

Determinants of high blood pressure in children: a case-control study in a rural area of the Espírito Santo State*

Determinantes da pressão arterial elevada em crianças: um estudo caso-controle em área rural do Espírito Santo

Determinación de la presión arterial alta en niños: un estudio caso-control en zona rural del Espírito Santo

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ABSTRACT

Objective: This study aims to identify and analyze the predictor factors of the occurrence of High Blood Pressure (HBP) in children aged from 7 to 10 years old from a rural municipality in *Espírito Santo* State.

Methods: The subjects were divided into two groups, as follows: cases (SBP or DBP \geq P95) and controls (BP < P90). The subjects were paired by sex and age. The sampling has been built from subject random selection, where were evaluated 395 children, 79 cases and 316 controls. **Results:** The prevalence of overweight in the cases was 8.9% and 11.1% in controls; the sedentary lifestyle was present in 88.1% of the cases and 87.9% of the controls; the average screen time was 97.7 minutes and 106.6 minutes per day in cases and controls, respectively.

Conclusion: It has been observed the need to create public policies aimed at health promotion in order to vulnerable groups can be receiving assistance since childhood.

Keywords: Child, High Blood Pressure, Hypertension.

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RESUMO

Objetivo: Identificar e analisar os fatores preditores da ocorrência da pressão arterial elevada em crianças de 7 a 10 anos de um município rural no Espírito Santo. **Métodos:** Foram constituídos dois grupos de estudo: os casos (PAS ou PAD \geq P95) e os controles (PA $<$ P90). Houve pareamento por sexo e idade. A amostra foi composta por sorteio sistemático e foram avaliadas 395 crianças, 79 casos e 316 controles. **Resultados:** A prevalência de excesso de peso nos casos foi de 8,9% e nos controles de 11,1%, o sedentarismo esteve presente em 88,1% dos casos e em 87,9% dos controles e a média do tempo de tela foi de 97,7 minutos e 106,6 minutos por dia nos casos e controles respectivamente. **Conclusão:** Observou-se a necessidade da criação de políticas públicas que visam promoção da saúde para que os grupos vulneráveis recebam assistência desde a infância.

Descritores: Criança, Pressão Alta, Hipertensão.

RESUMEN

Objetivo: Identificar y analizar los factores predictivos de la aparición de la hipertensión arterial en niños de 7 a 10 años de un municipio rural en el Espírito Santo. **Métodos:** Se construyeron dos grupos: los casos (PAS o PAD \geq 95) y controles (PA $<$ P90). Fueron emparejados por sexo y edad. La muestra se compone de la selección aleatoria y 395 niños fueron evaluados, 79 casos y 316 controles. **Resultados:** La prevalencia de sobrepeso en los casos fue de 8,9% y 11,1% en los controles, inactividad física estaba presente en el 88,1% de los casos y el 87,9% de los controles y el tiempo de pantalla medio fue 97,7 minutos y 106,6 minutos por día en los casos y controles, respectivamente. **Conclusión:** Se observó la necesidad la creación de políticas públicas para la promoción de la salud para los grupos vulnerables recibir asistencia de la infancia.

Descriptores: Niño, Alta Presión, Hipertensión.

INTRODUCTION

Circulatory diseases represent the leading cause of death worldwide.¹ A survey conducted by the Health Ministry² reveals that 24.8% of Brazilians are diagnosed as hypertensive. Arterial Hypertension (AH) significantly influences the quality of life of the population, occupying the first place in the pathologies that determine years of life lost due to premature death.³ A cohort study with schoolchildren showed that the onset of hypertension arose from factors triggered in the infantile period.

Although essential hypertension in children does not present as a risk factor for cardiovascular events in childhood, cardiovascular and hemodynamic changes are observed in these individuals from the second decade of life or even earlier.⁵

Hypertension and most chronic non-infectious diseases have as their main risk factors, overweight⁶, obesity and sedentary lifestyle. Comparing overweight individuals and individuals with normal weight, the risk of developing hypertension increases by 180%.

According to recent research⁸, the fact that the child is premature ($<$ 37 weeks) imposes greater future risks, such as organ immaturity and Low Birth Weight (LBW) damage, which in the long run may be triggering factors for High Blood Pressure (HBP).

Another factor is breastfeeding. A cohort study⁹ with 4,291 subjects found that those who were breastfed up to 8 months of age had lower BP levels than those who were not breastfed or were for less time.

According to some studies, the race also exerts influence on BP. Peripheral vascular resistance, increased sensitivity to sodium, and increased cardiovascular reactivity to stress appear to be predominant in black children compared to white children.¹⁰ Studies have shown that there is a higher prevalence of higher blood pressure levels in black children than in white children.^{9,11,12}

Inheritance is also an important risk factor.^{13,14} Children of hypertensive individuals have a higher chance of presenting HBP than children of normotensive.^{15,16}

An epidemiological survey¹¹ with 1450 students found that public school children were 3.95 times more likely to have elevated Systolic Blood Pressure (SBP) when compared to private school children. In a study carried out in *Vitória/ES*, it was concluded that the fact that the mother is illiterate or does not complete elementary education raises approximately 7.4 times the chance of the child presenting four cardiovascular risk factors, and this chance is decreasing with the increase of maternal schooling.⁶

Some surveys indicate that screen time is also linked to a HBP. A study¹⁷ conducted in Scotland with 4,512 people showed that screen time is related to high mortality and risk of cardiovascular diseases regardless of participation in physical activities.

The present case-control study is justified by the need to identify and analyze the predictors of elevated blood pressure in rural children. This may contribute to a better understanding of the factors associated with the development of arterial hypertension in children in rural areas, which has not yet been studied in Brazil.

METHODS

A case-control study was conducted with the objective of identifying the characteristics (exposures or risk factors) that occur in either greater or lesser frequency between the groups. Developed from a database of a health and nutrition project carried out in the municipality of *Santa Maria de Jetibá/ES* from 2009 to 2010.

The population was composed of children between the ages of 7 and 10 years old, from both genders, enrolled in the first cycle of elementary school in the public and private networks of the municipality. The control group sampling was randomly composed by lot, after individual pairing by sex and age. For each case 4 controls were selected.

Data collection was done through the application of two instruments: a form applied to children, which covered questions about eating habits and physical activity, and a questionnaire applied to parents, which contained

questions about parents and children, besides The direct measurement of anthropometric and hemodynamic measures of the children and the person present at the time of the interview.

In order to measure BP, the automatic device OMROM® model HEM-705CP was used, validated for the research¹⁸ and suitable size cuffs for the circumference of the children's arms according to the standards recommended by the National High Blood Pressure Education Program (NHBPEP).¹⁹ For analysis of hemodynamic measures, an average of 2 measurements of the Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) with a 5-minute interval between them were used. If a difference between the 1st and 2nd measurements of either SBP or DBP was greater than 5 mmHg, a 3rd measurement was performed, considering the average between the 2nd and 3rd measurements of the SBP and DBP. The categorization of children's blood pressure was done according to the normative values suggested by

the NHBPEP¹⁹, in other words, if either SBP or BPD above or equal to the 95 percentile was classified as hypertension, between the 90 to 95 percentile it was considered borderline arterial pressure (excluded of the study), and those values below the 90 percentile as normotensive. All children with high blood pressure levels were considered as cases. Controls, all of which had blood pressure values classified as normal.

The weight was measured in kilograms, with a precision scale of 100 grams. The height was measured in centimeters, with precision of 1 millimeter, using portable stadiometer fixed to the wall smooth and without skirting. The BMI was calculated according to the new curves proposed by the World Health Organization. The child that presented a BMI > 5 percentile and < 85 percentile for sex and age, overweight that presented a BMI ≥ 85 percentile for sex was considered eutrophic and age, and obesity who presented BMI ≥ 95 percentile for sex and age.²⁰

Table 1 - Distribution of the number of cases and controls by sex and age. *Santa Maria de Jetibá/ES – 2009/2010*

Age (years)	Sex				Total
	Male		Female		
	Cases	Controls	Cases	Controls	
7	12	48	10	40	110
8	12	48	11	44	115
9	8	32	10	40	90
10	9	36	7	28	80
Total	41	164	38	152	395

From the cases, 74.1% were exclusively breastfed for less than or equal to 6 months, 20.8% had a family history of AH, and 91.1% were considered eutrophic.

Table 2 – Comparative result of the case and control groups for the studied variables related to children, chi-square values, odds ratio and confidence interval. *Santa Maria de Jetibá/ES – 2009/2010*

Variable	Cases (79)		Controls (316)		x ²	p-value	OR	CI 95%
	n	%	n	%				
Nutritional state					0.326	0.685	1.281	0.547-3.003
Eutrophic	72	91.1	281	88.9				
Overweight and obesity	7	8.9	35	11.1				
Weight at birth					1.957	0.278	0.364	0.083-1.588
< 2,500 g	2	2.7	21	7.0				
≥ 2,500 g	73	97.3	279	93.0				
Gestational age					1.465	0.266	0.520	0.177-1.525
≥ 37 weeks	71	94.7	277	90.2				
< 37 weeks	4	5.3	30	9.8				
Kidney disease					0.001	1.000	0.987	0.320-3.038
Yes	4	5.1	16	5.1				
No	75	94.9	296	94.9				
Breastfeeding maternal exclusively					1.378	0.277	1.468	0.771-2.795
< 6 months	43	74.1	164	66.1				
≥ 6 months	15	25.9	84	33.9				
Sedentary leisure activity					0.002	1.000	1.017	0.445-2.323
≥ 4 hours	8	11.9	32	12.1				
< 4 hours	59	88.1	232	87.9				
Family history of AH					0.008	1.000	0.971	0.513-1.837
Yes	15	20.8	58	20.4				
No	57	79.2	227	79.6				
Tobacco exposure*					3.511	0.076	0.407	0.155-1.071
Yes	7	8.9	12	3.8				
No	72	91.1	303	96.2				

OR – Odds ratio

CI – Confidence Interval

*Maternal smoking.

For the statistical analysis and processing of the data, the SPSS program version 17.0 was used. Fisher's exact test was used when the number of observations of some category was less than 5. The Chances Ratio was also calculated for the categorical variables, and used a 95% confidence interval.

The research project was approved in the Ethics Committee from the Health Sciences Center at the *Universidade Federal do Espírito Santo (UFES)*, under the registration number in the *CEP/UFES 060/09*. The study in the public schools was officially authorized by the Municipal Department of Education from the municipality of *Santa Maria de Jetibá/ES*. All children participating in the study received a signed and informed consent form, which was signed so that they could participate in the study. The project was funded by the *Fundação de Amparo à Pesquisa do Espírito Santo (FAPES)* [Foundation for Research Support of Espírito Santo] (process nº 45727953/09) and the municipality of *Santa Maria de Jetibá/ES*.

RESULTS AND DISCUSSION

The total number of cases was 395, with 41 cases and 164 male controls and also 38 cases and 152 female controls.

The average physical activity time among the cases was 188.27 minutes/day, the sleep time was 9.61 hours/night and the screen time was 97.69 minutes/day. The controls had the average screen time higher than the cases, being 106.643

minutes/day, in addition to a physical activity time lower than the cases, totaling 176.55 minutes/day.

From the cases, 91.3% were white ($p = 0.05$), 77.5% studied at a school located in rural areas, 71.0% had mothers who studied 4 or less years, and 63.2% Were found in socioeconomic class C. The only variable that obtained a statistically significant difference was Race/Skin Color ($p = 0.05$).

In this study none of the analyzed variables was identified as a predictor of BP elevation. In both cases and controls, a high rate of exclusive breastfeeding was observed for a duration of less than or equal to 6 months, 74.1% and 66.1%, respectively (OR: 1.468), being higher in the cases. According to a prospective cohort study²¹, the longer the breastfeeding time, the lower the SBP and DBP values of the child, an idea that diverges from the findings of a study²² conducted in *Goiânia*, which did not find in its study a relationship between longer maternal breastfeeding and lower blood pressure levels.

Regarding the family history of AH, 20.8% of the cases presented a family history, little more than the controls, 20.4% (OR: 0.971), a finding that constitutes an important risk factor for the development of AH²³. 91.1% of the sample of cases and 88.9% of controls (OR: 1.281) were considered eutrophic, a fact that differs from the literature, since innumerable authors in several studies^{13,24-26} found association with overweight and HBP, an association that cannot be confirmed by the present study.

Table 3 – Comparative result between cases and controls for the studied variables related to physical activity, hours of sleep and screen time. *Santa Maria de Jetibá/ES – 2009/2010*

Variable	Cases (79)		Controls (316)		p-value
	Average	SD	Average	SD	
Physical activity time per day (minute)	188.27	118.552	176.55	96.952	0.099
Sleeping time per day (hour)	9.61	0.959	9.68	1.017	0.761
Screen time* per day (minute)	97.69	71.709	106.643	83.4047	0.751

SD – Standard Deviation

*Screen time: TV, computer e video game.

Table 4 – Chances Ratio and Confidence Interval between cases and controls for variables related to children race/skin color, type of school, maternal schooling and family socioeconomic classification. *Santa Maria de Jetibá/ES – 2009/2010*

Variable	Cases (79)		Controls (316)		x ²	p-value	OR	CI 95%
	n	%	n	%				
Race/skin color					0.099	0.059	2.255	0.986-5.158
White	73	91.3	259	82.2				
Non-white	7	8.8	56	17.8				
Type of school					0.052	0.327	1.356	0.760-2.421
Rural	62	77.5	226	71.7				
Urban	18	22.5	89	28.3				
Maternal schooling					0.008	0.881	-	-
≤ 4 years	49	71.0	193	70.7				
> 4 ≤ 8 years	10	14.5	45	16.5				
> 8 years	10	14.5	35	12.8				
Socioeconomic classification					0.006	0.356	-	-
A+B	1	1.3	14	4.5				
C	48	63.2	177	57.5				
D+E	27	35.5	117	38.0				

OR – Odds ratio

CI – Confidence Interval

The physical activity time was higher in the cases, but not significant ($p = 0.09$); however, 89.8% did not practice extracurricular sports, against 87.9% of controls (OR: 0.834). There is a strong association of physical activities and lower BP levels²⁴. The screen time was lower in the cases, even though it was not significant ($p = 0.751$), differing from the literature, since it has already been proven that the increase in screen time is directly proportional to the increase in BP in children.¹⁷ From those cases, 73.7% had never measured the BP, which may have overestimated BP levels for anxiety and nervousness at the time of measurement, converging with a cohort study²⁷ in the United Kingdom, which states that there is increased BP by emotional stress.

The fact that the mother had four years or less of the study, found in 71% of the cases and in 70.7% of the controls ($p = 0.881$) could not be associated with the HBP outcome, however in the literature results are already found as in a study⁶ of 1,282 children showed that maternal schooling influences the outcome of HBP in children, and the study years are inversely proportional to the increase in BP in children. The relationship between HBP and socioeconomic factors has not yet been fully clarified.²⁸

In the present study, cases (63.2%) and controls (57.5%) were more representative in the socioeconomic class C, a fact that could not be associated with an increase in BP. Nonetheless, the literature states that the prevalence growth AH is observed with the decrease of the socioeconomic level.²⁹

The fact that 77.5% of the cases studied in schools located in rural areas can be explained by the fact that the municipality is predominantly rural, having occupied, for the most part, the periphery and not the center of the city. The predominance of whites ($p = 0.05$) is easily argued by Pomerano's colonization history, which to this day leaves strong marks of their culture, such as the dialect commonly used by older residents.

The main limitation of the study was the number of individuals, only 395, a fact that may have made it difficult to see the actual risk factors and differences among the studied groups.

CONCLUSION

Even though this study has had some limitations, it has been concluded that there is a need to create public policies aimed at health promotion so that, in the near future, vulnerable groups are protected and deaths from diseases of the circulatory system are no longer so high in Brazil and in the world.

Governments play a key role in this improvement by supporting healthy choices and broadening access to health care, thereby contributing to reducing inequalities and consequent risks from these social inequities. Health promotion and prevention of risk factors in childhood, especially in vulnerable groups, should exceed the limits of health institutions. The "school" space is an environment

conducive to the discussion and dissemination of healthy practices of food, sensitization and health education, and should therefore be supported by governmental spheres, in search of real changes.

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