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ORIGINAL ARTICLE

ERICA: prevalence of fish consumption and its association with cardiovascular risk factors and healthy behavior in Brazilian adolescents

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Abstract
Objective: To describe the prevalence of fish consumption and its association with cardiovascular risk factors and healthy behavior in Brazilian adolescents.
Method: The authors investigated data from 71,533 participants of the Study of Cardiovascular Risk in Adolescents (Estudo de Riscos Cardiovasculares em Adolescentes - ERICA), a nationwide, cross-sectional, school-based study. Of these, 37,815 adolescents were included for blood analyses. All prevalence estimates were presented proportionally with their 95% confidence intervals. Bivariate relationships were evaluated with Pearson's Chi-square test, and a multinomial logistic regression model was applied, considering $p < 0.05$.
Results: Prevalence of fish consumption in the 7 days prior to the interview was 28.6% (95%CI 26.9-30.3), significantly higher among male adolescents (p = 0.0049), Asian descendants (p = 0.0270), private and rural school students ($p < 0.001$), and who resided in the Northern region ($p < 0.001$). A positive association between fish consumption and healthy behavior (breakfast consumption: OR=1.16; 95%CI 1.10-1.22; meals with family members: lunch: OR = 1.07; 95%CI 1.01-1.13; dinner: OR = 1.13; 95%CI 1.04-1.23; physical activity: OR = 1.14; 95%CI 1.02-1.28) and an inverse association with hypertriglyceridemia (OR = 0.84; 95%CI 0.73−0.98) remained significant even after adjustment for possible confounding factors.

Study conducted at the Universidade do Estado do Rio de Janeiro, Faculdade de Ciências Médicas, Programa de Pós-Graduação em Ciências Médicas, Núcleo de Estudos da Saúde do Adolescente, Rio de Janeiro, RJ, Brazil.

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Conclusion: This study demonstrated that fish consumption was associated with lower cardiovascular risk and may represent a marker of a healthy lifestyle in Brazilian adolescents.

Introduction

Fish consumption protects from cardiovascular disease (CVD) and decreases CVD mortality.[1] Clinical studies indicate beneficial effects and include a specific recommendation to consume at least 1 to 2 fish servings (3.5 oz per serving) per week, preferably oily fish, to reduce the risk of congestive heart failure, coronary heart disease, ischemic stroke, and sudden cardiac death in adults.[2] Guidelines for cardiovascular health promotion recommend at least two servings of fish weekly for children and adolescents.[3] In addition to healthy behavior, such as physical activity, breakfast consumption, and having meals with family members, fish consumption contributes to better overall diet quality and has proven effects over control of cardiovascular risk factors and childhood obesity.[4]

Few studies have evaluated the health benefits of fish consumption on lipid profiles,[5,6] on improving cognitive performance and academic achievement,[7] insulin sensitivity,[8] and blood pressure in adolescents.[6] Despite these advantages, it seems as if young people, in particular, have negative attitudes toward eating fish, possibly due to the peculiar smell, texture, and the fear of finding bones.[9]

Considering the period of intense changes, habits acquired during adolescence are significant determinants of growth and development. Unfortunately, inadequate diet, sedentary behavior, modern habits of skipping breakfast, and having meals in front of screens instead of families gathered around tables and eating together have been found among Brazilian adolescents. Adolescents' diet has been characterized by insufficient consumption of natural foods, low consumption of fish,[10] and high intake of ultra-processed foods, especially in school meals.[11] Skipping breakfast was observed in 68.7% of them, and it was associated with central obesity and high levels of total cholesterol, insulin, glucose and glycated hemoglobin.[12]

In this context, given the global awareness and relevance of this theme, the authors describe the prevalence of fish consumption and its association with cardiovascular risk factors and healthy behavior in Brazilian adolescents. As far as is known, no nationwide representative study has investigated these associations proposed in this research.

Methods

This research is part of the Study of Cardiovascular Risk in Adolescents (*Estudo de Riscos Cardiovasculares em Adolescentes* – ERICA), a multicenter, school-based country-wide cross-sectional study conducted between 2013 – 2014 in Brazil. ERICA's objective was to estimate the prevalence of cardiovascular risk factors and the association between these factors in adolescents of both sexes, aged between 12 and 17 years, from private and public schools, in Brazilian cities with more than 100,000 inhabitants.[13] A more detailed description of the sample design has been previously published.[14]

ERICA was conducted according to the principles of the Helsinki declaration. The study was approved by the Research Ethics Committee of the Institute of Studies on Public Health of the Universidade Federal do Rio de Janeiro (approval number 45/2008) and by the Ethics Committees of each participating institution. All students and their respective parents signed an informed consent form. Confidentiality and student privacy were secured throughout the study.[13]

For the present study, the authors used data from students randomly selected classes of 1,251 schools in 124 Brazilian cities aged 12 to 17 years. In addition, the authors analyzed a fasting blood sample from a sub-sample who attended morning classes in schools. Adolescents with physical or mental disabilities and pregnant were excluded from the analyses. All eligible students received information about the study and were invited to take part in the research.

The selected students answered a questionnaire that contained questions about sociodemographic aspects, physical activity, diet habits, and behaviors. All the information was collected by way of a handheld computer (Personal Digital Assistant, model LG GM750Q). The classification of the pubertal stage was self-reported, using the figures of Tanner's criteria. Subsequently, adolescents were categorized as pre-pubescent (stage I), pubescent (stages II-IV), and post-pubescent (stage V). Demographic questions included sex (male or female), age (categorized as 12-14 years; 15-17 years), race, type of school (public or private), school region (urban or rural), geographic region (North, Northeast, Southeast, South, Midwest), and maternal educational level. The race was self-reported as white, black, brown, yellow (Asian descendants), and native Brazilian.[15] Maternal educational level was categorized as illiterate; primary (elementary school); secondary (high school), and tertiary (college).

To assess the frequency of fish consumption in the last 7 days prior to the interview, the block on diet habits and behaviors included the question with the following answer options: "I do not eat fish"; "I haven't eaten fish in 7 days"; "I ate fish 1 or 2 days a week"; "I ate fish 3 or 4 days a week"; "I ate fish 5 or 6 days a week"; "I ate fish every day"; and "I do not remember." For the analysis, the authors grouped the answers "I do not eat fish" and "I haven't eaten fish in 7 days", obtaining the variable "I do not consume fish."

To assess the habit of fish consumption, the authors grouped all the options to obtain the variable "I consume fish." Those who answered "I do not remember" to the question about fish consumption were excluded from the analysis. Also, adolescents answered about the frequency of breakfast consumption and having meals with family members with the following possible answers: "never", "sometimes", "almost every day" and "every day". In terms of physical activity, those who practiced less than 300 minutes per week were considered "insufficiently active" and "active" who practiced for more than 300 minutes per week.

Anthropometric data were collected by trained researchers, according to written standardized procedures. Measurements were made in duplicate for quality control. The individuals were measured using light clothing and no shoes. Height was measured to the nearest 0.1 cm using a calibrated stadiometer (AltureExata®, Minas Gerais, Brazil), and the bodyweight was measured to the nearest 50g, by using an electronic scale (Model P150m, 200kg, Líder®, São Paulo, Brazil). Waist circumference was measured with the individual in the upright position, with the abdomen relaxed at the end of gentle expiration, using a non-elastic tape with resolution in millimeters and length of 1.5 meters (Sanny®, São Paulo, Brazil). Measurement was done horizontally, at half the distance between the iliac crest and the lower rib margin.[13] Body mass index (BMI) was calculated (defined as weight in kilograms divided by the square of height in meters), and the World Health Organization reference curves using the index BMI/age, according to sex, was used.[16] The authors classify the adolescents' nutritional status into three categories: "underweight" (very low/low weight), "normal weight", and "excess weight" (overweight/obese).

Systolic and diastolic blood pressure were measured by automatic oscillometric device Omron® 705-1T (Omron Healthcare, Bannockburn, IL, USA), which has already been validated for adolescents.[17] Before the blood pressure was measured in the right arm, the adolescent sat quietly for 5 minutes. Three consecutive measures were obtained for each individual, with a three-minute interval between each measurement. The mean of the last two measurements was used for the analysis.[13] Hypertension was defined as values of systolic or diastolic blood pressure $\geq$ 95th percentile for sex, age, and height.[18]

Blood samples were collected after a 12-hour overnight fast and were analyzed at the reference laboratory, and quality control was based on the criteria from the Clinical Pathology Society. Lipid profile was measured by way of an enzymatic colorimetric assay (Roche, Indianapolis, IN, USA; Modular analyzer). Plasma glucose levels were measured by the hexokinase method using a Siemens ADVIA 2400. Glycated hemoglobin was measured by ion-exchange chromatography, while insulin levels were measured via chemiluminescence using a Modular E170s unit (Roche Diagnostics).[13] The homeostatic model assessment of insulin resistance index (HOMA-IR) was calculated using the equation: plasma glucose (mmol/L) x insulin (μU/L)/22.5.[19] As previously reported, the cut-off of HOMA-IR associated with metabolic syndrome was 2.80 (sensitivity, 73.1%; specificity, 83%) in the overall adolescent population.[20]

The prevalence of fish consumption and the respective 95% confidence intervals (95% CI) were estimated according to sex, age, race, type, and region of school, for the country and geographic region. Pearson's Chi-square test was performed to investigate the association between exposure and categorical outcomes. The associations between fish consumption and cardiovascular risk factors and healthy behavior were separately examined in logistic regression analyses, estimating the odds ratio (OR), and investigated using a multivariate model, where the variables that presented statistical significance in the bivariate model were considered. Data analysis was performed using Stata® software (Stata Corp., College Station, TX, USA) version 14.0. Due to the complex sample design, the 'survey' command was used to correct estimates. The threshold of significance was set at 5% ($p < 0.05$) for all analyses.

Results

Overall, 71,533 adolescents answered the questionnaire. Of these, 37,815 adolescents were included for blood analyses. Among the adolescents evaluated, the average age was 14.6 years (SD = 1.6), 50.2% were male, 52.7% were aged between 12 and 14 years old, 48.9% reported brown skin color, 82.6% studied in public schools, and almost all schools surveyed were located in urban areas (96.1%). About 50.8% of adolescents evaluated resided in the Southeast, 21.3% in the Northeast, 11.8% in the South, 8.4% in the North, and 7.7% in the Midwest.

Only 28.6% (95%IC 26.9-30.3) of the adolescents consumed fish at least once in the 7 days prior to the interview, the highest prevalence being observed in the North region of Brazil (41.9%; 95%CI 40.1-43.6). Among adolescents who have reported fish consumption, 24.8% (95%CI 23.4-26.2) have done so in 1 or 2 days a week and 3.8% (95%CI 3.4-4.3) consumed 3-7days a week. No statistically significant difference was observed in the analysis between fish consumption groups of 1-2 days a week and 3-7 days a week.

Prevalence of fish consumption was significantly higher for male adolescents ($p = 0.0049$), yellow participants ($p = 0.0270$), those who studied in rural schools ($p < 0.001$), among adolescents that studied in private schools ($p < 0.001$), and whose mothers had higher educational levels ($p = 0.0056$). Considering healthy behavior, fish consumption was significantly more prevalent among active students and among adolescents who consumed breakfast and had meals with family members (Table 1). No significant difference was observed when adolescents were stratified by age, pubertal stage, blood pressure levels, waist circumference, or BMI (data not shown).

Results of the logistic regression are presented in Table 2. Fish consumption was associated with a protective effect in all geographic regions of Brazil ($p < 0.001$). Male adolescents had 1.2 times higher chances of having consumed fish compared to the girls ($p = 0.008$). Variations in age, pubertal stage, and nutritional status were not associated with differences in fish consumption. Self-reported yellow adolescents had 1.5 times higher chances of consuming fish compared to adolescents of other ethnicities ($p = 0.033$). Private school adolescents had 1.5 times higher chances of fish consumption compared to those studying in public schools ($p < 0.001$). Rural school adolescents had 2.8 times higher chances of fish consumption compared to those studying in urban schools ($p < 0.001$). In terms of physical activity, active adolescents had 1.2 times higher chances of fish consumption compared to the insufficient active ones ($p = 0.002$). As for the variables of healthy eating behavior, adolescents with daily consumption of breakfast and those who always had meals with family members had,

Table 1 Prevalence of fish consumption in adolescents, according to sociodemographic characteristics, pubertal stage and features of healthy behavior. Brazil, 2013-2014.

	Fish consumption in the last 7 days				
	No		Yes		p[a]
	%	(95% CI)	%	(95% CI)	
Total	71.4	(69.7-73.1)	28.6	(26.9-30.3)	
Sex					**0.0049**
Female	72.9	(71.3-74.5)	27.1	(25.5-28.7)	
Male	69.9	(67.6-72.2)	30.1	(27.8-32.4)	
Age (years)					0.7301
12-14	71.7	(69.4-73.8)	28.3	(26.2-30.6)	
15-17	71.2	(68.9-73.3)	28.8	(26.7-31.1)	
Race					**0.0270**
White	72.3	(69.5-74.9)	27.7	(25.1-30.5)	
Black	73.1	(70.2-75.8)	26.9	(24.2-29.8)	
Brown	70.7	(69.2-72.1)	29.3	(27.9-30.8)	
Yellow	64.0	(57.8-69.8)	36.0	(30.2-42.2)	
Native	67.2	(58.5-74.9)	32.8	(25.1-41.5)	
Type of school					<**0.001**
Public	72.9	(70.8-74.8)	27.1	(25.2-29.2)	
Private	64.7	(62.2-67.2)	35.3	(32.8-37.8)	
Region of school					<**0.001**
Urban	72.2	(70.9-73.5)	27.8	(26.5-29.1)	
Rural	51.9	(47.7-56.2)	48.1	(43.8-52.3)	
Geographic region					< **0.001**
North	58.1	(56.4-59.9)	41.9	(40.1-43.6)	
Northeast	68.1	(65.7-70.3)	31.9	(29.7-34.3)	
Southeast	72.8	(69.6-75.8)	27.2	(24.2-30.4)	
South	78.5	(75.0-81.7)	21.5	(18.3-24.9)	
Midwest	75.5	(73.7-77.1)	24.5	(22.9-26.3)	
Pubertal stage					0.5695
Pre-pubescent	76.6	(69.3-82.6)	23.4	(17.4-30.7)	
Pubescent	71.5	(69.3-73.5)	28.5	(26.5-30.7)	
Post-pubescent	71.2	(69.3-73.0)	28.8	(26.9-30.7)	
Physical activity					<**0.001**
Insufficient active	74.5	(72.6-76.4)	25.5	(23.6-27.4)	
Active	69.2	(66.9-71.4)	30.8	(28.6-33.1)	
Breakfast					<**0.001**
Never	76.3	(73.9-78.6)	23.7	(21.4-26.1)	
Sometimes	72.6	(70.2-74.8)	27.4	(25.2-29.8)	
Often	70.4	(67.4-73.2)	29.6	(26.8-32.6)	
Everyday	67.8	(65.4-70.2)	32.2	(29.8-34.6)	
Meals with family members					
Lunch					< **0.001**
Never	75.7	(73.0-78.1)	24.3	(21.9-26.9)	
Sometimes	72.7	(70.9-74.4)	27.3	(25.6-29.1)	
Often	70.4	(68.6-72.1)	29.6	(27.9-31.4)	
Always	68.6	(65.9-71.1)	31.4	(28.9-34.0)	
Dinner					**0.0019**
Never	75.6	(73.1-77.9)	24.4	(22.1-26.8)	
Sometimes	72.0	(69.8-74.1)	28.0	(25.9-30.2)	
Often	71.6	(69.7-73.4)	28.4	(26.6-30.3)	
Always	69.9	(67.4-72.2)	30.1	(27.8-32.6)	
Maternal education					**0.0056**
Iliterate	73.3	(67.6-78.2)	26.7	(21.7-32.4)	
Primary	72.5	(68.7-76.0)	27.5	(23.9-31.2)	
Secondary	71.4	(69.7-73.1)	28.6	(26.9-30.3)	
Tertiary	66.8	(64.8-68.7)	33.2	(31.2-35.2)	

Note: 95%CI, 95% confidence interval.
Bold values refer to $p < 0.05$.
[a] Chi-square test.

Table 2 Association between fish consumption and variables of interest among Brazilian adolescents by logistic regression bivariate model.[a]

	OR	95%IC	*p*
Geographic region			
North	1.0	–	–
Northeast	0.60	0.54 – 0.67	<**0.001**
Southeast	0.54	0.43 – 0.67	<**0.001**
South	0.38	0.29 – 0.51	<**0.001**
Midwest	0.42	0.37 – 0.48	<**0.001**
Sex			
Female	1.0	–	–
Male	1.21	1.05 – 1.39	**0.008**
Age			
12-14	1.0	–	–
15-17	0.88	0.73 – 1.08	0.225
Race			
White	1.0	–	–
Black	0.90	0.75 – 1.08	0.253
Brown	1.02	0.87 – 1.19	0.823
Yellow	1.56	1.04 – 2.34	**0.033**
Native	0.89	0.49 – 1.61	0.694
Nutritional status			
Normal weight	1.0	–	–
Underweight	0.90	0.66 – 1.24	0.537
Excess weight	1.13	0.99 – 1.29	0.074
Pubertal stage			
Pre-pubescent	1.0	–	–
Pubescent	1.33	0.70 – 2.50	0.378
Post-pubescent	1.23	0.66 – 2.29	0.508
Blood pressure			
Normal	1.0	–	–
High	1.06	0.94 – 1.19	0.374
Waist circumference			
Normal	1.0	–	–
High	1.15	0.96 – 1.36	0.123
Type of school			
Public	1.0	–	–
Private	1.52	1.27 – 1.82	<**0.001**
Region of school			
Urban	1.0	–	–
Rural	2.80	2.33 – 3.37	<**0.001**
Physical activity			
Insufficient active	1.0	–	–
Active	1.20	1.07 – 1.35	**0.002**
Breakfast			
Never	1.0	–	–
Sometimes	1.34	1.20 – 1.50	<**0.001**
Often	1.54	1.16 – 2.05	**0.003**
Everyday	1.61	1.37 – 1.89	<**0.001**
Meals with family members			
Lunch			
Never	1.0	–	–
Sometimes	1.09	0.92 – 1.30	0.301
Often	1.33	1.09 – 1.61	**0.005**
Always	1.50	1.25 – 1.81	<**0.001**
Dinner			
Never	1.0	–	–
Sometimes	1.23	1.02 – 1.48	**0.030**
Often	1.27	1.04 – 1.56	**0.021**
Always	1.58	1.29 – 1.95	<**0.001**
Maternal education			
Iliterate	1.0	–	–
Primary	1.28	0.86 – 1.89	0.221
Secondary	1.29	0.93 – 1.79	0.126
Tertiary	1.61	1.17 – 2.22	**0.004**

Bold values refer to $p < 0.05$.
[a] Bivariate logistic regression – model without adjustments.

respectively, 1.6 and 1.5 times higher chances of fish consumption compared to those who never ate breakfast and never had lunch or dinner with their family members ($p < 0.001$). Adolescents whose mothers had tertiary education had 1.6 times higher chances of fish consumption compared with other adolescents ($p = 0.004$). Association between fish consumption and healthy behavior, adjusted for a geographic region, sex, BMI, and maternal education by multivariate regression, was maintained (Table 3).

The authors present the association between fish consumption and laboratory tests related to cardiovascular and metabolic risk in Table 4. The authors observed a significant inverse association of fish consumption with hypertriglyceridemia (OR = 0.84; 95%CI 0.73−0.98). This association remained significant, even after adjustments for sex, BMI, physical activity, geographic region, and maternal education (OR = 0.80; 95%CI 0.68-0.96). No significant differences were observed in fish consumption according to levels of total cholesterol, low-density lipoprotein cholesterol (LDL-c), high-density lipoprotein cholesterol (HDL-c), glucose, glycated hemoglobin, insulin, and HOMA-IR levels.

Discussion

This is the first nationwide multicenter study with a representative sample of Brazilian adolescents in which important information is shown regarding the prevalence of fish

Table 3 Association between fish consumption and healthy behavior, adjusted for geographic region, sex, BMI and maternal education by multivariate regression.

	OR	95% CI	*p*
Breakfast	1.16	1.10 – 1.22	<**0.001**
Meals with family members			
Lunch	1.07	1.01 – 1.13	**0.015**
Dinner	1.13	1.04 – 1.23	**0.005**
Physical activity	1.14	1.02 - 1.28	**0.023**

Note: BMI; body mass index.
Bold values refer to $p < 0.05$.

Table 4 Association between fish consumption and laboratory tests among Brazilian adolescents by logistic regression bivariate model.[a]

	OR	95%IC	*p*
Total cholesterol			
< 150 mg/dL	1.0	–	–
≥ 150 mg/dL	1.07	0.95 – 1.22	0.270
LDL-c			
< 100 mg/dL	1.0	–	–
≥ 100 mg/dL	1.08	0.89 – 1.31	0.457
HDL-c			
≥ 45 mg/dL	1.0	–	–
< 45 mg/dL	1.08	0.93 – 1.25	0.332
Triglycerides			
< 100 mg/dL	1.0	–	–
≥ 100 mg/dL	0.84	0.73 – 0.98	**0.023**
Fasting glucose			
70-99 mgdL	1.0	–	–
≥ 100 mg/dL	0.98	0.68 – 1.40	0.902
Glycated hemoglobin			
$< 5.7\%$	1.0	–	–
$\geq 5.7\%$	1.02	0.79 – 1.33	0.865
Insulin			
< 15 mU/L	1.0	–	–
≥ 15 mU/L	1.03	0.90 – 1.18	0.684
HOMA-IR			
≤ 2.80	1.0	–	–
> 2.80	1.05	0.94 – 1.18	0.396

Note: 95%CI, 95% confidence interval; HDL-c, high-density lipoprotein cholesterol; HOMA-IR, homeostatic model assessment of insulin resistance; LDL-c, low-density lipoprotein cholesterol. Bold values refer to $p < 0.05$.

[a] Bivariate logistic regression – model without adjustments.

consumption and its association with cardiovascular risk factors and healthy behavior.

Almost thirty percent of the participants in the present study related fish consumption. Previous Brazilian study showed a fish consumption rate below 1% among adolescents.[10] The prevalence of fish consumption in adolescents is heterogeneous throughout the world, and few studies involve a large number of participants. In the National Health and Nutrition Examination Survey (2003-2014), involving 8,186 adolescents aged 12-19 years, 56.3% reported fish intake in the last 30 days.[3] In a European survey, the prevalence of fish consumption reported by 2,330 adolescents was 22.3%.[21] In the Chinese cohort study involving 2,095 adolescents, 43.7% had 3 meals, including fish per week; 43.0% had 4-6 meals and only 13.2% had $\geq$ 7 meals.[22] Rouche et al. observed that only 20% of 19,172 school Belgium adolescents reported fish consumption $\geq$ two days a week.[23] In a Swedish study involving 11,222 adolescents, 35% of them never or seldom consumed fish, and only 15% reported fish consumption at least twice a week. Different from the present study's results, low consumption of fish was associated with a 17% increased risk of overweight or obesity.[24]

Brazil is a continental country with a large physical area and diversity of soils, climates, and productive potentials. The high consumption of fish in the North region can be influenced by the great biodiversity of the Amazon Rain Forest which occupies almost the entire area and is crossed by thousands of rivers. Extractive fishing is one of the main activities of this region, and fish is considered an important natural resource in the diet of inhabitants of riverside communities. In areas close to production, fish can be consumed in a short time, with better quality and lower prices. Otherwise, the transport to other consumers far from the production site and the marketing impact can lead to loss of quality and contribute to increasing prices and could explain the lower consumption in other macro-regions and urban areas.[25] Although Brazil has an extensive coastline, with large hydrographic basins and potential aquaculture, most of the present study's participants reported no weekly fish consumption.

In the present study, the prevalence of fish intake was significantly higher in yellow adolescents. This dietary habit could be attributed to cultural eating habits among Asian immigrants and their descendants. This typical diet seems to have contributed greatly to low mortality from cancer and ischemic heart disease and low prevalence of obesity and might be associated with longevity in the Japanese population.[26]

The authors observed that adolescents from private schools and whose mothers had higher education often consume fish. Maternal eating habits may be influenced by maternal levels of education with implications for the dietary quality of children and childhood obesity. Mothers with higher education showed higher levels of control over feeding and lower levels of emotional feeding scores, suggesting a possible association with socioeconomic status and possibly representing a better quality of eating habits of these adolescents in the long term.[27]

The present study showed that habitual fish consumption could be a marker of healthy behavior and associated with a protective effect against CVD. A statistically significant association between fish consumption and higher levels of physical activity was also observed in this study, which is corroborated by other authors.[7,28] Fish intake was significantly higher in those who ate breakfast and had meals with family members every day. Similarly, the daily intake of fish was significantly higher in those adolescents who ate breakfast with family members than in those who ate alone in the study performed by Sugiyama et al. ($p < 0.01$).[29] These findings suggest a positive association between breakfast consumption, having meals with family, and ingesting healthy foods.

The present study showed an inverse association between fish consumption and hypertriglyceridemia. This result is in agreement with previous surveys. In a cross-sectional study of 100 participants, aged 9-11 years old, Gump et al. observed that fish consumption was associated with a significantly atheroprotective lipid profile. Participants who consumed fish had significantly higher HDL-c and lower triglyceride levels.[5] Tam et al. explored fish consumption and cardiometabolic traits in 2,095 healthy Chinese adolescents. The authors observed that participants with low fish intake generally had elevated triglyceride levels, but lower total cholesterol, HDL-c, and LDL-c, and these associations remained statistically significant after adjustment for sex, age, BMI, parents' education levels.[22] Arenaza et al. demonstrated that adolescents with a healthy metabolic profile, such as lower triglyceride levels and higher HDL-c levels, have higher fish consumption compared to those with metabolic abnormalities.[30] Lauritzen et al. investigated the association between fish intake and metabolic syndrome features in a cross-sectional study with 109 adolescents. However, most adolescents had a healthy lipid profile as well as markers of glucose homeostasis within usual limits, and overall negative outcomes were rare.[8]

Although the strategy and the sample size are strengths of the present study, there are some limitations. First, the study design was cross-sectional and did not allow us to establish temporal relationships. Another potential limitation is that information on dietary intake was self-reported and could lead to under-or overestimation; hence, it was susceptible to bias. Therefore, replication in other independent studies is required to confirm the present findings.

Considering the representativeness of the ERICA study, the prevalence of fish consumption is low, even among a representative sample of Brazilian adolescents. However, the authors observed a positive association between fish consumption and healthy behavior and an inverse association with hypertriglyceridemia. These results may assist in the development of health policies, preventive programs for chronic diseases and can support the promotion of behavioral changes early in life to prevent obesity and other cardiovascular risk factors during adolescence. For adolescents, school is a favorable environment for the development of actions and strategies for stimulating the formation of healthy habits, such as fish consumption.

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Conflicts of interest

The authors declare no conflicts of interest.

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