Artículo Original / Original Article

Dyslipidemia in children with feeding difficulties – a cross-sectional study in a Brazilian reference center

Dislipidemia en niños con dificultades alimentares - estudio transversal en un centro de referencia brasileño

ABSTRACT

This study aimed at describing the lipid profile of children with feeding difficulties (FD), as well as to verify the impact of clinical types of FD and other markers on the presence of dyslipidemias (DLP). It was a cross-sectional study with 61 children between 2 and 10 years old. The following data was collected from medical records: age, gender, duration of exclusive breastfeeding (months), dosages of total cholesterol, HDL, LDL, VLDL and triglycerides (according to recommendations for age), type of FD, BMI z-score, dietary intake of carbohydrates and lipids (% energy intake), and daily consumption of milk (ml), fiber (g) and sugar sweetened beverages (SSB, ml). T-Student-test and ANOVA test were used, with a 5% significance level. Children were mostly picky eaters (55.7%), and 47.5% had dyslipidemia, mostly low HDL-c (27.6%) and hypertriglyceridemia (21.9%). No significant relationship was found between DLP and duration of exclusive breastfeeding ($p = 0.93$), BMI ($p > 0.40$), type of FD ($p > 0.26$), or dietary characteristics ($p > 0.12$). Children with dyslipidemia tended to drink higher volumes of SSB when compared to recommended values ($p = 0.044$). The prevalence of DLP found was higher than the average shown in children. More studies are needed to prove if there is a true association between FD and dyslipidemia. **Keywords:** Children; Dietary intake; Dyslipidemia; Feeding difficulties; Lipid profile; Picky eating.

RESUMEN

El objetivo de este estudio fue describir el perfil lipídico de niños con dificultades alimentares (DA) y verificar el impacto de los tipos clínicos de DA y otros marcadores sobre la presencia de dislipemias (DLP). Se trató de un estudio transversal con 61 niños de 2 a 10 años. Se obtuvieron los datos de edad, sexo, duración de la lactancia materna exclusiva (meses), colesterol total, HDL, LDL, VLDL y triglicéridos (según las recomendaciones para la edad), tipo de DA, índice-z del IMC, consumo dietético de carbohidratos y lípidos (% energético), consumo diario de leche (ml), fibra (g) y bebidas endulzadas (SSB, ml). Se usaron pruebas T-Student y ANOVA, con nivel de significancia del 5%. Los niños fueron selectivos (55,7%) y

Ana Beatriz Bozzini¹, Priscilla Maximino¹, Rachel Machado¹,
Raquel Ricci¹, Cláudia Ramos¹, Mauro Fisberg¹.

1. Instituto PENSI. Hospital Infantil Sabará.
Fundação José Luiz Egydio Setúbal.
San Pablo, Brazil

Corresponding Author: Rachel HV Machado. Instituto PENSI.
Hospital Infantil Sabará / Fundação José Luiz Egydio Setúbal.
(Av. Angélica 2071 2nd floor – Higienópolis/SP – 01228-200.
Brazil.
Phone: +55 11 999143409.
E-mail: rhvmachado@gmail.com

Este trabajo fue recibido el 19 de febrero de 2018.
Aceptado con modificaciones: 14 de junio de 2018.
Aceptado para ser publicado: 06 de agosto de 2018.

el 47,5% dislipidémicos, principalmente con HDL-c bajo (27,6%) y hipertrigliceridemia (21,9%). No se encontró relación significativa entre DLP y la duración de la lactancia materna exclusiva ($p = 0,93$), el IMC ($p > 0,40$), el tipo de DA ($p > 0,26$) o las características dietéticas ($p > 0,12$). Los niños dislipidémicos tendieron a beber mayores volúmenes de SSB en comparación con los valores recomendados ($p = 0,044$). La prevalencia de DLP encontrada es más alta que el promedio que se muestra en niños. Se necesitan más estudios para demostrar asociaciones sólidas entre DA y dislipidemia.

Palabras clave: Alimentación exigente; Dificultades de alimentación; Dislipidemia; Ingesta dietética; Niños; Perfil lipídico.

INTRODUCTION

In the past years, it has become evident that atherosclerosis in adulthood begins precociously, since alterations in lipid metabolism during childhood and adolescence tend to persist in adult life and increase the risk for the development of atherosclerotic lesions¹. The risk factors for cardiovascular diseases –in general– have increased in youth, with the main examples of dyslipidemias (DLP), hypertension and obesity, together with poor eating habits and a sedentary lifestyle^{2,3}. Even though cardiovascular diseases are rare among children, DLP is associated with alterations in the elasticity of the carotid artery, average thickness of the intima layer and the brachial-mediated dilatation from childhood to adulthood⁴. Risk factors related to metabolic imprinting such as gestational diabetes, maternal overweight and untreated DLP during pregnancy, parental overweight, low birth weight, preterm birth and short duration of exclusive breastfeeding also play a role in the development of cardiovascular diseases⁵.

The prevalence of dyslipidemia in children and adolescents varies across countries, with reports of 19.7% in Korean children⁵ and 22.9% in American adolescents⁶. Some studies report a prevalence variation from 2.9 to 33%, with an increase proportional with age⁷. Among biochemical markers of dyslipidemia, increased triglycerides is the most commonly reported (prevalence of around 14.2%), followed by increased total cholesterol levels (9.6%) in children⁶. In Brazil, the prevalence of dyslipidemia among children and adolescents varies from 10% to 23.5%, depending on the region of the country and type of DLP⁸.

Because it is a risk factor for the development of cardiovascular diseases that could be prevented, several public actions have been designed aiming at the early screening of DLP. In 2011, the National Heart, Lung, and Blood Institute (United States) published guidelines with recommendations for the screening, monitoring and treatment of children and adults under 21 years of age at risk of precocious cardiovascular events. Besides the screening process of children with positive family history, the group recommends a universal screening process –regardless of the presence of risk factors– for children over 9 years old^{9,10,11}. According to an update from the Brazilian Directive on Dyslipidemias and Prevention of Atherosclerosis, carried out in 2017 by the Brazilian Society of Cardiology⁸, lipid profiles should be assessed in children starting at 2 years of age when there is a family history of early ischemic arterial disease; if parents have total cholesterol above 240 mg/dL (in addition to other diseases or risk factors for atherosclerosis or of diseases that occur with dyslipidemia); If parents use drugs that alter the lipid profile and/or in the presence of clinical manifestations of dyslipidemia. The updated material also establishes that the diagnosis of dyslipidemia is set through at least one altered measurement of markers (total cholesterol, LDL-c, HDL-c and/or triglycerides).

DLP can be both prevented and treated with the help of healthy eating habits, and current guidelines⁸ advise

the reduction of LDL cholesterol through the decrease in intake of saturated and trans fatty acids, limited sugars and refined carbohydrates, as well as weight control for those with overweight and obesity, and adequate intake of fibers¹². Sugar intake, especially the sugar added to processed foods, may be associated with adverse cardiovascular health factors in children, specifically elevated diastolic blood pressure and triglycerides¹³. A diet which is rich in antioxidant food sources (fruits, vegetables, oilseeds and fish) should also be standardized¹⁴; and both diets which are rich in polyunsaturated fats and low in overall fat have been proven efficient in the reduction of body mass index, blood pressure, increase of HDL-c, reduction of LDL-c and vasodilation¹⁵. Drug treatment such as statins, supplements, fish oil and bile acid sequestrants could be indicated depending on the type of dyslipidemia and sometimes, on the duration of unsuccessful clinical treatment⁸.

The prevalence of feeding difficulties (FD) –behaviors of food refusal and/or severe eating restrictions, together with a problematic relationship between child and caregiver– among children has been described to be as high as 50% worldwide. In general, children with FD do not present balanced eating habits. FD is usually categorized under the three main eating behaviors that concern parents: limited appetite, selective intake, and fear of feeding; with each category ranging from normal (misperceived) to severe (behavioral and organic) levels¹⁶. Although inadequate diets rarely hamper growth patterns and weight gain in these cases, selective children can present insufficient intake of specific food groups, which increases the concern among parents and clinical staff as to the possible adverse health effects. Children with FD usually avoid foods which are rich in protective factors against DLP (fruits and vegetables, whole foods and other sources of antioxidants), preferring snacks, milk and/or sugar sweetened beverages (SSB) in many cases^{16,17,18}. The monotony of inadequate diet patterns may constitute a risk for development of dyslipidemia. Although this monotonous pattern could be much more relevant in picky eaters, it is also important to investigate the lipid profiles of children with other types of FD. Nevertheless, there is currently scarce evidence on dyslipidemia among children with FD. Hence, the objective of this study was to describe the lipid profile of children with different types of FD, as well as to explore associations between lipid profiles and type of FD, BMI, duration of exclusive breastfeeding and dietary intake characteristics.

MATERIAL AND METHODS

Study design and population

We conducted a cross-sectional study, carried out at the Centro de Dificuldades Alimentares (CDA), part of Instituto PENSI-Hospital Infantil Sabará-Fundação José Luiz Egydio Setúbal, located in São Paulo/Brazil. CDA is an outpatient service which follows children and adolescents between 0 and 18 years of age with complaints of FD (except for the diagnosis of eating disorders according to DSM-5¹⁹). The

population was assembled by convenience. All patients followed in the service until the end of data collection were invited to participate (n= 148, August, 2014 to November, 2017). Patients less than 24 months of age and 10 years or more were excluded to make the sample more homogeneous in age and to facilitate comparisons with biochemical data, as well as availability of full biochemical analysis of lipogram. Thus, our final sample size was 61 children. All patients presented written consent forms signed by their responsible caregiver after ethical approval of the project (CAAE 32939314.0.0000.5567; approval granted in 13/08/2014 under document n. 808.394).

Data collection

Data were collected from the interviews with patients' mothers, as part of the service protocol, which consists of an appointment with a pediatrician, speech therapist and nutritionist together, followed by a multidisciplinary discussion. FD were diagnosed as "children with limited appetite", "agitated children", "phobic children", "misperception of caregivers", "picky eaters", and "organic causes", according to criteria suggested by Kerzner et al¹⁶. Families received feedback including a therapeutic plan designed by each specialty (such as diet plans and nutritional education activities, medications, stimulation and reestablishment of oral functions or even referral to other professionals). The guidelines used by each specialty were defined according to standards for age and are described by Maximino et al.²⁰.

Data were collected at the initial appointment at CDA, and information was later extracted from records, of which the following variables were selected: age (months), gender, duration of exclusive breastfeeding (in months), biochemical levels of lipid profile (fasting total cholesterol, HDL-c, LDL-c, VLDL-c and triglycerides; classified according to official recommendations for age (Table 1), FD diagnosis conducted by the multidisciplinary team, BMI (classified according to WHO standards BMI/age (2007/2008)²¹, dietary intake of carbohydrates and total fat (both in % energetic value of the diet), and dietetic fibers (g/day classified according to guidelines from IOM)²²; and daily intake of SSB (natural or artificial juices, refreshments or fizzy drinks, total daily intake in ml) and milk intake (ml/day). Dietary intake was obtained from 3-day food records analyzed by the service nutritionist according to the service protocol, previously described.

Statistical analysis

After the evaluation of data consistency, statistical analysis was conducted using SPSS v21 software. Descriptive analysis was conducted through distribution of frequencies (%) for categorical variables and mean/median $\pm$ standard deviation (SD) and percentiles for continuous variables. After testing the normality and homogeneity of continuous variables comparisons were made using Student-t test, ANOVA-test (or equivalent non-parametric tests). A level of significance of 5% was considered.

RESULTS

General characteristics of sample are described in Table 2. The sample was composed of mostly male children (72.1%), with median of age around 48 months (Interquartile range= 35.5-68.0), and an average BMI of $+0.04 \pm 1.52$. Around 22.1% of children presented excessive weight: 13.6% were overweight and 8.5% were obese. The most frequent FD diagnosis was picky eater (55.7%), followed by limited appetite (14.8%). Children were exclusively breastfed for average of 3.8 months.

Regarding the lipid profile of children, 47.5% of children presented at least one altered marker and were classified as having dyslipidemia. From these children, isolated low levels of HDL-c were identified in 27.6% (n= 8) of the sample, followed by isolated hypertriglyceridemia in 21.9% (n= 7), and isolated hypercholesterolemia in 17.2% (N= 5). One child (3.4%) presented alterations in all markers. The remaining children presented mixed hyperlipidemia, characterized by a combination of low HDL-c and hypertriglyceridemia (31%) or of hypercholesterolemia and hypertriglyceridemia (6.9%). Overall, the most common types of DLP were hypertriglyceridemia and low HDL levels (both around 30% prevalent) (Figure 1).

No relationship was found between presence of DLP and duration of exclusive breastfeeding (t= 0.081; IC95% -1.58-1.71; p= 0.93); average duration of breastfeeding was very similar in children with (3.75m $\pm$ 2.8) and without DLP diagnosis (3.8m $\pm$ 3.4). Lipid profiles were not associated with BMI (p> 0.40; Anova test) or with type of FD (p= 0.26; Kruskal Wallis test for LDL and triglycerides levels; p> 0.45, Anova test for HDL and total cholesterol).

Table 1. Lipid profile reference. Brazilian Society of Cardiology⁸.

Category	Low mg/dl	Acceptable mg/dl	Limit mg/dl	High mg/dl
Total Cholesterol (TC)	----	< 170	170-199	$\geq$ 200
LDL	----	< 110	110-129	$\geq$ 130
Non-HDL	----	< 120	120-144	$\geq$ 145
Triglycerides: ages 0-9	----	< 75	75-99	$\geq$ 100
HDL	< 40	> 45	< 45	----

Table 2. General characteristics of population. Instituto Pensi, 2017.

Variables (n=61)	% (N) or mean values $\pm$ SD
Gender	
Female	27.9% (17)
Male	72.1% (44)
Age (months)	53.9 $\pm$ 23.8
BMI/Age (z-score)	+0.04 $\pm$ 1.52
Duration of exclusive breastfeeding (months)	3.8 $\pm$ 3.1
Lipid profile	
Total Cholesterol mg/dl	162.6 $\pm$ 32.3
HDL-c mg/dl	56.2 $\pm$ 46.5
LDL-c mg/dl	94.6 $\pm$ 25.2
Triglycerides mg/dl	90.6 $\pm$ 55.2
Classification of dyslipidemia	47.5%
Feeding difficulties diagnosis	
Agitated	3% (3)
Limited appetite	14.8% (9)
Phobia	8.2% (5)
Misinterpretation of caregivers	11.5% (7)
Organic	4.9% (3)
Picky eating	55.7% (34)
Other types	4.9% (3)

Figure 1. Classification of lipid profile according to recommendations by age. Instituto PENSI, 2017.

The assessment of dietary intake showed that children with dyslipidemia tended to drink higher volumes of milk and SSB, ate slightly more carbohydrates and less fiber and fat than those with normal lipid profiles (Figures

2 and 3). However, values were very similar between groups, and T-Student tests showed no significant differences between these results ($p > 0.12$). Overall, dietary intake was within the recommended range (age-

Figure 2. Macronutrient and fiber intakes according to presence of DLP. Instituto PENSI, 2017

Footnote: Absolute intake values according to DLP classification (DLP vs normal values, respectively), after T-Student test: a) Fat intake (30.1% vs 31%, p= 0.49) b) Carbohydrate intake (57.7% vs 55.6%, p= 0.37) c) Fiber intake (7.7g vs 8.4g, p= 0.75).

Figure 3. Milk and SSB intake according to presence of DLP. Instituto PENSI, 2017.

Footnote: Absolute intake values according to DLP classification (DLP vs normal values, respectively), after T-Student test: a) SSB intake (241.3ml vs 204.6ml, p= 0.54) b) Milk intake (557.3ml vs 445.5ml, p= 0.12)

adjusted) for both carbohydrate and fat intake, and all children presented poor fiber intake patterns. According to the new recommendation for SSB intake in infancy (maximum 150 ml/day²³), results showed that children

classified as having dyslipidemia in this sample tended to drink higher volumes (around 90 ml/day) of SSB when compared to recommended values ($t= 2.11$; IC95% -2.8-179.8; $p= 0.044$).

DISCUSSION

Despite an overall healthy lipid profile found in the present population, high frequencies of inadequacies (values above or below recommendations) were identified—mostly alterations in HDL-c and triglycerides—and almost half of sample had dyslipidemia. Moreover, more than one third of children assessed presented mixed hyperlipidemia.

Prevalence of DLP in youth has been estimated as 23% worldwide^{6,24}. In the northeast region of Brazil (Bahia), DLP in children between 7 and 14 years old was described as 25.5%²². In the Southern region of Brazil, much lower rates have been reported: 4.7% and 8.9% for hypercholesterolemia and hypertriglyceridemia, respectively, in teenagers between 10 and 12 years old²⁵. Reuter et al.²⁶ reported a prevalence of dyslipidemia in 1,243 children aged 7 to 17 years old—also in the South of Brazil—of 36.6% in girls and of 46.6% in boys and 30% overweight/obesity. Considering this context, the prevalence of dyslipidemia found in the present population is approximately double most of data described for children in the same age elsewhere; and similar to what has been described in Brazilian adults (59.74%)⁸. Hypertriglyceridemia and low HDL were the most frequent types of dyslipidemia in the present sample. Although the general DLP prevalence is different from the national average, individual markers are somewhat like other Brazilian studies performed, but with adolescents. In the ERICA study⁹, conducted with 38069 adolescents, results showed a similar prevalence of low HDL-c (46.8%), hypercholesterolemia (20.1%) and hypertriglyceridemia (7.8%). Faria et al.²⁷, in a study with 1937 children between 2 and 19 years old, reported altered levels of LDL-c (44%) and triglycerides (56%) of the children, and 44% and 50% of adolescents, respectively.

When comparing the present results with the literature, two factors are noteworthy: 1) the prevalence of dyslipidemia in a population younger than that commonly described as having dyslipidemia; and 2) the high prevalence of DLP in a population with normal BMI. The fact that most studies on childhood DLP focus on populations at risk (such as overweight or obese children and adolescents, with family history of cardiovascular disease or dyslipidemia) impairs comparison and discussion of the present results. Moreover, the average age range of the present population (2 to 10 years old) is scarcely studied in this context, since mandatory screening is not applied at this life stage⁹. While searching for factors that could suggest reasons for these elevated DLP rates, the mean duration of exclusive breastfeeding was not associated with the changes described in the lipid profile, even though it has been described elsewhere that a short duration of exclusive breastfeeding increases the risk of childhood dyslipidemia²⁸. The homogeneous results of this variable throughout the sample (there was no group with higher or lower duration of exclusive breastfeeding to compare) could be one of the reasons of the lack of association found. The sample analyzed presented a higher duration of exclusive breastfeeding compared to national data: in Brazil, the average duration of exclusive breastfeeding is

low (around 2 months), and according to the latest national survey on breastfeeding²⁹, only 36.6% of Brazilian children are exclusively breastfed for 6 months.

We found a relatively low prevalence of overweight compared to the prevalence of dyslipidemia. Similarly, in 414 healthy children 8.9 years of age in routine follow-up, Franca et al (2006)²⁹ reported a prevalence of 30% of dyslipidemia and only 4% overweight. However, most studies on dyslipidemia during childhood address overweight populations. In a Brazilian study³⁰ with a predominantly overweight population between 2 and 18 years of age (most of whom between 10 and 18 years old), dyslipidemia was reported in 85.3% of the population; 43.8% had only low HDL-c; 1.8% had high LDL-C and 0.5% high triglycerides. Distribution according to age showed that alterations in TC was more frequent in the range of six to nine years old, LDL-c and triglycerides between 10-18 years old, and HDL-c between two and five years old. Regarding other risk factors, level of physical activity was not assessed in this population, due to the absence of direct measurements to evaluate this profile; and the genetic risk of dyslipidemia was also not assessed in this analysis, constituting a possible bias.

Analysis of possible associations between dietary intake and lipid profiles have shown adequate intake of carbohydrates, fats and milk; and children presented inadequate intake of fibers and SSB. Children with dyslipidemia in this sample presented excessive SSB intake compared to recommendations. Accordingly, many studies report associations between inadequate dietary intake and altered lipid profiles. In a multi-ethnic sample of children, intake of SSB was positively associated with higher triglyceride concentrations among consumers³¹. In American children and adolescents, usual intake of added sugars was also significantly associated with several measures of lipid profiles³²⁻³³. The premise that higher SSB intakes could be one of the possible reasons of DLP in children with FD was first hypothesized by the CDA team due to a previous study carried out by Maximino et al (2016)²⁰ with a population from the same research center as the present data. In that study, authors describe an excessive consumption of juices (carbohydrates with high glycemic index, which could impact biochemical levels), regardless of the type of FD, highlighting the need for nutritional counseling. Additionally, clinical observation also highlights frequent use of dairy compounds, often sugary and complemented with cereals and mucilage. In the present study, however, data on the composition of the dairy compounds used by this population was not available for comparison.

Unfortunately, no other studies with such comparisons (specifically children with FD) were found to discuss the present results. More controlled studies are necessary to determine whether there is risk for DLP related to dietary patterns in patients with FD or if the low intake of protective foods itself would determine such a risk. To our knowledge, this is the first report which describes a possible association between FD and dyslipidemia, possibly mediated by higher

consumption of SSB. New studies are necessary to prove the need for screening or, minimally, to alert pediatricians about the risk for DLP in children with FD, regardless of age and BMI.

The study has limitations, such as the absence of a control group, superficial data on family history of dyslipidemia, as well as lack of information on children's physical activity. Moreover, the cross-sectional design does not allow for any causal inferences. On the other hand, the study contributes to the literature, given the scarceness of data regarding the prevalence of dyslipidemia in children with FD, and for the discussion about the cause/effect relationships that may exist between both.

CONCLUSIONS

The prevalence of dyslipidemia reported was higher than the average found for populations without diagnosis of feeding difficulties, even though the population had a normal BMI. The main types of dyslipidemia found were hypertriglyceridemia and low levels of HDL. The type of feeding difficulty and breastfeeding duration were not associated with dyslipidemia. There was excessive intake of SSB in children with dyslipidemia in the sample. More studies are needed to prove robust associations between FD and dyslipidemia.

Funding and disclaimers. The study was coordinated by the PENSI Institute (Brazil). The funder has contributed to the conduct of the study, but not to the analysis of data, interpretation of findings or the preparation of the manuscript. This research received no specific grant from any funding agency, commercial or not-for-profit sectors.

Conflict of interest. The PI of the project participated as a seaker at events such as – Abbott, CPW, EMS, Danone, Nestlé, Nutrociencia, PICME, Sanofi, Wyeth; scientific board member of Danone Institute International, Danone Research, Mondelez. Supports research projects at Abbott, CNPq, Coca-Cola, CPW, Danone Institute International, Danone Research, Fapesp, Fap Unifesp, Nestlé. Authors have no participation in food, nutrition or pharmaceutical companies, and there is no influence of any company in any of the projects, conferences or publications conducted.

Authorship. Ana Bozzini: carried out the study, participated in the design, data analysis and preparation on manuscript. Rachel Vieira Machado: carried out the study, participated in the design, data analysis and preparation on manuscript. Cláudia Ramos, Priscilla Maximino, Raquel Ricci: assisted in carrying out the study and preparation on manuscript. Mauro Fisberg: supervised and assisted all phases of the study (Project PI).

Ethical Standards disclosure. This study was conducted according to the guidelines established in the Declaration of Helsinki and all procedures involving human subjects/patients

were approved by the PENSI Institute Ethical Committee (Brazil). Written informed consent was obtained from the parents of all subjects/patients.

REFERENCES

1. Yoon M. Dyslipidemia in Children and Adolescents: When and How to Diagnose and Treat? *Pediatr Gastroenterol Hepatol Nutr* 2014; 17(2): 5-92.
2. Silva N, Souza MCC. Dyslipidemia prevalence in children and adolescents: a systematic review. *Interbio* 2014; 8(2): 50-59.
3. Halpern A, Mancini MC, Magalhães MEC, Flsberg M, Radominski R, Bertolami MC, et al. Metabolic syndrome, dyslipidemia, hypertension and type 2 diabetes in youth: from diagnosis to treatment. *Diabetol Metab Syndr* 2010; 2: 55.
4. Juonala M, Viikari JS, Rönnemaa T, Marniemi J, Jula A, Loo BM, et al. Associations of dyslipidemias from childhood to adulthood with carotid intima-media thickness, elasticity, and brachial flow-mediated dilatation in adulthood: the Cardiovascular Risk in Young Finns Study. *Arteriosclerosis Thromb Vasc Biol* 2008; 28(5): 1012-1017.
5. Yang S, Hwang JS, Park HK, Lee HS, Kim HS, Kim EY.. Serum lipid concentrations, prevalence of dyslipidemia, and percentage eligible for pharmacological treatment of Korean children and adolescents; data from the Korea National Health and Nutrition Examination Survey IV (2007-2009). *PLoS One*. 2012; 7: e49523.
6. Li J, Motsko SP, Goehring EL, Tave A, Pezzullo JC, Jones Jk. Prevalence of pediatric dyslipidemia: comparison of a population-based claims database to national surveys. *Pharmacoepidemiol Drug Saf* 2010; 19(10): 1031-1040.
7. Pereira B, Arruda KGd, Cavalcanti MTdS, Diniz dS. Lipid Profile of Schoolchildren from Recife, PE. *Arq Bras Cardiol* 2010; 95(5): 606-613.
8. Faludi AA, Izar McD O, Saraiva JFK, Chacra APM, Bianco HT, Afiune Neto A. Update of the Brazilian Directive on Dyslipidemias and Prevention of Atherosclerosis – 2017. *Arq Bras Cardiol* 2017; 109(2 Suppl 1): 1-76.
9. National Institutes of Health (NIH). Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents. US Department of Health and Human Services; 2012 Oct.
10. Wilson DP, McNeal C, Blackett P. Pediatric dyslipidemia: recommendations for clinical management. *South Med J*. 2015; 108(1): 7-14.
11. Smith AJ, Turner EL, Kinra S. Universal Cholesterol Screening in Childhood: A Systematic Review. *Acad Pediatr* 2016; 16(8): 716-725.
12. Siri-Tarino PW, Krauss RM. Diet, lipids, and cardiovascular disease. *Curr Opin Lipidol* 2016; 27(4): 323-328.
13. Kell KP, Cardel MI, Bohan Brown MM, Fernández JR. Added sugars in the diet are positively associated with diastolic blood pressure and triglycerides in children. *Am J Clin Nutr* 2014; 100(1): 46-52.
14. Schuster J, Oliveira AM, Bosco SM. The role of nutrition in the prevention and treatment of cardiovascular and metabolic diseases. *Rev Soc Cardiol RS*. 2015; 28.
15. Thomazella MC, Góes MF, Andrade CR, Debbas V, Barbeiro DF, Correia RL, et al. Effects of high adherence to mediterranean or low-fat diets in medicated secondary prevention patients. *Am J Cardiol* 2011; 108(11): 1523-1529.
16. Kerzner , Milano , MacLean C, Berall , Stuart , Chatoor. A

- Practical Approach to Classifying and Managing Feeding Difficulties. *Pediatrics*. 2015; 135(2): 344-353.
17. Taylor CM, Northstone K, Wernimont SM, Emmett PM. Picky eating in preschool children: Associations with dietary fibre intakes and stool hardness. *Appetite*. 2016; 1(100): 263-271.
18. Almeida CAN, Melo ED, Maranhão HS, Vieira MC, Barros R, Fisberg M. Feeding difficulties in infancy: review of the literature focusing on the impact. *Ped Moderna* 2012; 48: 9.
19. American Society of Psychiatry. *Diagnostic and Statistical Manual of Mental Disorders - DSM V*. 2013.
20. Maximino P, Machado HV, Junqueira P, Ciari M, Tosatti AM, Ramos dCC, et al. How to monitor children with feeding difficulties in a multidisciplinary scope? Multidisciplinary care protocol for children and adolescents. *J Hum Growth Dev* 2016; 26(3): 327.
21. World Health Organization. *WHO child growth standards and the identification of severe acute malnutrition in infants and children*. 2009.
22. Institute of Medicine. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids*. Food Nutrition Board. 2002.
23. American Academy of Pediatrics. *Fruit Juice in Infants, Children, and Adolescents: Current Recommendations*. *Pediatrics* 2017; 139(6): e20170967.
24. Alcântara Neto Dd, Silva dCR, Assis MO, Pinto dj. Factors associated with dyslipidemia in children and adolescents enrolled in public schools of Salvador, Bahia. *Rev Bras Epidemiol* 2012; 15(2): 335-345.
25. Lunardi CC, Moreira M, Santos Ld. Blood lipids abnormalities and overweight prevalence in students of Santa Maria, RS, Brazil. *Rev Bras Med Esporte* 2010; 16(4): 250-253.
26. Reuter CP, da Silva PT, Renner JD, de Mello ED, Valim AR, Pasa L, et al. Dyslipidemia is Associated with Unfit and Overweight-Obese Children and Adolescents. *Arq Bras Cardiol* 2016; 106(3): 188-193.
27. Faria ECF, Dalpino FB, Takate R. Serum lipids and lipoproteins in children and adolescents from a public university hospital outpatient clinic. *Rev Paul Pediatr* 2008; 26(1): 54-58.
28. Salazar-Martinez E, Rodriguez-Valentin R, Albavera-Hernandez C, Carreon-Rodriguez A, Lazcano-Ponce E. Number of colony-forming unit-Hill colonies among children and teenagers with obesity, dyslipidemia and breastfeeding history. *Nutr Metab Cardiovasc Dis* 2016; 26(6): 534-540.
29. Siqueira Boccolini C, de Moraes Mello Boccolini P, Ramos Monteiro F, Isoyama Venâncio S, Justo Giugliani ER. Tendency of lactation indicators in Brazil in three decades. *Rev Saúde Pública* 2017; 51: 1-9.
30. Ramos AT, Carvalho FD, Gonzaga NC, Cardoso AS, Noronha JAF, Cardoso MAA. Lipid profile in overweight children and adolescents. *J Hum Growth Dev* 2011; 21(3): 780-788.
31. Van Rompay MI, McKeown NM, Goodman E, Eliasziw M, Chomitz VR, Gordon CM, et al. Sugar-Sweetened Beverage Intake Is Positively Associated with Baseline Triglyceride Concentrations, and Changes in Intake Are Inversely Associated with Changes in HDL Cholesterol over 12 Months in a Multi-Ethnic Sample of Children. *J Nutr*. 2015; 145(10): 2389-2395.
32. Kell KP, Cardel MI, Brown MMB, Fernández JR. Added sugars in the diet are positively associated with diastolic blood pressure and triglycerides in children. *The Am J Clin Nut*. 2014; 100(1): 46-52.
33. Zhang Z, Gillespie C, Welsh JA, Hu FB, Yang Q. Usual Intake of Added Sugars and Lipid Profiles Among the U.S. Adolescents: National Health and Nutrition Examination Survey, 2005–2010. *J Adol Health*. 2015; 56(3): 352-359.