

Evaluation of Risk and Protection Factors Associated with High Blood Pressure in Children

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Abstract

Background: Epidemiological studies have shown an increased prevalence of high blood pressure in pediatric patients. Today we know that risk factors can be detected during childhood and may help in preventing the disease.

Objective: To evaluate risk and protection factors related to high blood pressure in childhood.

Methods: We evaluated children aged 3 to 10 years, residing in the east and southwest sanitary districts of the City of Goiânia, Goiás, and obtained the following data: birth weight, breastfeeding, family history of high blood pressure and obesity, weight, height, body mass index (BMI), and blood pressure. We applied the Mann-Whitney U-test to these variables in order to compare pressure variation.

Results: In this sample, 519 children were evaluated, and 246 (47.4%) of them were male. The BMI assessment identified 109 (21%) overweight children, of which 53 (10.3%) were obese. Predominant and/or exclusive breastfeeding for less than 6 months was found in 242 (51.2%). The mean systolic pressure was significantly higher in children with exclusive and/or predominant breastfeeding for less than 6 months ($p = 0.04$), and in children with family history of high blood pressure ($p = 0.05$), and in overweight children ($p < 0.0001$). These data were confirmed in multivariate analysis.

Conclusion: In this sample, we observed that overweight and hereditary factors may be associated with elevated blood pressure, and that breastfeeding for more than 6 months seems to offer a protective effect. (Arq Bras Cardiol 2010; 94(4):458-463)

Key words: Blood pressure; risk factors; child health (public health); Goiás, Brazil.

Introduction

High blood pressure is an important risk factor for cardiovascular disease, which currently represents a major cause of mortality and morbidity worldwide¹.

Epidemiological studies have shown an increase in its prevalence in the pediatric population². Today we know that the factors associated with high blood pressure among adults could have been detected in childhood³⁻⁵.

The early assessment of risk factors such as birth weight⁶, diet in childhood⁸, nutritional status, social circumstances⁹, and the identification of protective factors may contribute to an early intervention and prevention of cardiovascular disease in children who are more likely to develop it.

This study proposes to evaluate the risk factors associated with high blood pressure in children (low birth weight, overweight/obesity, family factors) and protective factors, such as breastfeeding duration period.

Methods

The study was conducted in the City of Goiânia, capital of the state of Goiás, which has a population of 1,244,645 inhabitants¹⁰.

This was an epidemiological observational, descriptive, cross-sectional study, conducted in 2006, in a representative sample of children of both genders, aged 3-10 years and 11 months, residing in regions that represented the east and southwest sanitary districts of Goiânia, and who were assisted by the Family Health Teams of their respective regions.

The Municipal Health Department divided the city of Goiânia in 11 sanitary districts, based on the principle of decentralization of the National Health System. For this study, we used two sanitary districts which are located in opposite geographical areas, both assisted by the Family Health Program.

Considering that there are 979 children in these regions who are assisted by the Family Health Program, at a significance level of 5% and test power of 80%, and using a margin of error of 3%, the minimum sample size was estimated to be 510 children.

A team of students from the School of Medicine of the Federal University of Goiás, previously trained and

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accompanied by Family Health Program agents, made home visits in order to invite children and their parents to participate in the project.

Children of both genders, whose ages ranged from 3 to 10 years and 11 months, were invited to participate.

In a first step, they received information on the project, and a parental or guardian-signed informed consent was obtained for each child. Subsequently, basic data were collected through interviews with the children's parents, the Child Health Card was evaluated, and secondary data were obtained based on physical examination.

We excluded from the project those children whose guardians declined to participate or did not follow all the steps of the protocol.

A registration form for each child was completed with the following information: name, address, contact telephone number, age, date of birth, date of visit, gender, and skin color (classified by phenotypic characteristics as white and non-white).

As for history, we obtained data on family history of high blood pressure and obesity (father, mother, and grandparents), gestational age at birth, term or non-term birth, birth weight, and duration of exclusive and/or predominant breastfeeding. Data for the newborns were collected with bas on the evaluation of the Child Health Card and the family history, by asking the accompanying parent objective yes-or-no questions.

Low birth weight was defined for those children who had birth weight of less than 2,500 g¹¹.

Data on predominant and/or exclusive breastfeeding were collected with base on interviews with agents, and organized according to duration - more than 6 months, or not - according to the indicators proposed by the World Health Organization (WHO)¹².

Physical evaluation of the children consisted of weight, height and blood pressure measurements.

Height was measured with an inelastic tape fixed to a wall, with the child standing straight against the wall with feet placed together, and a stadiometer graduated in millimeters adjusted on the head. Weight (kg) was obtained using a portable scale with a 50 g accuracy, Sport MEA-07400 model-Plenna. The standard chart of the National Center for Health Statistics Percentiles was used as reference¹³.

We calculated the body mass index (BMI) (kg/m²) and the BMI percentile (BMIp) for each child. Children with BMIp of less than 3 were considered malnourished, those with BMIp values between 85 and 95 were considered overweight, and those with BMIp over 95 were classified as obese, according to data from Conde and Carlos¹⁴ and Tomkins¹⁵. Children with BMIp > p 85 were considered overweight, and this includes overweight and obese children.

Blood pressure (BP) was measured by the auscultatory method, using a duly calibrated BD aneroid sphygmomanometer. The measurement was done in the right arm, with a cuff that had a bladder length of at least 80%, and a width equal to 40% of arm circumference, after 5 minutes of rest, with the child seated, the arm supported at heart level, the stethoscope located on the pulse of the brachial artery, in a controlled environment,

according to the recommendations of the Fourth Task Force¹⁶. The arithmetic mean of two measurements with an interval of 5 minutes was considered. After a period of 2 months, the children's blood pressure was re-evaluated. The average value of the measurements of the first and the second assessment was compared with the percentile table, following the technique standardized by the Fourth Task Force¹⁶. Blood pressure values above the 95th percentile were considered high.

For the development of the database and its analysis, we used the softwares Epi-Info, version 3.2.2, and SPSS 10.0 for Windows. We used Mann-Whitney U-test to compare the blood pressure variation with the variable. For the multivariate analysis, we used multiple linear regression, and the systolic and the diastolic pressures were considered as the outcome variable. We studied the following variables: positive family history of hypertension and obesity (father, mother, and grandparents), individually or collectively, overweight, duration of predominant breastfeeding, birth weight, skin color, gestational age (term or non-term), and gender. Multivariate analysis was performed for variables with $p < 0.2$. A 95% confidence interval was determined, considering significant $p < 0.05$.

The research project was approved by the Ethics Committee of the Federal University of Goiás General Hospital.

Results

We evaluated 519 children: 246 (47.4%) males, and 248 (47.9%) white. The age ranged from 3 to 10 years and 11 months ($X: 7.16 \pm 2.15$). In the distribution by age group, 248 were aged between 3 and 6 years and 11 months (47.7%), and 271 were aged between 7 to 10 years and 11 months (52.2%).

The anthropometric and clinical characteristics are described in Table 1.

A total of 94 children (27.9%) were preterm, and 30 (5.7%) had low birth weight.

The BMI assessment showed the following distribution: 53 (10.3%) were obese; 56 (10.8%) were overweight; 373 (71.9%) had normal weight for gender and sex; and 37 (7.1%) were malnourished. Therefore, a total of 109 (21%) children were overweight (BMIp > p 85).

A total of 510 children had normal blood pressure (98.3%) and 9 (1.7%) had elevated blood pressure (BPp > 95), of which 100% had SBP > 95, and 11% (1) had DBP between 90 and 95. There were no malnourished children among the

Table 1 - Clinical and anthropometric characteristics (weight at birth, age, weight, height and BMI) of the study sample

Characteristics	Variation	Mean
Birthweight (kg)	1.0 - 4.8	3.2 ± 0.5
Age (years)	3.0 - 10.6	7.16 ± 2.15
Current weight (kg)	11.0 - 72.3	24.9 ± 9.1
Current height (cm)	90.0 - 159.0	123.0 ± 14.5
BMI (kg/m ²)	8.3 - 17.3	16.5 ± 11.1

hypertensive group. However, 44.4% (4) were obese, 33.3% (3) were overweight, and 22.3% (2) were eutrophic.

Positive family history of hypertension was observed in 342 grandparents (71.8%), 38 mothers (8.15%), and 48 fathers (10.7%). Obesity was observed in 104 grandparents (21.8%), 34 fathers (7.1%), and 43 mothers (6.5%). We found no association between obesity of fathers and hypertension, and there were only a 1.9% association between obesity of grandparents and hypertension, and a 1.8% association between obesity of mothers and hypertension, both not statistically significant.

A total of 242 (51.2%) children were predominantly breastfed for periods of less than 6 months.

Univariate analysis of elevated blood pressure risk factors was performed by considering the following: low birth weight; skin color; family history of hypertension and obesity (father, mother and grandparents); overweight; obesity; 1 gestational age (term or non-term); and gender. Breastfeeding duration was considered a protective factor.

The mean systolic blood pressure was significantly lower in children with predominant breastfeeding over 6 months (Fig. 1), and higher in those with positive paternal history of hypertension (Fig. 2), with a BMI in the overweight range (Fig. 3), and with obese mother ($p = 0.008$) (Fig. 4). The variables birth weight, skin color, gender and gestational age showed no statistically significant relationship.

In the evaluation of diastolic blood pressure, values were significantly reduced in children with predominant and/or exclusive breastfeeding for more than 6 months ($p = 0.039$),

and elevated in those with overweight.

In multivariate analysis, in the model for systolic pressure, the following variables remained significant: predominantly breastfed for less than 6 months ($p = 0.042$); hypertensive father ($p = 0.053$); obese child ($p < 0.0001$); and overweight child ($p = 0.005$).

As only 1 child had an increase in diastolic pressure, the multivariate analysis was not considered for this model.

Discussion

This study focused on the risk factors associated with hypertension in children. We used two densely populated sanitary districts of the city of Goiânia as a research environment, including children who were being assisted by the Family Health Program in 2006.

The occurrence of hypertension in the study sample consisted of 9 cases (1.7%), which is in agreement with the current literature that reports a prevalence of 1%-13%, depending on the methodology employed¹⁷. Other studies in the Midwest Region of Brazil showed values ranging from 2.3% to 5%, but there the evaluated children were aged over 6 years^{18,19}.

As to newborn data, low birth weight showed a prevalence of 6%, which approaches the value of 7.5% for Goiânia, reported in the Datasus Live Birth Information System²⁰. We observed no association with elevated mean blood pressure. Despite the hypothesis that some factors present in the neonatal period are responsible for permanent changes in

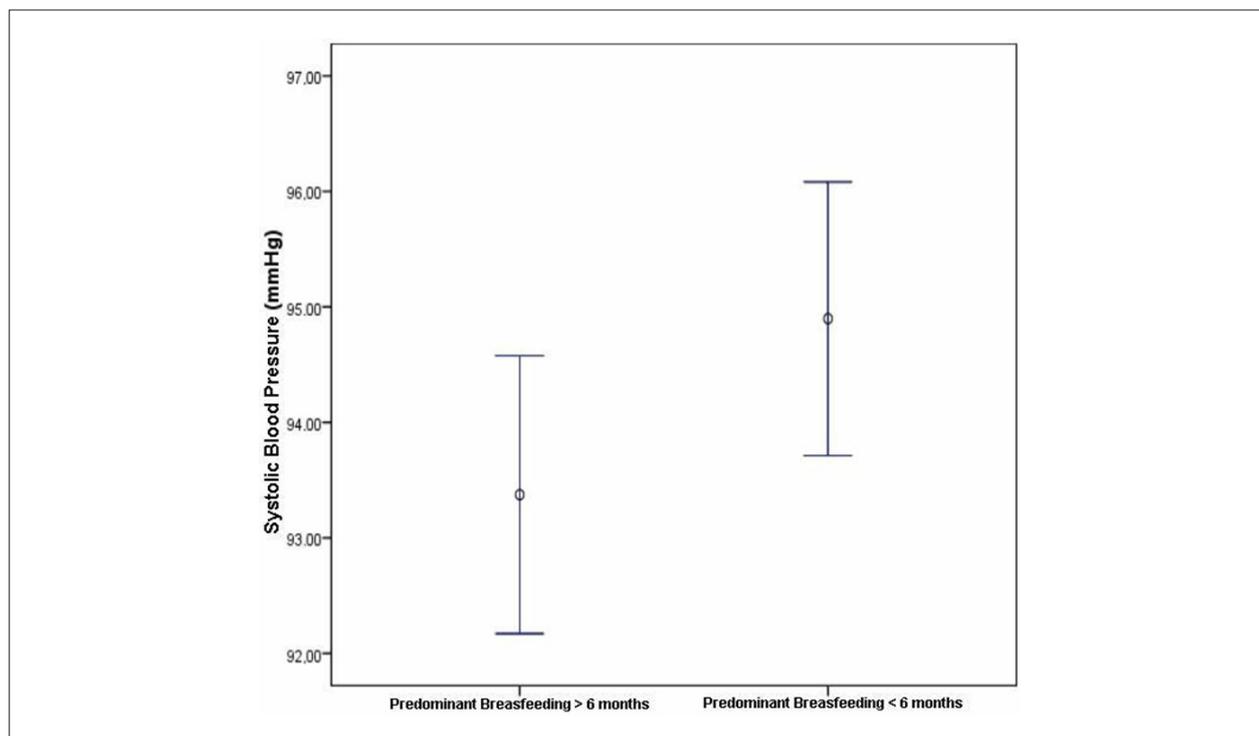


Figure 1 - Mean and standard deviation of systolic blood pressure (mmHg) in children who received exclusive/predominant breastfeeding for a longer period ($n = 230$) and for less than 6 months ($n = 242$). Mean \pm standard deviation of systolic blood pressure: 94.89 ± 9.12 with exclusive or predominant breastfeeding for less than 6 months; and 93.37 ± 9.51 for longer periods. Mann-Whitney U-test, $p = 0.042$.

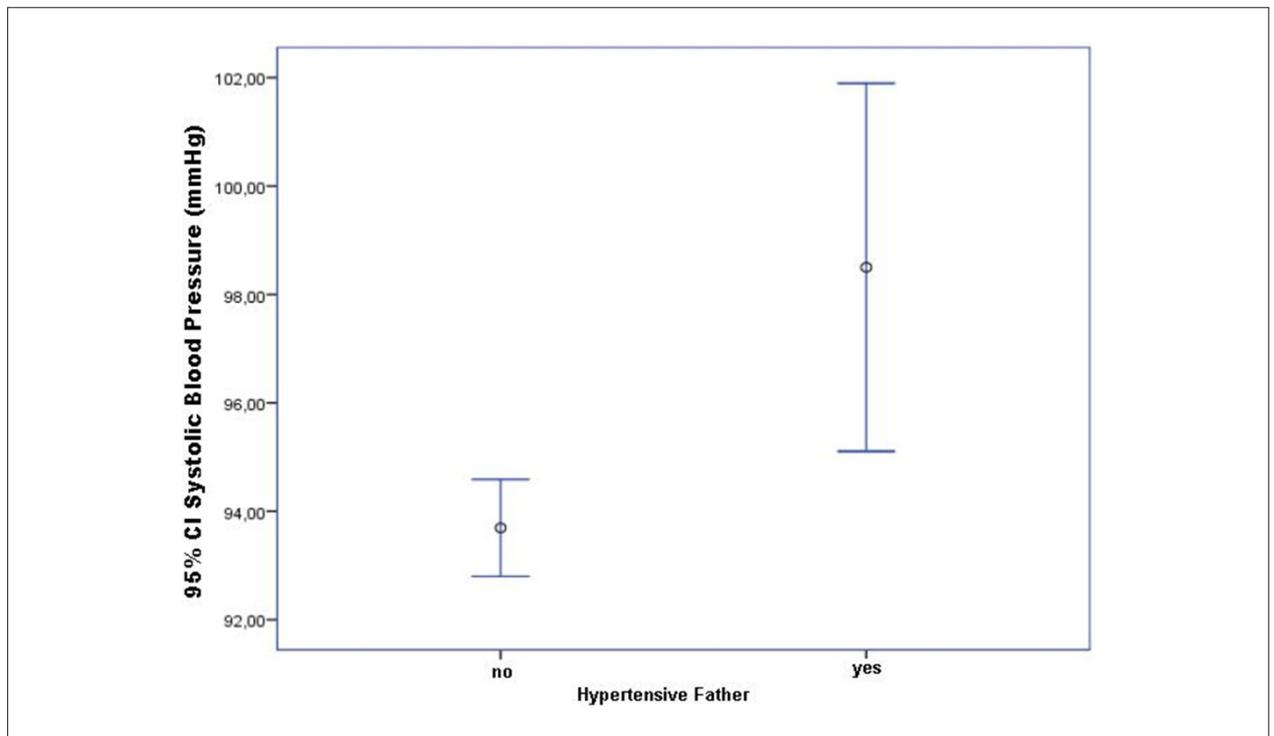


Figure 2 - Mean and standard deviation of systolic blood pressure (mmHg) in children with hypertensive fathers (n = 48) or non-hypertensive fathers (n = 400). Mean \pm standard deviation of systolic blood pressure in children of hypertensive father: yes = 98.5 ± 11.69 , no = 93.69 ± 9.11 . Mann-Whitney U-test, $p = 0.05$.

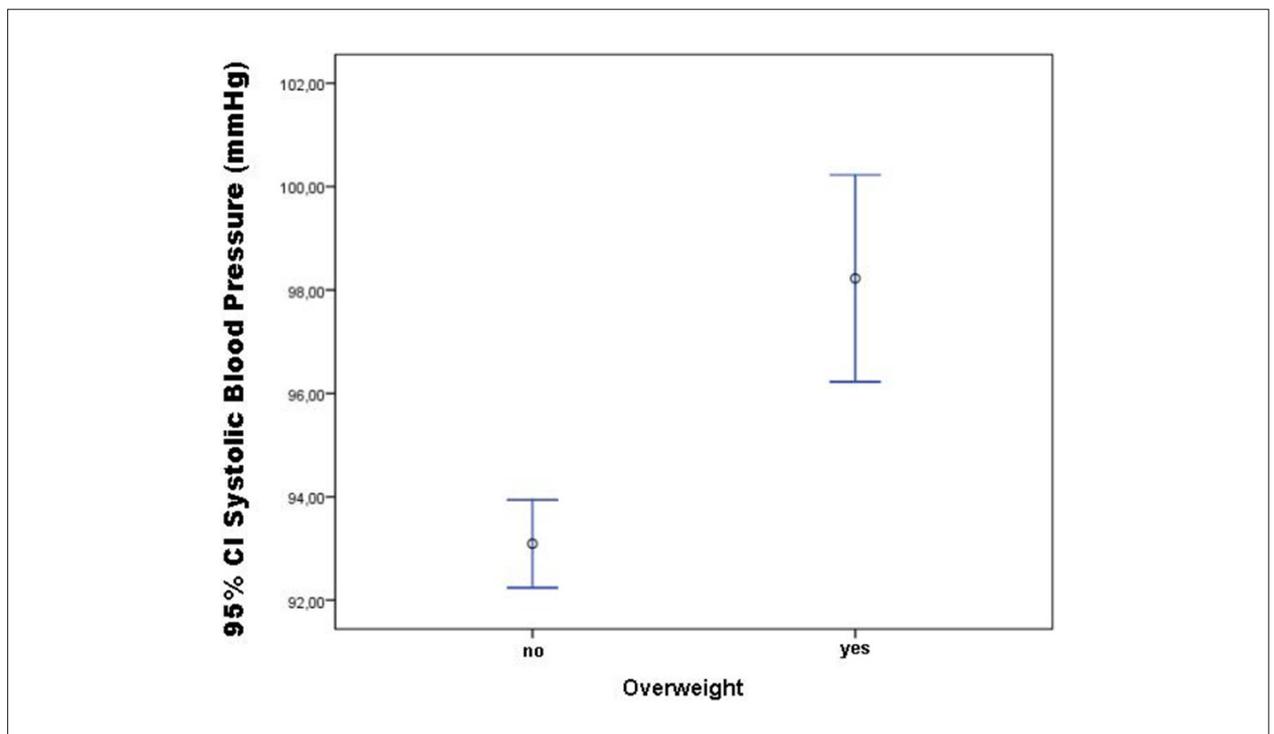


Figure 3 - Mean and standard deviation of systolic blood pressure (mmHg) in children with (n = 109) or without (n = 410) overweight and obesity. Mean \pm standard deviation of systolic blood pressure in children with overweight and obesity: yes = 98.12 ± 10.54 ; no = 93.09 ± 8.76 . Mann-Whitney U-test, $p = 0.000$.

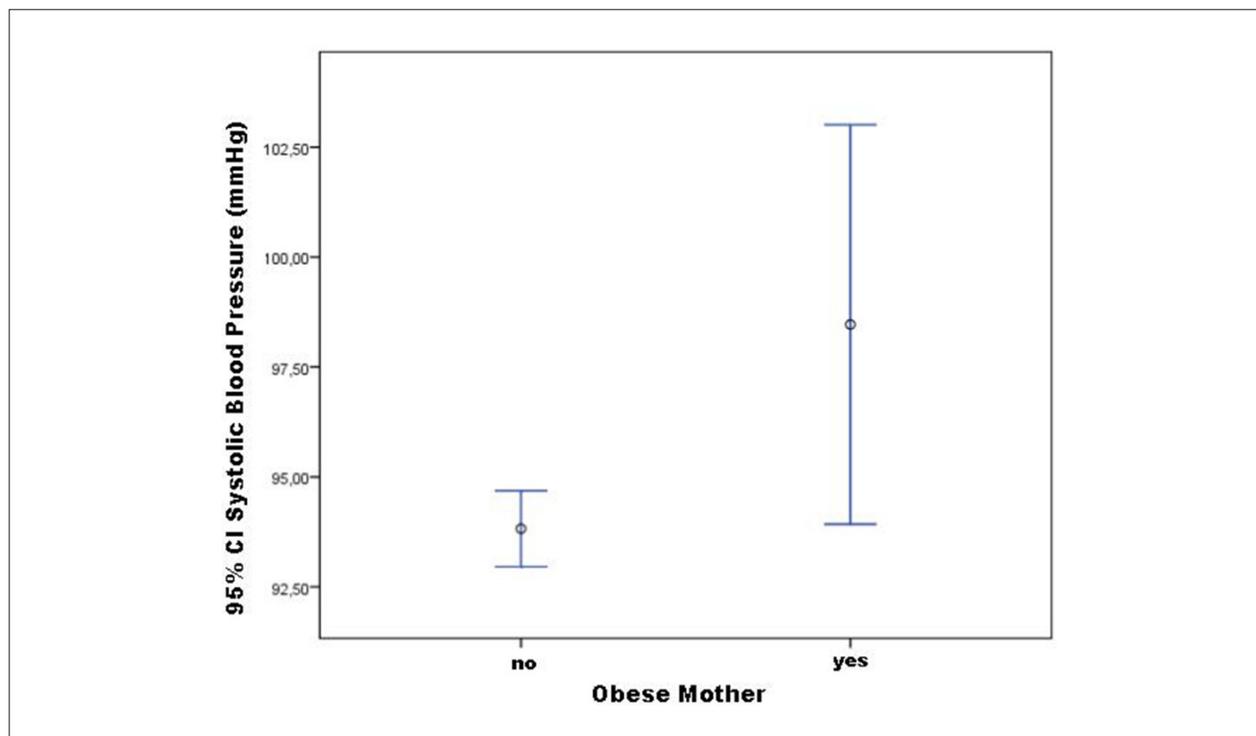


Figure 4 - Mean and standard deviation of systolic blood pressure (mmHg) in children with obese mothers (n = 43) or non-obese mothers (n = 433). Mean \pm standard deviation of systolic blood pressure in children with obese mothers: yes = 93.00 ± 1.00 , no = 98.00 ± 4.00 . Mann-Whitney U-test, p = 0.008.

the body of individuals²¹, other studies have shown that the amount and speed of weight gain are more relevant in determining blood pressure in children^{22,23}.

The BMI percentile showed a prevalence of obesity and overweight consistent with other studies. In Brazil, Abrantes et al²⁴, using data collected in a survey on living standards conducted by the Brazilian Institute of Geography and Statistics (IBGE) in 1997, found a prevalence of obesity in children in the Northeast and Southeast regions ranging from 8.2% and 11.9%. Monego & Jardim¹⁹ found a 4.9% prevalence of obese children and an 11% prevalence of overweight children (excess weight of 16%) in a population of children aged 7 to 14 years, in the city of Goiânia.

In univariate analysis, positive paternal history for hypertension, and positive maternal history for obesity, as well as obesity and overweight in children predispose to an increased risk of hypertension.

In multivariate analysis, these factors significantly influenced the values of the children's blood pressure, with the exception of positive maternal history for obesity.

In univariate analysis, children who were predominantly breastfed for more than 6 months had lower systolic and diastolic blood pressures, which seems to indicate a protective effect in longer breastfeeding.

There is inconsistent and conflicting evidence on the association between breastfeeding and blood pressure elevation in children²⁵, and several reasons for this have been listed. The lack of standardization of a time-limit defining exclusive breastfeeding, or even no consideration given to this

exclusivity and different types of food offered to the children in association with mother's milk²⁶ hinder the development of a definitive conclusion.

Other observational studies suggest that breastfeeding may be associated with a lower blood pressure in childhood²⁷⁻²⁹. Some argue that there is an exaggeration in this correlation³⁰, whereas others mention a small reduction in diastolic blood pressure³¹.

The association between obesity/overweight and hypertension in children has been reported by several studies, and all find a higher prevalence of hypertension in obese children than in eutrophic children. Sorof et al³² found that obese children have a threefold greater prevalence of hypertension than non-obese children.

Some studies show a relationship between obesity-related cardiovascular damages and the consequent increase in blood pressure; and systolic hypertension is the first sign of this change^{32,33}.

According to the Bogalusa Study³⁴, 77% of obese children remain obese into adulthood, which emphasizes the need to develop strategies focusing on the nutritional status of children, related both to the prevention of obesity itself and of high blood pressure in adulthood.

In short, despite the limitations of this study, the sample showed an association of risk between overweight and hereditary factors, as well as a protective effect of longer breastfeeding on blood pressure elevation in children aged between 3 and 10 years and 11 months.

We believe that, for the prevention of hypertension and other comorbidities in adulthood, there is a need for

public health policies with a focus on actions to promote breastfeeding and combat excess weight in childhood.

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Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any post-graduation program.