Factors associated with dyslipidemia in children and adolescents enrolled in public schools of Salvador, Bahia

Fatores associados à dislipidemia em crianças e adolescentes de escolas públicas de Salvador, Bahia

Abstract

Objective: We assessed the factors associated with dyslipidemia in children and adolescents enrolled in the public school system of the city of Salvador, Bahia. **Methods:** All participants were submitted to anthropometric evaluation and to cholesterol and triglyceride blood tests. Data related to food intake, physical activity and family socioeconomic and housing conditions were obtained from parents or guardians. Data were analyzed using multivariate logistic regression. **Results:** The prevalence of dyslipidemia was 25.5% (IC:95% 22.7; 28.3). We observed a significant positive association between dyslipidemia and the following factors: overweight (OR = 3.40, 95% CI 2.07 to 5.58), moderate and high intake of risk food (OR = 1.49, 95%: 1.01 to 2.19), low and moderate intake of protective foods (OR = 1.54, 95% CI 1.05 to 2.26) and lower maternal level of schooling (OR = 1.72, 95%: 1.05 to 2.26). **Conclusion:** Overweight, inadequate food intake and low maternal level of schooling were factors associated with dyslipidemia.

Keywords: Prevalence. Risk factors. Dislypidemia. Cardiovascular diseases. Children. Adolescents.

Osvaldo Dário de Alcântara Neto[I]
Rita de Cássia Ribeiro Silva[I]
Ana Marlúcia Oliveira Assis[I]
Elizabeth de Jesus Pinto[II]

[I] Escola de Nutrição. Universidade Federal da Bahia. Salvador, BA, Brasil.

[II] Instituto de Matemática. Universidade Federal da Bahia. Salvador, BA, Brasil.

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Correspondence: Rita de Cássia Ribeiro Silva. Rua Desembargador Oscar Dantas, 96 apt 402 – Graça – Salvador, BA CEP 40260-150. E-mail: rcrsilva@ufba.br

Resumo

Objetivo: Este estudo aborda os fatores associados a dislipidemia em crianças e adolescentes matriculados na rede pública de ensino da cidade de Salvador, BA. **Métodos:** Os participantes foram submetidos a avaliação antropométrica, coleta de sangue para dosagem de colesterol e triglicérides. As informações relacionadas a consumo alimentar, atividade física e condições socioeconômicas e de moradia da família foram fornecidas pelos responsáveis. Regressão logistica mutivariada foi utilizada para as avaliações de interesse. **Resultados:** A prevalência de dislipidemia encontrada no presente estudo foi de 25,5% (IC:95% 22,7; 28,3). Observou-se associação positiva e estatiticamentre significante entre dislipidemia e excesso de peso (0R = 3,40; IC95%: 2,07-5,58), moderado e alto consumo de alimentos de risco (OR = 1,49; IC95%: 1,01-2,19), baixo e moderado consumo de alimentos protetores (OR = 1,54; IC95%: 1,05-2,26) e menor nível de escolaridade materna (OR = 1,72; IC95%: 1,05-2,26). **Conclusão:** O excesso de peso, consumo alimentar inadequado e baixa escolaridade materna constituem fatores associados a dislipidemia.

Palavras-chave: Prevalência. Fatores de risco. Dislipidemia. Doenças cardiovasculares. Crianças. Adolescentes.

Introduction

Experts have warned about the increase in dyslipidemia in children and adolescents. In Brazil, there are no national epidemiological data on the prevalence of this disease that cover the entire country. However, specific studies have shown high prevalences of dyslipidemia in children and adolescents, varying between 3.1% and 46.5%, in some regions of this country[1-10].

Some studies have been performed to assess factors associated with dyslipidemia[3-7]. These studies argue that, in the majority of cases, the risk of dyslipidemia is associated with excessive weight. Specialists have emphasized that the trend towards the increase in the proportion of overweight and obesity – such as what has occurred in developed countries – has led to metabolic changes in lipid profile[11]. The occurrence of overweight and obesity, in their turn, depends on a series of environmental factors associated with lifestyle, among which physical inactivity and negative changes in eating habits are included[12,13]. However, it is not possible to disregard the role of maternal level of education in the adoption of healthy behavior, which may thus influence the magnitude of occurrence of this health problem[14].

Many studies have indicated an association between dyslipidemia and the occurrence of non-communicable chronic diseases (NCCD), especially circulatory system diseases (CSD). Among CSDs, cerebrovascular diseases and ischemic heart diseases stand out, as they totaled more than 47% of CSD deaths in Brazil, in 2004[15]. Thus, the identification of factors that lead to dyslipidemia can contribute to the development of preventive health programs, aiming at lifestyle changes and health promotion, and thus preventing thousands of adolescents from prematurely developing coronary artery disease.

In view of this situation, the present study was conducted to assess factors associated with dyslipidemia in children and adolescents enrolled in the public school network of the city of Salvador, BA, Brazil.

Methods

Study design/population/sample

A cross-sectional study was conducted with students of both sexes aged between seven and 14 years. These students had been identified in a previous broader investigation that aimed to analyze factors associated with iron-deficiency anemia in children and adolescents enrolled in the public school network of the city of Salvador[16].

The sampling process of the original study involved a complex design, with the stratification of schools on two levels (state and municipal), followed by three-stage cluster sampling, described as follows: the first stage is represented by health districts; the second, schools; and the third, students. Due to field logistics issues, information about the students selected were obtained from six out of the 12 districts existing in Salvador, where there were 117 state schools (corresponding to 53.9% of all schools) and 173 municipal schools (corresponding to 48.8% of all schools). State schools included 58,059 students, while municipal schools included 56,555 students. A total of ten students from each of the 58 municipal schools and 23 students from each of the 27 state schools were needed to meet the previously defined sample size, totaling 1,200 students. Of all these initially selected, 937 children and adolescents of both sexes, aged between seven and 14 years, participated in the present study. Considering the objective pursued by this study and the fact that this sample was not estimated, an a posteriori sample error was calculated. Under these circumstances, there was a posteriori error of 2.8% to detect a prevalence of dyslipidemia of 25.5%, with a confidence level of 95%.

Dependent variable

Dyslipidemia – cholesterol level and triglyceride level

An Accutrend® CGT portable monitor (Roche Diagnostics) was used to determine total cholesterol and triglyceride levels, adopting a reflectance photometry method. Calibration was automatic and performed in children and adolescents, using a Code Strip that follows each flask with reagent strips. The product code is 40000486 and it is manufactured by Roche Diagnostics GMBH, a German company registered with the Brazilian Health Ministry under number 12016400350.

The reference values used to diagnose hypercholesterolemia and hypertriglyceridemia in children and adolescents were recommended by the *I Diretriz de Prevenção da Aterosclerose na Infância* and *Adolescência* (1st Guidelines for Atherosclerosis Prevention in Childhood and Adolescence) of the *Sociedade Brasileira de Cardiologia* (Brazilian Heart Society)[17]. Individuals who showed an increased value in at least one of the following tests were considered to be dyslipidemic: Cholesterol ≥ 170 (mg/dl) and/or Triglycerides ≥ 130 (mg/dl).

Independent variables

Physical activity level

The physical activity level was assessed using the Previous Day Physical Activity Recall (PDPAR). This questionnaire was developed by Russell R. Pate of the University of South Carolina, USA, and translated and modified by M.V. Nahas of the *Núcleo de Pesquisa em Atividade Física e Saúde* (Physical Activity and Health Research Center) of the *Universidade Federal de Santa Catarina* (SUÑÉ, 2007)[18]. This questionnaire provides information about the intensity and time spent on physical activities. The final PDPAR score is subsequently obtained from these values by multiplying the intensity coefficient (3, 2 or 1 for intense, moderate or mild, respectively) by the exercise duration coefficient (1, 2 and 3 for <15`, 15-30` and >30`, respectively). In the present study, the score obtained was distributed into tertiles: 1st tertile (0 to 5 points), 2nd tertile (6 to 12 points) and 3rd tertile (≥ 13 points$_{\text{Reference category}}$).

Anthropometric state

Anthropometric measurements were collected in the school in a standardized manner, following the procedures recommended by the Anthropometric Standardization Reference Manual (LOHMAN et al., 1988)[19]. Weight was obtained with the help of the Marte microelectronic scale, model PP 200-50, with a capacity of 199.95 kg and accuracy of 50 grams. The Leicester Height Measure stadiometer, divided into tenths of centimeters, was used to measure height. The anthropometric data collection procedure recommended by Lohman et al (1988)[19] was adopted.

Participants' age was recorded from the information of the Municipal and City Departments of Education. Age was confirmed by checking the birth certificate or identity card during interview.

Anthropometric measurements were collected (weight and height) to calculate body mass index (BMI). The World Health Organization percentile tables (2007)[20] were used as framework to assess the anthropometric state, according to age (between two and 20 years) and sex. The WHO proposal (2006)[21] was used for classification: low weight (< percentile 3), eutrophia (≥ percentile 3 and < percentile $85_{\text{Reference category)}}$, overweight (≥ percentile 85 and < percentile 97), and obesity (≥ percentile 97). The overweight and obesity categories were grouped together for the analysis. Thus, overweight individuals had a BMI value ≥ percentile 85.

Food intake

The Quantitative Food Frequency Questionnaire (FFQ) developed by Slater et al.[22] was used to assess food intake frequency. This instrument was validated by Voci et al[23]. There were 132 food items in the FFQ, with the inclusion of regional foods. Each food item in the FFQ included intake frequency categories, ranging from "never" (lack of intake) to "daily", and the number of times such food items were consumed on the day, ranging from "once" to "six times/day". Food items were distributed into two groups, according to their recognized role in the development of risk factors for Cardiovascular Diseases[24,25]. The inclusion criterion for each food in the group was the fact that at least 70% of participants reported the intake of such foods.

Group 1: comprised by foods considered to be of risk for the development of dyslipidemia: whole dairy products (cheese, *requeijão* – typical type of soft cheese produced in Brazil); animal fat (lard, bacon, butter, pork rind); vegetable fat (margarine); fried foods (potatoes, *pastéis* – a typical Brazilian fried filled pastry, savory snacks); meats (poultry, fried fish, beef and pork); meat-derived foods (luncheon meat, hotdogs, hamburgers, meat-based preparations); and eggs.

Group 2: comprised by foods considered to be protective against the development of dyslipidemia: fruits; vegetables; legumes; roots; cereals and derivatives (rice, bread, crackers and flours).

Food intake assessment was performed according to the methodology proposed by Fornés et al (2002)[25], which adopts a daily intake equivalent to 30 days in the month (monthly intake) as framework. Thus, a certain weight value was attributed to each intake frequency category, based on the monthly frequency. In addition, the daily intake of food items corresponds to the maximum weight value (weight 1). The remaining weight values were obtained according to the following equation:

$$\text{Weight} = (1/30)\ [(a+b)/2]$$

Where "a" and "b" represent the numerical interval of monthly intake frequency. As the majority of possibilities of food frequency responses reflect the weekly intake, the number of weekly responses was converted into monthly intake. Considering the fact that one month has four weeks, the weekly intake was multiplied by four, thus obtaining the monthly intake frequency. An intake frequency score was attributed to each food consumed by participants. Subsequently, these variables

were distributed into tertiles. Group 1 was categorized accordingly: 1st tertile – low intake$_{\text{Reference category}}$; 2nd tertile – moderate intake; 3rd tertile – high intake. Group 2 was categorized accordingly: 1st tertile – low intake; 2nd tertile – moderate intake; 3rd tertile – high intake$_{\text{Reference category}}$.

Socioeconomic characteristics and housing and environmental conditions

Data on housing characteristics (home ownership conditions, type of construction, primary flooring material, primary roof material and part of the home, number of residents per room) and basic sanitation (water supply, garbage collection and sewage system) to construct an index adapted to the model proposed by Issler & Giugliani (1997)[26]. A score was given to each situation, 0 being the most favorable and 1 being the most unfavorable. The sum of these values characterizes the housing and environmental condition index, categorized into two strata: adequate (score ≤ 04 $_{\text{Reference category}}$) and inadequate (score > 04).

In addition, data on maternal level of education were collected (proxy indicator of household socioeconomic conditions). A total of three levels were considered for this variable, according to the school grades: level 1 – until the 4th grade; level 2 – between the 5th and 8th grades; and level 3 – secondary and higher education$_{\text{Reference category}}$.

Ethical questions/issues

The study protocol was submitted to the *Universidade Federal da Bahia* (Bahia Federal University) Collective Health Institute Research Ethics Committee, which assessed and approved it according to its ethical relevance.

Data analysis

The variables that showed a p value ≤ 0.30 in the univariate analysis were selected, according to the criterion suggested by Hosmer & Lemeshow (1989)[27]. Subsequently, multivariate analysis was performed using the logistic regression technique. The magnitude of association between associated factors and the occurrence of dyslipidemia was described in Odds Ratios (OR) and respective 95% confidence intervals (95%CI). Variables with a p value < 0.05 remained in the adjusted model.

Statistical analyses were corrected by the complex sampling design, using the set of STATA's SVY commands (version 9.0).

Results

Of all 1,200 initially selected students, there were 69 losses (5.75 %), resulting in a sample with 1,131 participants. These losses occurred due to refusals, children moving to other cities, or their being transferred to other schools. Of all these, 194 students were excluded due to the lack of lipidogram records. Consequently, the sample that was effectively studied was comprised of 937 children and adolescents of both sexes, aged between seven and 14 years.

It should be emphasized that there were no statistically significant differences between the socioeconomic, anthropometric and demographic characteristics of the original sample and those of the sub-sample used in this study (data not shown).

The prevalence of dyslipidemia was estimated to be 25.5% (95%CI 22.7; 28.3) (adolescents had at least one of the disorders studied). Of all 937 children and adolescents, 49.9% of participants were females and the majority of them were aged between ten and 14 years (86.0%). With regard to socioeconomic conditions, 32.9% lived under inadequate housing conditions and 32.6% of mothers had completed the 4th grade of primary school. Physical inactivity was frequent in 27.6% of children and the intake of foods considered to be moderate and high risk for dyslipidemia was 67.5%, a prevalence that was slightly higher than that observed for low and moderate intake of protective foods (62.9%). The occurrence of overweight/obesity was identified in 12.4% of participants (Table 1).

The results of the univariate analysis indicate a statistically significant positive association between dyslipidemia and anthropometric status (p<0.001) and a borderline significance level for the frequency of intake of the protective foods selected (p=0.051). There were no statistically significant associations for the remaining variables studied (p<0.051) (Table 2).

According to the data shown in Table

Table 1 - Demographic, socioeconomic, anthropometric and lifestyle characteristics in children and adolescents aged between 7 and 14 years, enrolled in public schools of the city of Salvador, Bahia, Brazil, 2008.

Tabela 1*- Características demográficas, socioeconômicas,antropométricas e de estilo de vida em crianças e adolescentes com idade entre 7 e 14 anos matriculadas na rede pública de ensino do município de Salvador, Bahia, Brasil, 2008.*

Variables	N	%
Sex		
Female	468	49.9
Male	469	50.1
Age (years)		
7-9.99	131	14.0
10-14.99	806	86.0
Environmental and household living condition index		
≤ 04 adequate	559	59.7
> 04 inadequate	378	40.3
Maternal level of education*		
Secondary or higher education	283	30.8
Primary education (5th through 8th grades)	334	36.3
Primary education (1st through 4th grades)	302	32.9
Anthropometric state		
Eutrophia	698	74.5
Low weight	123	13.1
Overweight/obesity	116	12.4
Physical activity †		
Inactive (1st tertile 0 – 5)	242	27.6
Moderately active (2nd tertile 6 – 12)	344	39.2
Active (3rd tertile >13)	291	33.2
Food intake (tertile) ‡		
High risk foods		
Low intake (1st tertile)	304	32.5
Moderate and high intake (2nd and 3rd tertiles)	631	67.5
Protective foods		
Low and moderate intake (1st and 2nd tertiles)	588	62.9
High intake (3rd tertile)	347	37.1

(*) Escolaridade materna n = 919; (†) Atividade Física n = 877; (‡) Consumo alimentar n = 935
(*) *Maternal schooling n = 919,* (†) *Physical Activity n = 877;* (‡)*Food consumption n = 935.*

3, dyslipidemia was significantly associated with low maternal level of education (OR=1.72; 95%CI: 1.08-2.75), low intake of protective foods (2nd and 3rd tertile) (OR=1.54; 95%CI: 1.05-2.26), moderate and high intake of high risk foods (2nd and 3rd tertile) (OR=1.49; 95CI%: 1.01-2.19) and excessive weight (overweight, obesity) (OR= 3.14; 95CI%: 193-5.12).

Discussion/Conclusion

The prevalence of dyslipidemia found in the present study (25.5%) is lower than

Table 2 - Odds ratio (OR) of association between dyslipidemia and demographic, socioeconomic, anthropometric, and lifestyle characteristics in children and adolescents aged between 7 and 14 years enrolled in public schools of the city of Salvador, Bahia, Brazil, 2008.

Tabela 2 *- Odds ratio (OR) da associação entre dislipidemia e variáveis demográficas, socioeconômicas, antropométricas e de, estilo de vida em crianças e adolescentes com idade entre 7 e 14 anos matriculados na rede publica de ensino do município de Salvador, Bahia, Brasil, 2008.*

Variables	n	% Dyslipidemia	Crude OR	95%CI
Sex				
Female	468	28.1	1.19	0.851 – 1.681
Male	469	24.6	1	
Age (years)				
7-9.99	131	29.1	1	
10-14.99	806	25.9	0.85	0.526 – 1.369
Maternal level of education				
Secondary or higher education	283	21.6	1	
Primary education (5th through 8th grades)	334	26.1	1.29	0.832 – 1.985
Primary education (1st through 4th grades)	302	28.6	1.45	0.925 – 2.280
Anthropometric state				
Eutrophia	698	24.0	1	
Low weight	123	20.2	0.83	0.471 – 1.369
Overweight/obesity	116	26.4	3.10	1.949 – 4.931
Physical activity†				
Inactive (1st tertile 0 – 5)	242	28.3	1.41	0.899 – 2.224
Moderately active (2nd tertile 6 – 12)	344	28.6	1.43	0.944 – 2.181
Active (3rd tertile >13)	291	21.8	1	
Food intake (tertile) ‡				
High risk foods				
Low intake (1st tertile)	304	23.8	1	
Moderate and high intake (2nd and 3rd tertiles)	631	27.7	1.22	0.852 – 1.758
Protective foods ‡				
Low and moderate intake (1st and 2nd tertiles)	588	29.1	1.43	0.998 – 2.045
High intake (3rd tertile)	347	22.3	1	

(*) Escolaridade materna n = 919; (†) Atividade Física n = 877; (‡) Consumo alimentar n = 935.
(*) *Maternal schooling n = 919*; (†) *Physical Activity n = 877*; (‡) *Food consumption n = 935.*

Table 3 - Odds Ratio/OR assessing the factors associated with dyslipidemia in children and adolescents aged 7 to 14 years old, in public schools of the city of Salvador, Bahia, Brazil, 2008.
Tabela 3 *– Odds Ratio/OR para avaliação dos fatores associados a dislipidemia em crianças e adolescentes de 7 a 14 anos de idade, da rede pública de ensino do município de Salvador, Bahia, Brasil, 2008.*

Variables	Adjusted OR	95%CI	p value
Maternal level of education			
Secondary or higher education	1		
Primary education (5th through 8th grades)	1.35	0.86 – 2.13	0.191
Primary education (1st through 4th grades)	1.72	1.08 - 2.75	0.023
Food intake (tertile)			
Protective foods			
High intake (1st tertile)	1		
Low and moderate intake (2nd and 3rd tertiles)	1.54	1.05 - 2.26	0.026
High risk foods			
Low intake (1st tertile)	1		
Moderate and high intake (2nd and 3rd tertiles)	1.49	1.01 – 2.19	0.044
Anthropometric state			
Eutrophia	1		
Low weight	0.75	0.43- 1.31	0.31
Overweight/Obesity	3.40	2.07- 5.58	<0.001

that reported by Franca and Alves (2006) in Recife/PE (29.7%)[7] and by Moura et al (2000) in Campinas/SP (35%)[9]. However, it is in agreement with that observed by Giuliano et al (2005)[28] in Florianópolis/SC (22.0%) and by Seki et al (2001) in Londrina/PR (20.8%)[2]. In addition, this prevalence is higher than those found by Gerber & Zielinsky, (1997) in Bento Gonçalves/RS, (10.33%)[29] and by Grillo (2005) in Itajaí/SC (4.7%)[30]. Regardless of the cut-off points used for such diagnosis or even biochemical analysis techniques, the high prevalences of this event in children and adolescents in several regions of Brazil should be emphasized.

Data from the present study revealed the influence of excessive weight on the occurrence of dyslipidemia (Table 3). In Brazil, there are still few studies on the evaluation of factors that determine the development of dyslipidemia, such as excessive weight in children and adolescents. Of all studies included in the Brazilian literature, those conducted by Giuliano et al (2008)[28], Coronelli and Moura (2003)[3] and Carvalho et al. (2007)[8] should be emphasized. The results of these studies may indicate the atherogenic role of excessive weight in this life cycle, thus contributing to the occurrence of dyslipidemia. According to some authors, dyslipidemia occurs mainly due to the development of hyperinsulinism (resistance to insulin), which is initially peripheral and subsequently systemic, among other mechanisms[31]. The evidence found indicates that an adequate weight/height ratio improves the lipid profile and reduces cardiovascular risks[32].

Dyslipidemia may be attributed to environmental factors associated with lifestyle, among which inadequate eating habits and physical inactivity are particularly included. In the present study, the negative influence of low and moderate intake of protective

foods (2nd and 3rd tertiles) and moderate and high intake of high risk foods (2nd and 3rd tertiles) on the lipid status of children and adolescents who participated in this study could be observed. These intake patterns reflect the lifestyle changes experienced by children and adolescents, which may be explained by the nutritional transition identified for the Brazilian population in recent years[12,13]. These changes have promoted an increase in the intake of manufactured foods, eating out habits and replacement of traditional meals by snack foods. These changes lead to the intake of high energy density food products, such as those rich in fat and simple carbohydrates, to the detriment of sources of fibers, which are found in fruits and vegetables and have fewer calories and more nutrients. It should be emphasized that the results found in this study are in agreement with those that focus on the influence of the traditional Brazilian diet (based on rice and beans) as protective of factors associated with dyslipidemia[33,34]. The effects of soluble fibers on serum lipid concentrations have been reported in several studies, both with animals and human beings[35]. Results of these studies show that soluble fibers, such as pectin (fruits) and vegetable gums (oat, barley and legumes – beans, chickpeas, lentils and green peas), reduce gastrointestinal transit time and help to eliminate cholesterol[35] .

Results of the present study indicated the influence of low level of education on lipid profile changes due to excessive weight. Opportunities to improve one's level of education and to access information usually promote a more adequate choice of foods and, consequently, an improvement in the adequacy of anthropometric measurements. The influence of maternal level of education on the occurrence of dyslipidemia observed in this study could be suggesting, among other things, that mothers with a higher level of education are more actively participating in child care, which may result in a lower occurrence of dyslipidemia.

It should be emphasized that the main limitation of this investigation is in the fact that it had a cross-sectional design. This affects the interpretation of results, in the sense that it is not possible to establish causal relationships in this type of study, because it cannot indicate a temporal sequence between exposure to the factor and the subsequent development of the disease. However, the results found are compatible with those reported in the literature consulted. Some of these derived from intervention studies, which show that an improvement in eating habits and weight control are important aspects in dyslipidemia prevention, among the risk factors associated with cardiovascular diseases[35], [36]. In the present study, the photometry method was used to determine cholesterol and triglyceride levels, which could lead to a limitation due to classification errors and underestimated diagnosis. However, reflectance photometry to determine serum or plasma cholesterol and triglycerides has been currently used. Correlation coefficients (r) higher than 0.90, observed between the photometric method and laboratory methods, have promoted the use of the portable Accutrend® CGT monitor in epidemiological studies[37].

Despite these limitations, it could be concluded that dyslipidemia was associated with low maternal level of education, low intake of protective foods, moderate and high intake of high risk foods and excessive weight. It is possible that certain lifestyle changes, such as the maintenance of a nutritionally adequate diet and body weight control, among other aspects that include improvement in socioeconomic conditions, are associated with a reduction in risk factors for coronary arterial disease.

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