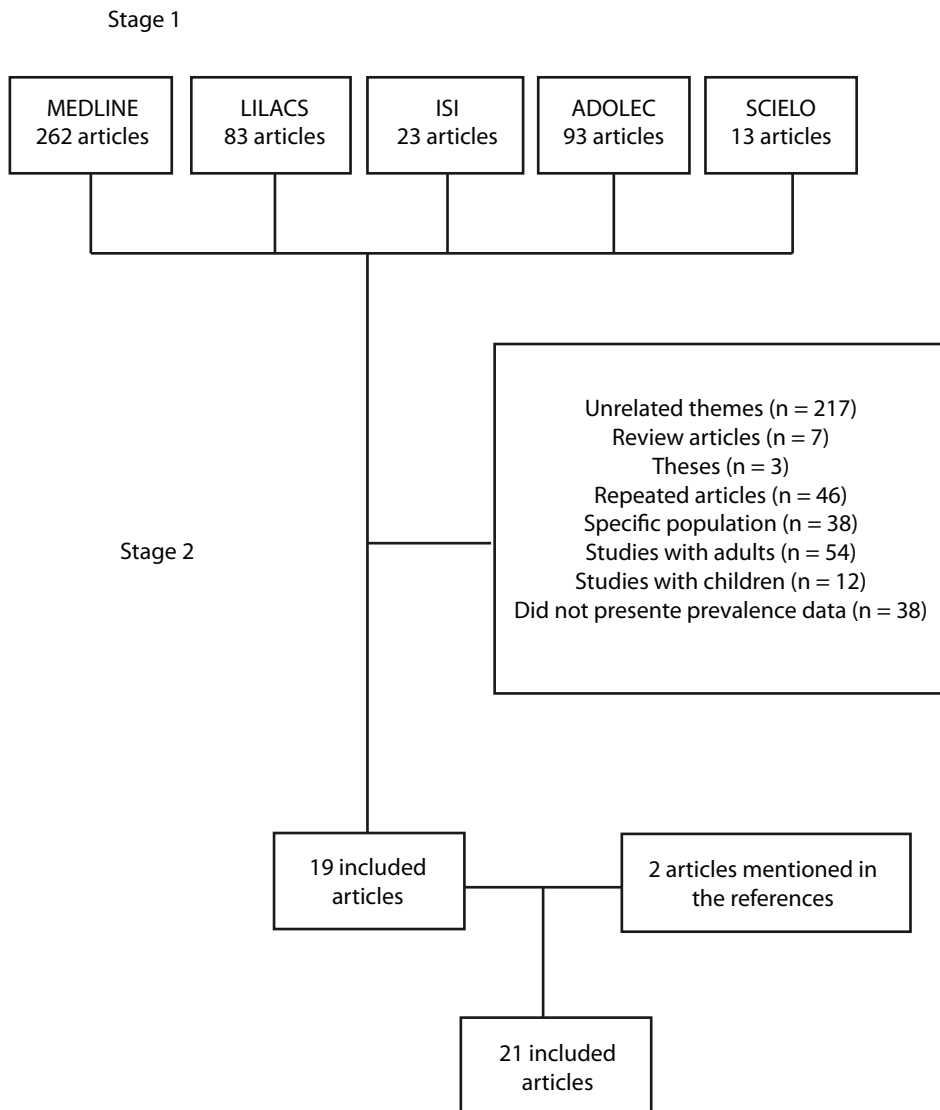


Figure 1 - Selection Flowchart of studies included in the review.

Figura 1 - Fluxograma da seleção dos estudos incluídos na revisão.

to municipal areas. Out of the 21 articles, 90% were performed by school-based surveys^{7,8,10,11,13,14,16-20,22-26,28-30} and 10% by household survey^{15,27}. In school-based surveys, the prevalence ranged from 2.5⁷ to 30.9%⁸; as to household surveys, prevalence ranging from 12.3²⁷ to 17.9%¹⁵ was described.

Table 2 presents a summary of the methods used in the study. The auscultatory method was used in 61.9%^{7,10,11,13,16,18-20,22-26} of the studies; the oscillometric method was used in 14.3%^{8,14,21}, and 23.8% did not report the used method^{15,17,27-29}. The calibration of the instrument used to measure BP was reported in 19% of the cases^{7,19,24,26}. As to the number of

evaluators to measure BP, 23.8% of the studies reported a single person^{7,8,11,22,26} and 4.8% indicated that measurement was conducted by 4 evaluators, who were subjected to audiometric evaluation.

Out of the 21 studies, 43% did not specify the use of cuffs with different sizes according to the circumference of the arm of the participant^{8,10,13-15,17,23,28,29}. Rest prior to BP measurement was described in 48% of the articles, and rest lasted from 2¹⁸ to 30 minutes¹³.

With regard to the number of BP measurements on the same day, 9.5% of the studies did not detail the collection logistics^{10,17}, one study reported one single measurement²³,

Chart 1 - Scores to evaluate the method used to measure blood pressure based on the VI Brazilian Guidelines on Hypertension (2010) and the Recommendations for Blood Pressure Measurement in Humans and Experimental Animals (2005).

Quadro 1 - Pontuação para avaliação do método utilizado na medida da pressão arterial baseada nas na VI Diretrizes Brasileiras de Hipertensão (2010) e nas Recommendations for Blood Pressure Measurement in Humans and Experimental Animals (2005).

Assessed item	Established by the guidelines	Score
Conditions prior to measurements	Not having practiced physical exercise for at least 60 minutes, not having ingested alcoholic drink, coffee, foods and drinks in the 30 minutes prior to measurement and having an empty bladder during measurement.	1
Placement of the arm during measurement	The arm should be at the point of the heart, with the hand palm turned up and elbow slightly flexed.	1
Placement of the evaluated person during measurement	Sitting position, legs not crossed, feet on the floor and back leaning on the chair.	1
Previous rest	At least 5 minutes.	2
Size of the cuffs	Obtain the approximate circumference of the mid-arm. After measurement, select the adequate cuff to the arm circumference.	2
Type of device	Mercury column, aneroid or electronic calibrated and validated phygomanometers.	1
Number of measurements	According to the Recommendations for Blood Pressure Measurement in Humans and Experimental Animals, there should be at least two measurements. The VI Brazilian Guidelines of Hypertension indicate at least three measurements.	2
Interval between measurements	At least 1 minute.	1
Used final value	Mean of the last two measurements should be used to represent BP. If there is a difference of 4 mmHg between the first and the second measurement, an additional one should be taken and, afterwards, the mean of these multiple measurements should be used.	2
Diagnostic criteria	Normotension: BP < 90 percentile, since it is lower than 120/80 mmHg; Borderline or "pre-hypertension": between 90 and 95 percentiles or BP higher than 120/80 mmHg;	3
Diagnostic criteria for SAH	High BP or hypertension: BP ≥ 95 percentile. BP measurement on different days	3
Total score		18

Table 1 - Characteristics of articles, referred recommendations, diagnostic criteria and prevalence of high blood pressure in Brazilian adolescents from 1995 to 2010.

Tabela 1 - Características dos artigos, recomendações referidas, critérios para o diagnóstico e prevalências de pressão arterial elevada em adolescentes brasileiros no período de 1995 a 2010.

Article	Place	n	Age group	Recommendations referred*	Terminology (Diagnostic criteria)	Prevalence of SAH or HBP by gender	Total prevalence
Costa and Sichieri ¹⁵ Rev Bras Epidemiol, 1998.	Rio de Janeiro (RJ)	646	12 - 19	1	SAH (P ≥ 95)	M - 60.9% F - 39.1%	SAH - 17.9%
Oliveira et al. ¹⁹ J Pediatr (Rio J), 1999.	Belo Horizonte (MG)	1005	6 - 18	2 [#]	Borderline BP (≥ 90 P < 95) SAH (P ≥ 95)	NI	SAH - 3.9%
Rezende et al. ⁷ Arq Bras Cardiol, 2003.	Barbacena (MG)	611	7 - 14	2	SAH (P ≥ 95)	3 rd measurement: M - 26.7% F - 73.3%	SAH 1 st measurement: 16.6% 2 nd measurement: 4.6% 3 rd measurement: 2.5%
Almeida et al. ¹³ J Bras Nefrol, 2003.	Sorocaba (SP)	633	15 - 25	3	SAH (≥ 140x90 mmHg)	M - 75.6% F - 24.4%	SAH - 14.2%
Moura et al. ²⁵ J Pediatr (Rio J), 2004.	Maceió (AL)	1253	7 - 17	4, 2 ^{##}	SAH (P ≥ 95)	M - 44.1% F - 55.9%	HBP - 9.4%
Silva et al. ²² Arq Bras Cardiol, 2005.	Maceió (AL)	1253	7 - 17	4, 2 ^{##}	SAH (P ≥ 95)	M - 48.5% F - 51.5%	SAH - 7.7%
Mendes et al. ¹⁷ Rev Bras Saúde Mater Infant, 2006.	Recife (PE)	421	14 - 19	2 ^{##}	SAH (P > 90)	NI	SAH - 11.4%
da Silva and Rosa ²⁷ Arch Latinoam Nutr, 2006.	Porto Alegre (RS)	706	6 - 17	5, 2 ^{##}	Borderline BP (≥ 90 P < 95) SAH (P ≥ 95)	NI	HBP - 12.3%
Ribeiro et al. ²⁹ Arq Bras Cardiol, 2006.	Belo Horizonte (MG)	1450	6 - 18	5	Borderline BP (≥ 90 P < 95) SAH (P ≥ 95)	NI	Borderline BP - 12% SAH - ?
Monego and Jardim ¹⁸ Arq Bras Cardiol, 2006.	Goiânia (GO)	3.169	7 - 14	NI	Borderline BP (≥ 90 P < 95) SAH (P ≥ 95)	M - 43.7% F - 56.3%	SAH - 5%
Sakamoto et al. ⁸ Cien Cuid Saude, 2007.	Maringá (PR)	55	15 - 17	6	SAH (SAH or DBP P > 90)	M - 94.0% F - 6.0%	SAH - 30.9%
Rosa et al. ²¹ Arq Bras Cardiol, 2007.	Niterói (RJ)	456	12 - 17	3	SAH (P ≥ 95)	M - 57.1% F - 42.9%	SAH - 4.6%
Romanzini et al. ²⁶ Cad Saúde Pública, 2008.	Londrina (PR)	644	15 - 18	6	Pre-hypertension (P ≥ 90 ou ≥ 120/80 mmHg)	NI	HBP - 18.6%
Leite et al. ²⁴ Fisioter Mov, 2009.	Curitiba (PR)	270	10 - 16	NI	SAH (SBP and/or DBP with P ≥ 90 or BP ≥ 120/80 mmHg)	NI	HBP - 10.7%
Freitas et al. ¹¹ Rev Bras Enferm, 2010.	Fortaleza (CE)	307	12 - 17	NI	Borderline BP (≥ 90 P < 95) high BP (P ≥ 95)	NI	HBP - 11.7%
Vieira et al. ²⁸ Acta Paul Enferm, 2009.	Cuiabá (MT)	329	11 - 14	7	High BP (P ≥ 90)	M - 48.7% F - 51.3%	HBP - 11.2%
Rodrigues et al. ²⁰ J Pediatr (Rio J), 2009.	Vitória (ES)	380	10 - 14	3	Borderline BP (≥ 90 P < 95) SAH (P ≥ 95)	M - 50% F - 50%	SAH - 3.4%
Cândido et al. ¹⁴ Eur J Pediatr, 2009.	Ouro Preto (MG)	780	6 - 14	7	Pre-hypertension (≥ 90 P < 95) SAH (P ≥ 95)	M - 50% F - 50%	SAH - 2.7%
Gomes and Alves ²³ Cad Saúde Pública, 2009.	Recife (PE)	1878	14 - 20	7	SAH in < 17 years old (P ≥ 95) or 18 - 20 years old (≥ 140/90 mmHg)	NI	HBP - 17.3%
Cimadon, Geremia and Pellanda ¹⁰ Arq Bras Cardiol, 2010.	Bento Gonçalves (RS)	590	9 - 18	8	NI	NI	HBP - 11.1%
Griz et al. ¹⁶ Arq Bras Endocrinol Metabol, 2010.	Região Metropolitana de Recife (PE)	1824	14 - 20	9	SAH in < 17 years old (P > 95) or 18 - 20 years old (≥ 140/90 mmHg)	NI	SAH - 16.9%

*Recommendations referred: 1: Fifth Report of The Joint National Committee; 2: Task Force (#from 1987; ##from 1996); 3: IV Diretrizes Brasileiras de Hipertensão Arterial; 4: III Consenso Brasileiro de HAS (1998); 5: American Heart Association; 6: National High Blood Pressure Education Program; 7: V Diretrizes Brasileiras de Hipertensão Arterial; 8: I Diretriz de Prevenção da Aterosclerose na Infância e na Adolescência; 9: Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure.

PA: Blood pressure; HAS: Hypertension; PAE: High blood pressure; NI: Not informed.

*Recomendações referidas: 1: Fifth Report of The Joint National Committee; 2: Task Force (#de 1987; ##de 1996); 3: IV Diretrizes Brasileiras de Hipertensão Arterial; 4: III Consenso Brasileiro de HAS (1998); 5: American Heart Association; 6: National High Blood Pressure Education Program; 7: V Diretrizes Brasileiras de Hipertensão Arterial; 8: I Diretriz de Prevenção da Aterosclerose na Infância e na Adolescência; 9: Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure.

BP: Pressão arterial; SAH: Hipertensão arterial sistêmica; HBP: Pressão arterial elevada; NI: Não Informado.

Table 2 - Methods used to diagnose high blood pressure among Brazilian adolescents from 1995 to 2010.**Tabela 2** - Métodos utilizados para o diagnóstico de pressão arterial elevada em adolescentes brasileiros no período de 1995 a 2010.

Article	Size of the cuffs	Previous rest	Placement during measurement	Type of device	N. of measurements/Interval between measurements	Used value	Score
Costa and Sichiari ¹⁵	NI	15 min.	Sitting. Without smoking, eating or drinking for at least 15 min.	NI *	2 measurements, and a third one in case the difference was higher than 5 mmHg/10 min. interval.	Mean of 2 measurements. The first measurement was ignored, in the case of 3 measurements.	10
Oliveira et al. ¹⁹	25 x 12 cm and 18 x 9 cm	10 min.	Sitting. Right arm at the height of the precordium	Calibrated mercury column	2 measurements/10 min. interval	Mean of 2 measurements	15
Rezende et al. ⁷	Different sizes	3 to 5 min.	Sitting. Right arm at the height of the precordium	Calibrated aneroid	3 measurements on 3 different days/ 2 min. interval	Lowest value	16
Almeida et al. ¹³	26 x 13 cm. When arm circumference is inferior to 25 cm or superior to 32 cm, values were corrected by the Maxwell formula.	30 min.	NI	Mercury column	3 measurements/1 min. interval. When DBP or SBP differed in 6 mmHg or more, 3 new measurements were taken	Mean of 3 measurements	10
Moura et al. ²⁵	25 x 12 cm and 18 x 9 cm	NI	NI	Mercury column	2 measurements/2 min. interval	Measurement presenting $P \geq 95$	11
Silva et al. ²²	Different sizes	NI	NI	Mercury column	2 measurements	Mean of 2 measurements	13
Mendes et al. ¹⁷	NI	NI	NI	NI	NI	NI	0
da Silva and Rosa ²⁷	Different sizes	NI	Sitting. Right arm at the heart level. Interval of at least 30 minutes. After exercise or meal.	NI*	2 measurements/1 min. interval	Mean of 2 measurements	13
Ribeiro et al. ²⁹	NI	NI	NI	NI	2 measurements	Mean of 2 measurements	7
Monego and Jardim ¹⁸	Different sizes	2 min.	Sitting	Aneroid	2 measurements/ 2 min. interval	1 st measurement ignored, 2 nd measurement used	12
Sakamoto et al. ⁸	NI	5 min.	Sitting. Right arm at the heart level.	Electronic	2 measurements	NI	6
Rosa et al. ²¹	Different sizes	NI	NI	Electronic	3 measurements on 2 different days/1 min. interval	Mean of 6 measurements	14
Romanzini et al. ²⁶	Different sizes	5 min.	Sitting	Calibrated aneroid	2 measurements/ 3 min. interval. There could be the third measurement in case there was a 4 mmHg difference between measurements.	Mean of 2 or 3 measurements	11
Leite et al. ²⁴	Different sizes	5 min.	Sitting. Right arm at the heart level.	Calibrated mercury column	3 measurements/ 2 min. interval	Mean of 2 last measurements	12
Freitas et al. ¹¹	12 x 10 cm and 23 x 17 cm	5 min.	Sitting, uncrossed legs, feet on the floor, back leaning on the chair, empty bladder. Arm at the heart level, hand palm turned up and elbow flexed. The non-use of drugs or stimulating food was observed.	Aneroid	3 measurements/1 min. interval	Mean between the 2 last measurements	16
Vieira et al. ²⁸	NI	NI	NI	NI	2 measurements/5 min. interval	NI	3
Rodrigues et al. ²⁰	Adequate size	NI	NI	Mercury column	3 measurements /2 min. interval	Mean of 3 measurements	11
Cândido et al. ¹⁴	NI	NI	Sitting. Left arm at the heart level	Electronic	3 measurements/10 min. When pressure was above the 90 percentile, it was ratified with the auscultatory method	Mean of 3 measurements	11
Gomes and Alves ²³	NI	NI	Sitting.	Auscultatory method	1 measurement	Measured value	5
Cimadon, Geremia and Pellanda ¹⁰	NI	NI	NI	Aneroid	NI	NI	1
Gríz et al. ¹⁶	Adequate size	NI	Sitting	Mercury column	2 measurements/1 to 2 min. interval	NI	10

*These articles report having used equipment brands Sunmark and WANROSS, respectively, but did not describe the type of equipment; BP: Blood pressure; SAH: Hypertension; HBP: High blood pressure; NI: Not informed.

*Estes artigos referem ter usado aparelhos das marcas SunMark e WANROSS, respectivamente, porém não descrevem o tipo de aparelho; BP: Pressão arterial; SAH: Hipertensão arterial sistêmica; HBP: Pressão arterial elevada; NI: Não informado.

and the others mentioned two or three measurements. Studies that measured BP consecutively observed that the prevalence of HBP tends to decrease with the increasing number of measurements^{7,19,21}.

Concerning the choice of the final BP value, 48% used the mean of the obtained measurements^{13-15,19-22,26,27,29}, 24% did not inform the criteria used to choose the final value^{8,10,16,17,28}, 14% ignored the first measurement, therefore using the mean between the two others^{11,24} or the second measurement, when only two were taken¹⁸, and 10% used the mean presenting percentile ≥ 95 ²⁵ in the table of BP percentile or the lowest value found in measurements⁷.

The scores of the studies ranged from 0 to 16 points. By dividing the articles in tertiles, with regard to scores, the prevalence found in the first tertile (from 0 to 6 points) ranged from 11.1¹⁰ to 30.9%⁸, while in the last tertile (12 to 18 points), prevalence ranged from 2.5⁷ and 12.3%²⁷. Figure 2 represents the relation between the aforementioned scores and the prevalence found in the articles used in this study. A significant negative correlation was observed ($r = -0.504$; $p = 0.020$) between the prevalence of HBP/SAH and the score of BP measurement quality.

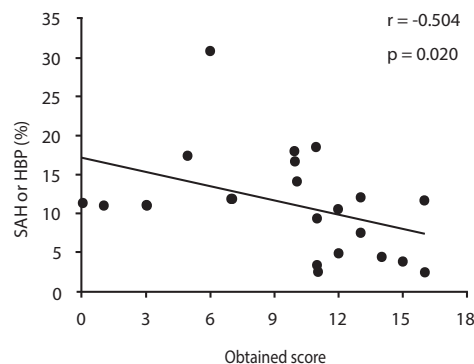
Discussion

With this review, it was possible to identify that prevalence studies of HBP in adolescents were mostly conducted in the Southeast, Northeast and South regions of the country. Only two studies were conducted in the Center-West region, and none was identified in the North region. Results showed that the prevalence of HBP ranged between regions. For instance, the highest prevalence of HBP identified in the Center-West region was of 11.7%, while in the Southeast and Northeast regions they were of approximately 17%, and in the South region, 30.9%. Likewise, there were differences concerning the lowest prevalence identified in the regions. These results suggest that the prevalence of HBP can be influenced by the region where the teenager

lives, therefore it is important that further studies try to identify the causes of such inter-regional variability.

The mean values of HBP identified in Brazil are close to those reported in international studies. In a study conducted in China, prevalence was of approximately 20%³¹. A study with adolescents in Mexico also observed prevalence of HBP in adolescents, of 20.6%³². Kollias et al.³³ studied adolescents aged 12 to 17 years old in Greece and found that 22.9% of these teenagers had HBP. However, it is worth to mention that, similarly to national studies, the comparison with international studies is also difficult due to the different employed methodological procedures.

The results in this study indicated that the age group of the samples in the studies ranged from 6 to 20 years old. Since the prevalence of HBP tends to increase with age³⁴, the number of individuals at different age groups is a factor that contributes with the different prevalence described by the studies³⁴. Out of the analyzed studies, 28.6%^{14,18,19,23,25,26} demonstrated prevalence stratified by age group, and most of them showed that the percentage distribution



SAH: Hypertension; HBP: High blood pressure.
SAH: Hipertensão arterial sistêmica; HBP: Pressão arterial elevada.

Figure 2 - Relationship between the prevalence of high blood pressure in Brazilian adolescents from 1995 to 2010 and the scores obtained in relation to the used methodological processes ($r = -0.504$; $p = 0.020$).

Figura 2 - Relação entre as prevalências de pressão arterial elevada em adolescentes brasileiros no período de 1995 a 2010 e os escores obtidos em relação aos processos metodológicos utilizados ($r = -0,504$; $p = 0,020$).

of HBP as to age group increased with age^{14,19,23,25,26}. However, in the study by Monego et al.¹⁸, which included children and adolescents (7 to 14 years old), such a relationship was not shown, once much of the HBP prevalence was concentrated in the age group of children (7 to 10 years old). A study conducted by Gomes et al.²³, who worked only with the teenage population (14 to 20 years old), showed the increasing percentile with age, and found values of 14.9% in the age group of 14 to 15 years old, to 18.8% in the age group of 18 to 20 years old. Such relationship, which is similar to the one found by Romanzini et al.²⁶, who also worked with teenagers, is possibly caused by hormone changes and alterations in the body composition observed in this stage of life.

Most studies opted for the school-based surveys. This methodology has been adopted since it provides easy access to this population. The results of the study indicated that in school-based surveys, the prevalence ranged from 2.5 to 30.9%; as to household surveys, prevalence ranged from 12.3 to 17.9%, indicating more homogeneous data in household studies. The wider variability in school-based studies can be caused by the influence of factors related to school on the students. In fact, factors that are known to have an impact on blood pressure levels, such as climate, access to food and spaces available for the practice of physical activities in the school influence all of the students. Since the studies on this subject include different schools, such influence ends up leading to variable results. On the other hand, in household surveys, the influence of school is minimized, since there are students from more schools.

With this review, it was possible to identify that the criteria used to determine the high levels of blood pressure were different between studies. In fact, while some studies used the percentile higher than 90 as a cutoff point to define HBP^{8,17,24,26,28,29}, others used the percentile for people aged more than 18 years old^{15,19}, as opposed to the recommendations of the VI Brazilian Guidelines of Hypertension, which indicates that the pressure of an individual

aged from 1 to 17 years old is considered to be normal if percentile values are under 90, and also lower than 120/80 mmHg; between the 90 and 95 percentiles, it can be considered as borderline or pre-hypertension; if it is equal to or higher than 95, it can be considered as hypertension³⁵, according to the protocol used in 66.7% of the studies in this research^{7,11,14-16,18-23,25,27,29}.

According to the VI Brazilian Guidelines of Hypertension⁴, in order to diagnose SAH several procedures must be conducted. The results in this study indicated a significantly negative correlation between the score of BP measurement quality and the prevalence of HBP or SAH. These results suggest that the prevalence of HBP or SAH observed in the studies may have been overestimated because of the non-realization of the recommended procedures to measure BP.

Among the factors that apparently have more influence on BP data, the number of measurements seems to be very important. In fact, while studies that used three measurements presented their highest prevalence as 14.2%¹³, those that used two or less measurements identified prevalence of up to 30.9%⁸. One of the studies in this review³⁶ observed prevalence of HBP of 8.7% in the first measurement and 2.3% in the third BP measurement. Another variable that has major influence on the estimates of HBP is the number of days in which the measurement was taken. Rezende et al.⁷ obtained prevalence of 16.6; 4.6; and 2;5% for BP measurements on the first, second and third days, respectively. Therefore, it is important to be careful when analyzing studies that took only one measurement on the same day, or several measurements on one day, since these two factors are directly related to the overestimation of HBP or SAH prevalence.

The results of the studies included in this review pointed out to the presence of high BP in childhood and adolescence. In practice, these results suggest that health managers and professionals should elaborate health promotion actions that can be employed at early ages.

One limitation of this study was the use of a score to classify the quality of the studies, and such a score was not previously validated. Even though the items used to create the score were established according to the protocols to measure BP recommended in literature, it is possible that, despite being logical, the weights given to each item may have presented bias.

Conclusion

Based on this review, it was observed that the great variation related to the prevalence of HBP can be at least partly attributed to the quality of the procedures used to measure BP.

Besides, regional divergences should be minimized, with stimulation to conduct studies in the Center-West and North regions. Another important observation is that the results should be stratified by age group, once the evidence demonstrates differences in the prevalence of HBP between children and adolescents. Besides, household studies should be stimulated in order to know the risk factors related to children and adolescents outside of school, thus providing indications so that possible public policies and health promotion initiatives can be elaborated for this population as a whole; therefore, it could contribute with the prevention of this cardiovascular risk factor in adult life.

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