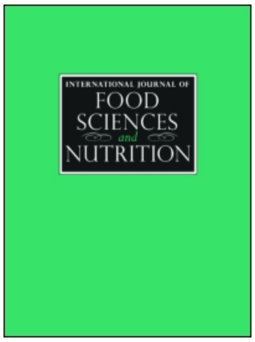

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RESEARCH ARTICLE

Dietary calcium intake is inversely associated with blood pressure in Brazilian children

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ABSTRACT

This study aimed to evaluate the dietary calcium intake and its association with blood pressure in childhood. It is a cross-sectional study with a sample of 347 Brazilian children aged 8 and 9 years. We evaluated calcium intake through three dietary records. Blood pressure was measured following the recommendations of the Brazilian Society of Cardiology. The intake of calcium was below recommendations for almost all children (96.3%). There was statistically significant difference in the means of systolic ($p = .041$) and diastolic ($p = .047$) blood pressure in the tertiles of calcium intake. After adjustment of regression model, each tertile of calcium intake showed that the systolic and diastolic blood pressure was reduced in 1.53 (95% confidence interval: −2.84 to −0.21) and 1.83 mmHg (95% confidence interval: −3.49 to −0.19), respectively. Our results showed an inverse association between dietary calcium intake and blood pressure in childhood.

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Calcium; dietary intake; children; blood pressure

Introduction

High blood pressure is the main cardiovascular risk factor, since it potentiates the occurrence of several cardiovascular diseases, in way that it has been emphasized that an early diagnosis is an important strategy in public health (Christofaro et al. 2011).

Historically, hypertension in children is considered rare and with a secondary origin. However, changes in the behaviors related to health, including the epidemic of children obesity, indicated that the rates of hypertension are increasing (Feber & Ahmed 2010; Falkner 2010).

The management and control of blood pressure requires the adoption of a healthy lifestyle, which includes a balanced diet. It has been reported that intake of certain nutrients such as sodium and saturated fat can result in undesired responses in blood pressure and cardiovascular system (Millen et al. 2001). In contrast, some studies have suggested a protective effect of calcium intake on hypertension (Allender et al. 1996; Van Mierlo et al. 2006).

Despite being a nutrient with known importance to bone health, estimates reported in surveys with children and adolescents have shown a calcium intake below the recommended level (Iuliano-Burns et al. 1999; Salamoun et al. 2005). Moreover, with regard to its potential effect on blood pressure, some findings are still controversial, and studies involving children are scarce in the literature (Allender et al. 1996; Van Mierlo et al. 2006). Thus, the aim of this study was to evaluate the dietary calcium intake and its association with blood pressure in Brazilian children.

Materials and methods

Study design and population

This is a cross-sectional study performed with children aged 8 and 9 years living in Viçosa. It is a Brazilian city in the state of Minas Gerais, located in the region of the Forest Zone, with a population of 72,220 inhabitants and a human development index of 0.775 (IBGE 2016). The study is part of a wider research about nutritional and health profile of children aged 8 and 9 years living in Viçosa. This age group was chosen to avoid possible physiological variations that exist in different ages.

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Sampling

The sample calculation was performed with the use of Epi Info software (version 7.0; Atlanta, GA), considering the total number of students aged 8 and 9 years in 2012 ($N = 1259$), an estimated prevalence of 50%, a standard error of 5% with confidence interval of 95%, sample error of 20%, estimated loss of 20%, and 10% for the multivariate analysis. The estimated prevalence, used in the sample calculation, considered the heterogeneity of the various outcomes measured in the wider search, picking up the value of 50%, which maximizes the sample size. This calculation resulted in a sample of 381 children, from which 80% were from public schools and 20% from private schools, with respect to the proportionality between the education systems.

The children were selected randomly through a drawing of lots in the software Microsoft Excel 2007. The subjects selected were approached at school and oriented to give an invitation letter to their parents or guardians, which explains the objectives of study, and the Informed Consent Form to be signed by them.

To be included in the study, the child should be aged between 8 and 9 years, 11 months and 29 days on the date of evaluation and written consent signed by parents or guardians authorizing their participation in the study. Any health alteration or the use of any kind of medication that could interfere with the blood pressure, nutritional status, and biochemical parameters of the children were considered as exclusion criteria.

Demographic and socioeconomic characteristics

After receiving consent from the parents or guardians, they answered a questionnaire about socioeconomic and demographic information, including age, sex, skin color, residency area, type of school, maternal age, and maternal education. For the economic classification of the families, the criteria established by the Brazilian Association of Research Companies (ABEP 2013) were used.

Blood pressure

To measure the blood pressure, a digital electronic equipment on the arm, which has automatic air inflation and deflation, having the size of the arm cuff appropriate to the patient, and following the recommendations of the Brazilian Society of Cardiology (SBC 2007) was used. The child was at rest, sitting for at least five minutes before the measurement. The measurement was performed three times, once on each arm, with a repetition on the arm that presented the highest value, and this last measure was registered on the form. Furthermore, the child was questioned about the desire to urinate, previous practice of physical activity and the elapsed time since the last meal, considering their influence in blood pressure (Araújo et al. 2008).

Blood pressure was evaluated considering sex, age, and height percentile, according to the classification of Brazilian Society of Cardiology (SBC 2007), and children with blood pressure equal or superior to 95 percentile were classified as hypertensive.

Calcium intake and other nutrients

Data of dietary calcium intake and other nutrients were collected through three dietary records in nonconsecutive days, including one day of weekend. Records were completed by children themselves under supervision of a parent or guardian, after receiving orientations about how to fill them. The data registered were reviewed by a nutritionist with the assistance of a photographic album to verify the sizes of the portions consumed in home measurements.

The chemical composition of the foods was analyzed using the software Diet Pro 5i (Viçosa, Brazil). We prioritized the Brazilian tables of food composition, considering that the content of micronutrients in many foods depend of their concentration in the soil (Amarante et al. 2011).

Apart from calcium intake, we estimated the consumption of carbohydrates, fiber, protein, saturated fat, monounsaturated fat, polyunsaturated fats, vitamins (vitamin C, thiamine, riboflavin, niacin, and vitamin B_6) and others minerals (sodium, iron, potassium, magnesium, phosphorus, and zinc). The adequacy of dietary intake was evaluated by the recommendations of Institute of Medicine (Otten et al. 2006; Ross et al. 2011) and by the I Guideline of Prevention of Atherosclerosis in Childhood and Adolescence (SBC 2005). For sodium, despite the Adequate Intake (AI) being available, the analysis of intake of this nutrient was performed based on the Tolerable Upper Intake Level (UL), since intake of Brazilian population in general is greater than recommendation (Sarno et al. 2009).

Anthropometric measures

The weight and height were measured for the calculation of Body Mass Index (BMI), according the recommendations of Jelliffe (1968). Body weight was measured using an electronic scale, with capacity of 150 kg and sensibility of 50 g. Height was measured in vertical anthropometer, with an extension of 2 m, divided into centimeters, and subdivided into millimeters. The measurement of height was performed in duplicate, and the final value was determined using the mean of the two measures. Nutritional status was evaluated using BMI-for-age according to the cutoff points in score-*z* proposed by World Health Organization (WHO 2007).

Waist circumference was measured with flexible and inelastic measuring tape with an extension of 2 m, divided into centimeters and subdivided into millimeters. The measurement was realized during normal expiration, in midpoint between the iliac crest and the last rib. Subjects were classified according to the cutoff points proposed by McCarthy et al. (2001).

Sedentary behavior

A questionnaire about the lifestyle, developed in preliminary research with the same study population, was applied to parents or guardians to estimate the screen time (time spent by the child sitting for long periods front of the television, video-game or computer) in hours per day. Children with screen time bigger than two hours per day were classified as sedentary behavior (Andaki 2010).

Biochemical analyses

After fasting for 12 hours, the blood was collected for biochemical analyses. Serum measures of total cholesterol, low-density lipoprotein (LDL) and high-density lipoprotein (HDL), triglycerides, and fasting glucose were performed. The cutoff point suggested by Brazilian Society of Diabetes (SBD) was used as a parameter for interpretation of fasting glucose; and the cutoff points recommended by Brazilian Society of Cardiology (SBC 2005) were used for total cholesterol, LDL, HDL, and triglycerides.

Ethical aspects

This research was approved by Ethics Committee in Research with Human Beings of Universidade Federal de Viçosa (Protocol no.: 045/202, on 23 May 2012) and was performed in accordance with the ethical standards established in the 1964 Declaration of Helsinki and its later amendments.

Statistical analyses

Statistical analyses were conducted with Stata version 9.1 software (College Station, TX). Continuous variables were evaluated in regards to normality of distribution using the Shapiro–Wilk test, histogram, skewness and kurtosis. Categorical variables were expressed in absolute and relative values, and quantitative variables were expressed in measures of central tendency and dispersion. Means and medians of nutrients intake and their tertiles were estimated from the dietary data corrected by intra-individual variability (Fisberg et al. 2005) and adjusted for energetic intake according to the residual method (Willett & Stampfer 1998).

Initially, we conducted bivariate analyses to compare differences in the means of systolic and diastolic blood pressure in each tertile of calcium intake and in the categories of the other variables. We used the Student *t*-test for dichotomous variables, and analysis of variance (ANOVA) for variables with three or more categories, considering a p-value $\leq .05$ as statistically significanct. Covariates with p-value less than .20 in bivariate analysis were included in multivariate linear regression analysis to obtain the effective estimates of the calcium intake on systolic and diastolic blood pressure adjusted for possible confounding factors.

Results

Among the children recruited for study, we lost 34 of them (8.9%) due to non-delivery of dietary records and non-measurement of blood pressure. However, the number of losses was low and within the number predicted in the sample calculation. Furthermore, these subjects did not differ significantly from the sample studied regarding the characteristics demographic, socioeconomic, anthropometric, biochemical and lifestyle (data not shown).

A sample of 347 children was evaluated, the majority being females from urban area and the economic class C (Table 1). It was observed that 32% had overweight or obesity, more than half of them were diagnosed with high total cholesterol, and 34.2% had sedentary behavior (Table 2).

The prevalence of hypertension was 3.8%. In turn, the prevalence of hypertension in obeses and non-obeses was 5.4% and 3.0%, respectively. Mean systolic and diastolic blood pressure was 99.30 mmHg (standard deviation: 11.12) and 60.50 mmHg (standard deviation: 12.75), respectively.

Table 1. Mean and standard deviation (SD) of systolic and diastolic blood pressure according to demographic, maternal and socioeconomic characteristics in children from Viçosa, Minas Gerais, Brazil, in 2012.

		Systolic blood pressure (mmHg)		Diastolic blood pressure (mmHg)	
Variables	*N* (%)	Mean (SD)	*p* Value	Mean (SD)	*p* Value
Sex			0.039*		.195
Male	142 (40.9)	98.3 (10.3)		59.8 (11.9)	
Female	205 (59.1)	100.8 (12.1)		61.6 (13.9)	
Age			0.492		.109
8 years	172 (49.6)	99.7 (12.9)		61.6 (14.9)	
9 years	175 (50.4)	98.9 (8.9)		59.4 (10.1)	
Skin color			0.474		.409
Black	91 (26.2)	99.7 (11.9)		60.4 (13.9)	
No black	256 (73.8)	98.9 (9.1)		59.9 (12.7)	
Residence area			0.018*		.012*
Urban area	316 (91.1)	99.7 (11.2)		61.0 (12.9)	
Rural area	31 (8.9)	94.8 (8.7)		55.0 (9.5)	
Type of school			0.785		.343
Public	270 (77.8)	99.2 (10.7)		60.2 (13.1)	
Private	77 (22.2)	99.6 (12.5)		61.7 (11.5)	
Maternal age			0.063		.016*
<30 years	54 (15.7)	96.0 (7.6)		55.9 (8.3)	
30 to 45 years	270 (78.7)	99.9 (11.7)		59.5 (7.8)	
>45 years	19 (5.6)	98.6 (9.9)		61.4 (13.6)	
Maternal education			0.752		.474
<8 years of schooling	119 (32.4)	98.6 (10.9)		59.8 (10.8)	
8 to 11 years of schooling	69 (20.4)	99.3 (11.2)		60.3 (14.3)	
≥12 years of schooling	160 (47.2)	100.0 (11.2)		62.4 (11.9)	
Economic class			0.161		.163
A	10 (5.5)	103.8 (14.3)		64.4 (14.1)	
B	95 (27.4)	97.8 (10.6)		59.7 (11.1)	
C	172 (49.5)	99.7 (11.2)		59.7 (11.9)	
D/E	61 (17.6)	99.3 (10.3)		62.9 (16.3)	

*$p < .05$.

A median of calcium intake of 458.43 mg/day was verified, and a high percentage intake of this nutrient was recommended (96.3%). In addition, high percentage of inadequacy for fiber and potassium, as well as, frequency of sodium intake above the UL were observed in ~16% (Table 3).

Higher means of systolic and diastolic blood pressure were observed in the children living in urban area, with excess of weight, waist circumference increased, and in the higher tertile of height (Tables 1 and 2). Furthermore, higher mean of systolic blood pressure in girls, as well ashigher means of diastolic blood pressure among children whose mothers were older than 45 years (Table 1) and those in the higher tertile of protein intake (Table 3) was verified. In contrast, children with highest niacin intake had lower mean of diastolic blood pressure. There was no statistically significant difference in the means of blood pressure in the tertiles of sodium consumption (Table 3).

There was a statistically significant difference in the means of systolic and diastolic blood pressure in the tertiles of calcium intake, and an inverse relationship between dietary calcium intake and blood pressure was observed (Figure 1).

The variables, such as sex, age, maternal age, economic class, triglycerides, sedentary behavior, dietary intake of lipid, riboflavin and vitamin B6, were also included as covariates in the multivariate linear regression analysis (p-value $< .20$).

After the adjustment of regression model, a significant inverse association between calcium intake and blood pressure was observed, in which for each tertile of calcium intake, the systolic and diastolic blood pressure was reduced by 1.53 and 1.83 mmHg, respectively (Table 4).

Discussion

In the present study, we observed high percentage of inadequacy in the calcium intake. Previous studies examining the intake dietary of children and adolescents also reported high frequency of suboptimal calcium intake, when compared to daily recommendations for this age group (Iuliano-Burns et al. 1999; Salamoun et al. 2005).

Population researches have attributed the low calcium intake to the limited consumption of milk and dairy, low ingestion of fruits and vegetables, concomitant with an elevated intake of soft drinks with low

Table 2. Mean and standard deviation (SD) of systolic and diastolic blood pressure according to anthropometric, biochemical and lifestyle characteristics in children from Viçosa, Minas Gerais, Brazil, in 2012.

		Systolic blood pressure (mmHg)		Diastolic blood pressure (mmHg)	
Variables	*N* (%)	Mean (SD)	*p* Value	Mean (SD)	*p* Value
BMI-for-age			<.001***		.001**
Undernutrition	15 (4.3)	93.3 (9.9)		54.4 (4.4)	
Eutrophy	221 (63.7)	97.3 (10.5)		59.1 (13.3)	
Overweight	70 (20.2)	101.5 (8.9)		62.9 (7.5)	
Obesity	41 (11.8)	108.5 (12.8)		65.9 (16.4)	
Waist circumference			<.001***		.001**
Normal	200 (57.6)	96.6 (10.4)		58.5 (13.4)	
Increased	147 (42.4)	102.9 (10.9)		63.2 (11.3)	
Height			<.001***		.037*
<mean[a]	173 (49.9)	96.7 (11.1)		59.1 (12.3)	
≥mean[b]	174 (50.1)	101.9 (10.5)		61.9 (13.1)	
Fasting glycemia			.740		.626
Normal	328 (95.1)	99.3 (11.2)		60.3 (12.6)	
High	17 (4.9)	98.4 (10.3)		61.9 (15.1)	
Total cholesterol			.862		.495
Normal	65 (18.8)	98.6 (10.4)		59.2 (17.4)	
Limitrophe	87 (25.3)	99.3 (9.9)		59.8 (11.9)	
High	193 (55.9)	99.5 (11.9)		61.1 (11.1)	
LDL			.959		.929
Normal	133 (38.5)	99.1 (9.9)		60.1 (15.0)	
Limitrophe	139 (40.3)	99.3 (12.4)		60.6 (11.5)	
High	73 (21.2)	99.6 (10.9)		60.6 (10.5)	
HDL			.382		.947
Desirable	263 (76.2)	98.9 (11.3)		60.4 (12.7)	
Low	82 (23.8)	100.2 (10.7)		60.5 (12.9)	
Triglycerides			.097		.6406
Normal	288 (83.5)	98.8 (10.8)		60.4 (12.5)	
Limitrophe	35 (10.1)	101.2 (12.2)		59.3 (15.0)	
High	22 (6.4)	103.4 (12.9)		62.6 (12.5)	
Sedentary behavior			.160		.255
Yes	118 (34.2)	100.4 (11.9)		61.6 (12.6)	
No	227 (65.8)	98.6 (10.6)		59.9 (12.9)	

BMI: Body Mass Index; [a] < 115.9 cm; [b] ≥ 115.9 cm.
$^*p < .05$; $^{**}p < .01$; $^{***}p < .001$.

calcium content, in the past years (NIH 2000; IBGE 2004). Thus, it is necessary to optimize calcium intake in this population through changes in dietary behavior, increased intake of food sources of this nutrient, consumption of fortified food, or, in the latter case, supplementation (Pereira et al. 2009).

The prevalence of hypertension in this study was 3.8%. According to national and international studies, the prevalence of this outcome in children varies greatly from 1% to 13%, and it depends on methodological aspects, such as cutoff points adopted, age group, number of visits, number of measurements per visit, and follow-up time (Salgado & Carvalhaes 2003). Besides, when blood pressure is measured multiple times, as in the protocol used in our study, the prevalence tends to drop due to regression to the mean, since the child gets accustomed to the procedure and gets more relaxed (Kay et al. 2001).

The results of our study confirmed the hypothesis of an inverse association between calcium intake and blood pressure in the children evaluated. Other authors also investigated the relationship between calcium intake and blood pressure in individuals in the pediatric age group, but, a significant effect has been observed only for the systolic blood pressure (Gillman et al. 1992, 1995).

Gillman et al. (1992) performed a study with 89 children aged 3–6 years, and the results showed that for each increment of 2.5 mmol of dietary calcium per 4200 kJ per day, systolic blood pressure was 2.27 mmHg lower. However, no such association was found for diastolic blood pressure. Subsequently,

Table 3. Mean and standard deviation (SD) of systolic and diastolic blood pressure according to tertiles of dietary macro and micronutrients intake in children from Viçosa, Minas Gerais, Brazil, in 2012.

		Mean (SD) of systolic blood pressure (mmHg)				Mean (SD) of diastolic blood pressure (mmHg)			
Variables	Inadequacy (%)	1st tertile	2nd tertile	3rd tertile	*p* Value	1st tertile	2nd tertile	3rd tertile	*p* Value
Carbohydrate	38.6	98.7 (12.6)	99.2 (10.8)	99.9 (9.9)	.693	59.7 (13.3)	59.7 (9.4)	62.1 (14.9)	.247
Protein	17.8	98.9 (12.6)	97.9 (9.0)	101.1 (11.3)	.098	58.7 (13.5)	59.6 (10.4)	63.3 (13.7)	.016*
Lipid	61.6	98.2 (10.4)	99.3 (10.3)	100.5 (12.5)	.300	60.0 (14.5)	58.9 (10.8)	62.6 (12.5)	.070
MUF	0.29	98.4 (10.4)	99.3 (11.6)	100.3 (11.4)	.431	60.3 (14.8)	60.2 (11.3)	60.9 (11.9)	.873
PUF	0.58	98.2 (10.3)	99.4 (11.9)	100.3 (11.1)	.374	58.9 (13.4)	60.7 (10.5)	61.9 (14.0)	.217
SF	69.1	99.9 (12.3)	99.1 (10.5)	98.9 (10.5)	.781	59.9 (11.0)	60.9 (10.1)	60.6 (16.3)	.848
Fiber	89.3	99.5 (13.1)	99.2 (9.5)	99.2 (10.6)	.968	61.6 (14.6)	59.3 (12.1)	60.6 (11.3)	.399
Sodium	15.8	98.8 (10.7)	99.8 (11.5)	99.3 (11.2)	.798	59.9 (11.1)	61.2 (11.8)	60.4 (15.1)	.715
Iron	12.3	100.5 (10.3)	98.8 (11.5)	98.6 (11.5)	.373	60.8 (9.4)	60.7 (15.2)	60.1 (13.1)	.908
Potassium	97.9	98.5 (10.4)	100.4 (12.6)	98.9 (10.3)	.402	59.2 (12.1)	62.1 (12.3)	60.2 (13.7)	.213
Magnesium	45.5	99.8 (12.3)	99.3 (10.9)	98.8 (10.1)	.814	60.1 (13.4)	60.8 (11.2)	60.6 (13.7)	.908
Phosphorus	43.8	99.4 (10.4)	99.9 (11.4)	98.6 (11.6)	.659	61.2 (14.6)	60.1 (11.7)	60.2 (11.8)	.778
Zinc	48.4	99.3 (11.4)	98.2 (9.9)	100.4 (11.9)	.352	59.7 (11.2)	60.5 (14.6)	61.3 (12.2)	.652
Vitamin C	40.6	98.8 (11.2)	99.9 (10.5)	99.2 (11.7)	.758	59.1 (12.2)	61.3 (11.0)	61.1 (14.7)	.351
Thiamine	2.8	99.6 (12.2)	100.0 (10.8)	98.6 (10.2)	.613	58.9 (14.6)	61.2 (10.7)	61.4 (12.6)	.269
Riboflavin	21.0	98.9 (10.6)	99.3 (12.6)	99.7 (10.3)	.866	62.2 (14.2)	60.1 (11.9)	59.1 (11.9)	.150
Niacin	8.3	97.6 (12.0)	99.9 (10.3)	100.5 (10.8)	.105	62.3 (13.7)	61.7 (9.0)	57.6 (14.3)	.008**
Vitamin B_6	17.5	98.6 (11.9)	99.5 (10.4)	99.9 (10.9)	.652	58.9 (14.5)	59.9 (10.5)	62.7 (12.8)	.070

MUF: Monounsaturated fat; PUF: Polyunsaturated fat; SF: Saturated fat.
$^*p < .05$; $^{**}p < .01$.

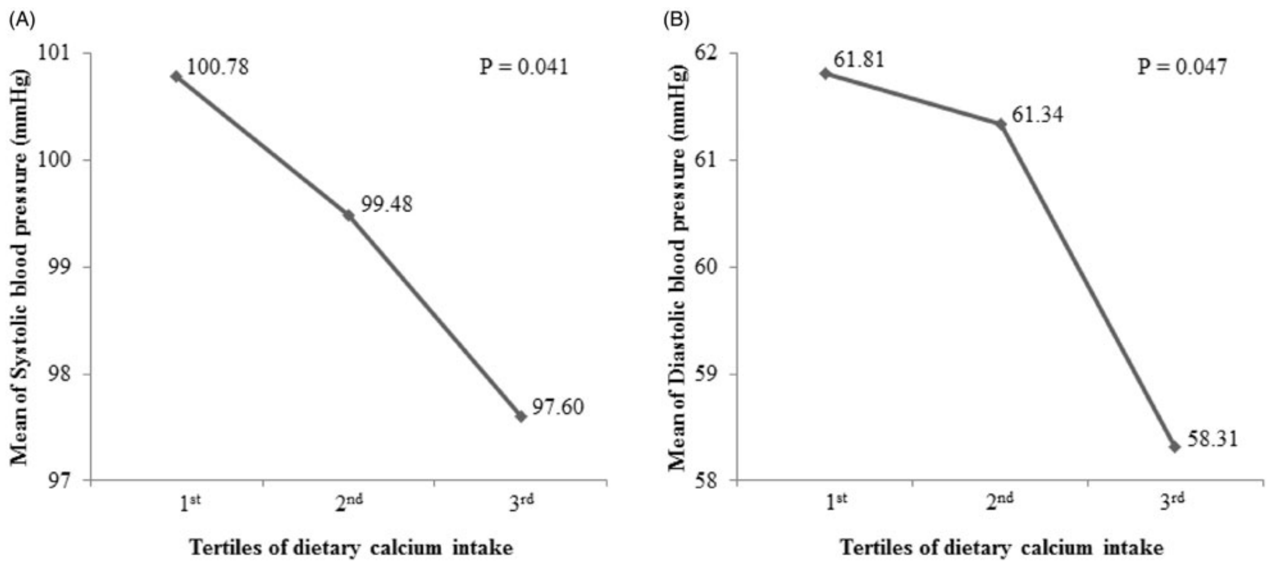

Figure 1. Mean of systolic (A) and diastolic (B) blood pressure according to tertiles of dietary calcium intake in children from Viçosa, Minas Gerais, Brazil, in 2012.

Table 4. Linear regression coefficients (β) crude and adjusted of the association between tertiles of dietary calcium intake and blood pressure in children from Viçosa, Minas Gerais, Brazil, in 2012.

Variáveis	β (Crude)	95%CI	β (Adjusted)	95%CI	*p* Value
Systolic blood pressure (mmHg)	−1.59	−3.03 to −0.16	−1.53[a]	−2.84 to −0.21	.023*
Diastolic blood pressure (mmHg)	−1.75	−3.16 to −0.14	−1.83[b]	−3.49 to −0.19	.029*

[a]Adjusted for sex, residence area, maternal age, economic class, height, BMI by age, waist circumference, sedentary behavior, triglycerides, dietary intake of protein and dietary intake of niacin.
[b]Adjusted for age, residence area, maternal age, economic class, height, BMI by age, waist circumference, dietary intake of protein, dietary intake of lipid, dietary intake of riboflavin, dietary intake of niacin and dietary intake of vitamin B_6.
*$p < .05$.

Gillman et al. (1995) conducted a placebo-controlled, double-masked randomized clinical trial to evaluate the effect of calcium supplementation on blood pressure in 101 children aged 9–13 years. After 12 weeks, systolic blood pressure increased by 1.0 mmHg in the intervention group and 2.8 mmHg in the placebo group, while there was less effect on diastolic blood pressure. Lower effect in diastolic blood pressure in these studies may have been due to low blood pressure, since their samples were children of very young age, and/or due to measurement error, considering the diastolic blood pressure is more difficult to measure.

Mechanisms have been proposed to explain the effect of dietary calcium on blood pressure. The protective effect of calcium on blood pressure may be partly explained by the influence of calcitriol in intracellular calcium concentration (Torres & Sanjuliani 2012). Low calcium intake increases the concentration of 1,25-dihydroxyvitamin D, which increases vascular smooth muscle intracellular calcium, thereby increasing peripheral vascular resistance and blood pressure. Dietary calcium reduces blood pressure in large part via suppression of 1,25-dihydroxyvitamin D, thereby normalizing intracellular calcium (Zemel 2001).

These evidences provide support for recommending an improvement in calcium intake, which may be important in blood pressure control in childhood, and prevention of development of hypertension later in life.

We point some limitations of this study. Considering that is a cross-sectional study, the associations cannot be interpreted as a cause–effect relationship. Moreover, despite that effect estimates were adjusted for several confounding factors, we cannot rule out the possibility of residual confounding. Also, it is important consider that the dietary intake evaluated through dietary records has the limitation of not capturing seasonal variations in the food consumption.

On the other hand, it is important to highlight that this study is one of the few that evaluated the relationship between calcium intake and blood pressure in children. Dietary intake was evaluated through dietary records of three nonconsecutive days (including weekend) to avoid bias of memory, and to represent more accurately the food consumption of the children. Moreover, the intra-individual variability of dietary intake was corrected, as well as, the effect of energetic intake was controlled in statistical analyses.

Conclusions

Our study supports the hypothesis of an inverse association between dietary calcium intake and blood pressure in Brazilian children. Dietary practices and nutritional education are needed to raise calcium intake in pediatric population, since dietary sources of calcium have low cost and are important for child health. More studies are necessary, mainly of longitudinal design, to better comprehend the involved mechanisms, and the relation between calcium intake and blood pressure in children from developing countries.

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Disclosure statement

The authors declare that there is no conflict of interest.

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