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ORIGINAL

Factors associated with non-frequent breakfast consumption in adolescents (EVA-JF Study)

Fatores associados ao consumo não frequente de café da manhã em adolescentes (Estudo EVA-JF)

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ABSTRACT

Objective

To estimate the association of infrequent breakfast consumption with socioeconomic, behavioral, and individual factors in a sample of Brazilian adolescents from public schools.

Methods

Cross-sectional study with adolescents aged from 14 to 19 from public schools in *Juiz de Fora*, state of *Minas Gerais*. The frequency of consumption of breakfast, snacks, soft drinks, industrialized drinks, the usual food consumption,

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body mass index, body fat percentage, and waist circumference were evaluated. Other socioeconomic, behavioral, and individual data were obtained through questionnaires. Logistic regression analysis and hierarchical selection of variables were used to verify the associated factors.

Results

The sample consisted of 805 adolescents; 53.4% reported infrequent breakfast consumption. Through hierarchical logistic regression analysis, it was evidenced that the house occupancy status (OR: 0.618; 95%CI: 0.4410.865; *p*=0.005) was the distal factor associated with infrequent breakfast consumption; the intermediate factors were the consumption of industrialized beverages (OR: 0.658; 95%CI: 0.486-0.890; *p*=0.007) and percentage of energy from processed foods (OR: 0.935; 95%CI: 0.907-0.964; *p*<0.001); and the proximal factors were the male gender (OR: 0.696; 95%CI: 0.520-0.932; *p*=0.0015) and being nonwhite (OR: 1.529; 95%CI: 1.131-2.069; *p*=0.006).

Conclusion

Male adolescents who lived in owned houses, with occasional consumption of industrialized beverages and a higher percentage of energy derived from processed foods, had lower chances of infrequent breakfast consumption, while non-white adolescents had higher chances.

Keywords: Adolescents. Breakfast. Feeding behavior. Socioeconomic factors.

RESUMO

Objetivo

Estimar as associações do consumo não frequente de café da manhã com fatores socioeconômicos, comportamentais e individuais em uma amostra de adolescentes de escolas públicas.

Métodos

Estudo transversal realizado com adolescentes de 14 a 19 anos matriculados em escolas públicas de Juiz de Fora (MG). Foram avaliadas a frequência de consumo de café da manhã, lanches, refrigerantes e bebidas industrializadas, consumo alimentar usual, IMC, percentual de gordura corporal e perímetro da cintura. Demais dados socioeconômicos, comportamentais e individuais foram obtidos através de questionários. A análise de regressão logística e seleção hierárquica das variáveis foram usadas para verificar fatores associados.

Resultados

A amostra foi composta por 805 adolescentes e 53,4% deles relataram consumo não frequente de café da manhã. Através da análise de regressão logística hierarquizada, evidenciou-se que a ocupação em domicílio próprio (OR: 0,618; IC95%: 0,441-0,865; p=0,005) foi o fator distal associado ao consumo não frequente de café da manhã, além dos fatores intermediários "consumo não frequente de bebidas industrializadas" (OR: 0,658; IC95%: 0,486-0,890; p=0,007) e "percentual de energia proveniente de alimentos processados" (OR: 0,935; IC95%: 0,907-0,964; p<0,001) e dos fatores proximais "sexo masculino" (OR: 0,696; IC95%: 0,520-0,932; p=0,0015) e "cor da pele não branca" (OR: 1,529; IC95%: 1,131-2,069; p=0,006).

Conclusão

Adolescentes que residiam em domicílios próprios, com consumo não frequente de bebidas industrializadas, com maior percentual de energia proveniente de alimentos processados e do sexo masculino apresentaram menores chances de consumo não frequente de café da manhã, enquanto, adolescentes com cor da pele não branca apresentaram maiores chances.

Palavras-chave: *Adolescentes. Desjejum. Comportamento alimentar. Fatores socioeconômicos.*

INTRODUCTION

From 10 to 19 years of age, adolescence is the transition period between childhood and adult life, when several physical, hormonal, psychological, and behavioral alterations occur [1,2]. Social, economic, cultural, environmental, behavioral, and psychological factors during this stage may impact the person's choices and habits, including the eating habits, which will be a part of his or her identity and reflect on morbidity patterns and future health spending [3].

Studies report faulty eating habits among adolescents, such as the elevated consumption of ultra-processed foods like soft and industrialized drinks and fast food, and the omission of fundamental meals, such as breakfast [4-7]. According to the Dietary Guidelines for the Brazilian Population, breakfast is one of the three most important meals of the day [8]. Its consumption is associated with improved anthropometric profiles and body composition, higher diet quality, superior academic performance, and more cognitive capacity [9,10]. On the other hand, its omission or occasional consumption is associated with unfavorable socioeconomic conditions and the development of cardiometabolic risk factors, favoring the development of non-communicable chronic diseases [11,7].

Henceforth, understanding the determinant and conditioning potential factors associated with the infrequent consumption of breakfast is essential to base decision-making and plan actions for effectively promoting healthy eating habits, including having breakfast every day. Thus, this study's objective is to estimate the associations between occasional breakfast consumption and socioeconomic, behavioral, and individual factors in a sample of Brazilian adolescents using hierarchical analysis.

METHODS

This cross-sectional study used data from research conducted with adolescents in the selected municipality (*Juiz de Fora*, in the Brazilian state of *Minas Gerais*) named Study of the Lifestyle in Adolescence – *Juiz de Fora* (EVA-JF Study, Portuguese acronym). We considered adolescents of both sexes, between 14 and 19 years old, who went to public schools in the city's urban area. Of the 49 schools with students in this age range, 20 were not eligible. To simplify the logistics and reduce the costs related to collecting and processing blood samples, we decided to consider only students enrolled in morning classes.

The sample calculation (n=790) was estimated with the software Epi Info (version 7.2.2.6, Center for Disease Control and Prevention, USA) using the following parameters: 9502 students enrolled in Basic Education in 2018 and 2019 (9th grade in elementary school and 1st, 2nd, and 3rd grades in high school); an 8% prevalence of obesity in the adolescent population; a 2% precision of the prevalence, with a standard error of 1%; confidence interval of 95% (95%CI), and expected losses of 20% [12,14].

The sample was stratified by the city's administrative regions (Central, Eastern, Northeastern, Northern, Western, Southeastern, and Southern), school year, school facility, class, and sex. The layers' sample size corresponded to their proportion in the general population (proportional allocation).

To select the participants, the records of the eligible classes were reordered with software that generated random numbers (Stats, version 2.0, Decision Analyst, USA). Adolescents were picked until the necessary number was reached and, in case of refusals or school transference, the next adolescent selected was called.

The data collection was performed by trained professionals in the institutions during the mornings between May 2018 and May 2019. More information on the study is available at Neves *et al.* [15].

The work was conducted in compliance with the Declaration of Helsinki and approved by the Ethics Committee in Research of the Federal University of *Juiz de Fora* (*Universidade Federal de Juiz de Fora*) (CAEE: 68601617.1.0000.5147). Participation was voluntary. Those above 18 years old signed a Free and Informed Consent Form. Minors signed a Free and Informed Assent Form, and their parents or the responsible adults also signed.

In relation to socioeconomic variables, the analysis considered the age, sex, self-referred race/ethnicity [white and non-white (brown, Black, Indigenous, or Asian-descendant)], house occupancy status (rented/

ceded or owned), mother's schooling (illiterate, incomplete elementary school, incomplete high school, complete high school or college), mother's current employment status (working or not working), socioeconomic status [medium/high (classes A or B1), medium (B2 or C1), and medium/low (classes C2 or DE), as per the Brazilian Economic Classification Criteria of the *Associação Brasileira de Empresas de Pesquisa* (Brazilian Association of Research Companies) [16]. The information was collected with an structured questionnaire applied in person with the adolescents.

The frequency of breakfast consumption was evaluated with the question: "Do you usually have breakfast?" The possible answers included: never; hardly ever; 1 or 2 days a week; 3 or 4 days a week; 5 or 6 days a week; every day. To analyze the frequency, the categories were: not frequent (0 to 4 days a week) and frequent (5 to 7 days a week).

Along with the categorial analysis, a trained team conducted two 24-hour recalls of eating habits on non-consecutive weekdays using the multiple-pass method [17]. We used a photographic album to estimate the ingested portions and quantities [18]. The total and macronutrient-related energetic values (both measured in kcal) were assessed with a table of nutritional composition and nutritional labels [19].

The food items were evaluated according to the NOVA classification system proposed by Monteiro *et al.* [20], which considers the food items' degree of industrial processing, dividing them into natural or minimally processed foods; culinary ingredients; processed and ultra-processed foods. In this study, culinary ingredients were grouped with natural or minimally processed foods, as they are usually used in culinary preparations, not in isolation.

Afterwards, to estimate the usual ingestion of food, nutrients, and energy, the data were adjusted in the program Multiple Source Method (version 1.0.1, German Institute of Human Nutrition, Potsdam-Rehbrucke, Department of Epidemiology), reducing intra-individual variation [21,22]. Later, we calculated the average daily energy contribution of each food group according to the NOVA classification.

A questionnaire also verified how often adolescents consumed ultra-processed food items in restaurants or fast-food chains, and soft and other industrialized drinks (powdered juice, juice and teas sold in cans or cartons, flavored water, guarana and currant syrup, energy drinks, fermented milk, chocolate drinks, sweetened and flavored yogurt). The periodicity with which these items were consumed was classified as non-frequent (0 to 4 days a week) and frequent (5 to 7 days a week) consumption, similarly to classification found in other works [23,24].

The evaluation of the participants' nutritional status started with measurements of their weight and height for the subsequent calculation of the body mass index. The weight was measured with the Tanita Ironman scale (model BC-553, Tanita Corp., Japan), which has a maximum capacity of 200 kg and a 50 g precision; the height was measured with a portable stadiometer (Alturexata, Brazil), with centimeter scales and 1mm precision, following a standard protocol [15]. The body mass index was classified within the growth curves of the World Health Organization according to sex and age, expressed in z-score and then categorized as per the weight status variable into non-overweight (z-score <1) and overweight (z-score ≥+1) [25].

The body fat percentage was assessed by bipolar electrical bioimpedance with Tanita Ironman (model BC-553, Tanita Corp., Japan) and classified with Lohman's cut-off points [15,26,27]. After, adolescents were classified as at risk or not at risk (≥25% for girls and ≥20% for boys). The waistline was measured once in the intermediary point between the inferior border of the last rib and the iliac crest's superior limit, or in the smallest diameter between the thorax and the hips (for adolescents who were overweight), with a Sanny measuring tape (American Medical Ltda., Brazil) [28]. As there is no consensus on the specific cut-off points for adolescents waist circumference, the risk classification was attributed to those with measures ≥the 90th

percentile of the sample, according to sex and age. All anthropometric and body composition assessments were conducted by a properly trained health professional [29,30].

To estimate the regular practice of physical education in the 12 months before the research, we used the International Physical Activity Questionnaire, a validated instrument that measures the frequency and type of exercise, as well as the time spent exercising in a habitual week [31,32]. Adolescents who exercised for more than 300 minutes a week (considering the five usual weekdays, excluding weekends) were understood as physically active [33].

Information regarding the total hours of sleep per night during weekdays was collected with the Pittsburgh Sleep Quality Index, which assessed sleep quality and duration [34]. According to the National Sleep Foundation, adolescents must sleep 8 to 10 hours a night [35]. Thus, sleep was classified as inadequate when <8 hours/night (<480 minutes) or adequate when ≥8 hours/night (>480 minutes).

The data were analyzed with the software SPSS®IBM® (version 20.0), with a significance level of 5% (p<0.05).

First, the quantitative continuous variables underwent the normality Kolmogorov-Smirnov test, with the normality parameters expressed with measures of central tendency (means) and dispersion (standard deviation). The qualitative variables were described with absolute (n) and relative (%) frequencies. To examine the factors associated with the non-frequent consumption of breakfast, we used hierarchical multiple logistic regression. For the hierarchization of variables, we established and maintained a conceptual model during the data analysis [36,37].

The literature does not offer a specific model to determine the frequency of breakfast consumption. The model we created for this purpose was based on the conceptual model proposed by Dahlgren and Whitehead [38], which approaches social determinants of health, and the one proposed by Alexandre *et al*. [39], discussing the variables influencing the adoption of healthy eating choices.

The hierarchical analysis was conducted as soon as the conceptual model of independent variables was established (Figure 1). First, we performed a univariate logistic regression considering a 95%CI. Then, the multivariate analysis started from the hierarchical entry into groups of variables that presented a statistical significance below 20% (p<0.20) in the previous stage, ordered as follows: Group 1: Socioeconomic characteristics; Group 2: Behavioral characteristics; Group 3: individual characteristics. The frequency of breakfast consumption (frequent or not frequent) was a dependent variable in every stage.

The backward LR method, employed in the hierarchical multiple logistic regression analysis, initially incorporates all the variables in each group separately, which may be eliminated in later stages depending on the results of F partial tests until the final model is produced. To interpret the results, we considered p<0.05. The statistical significances were obtained with the Wald test for heterogeneity. The Hosmer-Lemeshow test evaluated the final model's consistency, considering the adjustment adequate when p>0.05. To assess the model's explanatory power, we used the Nagelkerke R Square test.

RESULTS

The initial number of adolescents participating the EVA-JF study was 835. However, with the losses referring to the lack of data regarding food consumption, the study's final sample consisted of 805 adolescents. Table 1 presents the description of the participants' socioeconomic, behavioral, and individual characteristics, including the frequency of breakfast consumption. Most participants (53.4%) reported not having breakfast frequently (0 to 4 days a week).

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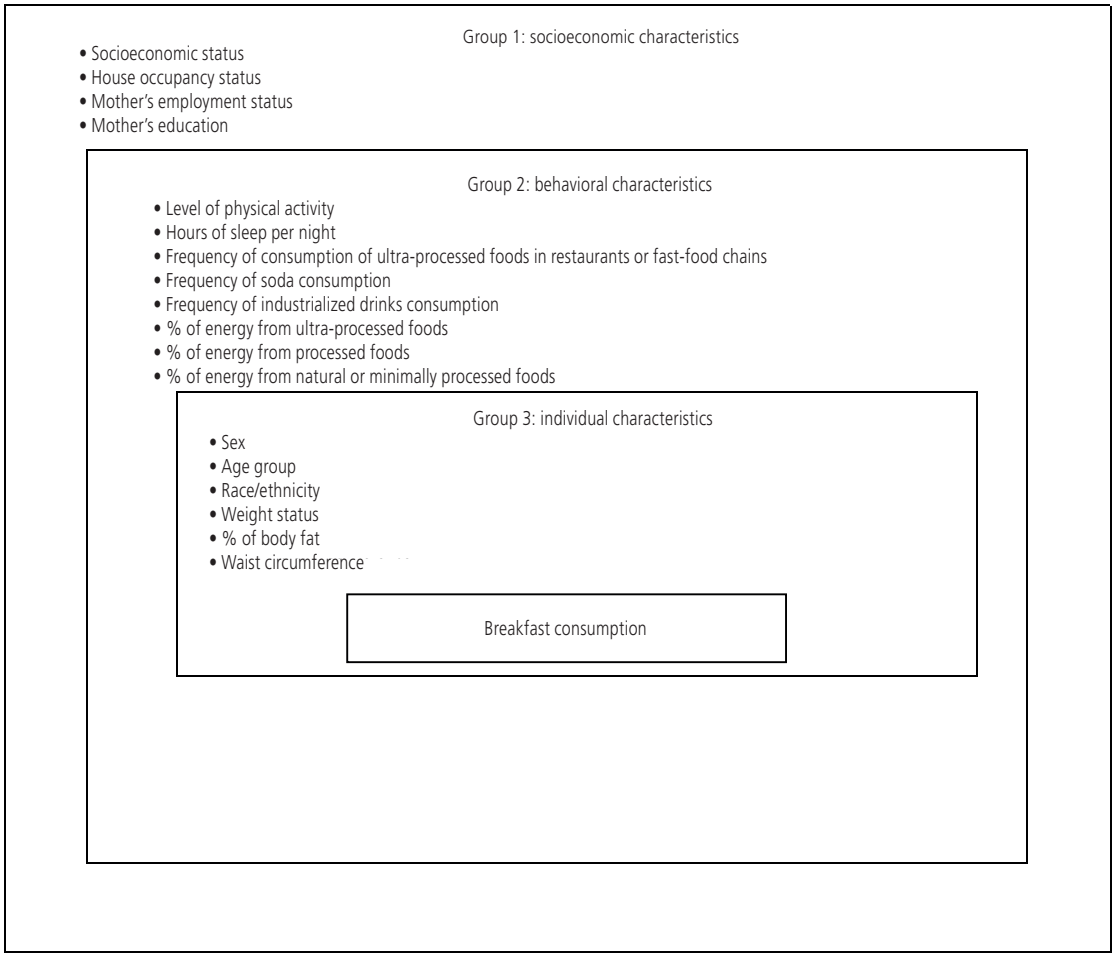

Figure 1 – Conceptual hierarchical model for determining the factors associated with infrequent breakfast consumption.
Source: Model adapted from Alexandre *et al.* [39] and Dahlgren and Whitehead [38].

Table 1 – Adolescents' socioeconomic, behavioral, and individual characteristics. *Juiz de Fora* (MG), Brazil, 2018-2019.

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Group 3	Socioeconomic characteristics	
	n	%
Socioeconomic status ♠		
Medium/low	161	20.0
Medium	471	58.5
Medium/high	173	21.5
House occupancy status		
Rent/concession	202	25.1
Ownership	603	74.9
Mother's employment status		
Not working	227	29.0
Working	556	71.0
Mother's education		
Illiterate or incomplete elementary school	30	4.2
Complete elementary school/ incomplete high school	31	43.0
High school	273	37.9
University	108	15.0

Table 1 – Adolescents' socioeconomic, behavioral, and individual characteristics. *Juiz de Fora* (MG), Brazil, 2018-2019.

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Group 2	Behavioral characteristics	
	n	% or M(SD)[a] †
Level of physical activity ●		
Insufficiently active	287	35.7
Active	518	64.3
Hours of sleep per night ↿		
Inadequate	133	16.5
Adequate	672	83.5
Consumption of ultra-processed foods in restaurants or fast-food chains δ		
Frequent	35	4.3
Not frequent	770	95.7
Consumption of soda δ		
Frequent	139	17.3
Not frequent	666	82.7
Consumption of industrialized drinks δ		
Frequent	289	35.9
Not frequent	516	64.1
% of energy from ultra-processed foods	---	45.7 (12.9)[a]
% of energy from processed foods	---	10.9 (4.9)[a]
% of energy from natural or minimally processed foods	---	43.3 (12.1)[a]
Group 1	**Individual characteristics**	
	n	%
Sex		
Female	464	57.6
Male	341	42.4
Age range ‡		
14 and 15	248	30.8
16 and 17	456	56.6
18 and 19	101	12.5
Race/ethnicity		
White	281	35.2
Non-white ↧	517	64.8
Weight status		
Not overweight	563	71.3
Overweight	227	28.7
% of body fat ‖		
Not at risk	346	51.0
At risk	332	49.0
Waist circumference ¶		
Not at risk	723	89.8
At risk	82	10.2
Frequency of consumption δ	**Breakfast**	
	n	%
Frequent	375	46.6
Not frequent	430	53.4

Note: [a]M (SD). † Valid percentages, considering eventual losses. ♠ Medium/low: classes C2 or D-E. Medium: classes B2 or C1. Medium/high: classes A or B1. ● Insufficiently active: <300 minutes/week. Active: ≥300 minutes/week. ↿ Inadequate: <480 minutes. Adequate: ≥480 minutes. δ Frequent: 5 to 7 days/week. Not frequent: 0 to 4 days/week. ‡ Average age of 16.1 years (SD=1.2). ↧ Non-white: brown, Black, Indigenous, or Asian. ‖ Not at risk <25% (female) and <20% (male). At risk: ≥25% (female) and ≥20% (male). ¶ Not at risk: <90th percentile of the sample, according to sex. At risk: ≥90th percentile of the sample, according to sex. M: Mean; SD: Standard-Deviation.

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Table 2 presents the socioeconomic, behavioral, and individual characteristics associated with non-frequent consumption of breakfast, according to the univariate logistic regression analysis. All the variables that presented $p>0.20$ were selected for the analysis of hierarchical regression.

Table 2 – Model of univariate logistic regression explaining non-frequent consumption of breakfast among adolescents. *Juiz de Fora* (MG), Brazil, 2018-2019.

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Group 3	Socioeconomic characteristics		
	OR	95% CI	p^*
Socioeconomic status ♠			
Middle/low	Reference		
Middle	0.660	0.425-1.011	0.050
Middle/high	0.790	0.552-1.139	0.209
House occupancy status			
Rent/concession	Reference		
Ownership	0.633	0.460-0.871	0.005
Mother's employment status			
Not working	Reference		
Working	0.931	0.687-1.262	0.645
Mother's education			
Illiterate or incomplete elementary school	Reference		
Complete elementary school/ incomplete high school	1.190	0.587-2.414	0.629
High school	1.058	0.519-2.156	0.876
University	0.897	0.415-1.935	0.781
Group 2	Behavioral characteristics		
	OR	95% CI	p^*
Level of physical activity ●			
Insufficiently active	Reference		
Active	1.075	0.805-1.435	0.626
Hours of sleep per night **1**			
Inadequate	Reference		
Adequate	0.940	0.650-1.351	0.720
Consumption of ultra-processed foods in restaurants or fast-food chains δ			
Frequent	Reference		
Not frequent	1.502	0.746-3.024	0.255
Consumption of soda δ			
Frequent	Reference		
Not frequent	0.734	0.506-1.064	0.103
Consumption of industrialized drinks δ			
Frequent	Reference		
Not frequent	0.635	0.471-0.856	0.002
% of energy from ultra-processed foods	1.012	1.002-1.024	0.025
% of energy from processed foods	0.933	0.906-0.961	<0.001
% of energy from natural or minimally processed foods	0.997	0.986-1.008	0.593
Group 1	Individual characteristics		
	OR	95% CI	p^*
Sex			
Female	Reference		
Male	0.617	0.468-0.813	0.001
Age group			
14 and 15	Reference		
16 and 17	0.894	0.658-1.215	0.474
18 and 19	1.011	0.643-1.589	0.963

Table 2 – Model of univariate logistic regression explaining non-frequent consumption of breakfast among adolescents. *Juiz de Fora* (MG), Brazil, 2018-2019.

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Group 1	Individual characteristics		
	OR	95% CI	*p**
Race/ethnicity			
White	Reference		
Non white ↓	1.670	1.253-2.225	<0.001
Weight status			
Overweight	Reference		
Not overweight	0.821	0.602-1.121	0.214
% of body fat ‖			
At risk	Reference		
Not at risk	0.734	0.541-0.995	0.046
Waist circumference ¶			
At risk	Reference		
Not at risk	0.709	0.444-1.131	0.149

Note: * The statistical significances were obtained with the Wald test for heterogeneity. ♠ Medium/low: classes C2 or D-E. Medium: classes B2 or C1. Medium/high: classes A or B1. ● Insufficiently active: <300 minutes/week. Active: ≥300 minutes/week. ↯ Inadequate: <480 minutes. Adequate: ≥480 minutes. δ Frequent: 5 to 7 days/week. Not frequent: 0 to 4 days/week. ↓ Non-white: brown, Black, Indigenous, or Asian. ‖ At risk: <25% (female) and <20% (male). Not at risk: ≥25% (female) and ≥20% (male). ¶ Not at risk: <90th percentile, according to sex. At risk: ≥90th percentile, according to sex. 95% CI: Confidence Interval of 95%; OR: Odds Ratio.

Through the final model of hierarchical multiple logistic regression shown in Table 3, we observed that the single socioeconomic variable in Group 3 that is associated with non-frequent consumption of breakfast was house occupancy status. Adolescents living in owned homes presented smaller chances of not consuming breakfast frequently (OR: 0.618; 95%CI: 0.441-0.865; *p*=0.005).

Table 3 – Final model of hierarchical multiple logistic regression explaining the non-frequent consumption of breakfast among adolescents. *Juiz de Fora* (MG), Brazil.

Group 3	Socioeconomic characteristics		
	OR	95% CI	*p**
House occupancy status			
Rent/concession	Reference		
Ownership	0.618	0.441-0.865	0.005
Group 2	**Behavioral characteristics**		
	OR	95% CI	*p**
Consumption of industrialized drinks δ			
Frequent	Reference		
Not frequent	0.658	0.486-0.890	0.007
% of energy from processed foods	0.935	0.907-0.964	<0.001
Group 1	**Individual characteristics**		
	OR	95% CI	*p**
Sex			
Female	Reference		
Male	0.696	0.520-0.932	0.015
Race/ethnicity ↓			
White	Reference		
Non-white	1.529	1.131-2.069	0.006

Note: Hosmer and Lemeshow Test=0.723; Nagelkerke R Square=0.089. *The statistical significances were obtained with the Wald test for heterogeneity. δ Frequent: 5 to 7 days/week. Not frequent: 0 to 4 days/week. ↓ Non-white: brown, Black, Indigenous, or Asian. 95% CI: Confidence Interval of 95%; OR: Odds Ratio.

Regarding the behavioral variables present in Group 2, the outcome was negatively associated with the consumption of industrialized drinks (OR: 0.658; 95%CI: 0.486-0.890; *p*=0.007) and the percentage of ingestion of processed foods (OR: 0.935; 95%CI: 0.907-0.964; *p* <0.001), which reduced the chances of incurrence.

As to the individual variables in Group 3, both sex (OR: 0.696; 95%CI: 0.520–0.932; *p*=0.015) and race/ethnicity (OR: 1.529; 95%CI: 1.131-2.069; *p*=0.006) were associated with the outcome, with male adolescents presenting reduced chances of non-frequent breakfast consumption, while nonwhite adolescents had greater chances.

In table 3, the Hosmer and Lemeshow tests are also described, demonstrating the adequate adjustment of the final model (*p*=0.723). The explanatory power was of about 9%, according to the Nagelkerke R Square test.

DISCUSSION

The results of the present study demonstrate a high prevalence of adolescents who do not have breakfast frequently. The creation of a conceptual model of multiple hierarchical logistic regression evidenced that socioeconomic (house occupancy status), behavioral (consumption of industrialized drinks and percentage of energy from processed items), and individual (male sex and being nonwhite) variables were associated to not having breakfast frequently.

The percentage of adolescents who did not have breakfast frequently in this study (53.4%) was similar to that found in the Study of *Estudo de Riscos Cardiovasculares em Adolescentes* (Cardiovascular Risks in Adolescents), a national health survey in which 51.4% of adolescents reported not having breakfast often or at all [40]. Our results were superior to the percentage found by Simões *et al.* [41] for the city of Curitiba, in the state of Paraná (41.4%; 95%CI: 36.8-46.1), and by Azeredo *et al.* [42] (38.1%), referring to 11- to 14-year-old adolescents assessed by the 2012 *Pesquisa Nacional de Saúde do Escolar* (National Adolescent School-based Health Survey). These differences may be due to methodological variations, such as the definition of frequency and the number of evaluated days.

The hierarchical regression analysis demonstrated that the only socioeconomic variable, that is, the single distal factor, associated with non-frequent breakfast consumption was house occupancy status. Adolescents who resided in owned houses had smaller chances of not having breakfast frequently. Along with other factors, such as the house's structural characteristics and the family's buying power, this variable is employed as an indirect indicator of socioeconomic status [43]. In the present study, the socioeconomic status and the mother's schooling were not associated with the outcome. However, some authors demonstrated that not having breakfast frequently was significantly more common among children and adolescents with lower socioeconomic status or whose mothers had fewer years of schooling [11,44-47].

Some studies also pointed to other socioeconomic variables associated with poorer dietary behavior. Another research with children and adolescents in *Juiz de Fora* [48] concluded that adolescents whose mothers had more children had fewer meals a day. Examining the eating habits of adolescents who participated in the 2009 *Pesquisa Nacional de Saúde do Escolar*, Tavares *et al.* [49] observed a direct association between the Human Development Index and healthier eating practices, suggesting a possible synergic influence between income, education, and health conditions.

Regarding behavioral variables, in an intermediary position concerning the outcome, the unusual consumption of industrialized drinks and the percentage of energy from processed foods were associated

with smaller chances of non-frequent consumption of breakfast in the hierarchical regression final model. Similarly, Ramsay *et al.* [50] noticed that adolescents who did not have breakfast often presented an enlarged contribution of caloric ingestion from items like non-alcoholic industrialized drinks and fruit juices. In a study with Norwegian adolescents, Medin *et al.* [51] observed that the irregular consumption of breakfast was associated with enlarged consumption of food items rich in sugar, fat, and sodium, including processed foods like fruit and bar candies, crystallized fruit, and industrialized and ultra-processed foods. Having breakfast is a possible marker of healthy eating [38]. Thus, its omission or infrequent consumption is often related to the augmented consumption of industrialized foods and lower diet quality [40,45,50,51].

As for Group 3, comprising the individual variables proximal to the outcome, the final conceptual model included sex and race/ethnicity, both with significant association with the outcome. Male adolescents had smaller chances of not having breakfast frequently than female ones. Similarly, other studies [52-54] demonstrated that the omission or unusual consumption of breakfast is more common among female children or adolescents. According to these authors, this is possibly so because girls are often more concerned or conscious of their appearance, with a relevant influence of the media on these issues. Reinforcing this hypothesis, in their study with Jordanian adolescents of both sexes, Ali *et al.* [52] observed that over a third of the participants believed that omitting breakfast would lead to weight loss.

Non-white adolescents had more chances of unusual breakfast consumption. These results are close to those of the research by Affenito *et al.* [55], who worked with data from the National Growth and Health Study, a cohort study with Black and white female children and adolescents. According to them, white girls had breakfast more often than non-white girls. On the other hand, in a cohort study with 809 adolescents who participated in the *Estudo Longitudinal de Avaliação Nutricional do Adolescente* (Adolescent Nutritional Assessment Longitudinal Study) in the state of *Rio de Janeiro*, Hassan *et al.* [56] did not find a significant association between race/ethnicity and irregular breakfast consumption. However, it is known that race-related inequalities produce vulnerabilities, especially health-related ones, and more exposure to general risk factors and behaviors [57].

Thus, the non-frequent consumption of breakfast is associated with female, non-white adolescents who live in rented or ceded houses, usually have industrialized drinks, and with a lesser proportion of energy derived from processed food items. That shows critical social, behavioral, and individual deficiencies that may be the object of public intervention geared toward adolescents.

Our study's main positive points were: 1) data collection with rigorous methods and trained professionals; 2) two non-consecutive 24-hour recalls, following the multiple-pass method, and the posterior estimation of eating habits with the Multiple Source Method, which counts on advanced statistical modeling techniques, generating more precise ingestion measures for individuals and populations. The study also presents the following limitations: 1) as a cross-sectional epidemiological study, it cannot establish causal relations, even as it may help produce hypotheses of possible health outcomes; 2) the lack of a conceptual model specifically for the non-frequent consumption of breakfast, which made it necessary to use an adapted model; 3) although the sample is representative, it is composed only of adolescents from public schools in *Juiz de Fora*, suggesting a cautious approach when extrapolating the results for students in private schools and other Brazilian cities.

CONCLUSION

The results of the present study identified determining sociodemographic, behavioral, and individual factors associated with non-frequent consumption of breakfast. Consequently, directed intervention actions

are made possible, such as those targeting awareness regarding the benefits of breakfast, leading to positive health impacts during adolescence and adult life.

CONTRIBUTORS

CÂNDIDO ACO was responsible for writing the manuscript (original draft, revision, and editing), the statistical analysis, and has primary responsibility for the final content. NEVES FS worked in the study's conception, design, and supervision, data collection and database curation, statistical analyses, and manuscript revision. FARIA ER and NETTO MP were responsible for the conception and design of the study and for revising the manuscript. OLIVEIRA RMS participated in the study conception and design, obtained financial support for the project originating this publication, and revised the manuscript. CÂNDIDO APC worked in the conception, design, and coordination of the study and performed the critical review of the manuscript's intellectual content. All the authors have approved the final manuscript as submitted and agree to the responsibility for every aspect of the work in ensuring the precision and integrity of all parts of the work.

REFERENCES

1. World Health Organization. Nurition in adolescence: issues and challenges for the health sector: issues in adolescent health and development. Geneva: Organization; 2005 [cited 2021 Apr 21]. Available from: https://apps.who.int/iris/bitstream/handle/10665/43342/9241593660_eng.pdf?sequence=1&isAllowed=y
2. Bulboz CTR, Rombaldi AJ, Gonzales NG, Azevedo MR, Madruga SW. Consumo alimentar conforme o tipo de alimentação consumida em escolas de zona rural no Sul do Brasil. Cien Saude Colet. 2018;23(8): 2705-12.
3. Ministério da Saúde (Brasil). Diretrizes nacionais para a atenção integral à saúde de adolescentes e jovens na promoção, proteção e recuperação da saúde. Brasília: Ministério; 2010 [cited 2021 Apr 21]. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/diretrizes_nacionais_atencao_saude_adolescentes_jovens_promocao_saude.pdf
4. Costa CS, Flores TR, Wendt A, Neves RG, Assunção MCF, Santos IS. Comportamento sedentário e consumo de alimentos ultraprocessados entre adolescentes brasileiros: Pesquisa Nacional de Saúde do Escolar (PeNSE), 2015. Cad Saude Publica. 2018;34(3):e00021017. https://doi.org/10.1590/0102-311X00021017
5. Melo AST, Neves FS, Batista AP, Coelho-Machado GLL, Sartorelli DS, Faria ER, *et al.* Percentage of energy contribution according to the degree of industrial food processing and associated factors in adolescents (EVA-JF study, Brazil). Public Health Nutr. 2021;24(13):1-10. https://doi.org/10.1017/S1368980021000100
6. Enes CC, Camargo CM, Justino MIC. Ultra-processed food consumption and obesity in adolescents. Rev. Nutr. 2019;32:e180170. https://doi.org/10.1590/1678-9865201932e180170
7. Monzani A, Ricotti R, Caputo M, Solito A, Archero F, Bellone S, *et al.* A Systematic Review of the Association of Skipping Breakfast with Weight and Cardiometabolic Risk Factors in Children and Adolescents. What Should We Better Investigate in the Future? Nutrients. 2019;11(2):1-23
8. Ministério da Saúde (Brasil). (Guia alimentar para a população brasileira. Brasília: Ministério; 2014 [cited 2021 Mar 02]. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/guia_alimentar_populacao_brasileira_2ed.pdf
9. Rampersaud GC. Benefits of breakfast for children and adolescents: update and recommendations for practitioners. Am J Lifestyle Medicine. 2008;3:86-103.
10. Hopkins LC, Sattler M, Steeves EA, Smith- Jones JC, Gittelsohn. Breakfast Consumption Frequency and Its Relationships to Overall Diet Quality, Using Healthy Eating Index 2010, and Body Mass Index among Adolescents in a Low-Income Urban Setting. Ecol Food Nutr. 2017;56(4):297-311.
11. Timlin MT, Pereira MA, Story M, Sztainer DN. Breakfast Eating and Weight Change in a 5-Year Prospective Analysis of Adolescents: Project EAT (Eating Among Teens). Pediatrics. 2008;121(3):e638-45. https://doi.org/10.1542/peds.2007-1035
12. Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional de Saúde do Escolar 2015. Rio de Janeiro: Instituto; 2016 [cited 2021 Dec 14]. Available from: https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=297870

13. Bloch KV, Klein CH, Szklo M, Kuschnir MCC, Abreu GA, Barufaldi LA, *et al.* ERICA: prevalências de hipertensão arterial e obesidade em adolescentes brasileiros. Rev Saude Publica. 2016;50(1):9s.

14. Instituto Brasileiro de Geografia e Estatística. Antropometria e análise do estado nutricional de crianças, adolescentes e adultos no Brasil. Rio de Janeiro: Instituto; 2010 [cited 2020 Dec 14]. Available from: https://biblioteca.ibge.gov.br/visualizacao/livros/liv45419.pdf

15. Neves FS, Fontes VS, Pereira PM, Campos AAL, Batista AP, Machado-Coelho GLL, *et al.* Estudo EVA-JF: aspectos metodológicos, características gerais da amostra e potencialidades de uma pesquisa sobre o estilo de vida de adolescentes brasileiros. Adolesc Saude. 2019;16:113-29.

16. Associação Brasileira de Empresas de Pesquisa. Critério de Classificação Econômica Brasil 2018. São Paulo: Associação; 2018 [cited 2020 June 15]. Available from: http://www.abep.org/criterio-brasil

17. Conway JM, Ingwersen LA, Vinyard BT, Moshfegh AJ. Effectiveness of the US Department of Agriculture 5-step multiple-pass method in assessing food intake in obese and nonobese women. Am J Clin Nutr. 2003;77(5):1171-78.

18. Zaboto CB. Photographic record for dietary surveys: utensils and servings. Campinas: Unicamp; 1996.

19. Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2008-2009: Tabela de composição nutricional dos alimentos consumidos no Brasil. Rio de Janeiro: Instituto; 2010 [cited 2020 June 15]. Available from: https://biblioteca.ibge.gov.br/visualizacao/livros/liv50002.pdf

20. Monteiro CA, Levy RB, Claro RM, Castro IRR, Cannon G. A new classification of foods based on the extent and purpose of their processing. Cad Saude Publica. 2010;26(11): 2039-49.

21. Harttig U, Haubrock J, Knüppel S, Boeing H, EFCOVAL Consortium. The MSM program: web-based statistics package for estimating usual dietary intake using the Multiple Source Method. Eur J Clin Nutr. 2011;65(1):S87-891.

22. Laureano GH, Torman VB, Crispim SP, Dekkers ALM, Camey SA. Comparison of the ISU, NCI, MSM, and SPADE Methods for estimating usual intake: a simulation study of nutrients consumed daily. Nutrients. 2016;8(3):166.

23. Martins BG, Ricardo CZ, Machado PP, Rauber F, Azeredo CM, Levy RB. Fazer refeições com os pais está associado à maior qualidade da alimentação de adolescentes brasileiros. Cad Saude Publica. 2019;35(7):e00153918. https://doi.org/10.1590/0102-311X00153918

24. Tavares LF, Castro IRR, Levy RB, Cardoso LO, Passos MD, Brito FSB. Validade relativa de indicadores de práticas alimentares da Pesquisa Nacional de Saúde do Escolar entre adolescentes do Rio de Janeiro. Cad Saude Publica. 2014;30(5):1029-41.

25. Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007;85(9):660-7.

26. Wu YT, Nielsen DH, Cassady SL, Cook JS, Janz KF, Hansen JR. Cross-validation of bioelectrical impedance analysis of body composition in children and adolescents. Phys Ther. 1993;73(5):320-28.

27. Lohman TG. The use of skinfold to estimate body fatness on children and youth. J Phys Educ Recreat Dance. 1987;58:98-103.

28. World Health Organization. Waist circumference and waist-hip ratio. Report of a WHO Expert Consultation. Geneva: Organization; 2008 [cited 2020 June 15]. Available from: https://apps.who.int/iris/bitstream/handle/10665/44583/9789241501491_eng.pdf?ua=1

29. Bacopoulou F, Efthymiou V, Landis G, Rentoumis A, Chrousos GP. Waist circumference, waist-to-hip ratio and waist-to-height ratio reference percentiles for abdominal obesity among Greek adolescents. BMC Pediatr. 2015;15:1-9. http://doi.org/10.1186/s12887-015-0366-z

30. International Diabetes Federation. The IDF consensus definition of the metabolic syndrome in children and adolescents. Brussels: IDF; 2007 [cited 2020 June 15]. Available from: https://www.idf.org/e-library/consensus-statements/61-idf-consensus-definition-of-metabolic-syndrome-in-children-and-adolescents.html

31. Matsudo S, Araújo T, Matsudo V, Andrade D, Andrade E, Oliveira LC, *et al.* International physical activity questionnaire (IPAQ): study of validity and reliability in Brazil. Rev Bras Ativ Fis Saúde. 2001;6(2):5-18.

32. Guedes DP, Lopes CC, Guedes JERP. Reproducibility and validity of the International Physical Activity Questionnaire in adolescents. Rev Bras Med Esporte. 2005;11:151-8.

33. World Health Organization. Who guidelines on physical activity and sedentary behaviour. Geneva: Organization; 2020 [cited 2020 June 15]. Available from: https://www.who.int/publications/i/item/9789240015128

34. Passos MHP, Silva HA, Pitangui ACR, Oliveira VMA, Lima AS, Araújo RC. Reliability and validity of the Brazilian version of the Pittsburgh Sleep Quality Index in adolescents. J Pediatr. 2017;93(2):200-6.

35. Hirshkowitz M, Whiton K, Albert SM, Alessi C, Bruni O, DonCarlos L, *et al.* National Sleep Foundation's updated sleep duration recommendations: final report. Sleep Health. 2015;1(4):233-43.

36. Victora CG, Huttly RS, Fuchs SC, Olinto MT. The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. J Epidemiol. 1997;26(1):224-7.

37. Fuchs SC, Victora CG, Fachel J. Modelo hierarquizado: uma proposta de modelagem aplicada à investigação de fatores de risco para diarréia grave. Rev Saude Publica. 1996;30(2):168-78.

38. Dahlgren G, Whitehead M. Policies and Strategies to Promote Social Equity in Health Stockholm. Stockholm: Institute for Future Studies; 1991.

39. Alexandre VP, Peixoto MRG, Schmitz BAS, Moura EC. Fatores associados às práticas alimentares da população adulta de Goiânia, Goiás, Brasil. Rev Bras Epidemiol. 2014;17:267-80.

40. Barufaldi LA, Abreu GZ, Oliveira JS, Santos DF, Fujimori E, Vasconcelos SML, *et al.* ERICA: prevalência de comportamentos alimentares saudáveis em adolescentes brasileiros. Rev Saude Publica. 2016;50(1):6s.

41. Simões AM, Machado CO, Hofelmann DA. Associação do consumo regular de café da manhã e comportamentos relacionados à saúde em adolescentes. Cien Saude Colet. 2019 [cited 2021 July 20]. Available from: http://www.cienciaesaudecoletiva.com.br/artigos/associacao-do-consumo-regular-de-cafe-da-manha-e-comportamentos-relacionados-a-saude-em-adolescentes/17315?id=17315

42. Azeredo CM, Rezende LF, Canella DS, Claro RM, Castro IRR, Luiz OC, *et al.* Dietary intake of Brazilian adolescents. Public Health Nutr. 2015;18(7):1215-24.

43. Buchmann C. Measuring family background in international studies of education: conceptual issues and methodological challenges. In: National Research Council. Methodological advances in cross-national surveys of educational achievement. Washington: The National Academies Press; 2002.

44. Lazzeri G, Ahluwalia N, Niclasen B, Pammolli A, Vereecken C, Rasmussen M, Pedersen TP, *et al.* Trends from 2002 to 2010 in daily breakfast consumption and its socio-demographic correlates in adolescents across 31 countries participating in the HBSC study. Plos One. 2016;11:e0151052. https://doi.org/10.1371/journal.pone.0151052

45. Rampersaud GC, Pereira MA, Girard BL, Adams J, Metzl JD. Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. J Am Diet Assoc. 2005;105(5):743-60.

46. Hallström L, Vereecken CA, Ruiz JR, Patterson E, Gilbert CC, Catasta G. Breakfast habits and factors influencing food choices at breakfast in relation to socio-demographic and family factors among European adolescents. The HELENA Study. Appetite. 2011;56(3):649-57.

47. Moreno-Maldonado C, Ramos P, Moreno C, Rivera F. How family socioeconomic status, peer behaviors, and school-based intervention on healthy habits influence adolescent eating behaviors. Sch Psychol Int. 2018;39(1):92-118.

48. Silva FA, Candiá SM, Pequeno MS, Sartorelli DS, Mendes LL, Oliveira RMS, *et al.* Frequência de refeições diárias e variáveis associadas em crianças e adolescentes. J Pediatr. 2017;93(1):79-86.

49. Tavares LF, Castro IRR, Levy RB, Cardoso LO, Claro RM. Padrões alimentares de adolescentes brasileiros: resultados da Pesquisa Nacional de Saúde do Escolar (PeNSE). Cad Saude Publica. 2014;30(12):2679-90.

50. Ramsay SA, Bloch TD, Marriage B, Shriver LH, Spees CK, Taylor CA. Skipping breakfast is associated with lower diet quality in young US children. Eur J Clin Nutr. 2018;72(4):548-56.

51. Medin AC, Myhre JB, Diep LF, Anderson LF. Diet quality on days without breakfast or lunch – Identifying targets to improve adolescents' diet. Appetite. 2019;135:123-30.

52. Ali RA, Abdel NMR, Al-Kloub MI, Alzoubi FA. Predictors of breakfast skipping among 14 to 16 years old adolescents in Jordan: The influential role of mothers. Int J Nurs Pract. 2019;25(6):e12778. https://doi.org/10.1111/ijn.12778

53. Fiuza RFP, Muraro AP, Rodrigues PRM, Sena EMS, Ferreira MG. Skipping breakfast and associated factors among Brazilian adolescentes. Rev Nutr. 2017;30(5):615-26.

54. Marchioni DML, Gorgulho BM, Teixeira JA, Verly Junior E, Fisberg RM. Prevalence of breakfast omission and associated factors among adolescents in São Paulo: ISA-Capital. Nutr Rev Soc Bras Aliment Nutr. 2015;40(1):10-20.

55. Affenito SG, Thompson DR, Barton BA, Franko DL, Daniels SR, Obarzanek E, *et al.* Breakfast consumption by African-American and white adolescent girls correlates positively with calcium and fiber intake and negatively with Body Mass Index. J Am Diet Assoc. 2005;105(6):938-45.

56. Hassan BK, Cunha DB, Veiga GV, Pereira RA, Sichieri R. Changes in breakfast frequency and composition during adolescence: the Adolescent Nutritional Assessment Longitudinal Study, a cohort from Brazil. Plos One. 2018;1:e0200587. https://doi.org/10.1371/journal.pone.0200587

57. Malta DC, Stopa SR, Santos MAS, Andrade SSCA, Oliveira MM, Prado RR, *et al.* Fatores de risco e proteção de doenças e agravos não transmissíveis em adolescentes segundo raça/cor: Pesquisa Nacional de Saúde do Escolar. Rev Bras Epidemiol. 2017;20(2):247-59.

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