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Family dyslipidemia and associated factors with changes in lipid profile in children

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Abstract *This article aimed to assess the prevalence of dyslipidemia and associated factors in children aged from 4 to 7 years old. It is a cross-sectional study conducted with 402 children aged from 4 to 7 years old, accompanied by a Lactation Support Program in the first six months of life. We measured total cholesterol, triglycerides and high-density lipoprotein (HDL) and low-density lipoprotein (LDL). We selected the variables that could be associated with the lipid profile, such as the family history of dyslipidemia, nutritional status and food consumption of children. We performed Poisson regression analysis with robust variance. The level of significance adopted was p<0.05. We observed increased LDL values in 46.8% (188), total cholesterol in 37.6% (151), triglycerides in 10.4% (42) and below-desirable HDL in 33.8% (136) of the children. There was a statistically significant association between the family history of dyslipidemia with total cholesterol, LDL and triglycerides (p<0.05 and p < 0.001, respectively); Early weaning with LDL (p < 0.05); Sedentarism with LDL and triglycerides (p < 0.05 and p < 0.001, respectively); as well as HDL with candy consumption (p < 0.05). There was a significant prevalence of changes in the lipid profile of the children. Nutrition education activities and programs aimed at this group are needed.*
Key words *Dyslipidemias, Children, Child's nutrition*

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Introduction

Changes in lifestyle throughout time have led to the rise of the epidemiological and nutritional transition[1]. This phenomenon is characterized by the reduction of malnutrition and the increase of overweight and obesity in all age groups, being also related to the appearance of non-communicable chronic diseases (NCD), with emphasis on cardiovascular diseases, which have dyslipidemias as the main risk factor for their development[2,3].

Dyslipidemias are defined as lipoprotein metabolism disorders, such as increased total cholesterol, low-density lipoprotein (LDL) and triglycerides, and decreased high-density lipoprotein (HDL), being developed according to the exposure to genetic and/or environmental factors[4,5].

These changes in the lipid profile contribute to the development of coronary artery disease (CAD), atherosclerosis and systemic arterial hypertension (SAH), being also secondary to obesity, which may arise during childhood and potentialize during life, according to the combination of other factors, such as lifestyle, eating habits and family history[6].

Atherosclerosis as a consequence of dyslipidemias occurs through the formation of atherogenic lipid plaques, which are deposited in the arterial wall and may cause obstruction of blood flow[7]. These lipid plaques may appear on the capillary surface of the aorta from 3 years old and in the coronaries during adolescence[8].

Studies have shown that children may present relevant changes in the lipid profile[7-9]. Thus, it is important to assess the lipid profile of this population in order to prevent the precocity of atherosclerotic processes and other related cardiometabolic alterations[10]. Therefore, this present study aimed to assess the prevalence of dyslipidemia and associated factors in children from 4 to 7 years old.

Methods

It is a cross-sectional study that assessed the lipid profile and related factors in children aged between 4 and 7 years, accompanied by the Lactation Support Program (PROLAC) in the first six months of life.

PROLAC is an Extension Program of the Federal University of Viçosa (UFV) in partnership with the São Sebastião Hospital and the Human Milk Bank in the city of Viçosa, whose main activities are the conduction of guidelines and follow-up of mothers in the postpartum period aiming to encourage and promote breastfeeding, besides providing monthly monitoring of the mother-child binomial during the first year of the baby's life.

We obtained information about the location of the children monitored between August 2003 (beginning of the Program) and August 2010 in PROLAC records, which was considered the limit for them to be aged between 4 and 7 years old at the time of the study.

As a criterion of non-inclusion in the study, we considered the use of medications or health changes presented by the child that interfered in his feeding and biochemical tests. After at least 3 attempts of household contact with those responsible for the children, the final sample consisted of 402 children.

Based on the means and standard deviations of LDL cholesterol in the group of children with and without history of familial dyslipidemia (106.42 ± 25.27mg/dL, 97.49 ± 23.31mg/dL, respectively), the sample presented power equal to 87.41% for a significance level of 5%. We used OpenEpi online software for analysis.

The explanatory variables of the study were nutritional status, eating habits, lifestyle, family history of dyslipidemia, exclusive breastfeeding time (at least four months), socio-demographic and birth condition.

We performed the biochemical analyzes of the lipid profile in the morning, at Laboratory of Clinical Analysis of the Health Division - UFV, after a 12-hour fasting by venipuncture with disposable syringes. We obtained dosages of total cholesterol, HDL, LDL and triglycerides. We measured total cholesterol, HDL and triglycerides by the enzymatic colorimetric method, with automation by the Cobas Mira Plus equipment (Roche Corp.). We calculated LDL concentrations using the Friedwald formula.[9] The lipid profile was classified according to the I Guidelines for the Prevention of Atherosclerosis in Childhood and Adolescence, published by the Brazilian Society of Cardiology[11].

We measured the weight and height of the children during assessment at Health Division - UFV, respectively, in a digital electronic scale with a maximum capacity of 150 kg and sensitivity of 50g, and in a vertical stadiometer fixed to the wall with a length of 2 meters divided in centimeters and subdivided in millimeters, being the techniques according to those recommend-

ed by Jelliffe[12]. We assessed the nutritional status by height/age (H/A) and body mass index/age (BMI/A), according to sex and age. according to anthropometric references of the World Health Organization (WHO)[13,14]. We measured the waist circumference using a flexible, inelastic tape measure, with 2 meters in length, divided in centimeters at the umbilical scar level. From this measure and height, we obtained the waist-to-height ratio (WHtR) of the children, determined by the quotient of the waist measurement (cm), by the measure of height (cm)[15].

We applied a food frequency questionnaire (FFQ) constructed by the researchers of this study, containing information regarding the frequency of consumption of some food such as candy, stuffed biscuit, chocolate powder, soft drinks, fruit and vegetables.

We obtained variables such as breastfeeding time (exclusive for four months) and birth weight from the PROLAC care records. Other variables such as: sex and age of the child, maternal education, family income, maternal work, marital status, family history of dyslipidemia, time in front of television (TV), time in sedentary activities and physical activity were obtained through the application of semi-structured questionnaires to those responsible for the children.

We conducted the data's statistical analyzes in the Social Package Statistical Science (SPSS) for Windows version 17.0 and STATA version 13.0 programs. We performed the characterization of the sample through the frequency distribution and the normality of the variables assessed by the Kolmogorov-Smirnov test. In the bivariate analysis, we estimated the prevalence ratio and confidence interval by the Poisson regression, with the variables that presented a value of $p < 0.20$ considered for inclusion in the multiple model with robust variance. The statistical significance considered was $\alpha \leq 0.05$.

The study was approved by the Human Research Ethics Committee of the Federal University of Viçosa. The children were only included in the study by signing the Informed Consent Term (ICT), by the parents or guardians. All volunteers were invited for individualized nutritional care with guidelines and delivery of the results found in the assessments performed. The children who presented changes in the lipid profile had nutritional follow-up and were conducted for consultation with a pediatrician, when the mother and/or guardian were interested.

Results

We assessed a total of 402 children, 55% (221) males and 45% (181) females. We observed that 79.2% (317) of mothers lived with a partner, 70.8% (283) worked and 65.3% (260) had more than eight years of study. We can highlight that 25.1% (88) of the children had a family history of dyslipidemia and 84.3% (339) did not practice regular physical activity. We found low birth weight in 30.8% (123) and breastfeeding for less than four months in 39.2% (155). Regarding the nutritional status, we found overweight in 25.4% (102) of the children and inadequate height in 2% (8).

Figure 1 demonstrates the characterization of the children's lipid profile. There was a border/incresead value of total cholesterol in 37.6% (141), LDL in 46.8% (158), triglycerides in 10.4% (42) and HDL below desirable in 33.8% (136) children.

Tables 1 and 2 present the results of prevalence ratio between the independent variables and the lipid profile of the children. We observed that there was a statistically significant association between the family history of dyslipidemia with total cholesterol ($p < 0.05$), LDL ($p < 0.05$) and triglycerides ($p < 0.001$). Children with a family history of dyslipidemia demonstrated a 1.3 times higher prevalence of total cholesterol and LDL altered compared to children who had no family history of dyslipidemia, while the result for triglycerides was 2.2 times higher.

Regarding the time of breastfeeding, we observed that there was a statistically significant association between exclusive breastfeeding of less than four months and LDL ($p < 0.05$). Children who were breastfed for less than four months had 1.26 times higher prevalence of altered LDL compared to those who were breastfed for longer than four months. Moreover, children who did not practice physical activity had 1.24 times higher prevalence of altered LDL ($p < 0.05$) and 2.22 times higher triglycerides ($p < 0.001$), compared to children who practiced.

There was no statistically significant association between the consumption variables and children's lipid profile (Table 3).

Table 4 presents the final regression analysis model. Total cholesterol, LDL and triglycerides, after adjustment for other variables, maintained a statistically significant association with the presence of familial dyslipidemia ($p < 0.05$). LDL cholesterol also maintained the association with breastfeeding time ($p < 0.01$). In the regression

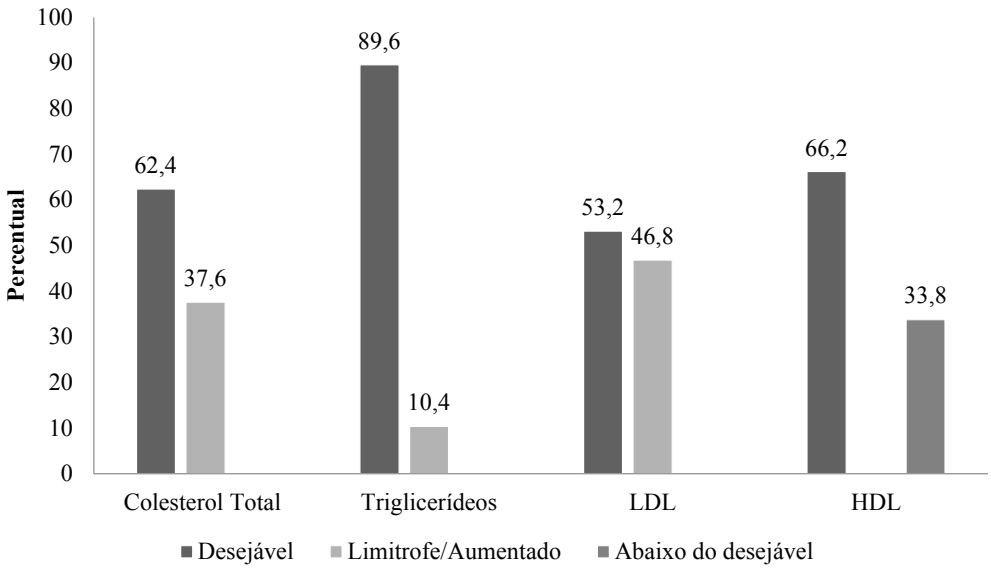

Figure 1. Classification of children's lipid profile from 4 to 7 years old.
LDL = Low density lipoprotein; HDL = High density lipoprotein.

Numerical data figure 1: Classification of children's lipid profile from 4 to 7 years old.

	Total cholesterol	Triglycerides	LDL	HDL
Desirable	62,4	89,6	53,2	66,2
Borderline/Increased	37,6	10,4	46,8	
Below desirable				33,8

analysis there was a statistically significant association between HDL and candy consumption ($p < 0.05$). Children who consumed candy more than seven times a week had 1.54 times higher prevalence of HDL change compared to children who consumed less frequently.

Discussion

The present study demonstrated a high prevalence of changes in children's lipid profile, with a main highlight for LDL cholesterol (46.8%). Changing the values of this lipoprotein can induce atherogenic processes even at an early age, and HDL when at low levels increases the risk for cardiovascular diseases (CVD), since it prevents the oxidation and aggregation of LDL in the arteries[3].

In a study conducted in Belém-PA with children and adolescents aged from 6 to 19 years old, changes in total cholesterol were observed in 33.4%, LDL in 18.6%, HDL in 29.5% and triglycerides in 15.8%, values close to those found in the present study, except for LDL[16]. A study conducted in Campina Grande-PB, aged from 2 to 9 years old, showed changes in LDL in 47.1% of the children , and total cholesterol in 37.8%, a result similar to this study[17].

Different results were found in a study conducted in Campinas-SP with children and adolescents aged from 2 to 19 years olf, with total cholesterol changed in 44%, LDL in 36%, HDL in 44% and triglycerides in 56% in the age group from 2 to 9 years old[18]. Franca & Alves[8] in a study with children and adolescents of Pernambuco found changes in total cholesterol in 29.7%, LDL in 25.4% and triglycerides in 18.9%, in children younger than 10 years old, being total cholesterol the result that is closest to this study.

The history of familial dyslipidemia was the main factor associated with dyslipidemia in children. There are few studies in the literature that relate the children's lipid profile with a family

Table 1. Socio-demographic characteristics, birth, lifestyle, family history and nutritional status of children from 4 to 7 years old.

Variables	N	%
Age		
4-5 years	177	44
6-7 years	225	56
Sex		
Male	221	55
Female	181	45
Household per capita income [a]		
< 255 reais	135	34
255-475,16 reais	130	32.7
≥ 475,16 reais	132	33.3
Mother's marital status		
With partner	317	79.2
Withouy partner	83	20.8
Maternal work [b]		
Work	283	70.8
Don't work	117	29.2
Escolaridade Materna [c]		
> 8 years	260	65.3
≤ 8 years	138	34.7
Family Dyslipidemia [d]		
Yes	88	25.1
No	262	74.9
Birth weight [e]		
≥ 3000g	277	69.2
< 3000g	123	30.8
Exclusive breastfeeding [f]		
≥ 4 months	240	60.8
< 4 months	155	39.2
Daily time in front of TV [g]		
≤ 2 hours	203	50.6
> 2 hours	198	49.4
Practice of Physical Activity		
Yes	63	15.7
No	339	84.3
Time in sedentary activities		
≤ 2 hours	151	37.6
> 2 hours	251	62.4
BMI/Age		
Low weight	10	2.5
Eutrophy	290	72.1
Overweight	73	18.2
Obesity	29	7.2
Height/Age		
Adequate height	394	98
Low height	8	2

[a]n=397 respondents/categorized in tertile [b]n=400 respondents [c]n=398 respondents [d]n=350 respondents [e]n =400 respondents [f]n = 395 respondents [g]n = 401 respondents. BMI = Body mass index by age.

history of dyslipidemia. Santos et al.[3] emphasized that the family history of dyslipidemia increases the probability of developing atherosclerosis and other CVD, which may still originate during childhood, demonstrating the importance of early intervention, since the combination of genetic and environmental factors can enhance this process. In a study conducted with adolescents, children of CAD patients, there were higher concentrations of total cholesterol, LDL, and lower HDL concentrations compared to those with no family history[19].

In the present study there was an association between early weaning of children (<4 months) and LDL concentrations. According to an observational study conducted in Pelotas-RS, infants exclusively breastfed for a longer period of time, developed better intelligence (IQ) and income and education in adulthood, compared to those non-breastfed infants due to breast milk present in its composition saturated long-chain fatty acids that contribute to neuronal development[20]. Another factor to consider is that exclusive breastfeeding proves to be a protective factor against overweight[21,22]. The presence of overweight and obesity is often associated with changes in the lipid profile[6].

The practice of regular physical activity was also related to children's LDL and triglyceride levels. According to Fagundes et al.[23], the practice of regular physical activity is capable to improve the lipid profile, causing an increase in HDL (4.6%) and a decrease in triglycerides (3.7%) and LDL (5%). In the same study, it was verified that adults who practiced physical activity during childhood and adolescence were 83% less likely to present dyslipidemia. In the study by Ribeiro et al.[24] with students aged from 6 to 18 years old, it was verified that the less active students presented 3.8 times more chance of increased total cholesterol in comparison to the more active ones, being also correlated to overweight. Considering these results, physical activity should be increasingly encouraged, with early start and maintenance during adolescence and adulthood[19].

Regarding children's food consumption, we verified a significant association between candy consumption greater than or equal to seven times a week and HDL. This result reflects inadequate food consumption, as these children who are likely to consume excessively candy do not have a nutritionally adequate diet. Studies with children demonstrate an increase in the consumption of low-nutrient foods rich in calories, sugars and fats, as well as the low consumption of

Table 2. Prevalence of changes in lipid profile and crude prevalence ratios, according to socio-demographic, birth, lifestyle, family history and nutritional status variables of children from 4 to 7 years old.

Variables	Total cholesterol		LDL-C		HDL-C		Triglycerides	
	Increased n (%)	PR (IC 95%)	Increased n (%)	PR (IC 95%)	Low n (%)	PR (IC 95%)	Increased n (%)	PR (IC 95%)
Child's sex								
Male	80 (36,2)	1	94 (42,6)	1	77 (34,8)	1	23 (10,4)	1
Female	71 (39,2)	1,08 (0,84-1,39)	94 (51,9)	1,22 (0,99-1,5)	59 (32,6)	0,93 (0,70-1,23)	19 (10,5)	1 (0,56-1,79)
Mother's marital status								
With partner	126 (39,7)	1	153 (48,3)	1	103 (35,7)	1	77 (11,3)	1
Withouy partner	25 (30,1)	0,75 (0,53-1,08)	35 (42,3)	0,87 (0,66-1,15)	32 (29)	1,18 (0,86-1,62)	6 (7,2)	0,63 (0,27-1,46)
Per Capita income								
≥ 475,16 reais	55 (40,7)	1	63 (46,6)	1	53 (39,2)	1	11 (8,1)	1
255-475,16 reais	49 (37,6)	0,92 (0,68-1,24)	64 (49,2)	1,05 (0,82-1,35)	40 (30,7)	0,78 (0,56-1,09)	13 (10)	1,22 (0,56-2,64)
<255 reais	47 (35,6)	0,87 (0,64-1,18)	60 (45,4)	0,97 (0,75-1,26)	41 (31)	0,79 (0,56-1,10)	16 (12,1)	1,48 (0,71-3,08)
Maternal work								
Work	106 (37,4)	1	133 (47)	1	101 (74,8)	1	30 (10,6)	1
Don't work	45 (30,4)	1,02 (0,78-1,35)	55 (47)	1,0 (0,79-1,25)	34 (25,2)	0,81 (0,58-1,12)	12 (10,2)	0,96 (0,51-1,82)
Maternal Education								
> 8 years	99 (38)	1	121 (46,5)	1	83 (31,9)	1	30 (11,5)	1
≤ 8 years	51 (37)	0,97 (0,74-1,26)	66 (47,8)	1,02 (0,82-1,27)	51 (36,9)	1,15 (0,87-1,53)	12 (8,7)	0,75 (0,39-1,42)
Birth weight								
≥3000g	107 (39)	1	132 (70,2)	1	92 (33,2)	1	31 (11,2)	1
<3000g	43 (35)	0,90 (0,68-1,20)	56 (29,8)	0,95 (0,75-1,20)	43 (34,6)	1,05 (0,78-1,41)	10 (8,1)	0,72 (0,36-1,43)
Months in EBF								
≥4 months	63 (35,8)	1	84 (42)	1	56 (32)	1	22 (9,1)	1
<4 months	86 (40,6)	1,14 (0,89-1,45)	101(54,1)	1,26 (1,03-1,54)*	77 (36,1)	1,08 (0,82-1,41)	19 (12,2)	1,25 (0,7-2,21)
Family Dyslipidemia								
Yes	96 (36,6)	1	120 (45,8)	1	82 (31,3)	1	23 (8,8)	1
No	43 (48,8)	1,33 (1,021,74)*	51 (57,9)	1,26 (1,01-1,57)*	34 (38,6)	1,23 (0,89-1,69)	17 (19,2)	2,20 (1,23-3,92)**

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Table 2. Prevalence of changes in lipid profile and crude prevalence ratios, according to socio-demographic, birth, lifestyle, family history and nutritional status variables of children from 4 to 7 years old.

Variables	Total cholesterol		LDL-C		HDL-C		Triglycerides	
	Increased n (%)	PR (IC 95%)	Increased n (%)	PR (IC 95%)	Low n (%)	PR (IC 95%)	Increased n (%)	PR (IC 95%)
Time in sedentary activities								
≤ 2 hours	62 (41,3)	1	73 (48,6)	1	59 (39,3)	1	15 (7,8)	1
> 2 hours	89 (35,4)	0,87 (0,68-1,12)	115 (45,8)	0,95 (0,77-1,18)	77 (30,7)	0,79 (0,61-1,04)	27 (13,1)	1,09 (0,6-1,96)
Daily time in front of TV								
≤ 2 hours	71 (35)	1	95 (46,8)	1	68 (33,5)	1	16 (10)	1
> 2 hours	80 (40,4)	1,16 (0,91-1,50)	93 (46,9)	1,01 (0,82-1,25)	68 (34,3)	1,03 (0,79-1,36)	26 (10,7)	1,67 (0,93-3,01)
Practice of Physical Activity								
Yes	90 (37,6)	1	104 (43,5)	1	74 (30,9)	1	17 (7,1)	1
No	61 (38,1)	1,05 (0,82-1,34)	84 (52,5)	1,24 (1,01-1,52)*	60 (37,5)	1,15 (0,87-1,51)	25 (15,1)	2,22 (1,25-3,95)**
BMI/Age								
No overweight	112 (37,5)	1	138 (48,5)	1	97 (32,4)	1	29 (9,7)	1
With overweight	39 (36,7)	1,01 (0,75-1,04)	50 (46,1)	1,05 (0,83-132)	39 (37,8)	1,16 (0,86-1,57)	13 (12,6)	1,30 (0,70-2,40)
Height/Age								
Adequate height	147 (37,3)	1	184 (46,7)	1	132 (33,5)	1	40 (10,1)	1
Low height	4 (50)	1,34 (0,66-2,71)	4 (50)	1,07 (0,53-2,15)	4 (50)	1,49 (0,73-3,02)	2 (25)	2,46 (0,71-8,48)
WHtR								
< 0,5	111 (36,3)	1	137 (44,7)	1	97 (31,7)	1	28 (9,2)	1
>0,5	39 (41,5)	1,14 (0,86-1,51)	50 (52,2)	1,18 (0,94-1,49)	37 (37,4)	1,24 (0,91-1,67)	14 (14,9)	1,62 (0,89-2,96)

EBF = exclusive breast feeding; TV= television; BMI = Body mass index by age. WC = waist circumference; WHtR = Waist-to-height ratio; PR = Prevalence ration; CI = confindence interval; LDL = Low density lipoprotein; HDL = High density lipoprotein. *p < 0,05; **p < 0,001.

Table 3. Prevalence of changes in the lipid profile and crude prevalence ratios, according to the food consumption variables of children from 4 to 7 years old.

Variables	Total cholesterol		LDL-C		HDL-C		Triglycerides	
	Increased n (%)	PR (IC 95%)	Increased n (%)	PR (IC 95%)	Low n (%)	PR (IC 95%)	Increased n (%)	PR (IC 95%)
Candy								
Consumption < 7x/week	41 (35,3)	1	8 (46,5)	1	33 (28,4)	1	54 (6,9)	1
Consumption ≥ 7x/week	109 (38,3)	1,08 (0,81-1,44)	133 (46,8)	1,0 (0,79-1,26)	103 (36,2)	1,27 (0,91-1,76)	34 (11,9)	1,73 (0,82-3,63)
Stuffed biscuit								
Consumption < 6x/week	60 (37,7)	1	14 (50,9)	1	51 (32)	1	81 (8,8)	1
Consumption ≥ 6x/week	91 (37,6)	0,99(0,79-1,28)	107 (44,2)	0,86 (0,7-1,06)	85 (35,1)	1,09 (0,82-1,145)	28 (11,5)	
Soft Drinks								1,42 (0,76-2,64)
Consumption < 6x/week	61 (39,1)	1	13 (52,5)	1	72 (33,9)	1	82 (8,3)	1
Consumption ≥ 6x/week	90 (36,7)	0,93 (0,72-1,21)	106 (43,2)	0,82 (0,66-1,01)	63 (33,8)	0,99 (,075-1,31)	29 (11,8)	1,42 (0,76-2,64)
Chocolate powder								
Consumption < 9x/week	64 (35,7)	1	17 (14,6)	1	60 (33,5)	1	89 (9,5)	1
Consumption ≥ 9x/week	87 (39,1)	1,09 (0,84-1,41)	99 (85,4)	1,02 (0,77-1,34)	76 (34,2)	1,18 (0,66-2,12)	25 (11,3)	0,89 (0,72-1,10)
Fruit								
Consumption ≥ 10x/week	80 (38,4)	1	21 (49)	1	71 (34,1)	1	102 (10,1)	1
Consumption < 10x/week	70 (36,6)	0,95 (0,73-1,22)	84 (43,9)	0,89 (0,72-1,10)	64 (33,5)	0,98 (0,74-1,29)	21 (10,9)	1,08 (0,61-1,93)
Vegetables								
Consumption ≥ 11x/week	71 (37,9)	1	25 (48,8)	1	72 (34,1)	1	103 (11,8)	1
Consumption < 11x/week	80 (37,5)	0,99 (0,76-1,27)	84 (44,4)	0,91 (0,73-1,12)	63 (33,3)	0,97 (0,74-1,28)	17 (9)	0,75 (0,42-1,36)

PR = prevalence ratio; CI = Confidence interval; LDL = Low density lipoprotein; HDL = high density lipoprotein; *p < 0,05, **p < 0,001. We categorized the frequencies of food consumption according to the median.

Table 4. Final model of the Poisson Regression analysis for the variables associated with children's lipid profile from 4 to 7 years old.

Lipid Profile	Variables	Adjusted RP (CI95%)	Value p*
↑ *Total cholesterol1*[1]	Presence of familial dyslipidemia	1,33 (1,02-1,74)	0,035
↑ *LDL cholesterol*[2]	Presence of familial dyslipidemia	1,30 (1,04-1,63)	0,020
	Early weaning (<4 months)	1,29 (1,05-1,59)	0,016
↓ *HDL cholesterol*[3]	Candy consumption > 7x/week	1,54 (1,05-2,25)	0,026
↑ *Triglycerides*[4]	Presence of familial dyslipidemia	2,20 (1,23-3,94)	0,007

WHtR = waist-to-height ratio; PR = prevalence ratio; CI = confidence interval; LDL = Low density lipoprotein; HDL = High density lipoprotein. * Multiple Poisson regression with robust variance. Adjusted by: 1maternal marital status; 2sex, WHtR, sports practice, consumption of stuffed biscuits, consumption of soft drinks; 3WHtR, income, familial dyslipidemia, time in sedentary activities; 4WHtR, daily time in front of the TV, sports practice, height/age, candy consumption.

foods rich in fiber, vitamins and minerals, such as vegetables and fruits by this population[6,17,25,26]. Inadequate feeding favors changes in lipid profile and contributes to overweight, and it is important to encourage the practice of healthy feeding since the childhood to prevent such changes[17].

Although this study does not demonstrate a significant association between the nutritional status and children's lipid profile, it is noteworthy that 25.4% of the children were overweight. According to the Household Budget Survey (HBS) 2008-2009, children between 5 and 9 years old, present a lower prevalence for malnutrition and higher for obesity, with a weight deficit diagnosed at 4.1% and overweight in 33.5% of Brazilian children[27]. The increase in body adiposity may contribute to changes in lipid profile and cardiovascular risk in adult life[28].

Despite the significant association found between candy consumption and HDL, many foods had no significant association with lipid profile. A limiting factor is that children's feeding was assessed through food records and FFQ, which, even though the filling forms were clarified, they may have led to an underestimation and/or overestimation of the quantities, types of foods that were consumed and offered to the children, as well as memory bias by mothers and/or guardians.

Another limitation of this study was that not all mothers and/or guardians were able to respond to variables such as maternal education, family income, family history of dyslipidemia, maternal work, breastfeeding, birth weight and child's daily time in front of the TV, thus there were losses in the sample regarding their information.

Therefore, we concluded that the children presented a high prevalence of changes in the lipid profile, which is directly related to factors such as early weaning, family history of dyslipidemia, sedentary lifestyle and inadequate food consumption.

Therefore, nutritional education activities and programs aimed at this group, which contemplate the practice of physical activity, exclusive breastfeeding and healthy feeding, are necessary in order to prevent such changes, since they may remain during adolescence and adulthood.

Collaborations

NA Souza and SA Vieira - Contribution to the study: data collection and analysis, article elaboration. PCA Fonseca and CA Andreoli - Contribution to the study: data collection and analysis. SE Priore - Contribution to the study: data analysis and article elaboration. SCC Franceschini - Contribution to the study: article elaboration and work guidance.

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