Household availability of lipids for consumption and its relationship with serum lipids in adolescents

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Disponibilidad domiciliar de lípidos para consumo y su relación con los lípidos séricos de adolescentes

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ABSTRACT

Objective: To analyze the correlation between household availability of lipids to be consumed and the serum lipid profile in adolescents.

Methods: This cross sectional study enrolled 95 adolescents aged 10–13 years, selected by random raffle in public schools of Viçosa, Southeast Brazil. A monthly shopping list was used to evaluate the availability of food *per capita*. A blood sample was collected from each adolescent and Brazilian Cardiology Society guideline was adopted as a reference for lipid profile adequacy. For categorical variables, the chi-square was applied and the *Odds Ratio* calculated. For comparison between groups, Mann-Whitney or Student's *t* test, Kruskall-Wallis test or ANOVA were applied. Association between biochemical parameters and lipid availability was evaluated by Spearman or Pearson correlation tests.

Results: 27.2% of the total available energy came from lipids. The availability of saturated fatty acids, monounsaturated and polyunsaturated agreed with the recommendation for their consumption. Regarding serum lipids, 51.9% of boys and 55.8% of girls showed alteration in total cholesterol (p=0.66); 18.6 and 25.6% of boys and girls, respectively, showed increased triglycerides level (girls>boys; p=0.02). In relation to LDL, 21.2 and 32.6% of boys and girls, respectively, showed alteration (p=0.91). The prevalence of inadequacy for HDL was of 26.9 and 30.2% of boys and girls, respectively (p=0.93). There was no correlation between the available lipids for consumption and the serum lipids. The teenagers with more than 35% of lipids to be consumed had 9.1-fold higher levels of total cholesterol (95%CI 1.81–61.74).

Conclusions: It is possible that adolescents with higher lipid availability at home show higher total cholesterol.

Key-words: dietary fats; dyslipidemias; adolescent nutrition.

RESUMO

Objetivo: Relacionar a disponibilidade domiciliar de lipídeos para consumo e o perfil lipídico sérico de adolescentes.

Métodos: Estudo transversal observacional. Avaliaram-se 95 adolescentes púberes de 10 a 13 anos de escolas públicas em Viçosa, Minas Gerais. Utilizou-se uma lista de compras mensal para avaliar a disponibilidade de alimentos *per capita*. Coletou-se amostra de sangue dos adolescentes, adotando-se o preconizado pela Sociedade Brasileira de Cardiologia como referência para adequação do perfil lipídico. Para as variáveis categóricas realizou-se o teste do qui-quadrado e calculou-se a *Odds Ratio*. Para comparar os grupos, aplicaram-se os testes

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Mann-Whitney ou *t* de Student, Kruskall-Wallis ou ANOVA. Verificou-se relação entre exames bioquímicos e disponibilidade de lipídeos pelas correlações de Spearmam ou de Pearson.

Resultados: Da energia total disponível, 27,2% foram provenientes de lipídeos. A disponibilidade de ácidos graxos saturados, monoinsaturados e poli-insaturados esteve de acordo com a recomendação de consumo. Em relação aos lipídeos séricos, 51,9% dos meninos e 55,8% das meninas apresentaram alterações de colesterol total (p=0,66); 18,6 e 25,6%, dos meninos e das meninas, respectivamente, apresentaram elevação de triglicerídeos, (meninas>meninos; p=0,02). Em relação ao LDL, 21,2 e 32,6% dos meninos e das meninas, respectivamente, apresentaram alterações (p=0,91). A prevalência de inadequação para HDL foi de 26,9 e 30,2% (p=0,93), para meninos e meninas, respectivamente. Não houve correlação entre os lipídeos disponíveis para consumo e os lipídeos séricos. Os adolescentes que possuíam mais que 35% de lipídeos disponíveis para consumo tiveram 9,1 vezes mais chances de apresentarem alterações de colesterol total (IC95% 1,81–61,74).

Conclusões: É possível que adolescentes com maior disponibilidade de lipídeos para consumo apresentem colesterol total mais elevado.

Palavras-chave: gorduras na dieta; dislipidemias; nutrição do adolescente.

RESUMEN

Objetivo: Relacionar la disponibilidad domiciliar de lípidos para consumo y el perfil lipídico sérico de adolescentes.

Métodos: Estudio transversal, observacional. Se evaluó a 95 adolescentes púberes de 10 a 13 años, de escuelas públicas en Viçosa, Minas Gerais (Brasil). Se utilizó una lista de compras mensual para evaluación de la disponibilidad de alimentos *per capita*. Se recogió muestra de sangre de los adolescentes, adoptándose lo preconizado por la Sociedad Brasileña de Cardiología como referencia para adecuación del perfil lipídico. Para las variables categóricas, se utilizó la prueba de chi cuadrado y se calculó la *Odds Ratio*. Para comparar los grupos, se aplicaron las pruebas de Mann-Whitney o *t* de Student, Kruskall-Wallis o ANOVA. Se verificó la relación entre exámenes bioquímicos y disponibilidad de lípidos por las correlaciones de Spearman o de Pearson.

Resultados: De la energía total disponible, el 27,2% fue proveniente de lípidos. La disponibilidad de ácidos grasos saturados, monoinsaturados o poli-insaturados, estuvo en conformidad con la recomendación de consumo. Respecto a los lípidos séricos, 51,9% de los muchachos y 55,8% de las muchachas presentaron alteraciones de colesterol total (p=0,66); 18,6 y 25,6% de los muchachos y muchachas, respectivamente, presentaron aumento de los triglicéridos (muchachas>muchachos; p=0,02). Respecto al LDL, 21,2 y 32,6% de los muchachos y muchachas, respectivamente, presentaron alteraciones (p=0,91). La prevalencia de inadecuación para HDL fue de 26,9 y 30,2% (p=0,93) respectivamente para muchachos y muchachas. No hubo correlación entre lípidos disponibles para consumo y lípidos séricos. Los adolescentes que poseían más que 35% de lípidos disponibles para consumo tuvieron 9,1 veces más posibilidad de presentar alteraciones de colesterol total (IC95% 1,81–61,74).

Conclusiones: Es posible que adolescentes con mayor disponibilidad de lípidos para consumo presenten colesterol total más elevado.

Palabras clave: grasas en la dieta; dislipidemias; nutrición del adolescente.

Introduction

In adolescence, which is defined by the World Health Organization (WHO) as the period between 10 and 19 years old, there are physiological, psychological and social changes that may occur in different ways in different individuals. This is a period of nutritional vulnerability and consolidation of food habits, which, if not adequate, can cause the risk of diseases[1].

The Household Budget Survey (HBS), conducted in metropolitan areas of Brazil between 2002 and 2003, showed that the diet of the Brazilian population was characterized by increased levels of saturated fat and lipid content in general, also showing that the evolution of food consumption patterns in the last three decades has tended towards the increase of risk factors for the development of obesity, diabetes, cardiovascular disease, certain types of cancers and other chronic diseases[2]. The 2008–2009 HBS showed that excess body weight in the population has been increasing since the mid-1970s and is found in about half of Brazilian people[3]. Campos *et al*[4] point out that, regardless of ethnicity, there is evidence that the individuals who consume high amounts of lipids, especially of the saturated kind, usually have high levels of serum cholesterol and higher risks of developing cardiovascular disease.

Lipids are macronutrients that perform energy, structural and hormonal functions in the body, adding flavor to food

and the feeling of satiety. They also convey liposoluble vitamins, being almost all of them composed of fatty acids. Saturated fatty acids are found primarily in animal fats. Unsaturated fatty acids are divided into monounsaturated fats, present in oils such as the olive oil, and polyunsaturated fats, common in soybean, canola and fish oils, including also the so-called trans, present in some industrialized products. There are also the polyunsaturated fatty acids called essential, which cannot be synthesized by the human organism, and that must be provided through feeding, among which we highlight omega 3 and 6[5].

The lipid profile is defined by biochemical determinations of total cholesterol (TC), high-density lipoprotein (HDL), low-density lipoprotein (LDL) and triglycerides (TG) after fasting for 12 to 14 hours[6], and can be used to assess the adequate balance of blood lipids.

In this context, it is important to check the food availability in adolescent households, since the exaggerated lipid intake may contribute to inadequate dietary habits, which can contribute to negative consequences on their future health. Therefore, this study aimed at verifying the relationship between the lipid availability for household consumption and the lipid profile of adolescents in Viçosa, Minas Gerais.

Method

This was a cross-sectional, observational study, taking the individual as the study unity. The sample selection was based on information from the Anísio Teixeira National Institute of Educational Studies and Research (INEP), which indicated, in 2008, the presence of 25 schools offering elementary education in the municipality of Viçosa[7]. The study encompassed 100% (n=19) of public schools in the urban area.

To calculate the sample size, the present study, which is part of a more comprehensive research[8], used the total number of adolescents between 10 and 13 years in the municipality, which, according to Datasus[9] was of 4,815; the frequency of excess weight of 10%, obtained in previous studies with the local population of adolescents[10], with acceptable margin variation of 2% and confidence level of 99%, totaling 92 adolescents to be studied. Due to the possible sample loss expected and for a higher homogeneity and distribution of the data regarding gender and age group, 20% were added to the initial calculation, totaling 110 adolescents.

The schools were visited and all the students who demonstrated interest in participating were subjected to random selection. The presence of chronic diseases and/or medications that could alter lipid metabolism constituted exclusion criteria. At the end, 146 adolescents of both sexes were randomly selected, who attended the assessment of sexual maturation, from which 25 were excluded for being pre-pubertal and one for abandonment. Thus, 120 adolescents underwent biochemical tests, but we were able to obtain the monthly shopping-list of the families with information on foodstuffs and quantities of 95 adolescents, which was the final number of the sample. All adolescents lived with their families in Viçosa. They were considered pubertal, according to the Tanner[11] classification, after being examined by a pediatrician.

The family shopping-list was used to assess the per capita food availability in households of adolescents and contained information about the monthly amount of food purchased. Such information was obtained by receipts or by estimating the amount and frequency of purchase in a single month[2,12]. The estimated calculation of food available daily per capita was achieved by dividing the monthly amount of available food at home by the number of residents and the number of days of that month[12]. Foods that did not have the specified amount were discarded.

The food composition and its lipid content were established by the Diet Pro® 4.0 software, from the Table of Dietary Guidelines for Americans (USDA). For foods that were not listed on this table, the information was taken from labels or tables of chemical composition[13].

The diets lipid values were compared with the diet recommended by the Institute of Medicine (IOM)[14], using the Acceptable Macronutrient Distribution Range (AMDR). According to the IOM, 25 to 35% of the total energy intake should be derived from lipids, 5 to 10% from omega-6 (ω-6 PFA) and 0.6 to 1.2% from omega-3 (ω-3 PFA).

The percentage of saturated fat (SFA) was considered high when it exceeded 7% and of monounsaturated (MFA) when above 20% of total caloric intake[15]. The availability of soy oil, widely used by Brazilians, was also measured, and the per capita amount stipulated by the food pyramid adapted to the Brazilian population, 16mL[16], was considered adequate.

The contribution of various kinds of meat to the final lipid composition of shopping-lists was also considered and integrated the data presented, since 100% of families reported buying meat regularly.

Collection of blood samples to determine the serum lipid profile was performed by technically qualified professionals from the Clinical Laboratory of the Division of Health from the Universidade Federal de Viçosa, after fasting for 12 hours,

with disposable material. We collected 10mL of venous blood, which was centrifuged in an Excelsa centrifuge (206 BL) for 10 minutes at 3,500rpm right after the collection (observing time for blood clotting). TC, HDL and TG were measured enzymatically, and automated by the Cobas Mira Plus (Roche®) equipment; LDL was calculated with the Friedwald[17] formula. The results were assessed according to the I Guideline for Prevention of Atherosclerosis in Childhood and Adolescence[15].

For analysis of categorical variables, the chi-square test was performed and the Odds Ratio (OR) was calculated. Quantitative variables were tested for normality with the Kolmogorov-Smirnov test, from which the best test was selected to compare two groups (Mann-Whitney or *t* Student test) or three groups (Kruskall-Wallis or ANOVA). The relation between biochemical exams and lipid availability was verified by the Spearman or Pearson correlation tests. The Sigma Statistic® 2.0 and Epi-Info 6.0 softwares were used, and $p<0.05$ was considered significant.

Participants presented informed consent term signed by their parents or guardians. The study was approved by the Ethics Committee in Research with Humans of the Universidade Federal de Viçosa.

Table 1 - daily caloric lipid availability per capita

	n	$\bar{X}$±DP	Md (min–max)
Male	52	592.8±263.2	532.9 (145.4–1,495.8)
Female	43	591.4±261.9	528.9 (235.6–1,510.3)
Total	95	592.2±261.3	530.0 (145.4–1,510.3)

X±DP: mean and standard deviation; Md: median; min-max: minimum and maximum values. Mann-Whitney Test (p=0.87)

Table 2 - Adequacy of per capita lipid availability obtained by the shopping-list of adolescents between 10 and 13 years, by gender

	Above (>35%)	Adequate (25–35%)	Below (<25%)
	%	%	%
Male (n=52)	21.2	55.8	23.1
Female (n=43)	16.3	58.2	25.6
Total	18.9	56.8	24.2

Chi-square: Above vs. Adequate (p=0.58); Adequate vs. Below (p=0.90); Above vs. Below (p=0.56)

Results

Boys totaled 54.7% (n=52) of the sample. The total daily energy available presented median of 1,952kcal (862.0–4,263) for both genders; 1,908kcal for boys, (862.2–4,263) and 1,959kcal (935.1–3,864) for girls (p=0.70).

Table 1 shows the per capita caloric availability of added lipids and constitution of foods. There was no gender difference for this parameter (p=0.87). Regarding total energy, the availability was of 27.7% for boys and 27.0% for girls. For the total sample, there was an availability of 27.2%.

Table 2 shows the percentage of lipids adequacy, according to the recommended levels. There was no difference between genders.

All the families interviewed purchased soy oil. Quantitative analysis of this product showed 23mL (5–72mL) available daily per capita, which meant approximately 760mL of soy oil available monthly for each family member.

The type of lipid, as source of the fatty acid types, was analyzed and is presented in Table 3. Table 4 presents the mean and median values of serum lipid profile in adolescents.

Table 3 - Amount and class of fatty acids available for consumption by adolescents from 10 to 13 years, by gender

Lipids (g)	Total (n=95)			Male (n=52)			Female (n=43)			*p*-value
	$\bar{X}$±DP	Md (min-max)	%	$\bar{X}$±DP	Md (min-max)	%	$\bar{X}$±DP	Md (min-max)	%	
TL	65.8±29.0	58.8 (16.2–167.8)	27.2	66.5±28.9	59.2 (16.2–166.2)	27.7	64.9±29.5	58.7 (16.2–167.8)	27.0	0.76
SFA	16.5±8.8	14.6 (3.0–49.9)	6.7	16.3±8.5	14.7 (3.0–43.6)	6.9	16.7±9.3	14.5 (3.0–49.9)	6.7	0.99
MFA	19.5±10.4	17.1 (4.3–67.5)	7.9	19.5±9.8	17.4 (4.3–54.9)	8.2	19.6±11.2	17.0 (4.3–67.5)	7.8	0.78
PFA ω-6	17.4±8.1	16.3 (1.2 –45.5)	7.5	17.9±9.0	16.8 (1.2–45.5)	7.9	16.9±7.1	15.9 (5.8–32.5)	7.3	0.53
PFA ω-3	2.3±1.1	2.1 (0.5–5.8)	0.9	2.3±1.2	2.2 (0.5–5.8)	1.1	2.2±0.9	2.0 (0.6–4.3)	0.9	0.54

X±DP: mean and standard deviation; Md: median; min-max: minimum and maximum values; %: percentage referring to total calories; TL: total lipids; SFA: saturated fatty acids; MFA: monounsaturated fatty acids; PFA ω-3: omega-3 polyunsaturated fatty acids; PFA ω-6: omega-6 polyunsaturated fatty acids

Table 4 - lipid serum profile of adolescents from 10 to 13 years, by gender

Lipids (mg/dL)	Male (n=52) $\bar{X}$±DP Md (min-max)	Female (n=43) $\bar{X}$±DP Md (min-max)	*p*-value
TC	154.9±25.9 151.5 (114.0–259.0)	157.5±30.9 154.0 (93.0–221.0)	0.65
TG	68.9±47.0 55.0 (21.0–276.0)	81.6±40.1 72.0 (30.0–195.0)	0.02
LDL	88.6±22.5 86.4 (47.0–181.0)	88.5±25.9 82.6 (39.8–147.6)	0.90
HDL	52.5±11.8 49.0 (31.0–85.0)	52.7±16.6 52.0 (24.0–115.0)	0.93

X±DP: mean and standard deviation; Md: median; min-max: minimum and maximum values; TC: total cholesterol; TG: triglycerides: LDL: low-density lipoprotein; HDL: high-density lipoprotein

Table 5 - Correlation between lipid profile and lipid availability for consumption by teenagers from 10 to 13 years

Serum lipids	Lipids available for consumption				
	TL	SFA	PFA ω-3	PFA ω-6	MFA
TC	-0.2	0.1	-0.1	-0.2	0.1
TG	0.1	0.1	0.1	0.1	0.3
LDL	-0.2	0.1	-0.1	-0.2*	0.1
HDL	-0.1	0.2*	-0.1	-0.1	0.2

TL: total lipids; SFA: saturated fatty acids; MFA: monounsaturated fatty acids; PFA ω-3: omega-3 polyunsaturated fatty acids; PFA ω-6: omega-6 polyunsaturated fatty acids; TC: total cholesterol; TG: triglycerides; LDL: low-density lipoprotein; HDL: high-density lipoprotein.
*p<0.05 (Pearson or Spearman Correlation).

Table 6 - Serum lipid profile in adolescents from 10 to 13 years, according to the adequacy of lipid availability

Serum lipids (mg/dL)	Below (<25%) $\bar{X}$±DP Md (min-max)	Adequate (25-35%) $\bar{X}$±DP Md (min-max)	Above (>35%) $\bar{X}$±DP Md (min-max)	*p*-value
TC	145.8±28.3 142.0 (93.0-205.0)*	156.5±29.5 152.5 (108.0-259.0)	167.7±18.2 164.0 (141.0-214.0)*	0.01
TG	72.8±47.1 64.0 (25.0-228.0)*#	76.9±45.8 66.5 (21.0-276.0)#	70.4±36.9 65.0 (27.0-164.0)*	<0.001
LDL	82.5±23.3 76.4 (47.0-130.6)	89.1±26.2 83.9 (39.8-181.0)	94.7±15.7 90.3 (77.8-145.8)	0.06
HDL	48.8±10.7 48.0 (26.0-75.0)	52.1±14.9 48.5 (24.0-115.0)	58.9±13.7 57.5 (35.0-82.0)	0.06

X±DP: mean and standard deviation; Md: median; min-max: minimum and maximum values; TC: total cholesterol; TG: triglycerides; LDL: low-density lipoprotein; HDL: high-density lipoprotein. **#**Dunn's multiple comparisons test: equal symbols on the same row indicate statistical difference (p<0.05)

Regarding the prevalence of changes, 69.8% (n=67) presented at least one and 5.3% (n=5) presented all four biochemical exams altered. It was verified that 51.9% of boys and 55.8% of girls had changes in TC values; 18.6 and 25.6% of boys and girls, respectively, presented high TG. In relation to LDL, 21.1 and 32.6% of boys and girls had high values for this parameter, respectively. The prevalence of HDL inadequacy was of 26.9 and 30.2%, respectively, for boys and girls.

Table 5 shows the correlations between lipid serum profile and lipid availability for consumption of the adolescents.

The results of the comparison between the lipid serum profile, according to the lipid availability adequacy for consumption, are found in Table 6.

Through OR, it was found that the adolescents who had more than 35% fat available for consumption were 9.11-fold more likely (95%CI 1.81–61.74) to present changes in total cholesterol than the adolescents with adequate or low availability.

Discussion

Important changes in serum lipid profile of the individuals were observed, as well as a high number of families with lipid availability over 35% of total calories. Such facts may be the result of the current trend of increased consumption of energetic foods with high fat content.

According to the HBS[2], in 2002 and 2003 in Brazil, the average energy availability per capita was of 1,800kcal/day. In 2006, using the shopping-list, Barbosa *et al*[12] studied female adolescents and found a median daily availability of 1,868kcal. Comparing to the present study, there was an increase of 7.7% in relation to the HBS[2] and 4.3% in relation to the study of Barbosa *et al*[12]. The 2008–2009 HBS[3] points out more satisfaction of the Brazilian population with the amount of food consumed, 64.5% of families report to always have enough food at their homes, a percentage that is higher than the presented in 2002–2003 (53.0%). Such facts may show that the population is having access to a larger amount of food, which may explain the increased caloric availability.

However, a considerate percentage of adolescents had larger quantities of lipids at home than the recommended for consumption. This fact requires attention, since it is expected that, as the availability is increased, the consumption may also increase. The prevalence of excess consumption of this nutrient is already reported in some studies[18-20]. If increasing access to food in Brazil is not complemented by concrete strategies of nutrition education, dietary inadequacies will probably tend to grow, bringing the risk of development of non-communicable chronic diseases by age groups ever younger.

The percentage of availability of SFA, MFA, ω-3 and ω-6 PFA were within the ranges recommended by the AMDR, which means that the adolescents had enough quantity and quality of lipids to balance their meals. It should be noted, however, a ratio of approximately 8:1 of ω-6 and ω-3 PFA. In a review study, Barbosa *et al*[21] address the controversial recommendations of this ratio, pointing out that in case it was smaller, there could be synergistic effects between the consumption of both fatty acids.

In a study with female adolescents, aged 14–17 years[10], there was a daily average per capita availability of 24mL soy oil; the values found in the present study, however, are inferior, but both are above the recommended by the food pyramid adapted to the Brazilian population[16]. This fact may contribute to the imbalance of the adequate proportion of ω-3 and ω-6 PFA, since soy oil is a source of ω-6 PFA[21].

The inadequacies found for serum cholesterol fractions (LDL and HDL) are worth highlighting, as well as those for TG. Different studies on adolescents presented similar means to those found in this study[22-25]. In a study conducted in northeastern Brazil with adolescents from public schools and at the same age group, Pereira *et al*[26] found a percentage of TC inadequacy of 36.2%, a value below those found for boys and girls in this study (51.9 and 55.8%, respectively). The authors also found that, as in this study, there were great inadequacies in the concentrations of HDL (56.0%), LDL (14.5%) and TG (35.3%). In Mexico, in a study with adolescents of both genders, it was also found a significant percentage of changes in lipid profile, 20% for TG, 20% for TC, 30% for LDL and 66% for HDL[27].

The inappropriate feeding behavior, as well as the decline of physical activity becoming increasingly prominent in modern life, may be determining factors for those inadequacies[28,29]. Intervention strategies are urgently needed and must be a concern of the family, the school and the government.

According to Katon, Flores and Salmerón[30], metabolic profile, including lipid variables, is strongly associated with sexual development. However, the fact that all adolescents in this study were in pubertal stage provided more homogeneity to the data. Girls had higher values in serum TG levels. Some studies found no gender differences[31,32], while others, similarly to the observed results, showed higher values for females[25,33-35].

According to the correlations presented, it was found that the lipid availability for was not related to the lipid profile of adolescents, except in two unexpected situations in which HDL was positively related to the availability of SFA ($r=0.21$; $p<0.05$) and LDL was negatively correlated with the availability of ω-6 PFA ($r=-0.25$; $p<0.05$). It is known that SFA are potentially atherogenic, and are related to the increase of TC and LDL but not HDL. The disproportionate consumption of ω-6 and ω-3 PFA may also have an atherogenic effect, increasing levels of LDL[15]. Such discrepancies may be explained by the fact that the family shopping-list may infer consumption, but not necessarily predict the actual food consumption.

The present study, as well as the HBS[2], did not take into consideration the food purchased outside the home environment, such as snacks or meals eaten elsewhere. This fact probably confirms the justification of the difficulty in relating the data presented. It is assumed that, by not considering such foods, consumption might be underestimated, making the availability inefficient at predicting changes in blood lipids.

From these results, it is noteworthy that, possibly, a larger number of lists, as well as the inclusion of products purchased outside the home environment by the adolescent, or the association of the list with an investigation that considers the consumption of food, would be useful resources in complementing the data. Another important point is the variation of information between tables and labels, which may underestimate or overestimate their lipid composition.

TC showed a association with the availability of lipids, and adolescents with more than 35% fat intake were more likely to present changes. In another study with adolescents, Guedes *et al*[24] found that at analyzing the intake of total lipids, girls who had an excess intake were 1.93-fold (95%CI 1.66–2.17) more likely to have high levels of TC. Boys were 1.61-fold (95%CI 1.42–1.83) more likely. In this case, it is verified that, despite the difficulty in relating available lipids with serum lipids, the shopping-list was able to present an important association.

The use of the shopping-list may have been a limitation of this study, once it is known that, regardless of the method chosen to quantify the food intake and/or availability, it is difficult to obtain valid and reliable data, since there is no method considered as gold standard. The difficulty in relating the availability of lipids for consumption with the lipid profile is adolescents can be explained, partly, by the errors, which are inherent to dietary assessment. However, the shopping-list allows us to learn about food availability in the context in which the individual belongs, which is a prerequisite in the identification of dietary habits, the planning of effective intervention and nutritional guidance.

In conclusion, this study suggests that the increased lipid availability for consumption in households is an issue that may be related to higher total cholesterol levels in adolescents. Since adolescence is a critical period for the incorporation of dietary habits and installation of changes in nutritional status, it is extremely important to introduce specific programs on adolescent health, focused on individual and family education and counseling, which could prevent or minimize problems in the short and long-term.

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