Dietary patterns of elementary school students in southern Brazil and associated factors: a cross-sectional school-based study

Padrões alimentares de escolares do ensino fundamental no sul do Brasil e fatores associados: um estudo transversal de base escolar

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ABSTRACT
The objective was to identify dietary patterns and associated factors in schoolchildren from public schools in a city in southern Brazil. Cross-sectional, school-based study (31 schools; 1,750 students, 12-19 years), in the city of Caxias do Sul/Rio Grande do Sul, Brazil. A self-applicable questionnaire was used for data collection. Principal Component Analysis was used to identify dietary patterns and Poisson regression to test associations, considering a statistical significance level of 5% ($p \leq 0.05$). Three dietary patterns explained 39.65% of the total variance: Fast Food (19.14%); Fruits & Vegetables (13.15%) and Dairy Products (7.36%). Fast Food pattern was more likely among older students (55%; p=0.036), black/brown (33%; p=0.004), with excessive sedentary behavior (48%; p=0.003), alcohol intake (81%; p<0.001) and more family meals (56%; p=0.027). Fruits & Vegetables was more likely among sufficiently active schoolchildren (33%; p<0.001) and with more family meals (49%; p=0.001), and 30% lower among those with regular self-perceived health (p=0.014). Probability of adherence to the Dairy Products pattern was 23% lower in black/brown skin color (p=0.024); it increased with the maternal education, being higher in adolescents whose mother had completed higher education (67%; p=0.002); it was higher in those with excessive sedentary behavior (55%; p<0.001) and with more family meals (50%; p=0.007). Fast Food pattern was associated with risk behaviors, Fruits & Vegetables pattern to healthy behaviors and Dairy Products pattern to both behaviors. Our findings contribute to the formulation of public policies aimed at promoting healthy eating and other health-promoting behaviors in this population group.

Keywords: feeding behavior, adolescent, principal component analysis, health risk behaviors.

RESUMO
O objetivo foi identificar padrões alimentares e fatores associados em escolares da rede pública de uma cidade do sul do Brasil. Estudo transversal, de base escolar (31 escolas; 1.750 alunos, 12-19 anos), na cidade de Caxias do Sul/Rio Grande do Sul, Brasil. Para a coleta de dados foi utilizado um questionário autoaplicável. A Análise de Componentes Principais foi utilizada para identificar os padrões alimentares e a regressão de Poisson para testar associações, considerando nível de significância estatística de 5% ($p \leq 0,05$). Três padrões alimentares explicaram 39,65% da variância total: *Fast Food* (19,14%); Frutas e Verduras (13,15%) e Laticínios (7,36%). O padrão *Fast Food* foi mais provável entre os alunos mais velhos (55%; p=0,036), pretos/pardos (33%; p=0,004), com comportamento sedentário excessivo (48%; p=0,003), consumo de álcool (81%; p <0,001) e mais refeições em família (56%; p=0,027). Frutas e Verduras foi mais provável entre escolares suficientemente ativos (33%; p<0,001) e com mais refeições em família (49%; p=0,001), e 30% menor entre aqueles com autopercepção de saúde regular (p=0,014). A probabilidade de adesão ao padrão Lácteos foi 23% menor na cor preta/parda (p=0,024); aumentou com a escolaridade materna, sendo maior em adolescentes cuja mãe tinha ensino superior completo (67%; p=0,002); foi maior naqueles com comportamento sedentário excessivo (55%; p<0,001) e com mais refeições em

família (50%; p=0,007). O padrão *Fast Food* esteve associado a comportamentos de risco, o padrão Frutas e Verduras a comportamentos saudáveis e o padrão Laticínios a ambos os comportamentos. Nossos achados contribuem para a formulação de políticas públicas voltadas para a promoção da alimentação saudável e outros comportamentos promotores de saúde nesse grupo populacional.

Palavras-chave: comportamento alimentar, adolescente, análise de componente principal, comportamentos de risco à saúde.

1 INTRODUCTION

Growing globalization and industrialization have promoted a transition in populations' dietary patterns. In several countries, the diet based on grains, fruits and vegetables has been replaced by industrialized foods[1]. This phenomenon also happens in Brazil, where there is a decrease in the consumption of traditional foods, such as rice and beans, concomitant with the increase in the consumption of processed and ultra-processed foods[2].

Adolescents also follow this transition and national data indicate excessive consumption of soft drinks, sugary drinks, snacks and ultra-processed products, in addition to insufficient consumption of fruits and vegetables[3]. This dietary pattern is characterized by being low in nutrients and rich in sugar, fat, sodium and energy[3]. Such characteristics have been implicated in the occurrence of overweight/obesity, in addition to metabolic alterations, in this population group. In a study with Brazilian adults and adolescents, those in the highest quintile of consumption of ultra-processed foods had a 98% and 26% greater chance of being obese and overweight, respectively, when compared to those in the lowest quintile[4]. Studies show that adolescents who adhere to unhealthy eating patterns have a higher prevalence of overweight and cardiometabolic alterations[5–8].

Considering that habits established in adolescence tend to persist into adulthood[6], it is important to investigate the pattern of food consumption of adolescents and the associated characteristics, in order to identify which segments should be prioritized in education and promotion of healthy eating, knowing that the proper consumption of food is one of the important aspects to prevent the emergence of chronic non-communicable diseases in adolescence[4,5].

Dietary patterns can be identified through multivariate statistical techniques and this approach takes into account that foods are not consumed in isolation, but in different

combinations, which can be determined by various aspects, including cultural, socioeconomic and geographic[9]. Thus, analyzing dietary patterns can be more enlightening when one intends to investigate eating habits and their relationship with sociodemographic and behavioral factors, as well as with health outcomes[9]. Therefore, the hypothesis of this study is that at least one of the dietary patterns will be composed of unhealthy eating markers and this pattern will be associated with unhealthy behaviors.

Given this context, the aim of this study was to identify dietary patterns and their associated factors in a sample of schoolchildren aged 12 to 19 years, enrolled in the 8th and 9th grades of public elementary schools in the urban area of Caxias do Sul/RS, Brazil.

2 METHODS

2.1 STUDY DESIGN, POPULATION AND SAMPLE CHARACTERISTICS

This work is an excerpt from the research project "Health risk behaviors in elementary school adolescents from Caxias do Sul/RS, Brazil", a cross-sectional, school-based study with students enrolled in the 8th and 9th grade of elementary school, from public schools in the municipality. Methodological aspects of this research were previously described in the study by Dell'Osbel *et al.* (2020)[10]. Students aged 12 to 19 years who were regularly attending classes during the research period (2016) were included in the study. It was considered as an exclusion criterion to have a cognitive disability that made it impossible for the student to answer the questionnaire.

The municipality is located in the mountainous region of Rio Grande do Sul, Brazil. Its Human Development Index is 0.782. According to the 2010 census, it has a population of 435,564 inhabitants[11]. At the time of the survey, 8,924 students were enrolled in the 8th and 9th grades of 100 public elementary schools in the city's urban area (61 municipal schools and 39 state schools). This number corresponded to 83% of all students enrolled in the respective years[12].

The sampling was by clusters in two stages. In the first stage the schools were selected and in the second were the classes. It was set to investigate 31 schools. The city is divided into 14 administrative regions in the urban area. In each of them, it was verified the number of existing schools and how much this number represented of the total number of schools in the municipality. This proportion was used to define the number of schools to be drawn in each region. Selection took place by probability proportional to the size of the school. The number of classes, on the other hand, took into account the percentage

contribution of the total number of 8th and 9th grade students in each region to the total number of students enrolled in these years (8,924), the sample size and the expected number of students in each class (25). In schools with two classes, one class of each year was drawn, and in those with 3 or more, two classes were drawn by simple random sampling.

2.2 DATA COLLECT

A self-administered, standardized and pre-coded questionnaire was used, with questions based on the 2015 National Adolescent Health Survey[13] and elaborated by the researchers. The instrument and the logistics were tested in a pilot study, with students from a school not selected for the research.

Data collection was carried out in the classroom, on a scheduled date. All students received the questionnaire, but only those who had the Free and Informed Consent Term signed by their parents/guardians and by the student themselves responded. The filling out of the questionnaires was carried out under the supervision of the research team composed of masters and doctoral students in Public Health and by graduate students in the health area, duly trained. The students were instructed not to put any identification on the questionnaires and, after filling them out, they were deposited in an urn. Fieldwork took place in May and June 2016.

To evaluate food consumption, the adolescents informed about the number of days (0–7) in the week before the survey that they consumed the healthy food markers (beans; raw vegetables; raw salad; cooked vegetables; fruits; milk; cheese; yogurt or dairy beverage) and unhealthy food markers (fried snacks; sausages; salty cookies or crackers; cookies or sweet biscuits; snack foods or chips; sweets; chocolate drink; soda; fast-food; boxed or powdered juice). This classification is based on data that show a relationship of these markers with protection and risk of chronic non-communicable diseases[14]. For the analyses, consumption was transformed into day-frequency. Demographic variables were: sex (male and female), age (12-13 years; 14 years; 15 years; ≥16 years) and self-reported skin color (white; black/brown; other). As a marker of socioeconomic conditions, maternal education was used (did not study/incomplete elementary school – included mothers who did not study or who studied, but did not complete elementary school; incomplete high school – included mothers who completed elementary school and those with incomplete secondary education; incomplete higher education – included

mothers who completed secondary education and those with incomplete higher education; complete higher education – included mothers who completed higher education, including postgraduate studies). The behavioral variables investigated were: level of physical activity (insufficient <300 min/week and sufficient ≥300 min/week)[13]; sedentary behavior – determined by the time spent in activities sitting (adequate <2 hours/day; excessive ≥2 hours/day)[15]; smoke in the last month (never smoked; not smoked in the last month; smoked at least one day); alcohol consumption in the last month (never drank; did not drink in the last month; drank at least one day); meals with the family at least once a week (no meal; one meal; two meals; three meals). As a health variable, the self-perception of health was investigated with the question "How do you consider your health?" and the following response options: excellent; very good; Good; regular; bad. For the analyses, the variable was categorized as excellent/very good/good; regular; bad.

2.3 STATISTICAL ANALYSIS AND JUSTIFICATION OF SAMPLE SIZE

The sample size for the larger project was calculated to estimate the prevalence of different health outcomes. The following assumptions were considered: prevalence of 50% of unknown outcomes, confidence level of 95%, margin of error of 3.5 percentage points and design effect of 1.5. The value found was increased by 20% for possible losses and refusals and 15% to control for confounding factors, resulting in a sample of 1,622 students. In all, 1,777 students participated in the survey, but 27 were excluded for leaving 30% or more of the answers blank in the questionnaire, resulting in a sample of 1,750 students. For the present study, the power of the sample size was calculated a posteriori, to detect associations between dietary patterns and schoolchildren's characteristics. This sample size had 80% power or greater and 95% confidence level to identify prevalence ratios of 1.29 or greater for exposures affecting 17.4% to 77% of the population. In addition, the sample was sufficient for the Principal Component Analysis (PCA), since the recommendation is five observations (individuals) for each variable (food items)[16]. In the present study, the number of food items was 18, so the required sample size would be 90 students.

Data were entered into the EpiData program, version 3.1, with double entry. Analysis of bank inconsistencies, descriptive analysis and PCA were performed using the IBM SPSS statistical package, version 22.0 (IBM Corp., Armonk, USA). Associations

were tested with the Stata MP statistical package, version 14.0 (Stata Corp., College Station, USA). Due to the high number of students who could not inform the mathernal education (24.9%), multiple imputation of data was performed for this variable, using the Stata mi command. To reduce the Monte Carlo simulation error, we arbitrarily chose to generate imputations with 20 new banks and the rseed command (1234) for reproducibility[17].

The derivation of the dietary patterns was performed using the PCA[16], considering the theoretical requirements for its realization. The Kaiser-Mayer-Olkin (KMO) coefficient was estimated, which indicates the strength of the relationship between the variables, with a value ≥0.60 being considered adequate. In addition, Bartlett's sphericity test was performed to test the null hypothesis, that is, the inexistence of a relationship between the variables. A $p<0.05$ indicates adequacy for performing data analysis. In the present study, the KMO coefficient was 0.75 and Bartlett's test of sphericity presented a $p<0.001$, both indicating that the correlations between the items were sufficient and adequate to proceed with the analysis. In order to examine the exploratory factor structure of the food frequency questionnaire, the varimax orthogonal rotation was performed. The number of factors to extract was defined based on the variance graph (Scree Plot), in which the points with the greatest slope indicate the appropriate number of components to retain, in the eigenvalue >1 and in the interpretability of the factors. Food items that presented an absolute factor loading ≥0.30 were considered to significantly contribute to a given factor. Factor scores, that is, individual factor values, were saved for each study participant. For the analysis of associations, the scores of each dietary pattern were divided into quartiles and categorized into low adherence (1st, 2nd and 3rd quartile) and high adherence (4th quartile), since the higher the score, the greater the adherence to the pattern[16].

The crude and adjusted prevalence ratios for each pattern and the independent variables were obtained using Poisson regression with robust variance. The statistical significance of the associations was assessed using the Wald test, verifying the heterogeneity of proportions in nominal categorical exposure variables, as well as the linear trend for ordinal categorical variables. Variables with $p\leq0.20$ in the crude analysis were taken for adjusted analysis, the latter being based on a conceptual model of determination[18], with two levels. The 1st level included the demographic and socioeconomic variables, which were adjusted for each other, and the 2nd level included

the behavioral and health variables, which were adjusted for each other and for the 1st level variables with p≤0.20. Variables with p≤0.05 were considered associated with dietary patterns.

2.4 ETHICAL ASPECTS

The Project was submitted and approved by a Research Ethics Committee, under opinion nº 1.379.794, according to the recommendations established in Resolution 466/12[19]. The Free and Informed Consent Term was read and signed by the parents/guardians and by the students, prior to data collection.

3 RESULTS

Table 1. Description of demographic, socioeconomic, behavioral and health variables in the sample of students aged 12 to 19 years, regularly enrolled in the 8th and 9th grades of public elementary schools in Caxias do Sul/Rio Grande do Sul, Brazil, 2016 (n=1750)

Variables	n (%)
Sex	
Male	837 (47.8)
Female	913 (52.2)
Age in years (n=1748)	
12–13	506 (29.0)
14	756 (43.2)
15	357 (20.4)
≥16	129 (7.4)
Skin color (n=1688)	
White	1178 (69.8)
Black/brown	302 (17.9)
Other	208 (12.3)
Maternal education	
Did not study/Incomplete elementary school	567 (32.4)
Incomplete high school	422 (24.1)
Incomplete higher education	579 (33.1)
Complete higher education	182 (10.4)
Physical activity min/week (n=1687)	
Insufficient <300	1114 (66.0)
Sufficient ≥300	573 (34.0)
Sedentary behavior hours/day	
Adequate <2	417 (23.8)
Excessive ≥2	1333 (76.2)
Smoke in the last month (n=1717)	
Never smoked	1372 (79.9)
Haven't smoked	219 (12.8)
Smoked at least one day	126 (7.3)
Alcohol consumption in the last month	
Never drank	547 (31.3)
Not consumed	637 (36.4)
Drank at least one day	566 (32.3)
Meals with the family at least once a week	
None	123 (7.0)
Once	355 (20.3)

Twice	649 (37.1)
Three	623 (35.6)
Self-perception of health (n=1721)	
Excellent/very good/good	1377 (80.0)
Regular	297 (17.3)
Bad	47 (2.7)

n, Absolute frequency. %, Relative frequency

Of the total number of students studied, 52.2% were female, 72.2% were between 12 and 14 years old and 69.8% declared themselves white. Approximately one third of the students' mothers had not studied or completed elementary school, while one third of them had incomplete higher education. Among students, 66% were insufficiently active (<300 min/week) and 76.2% had excessive sedentary behavior (≥2 hours/day). Almost 80% never smoked, while a third consumed alcohol at least once in the last 30 days. About 36% had three meals with the family at least one day a week and the majority (80%) had a positive self-perception of their health (Table 1).

Table 2 – Dietary patterns with the items that compose it, factor loading and % of explained variance of students aged 12 to 19 years regularly enrolled in the 8th and 9th grades of public elementary school in the city of Caxias do Sul/Rio Grande do Sul, Brazil, 2016 (n=1750)

Dietary pattern: Fast Food	**Factor loading**	**Food pattern: Fruits & Vegetables**	**Factor loading**	**Dietary pattern: Dairy Products**	**Factor loading**
Snack foods/chips	0.708	Raw vegetables	0.837	Milk	0.750
Fried snacks	0.677	Raw salads	0.788	Chocolate milk	0.695
Sweet cookies	0.657	Cooked vegetables	0.683	Cheese	0.476
Soda	0.600	Fruits	0.583	Yoghurt/Dairy beverage	0.429
Sweets	0.593				
Salty cookies	0.591				
Sausages	0.498				
Fast-food	0.492				
% of explained variance[b]	**19.14**		**13.15**		**7.36**

[a]In each dietary pattern, only food items with an absolute factor loading ≥0.30 were kept. Beans and canned or powdered juice were not retained in any dietary pattern. [b]Proportion of variance related to each factor loading, after orthogonal Varimax variation in PCA. (% of total variance: 39.65).

Regarding PCA, three factors were extracted, which explained 39.65% of the total variance. Of the 18 food items, only one (juice box) did not contain any factor, while the others were pure saturation, that is, they did not contain more than one factor. Dietary patterns were named according to the foods that constituted them: Fast Food, Fruits & Vegetables and Dairy Products. The Fast Food dietary pattern had the highest percentage of explanation for the variance (19.14%), that is, the pattern that would best represent the consumption of this population (Table 2).

Tables 3, 4 and 5 present the crude and adjusted prevalence ratios for high adherence to dietary patterns. After adjustment for confounding factors, the probability of high adherence to the Fast Food pattern increased linearly and positively with age, it was higher among black/brown schoolchildren, among those with excessive sedentary behavior (≥2 hours/day), among those who consumed alcohol in the last month and increased linearly and positively with the number of meals with the family (Table 3).

Table 3 – Crude and adjusted Prevalence Ratios, with the respective 95% confidence intervals, of high adherence to the Fast Food dietary pattern, according to demographic, socioeconomic, behavioral and health variables in public elementary school students in the city of Caxias do Sul/Rio de Grande do Sul, Brazil, 2016 (n=1750)

Variables	Dietary pattern: Fast Food			
	Crude PR PR (95% CI)	p-valor	PR adjusted[a] PR (95% CI)	p-valor
1st level				
Sex*		0.711		–
Male	1.00		–	
Female	1.03 (0.88–1.20)		–	
Age in years (n=1748)†		**0.016**		**0.036**
12–13	1.00		1.00	
14	1.08 (0.88–1.32)		1.08 (0.87–1.34)	
15	1.22 (0.92–1.60)		1.17 (0.87–1.57)	
≥16	1.56 (1.14–2.13)		1.55 (1.10–2.19)	
Skin color*		**0.003**		**0.004**
White	1.00		1.00	
Black/brown	1.36 (1.12–1.65)		1.33 (1.10–1.60)	
Other	1.25 (1.00–1.56)		1.23 (0.99–1.54)	
Mother's schooling†		0.922		–
Did not study/Incomplete elementary school	1.00		–	
Incomplete high school	1.15 (0.89–1.48)		–	
Incomplete higher education	1.02 (0.79–1.32)		–	
Complete higher education	1.04 (0.71–1.53)		–	
2nd level				
Physical activity min/week (n=1687)*		0.883		–
Insufficient <300	1.00		–	
Sufficient ≥300	0.99 (0.81–1.19)		–	
Sedentary behavior hours/day*		**0.003**		**0.003**
Adequate <2	1.00		1.00	
Excessive ≥2	1.49 (1.16–1.90)		1.48 (1.15–1.89)	
Smoke in the last month (n=1717)*		**<0.001**		0.569
Never smoked	1.00		1.00	
Haven't smoked	1.30 (1.04–1.64)		1.11 (0.87–1.42)	
Smoked at least one day	1.58 (1.23–2.03)		1.09 (0.83–1.44)	
Alcohol consumption in the last month*		**<0.001**		**<0.001**
Never drank	1.00		1.00	
Not consumed	1.26 (1.06–1.50)		1.18 (1.00–1.39)	
Drank at least one day	1.92 (1.58–2.34)		1.81 (1.52–2.15)	
Meals with the family at least once a week†		**0.026**		**0.027**
None	1.00		1.00	
Once	1.21 (0.83–1.74)		1.27 (0.85–1.89)	
Twice	1.08 (0.74–1.59)		1.12 (0.75–1.67)	
Three	1.44 (1.02–2.02)		1.56 (1.05–2.31)	
Self-perception of health (n=1721)†		**0.029**		0.118
Excellent/very good/good	1.00		1.00	

Regular	1.17 (0.94–1.45)	1.14 (0.91–1.43)
Bad	1.42 (0.96–2.09)	1.24 (0.82–1.87)

PR, Prevalence ratio. 95% CI, 95% confidence interval. [a]Each variable is adjusted for those at the same level and those at levels above. Only variables with p-value ≤0.20 were included. *Wald test for heterogeneity. [†]Wald test for linear trend.

As for the Fruits & Vegetables pattern, after adjustment, it was found that the probability of high adherence was 1.42 (1.20–1.68) times higher among students who had sufficient physical activity (≥300 min/week) when compared to insufficiently active (<300 min/week), increased linearly and positively with the number of meals eaten with the family and was 30% (0.53–0.93) lower among those who classified their health as regular, compared to those who rated it excellent/very good/good (Table 4).

Table 4 – Crude and adjusted Prevalence Ratios, with the respective 95% confidence intervals, of high adherence to the Fruits & Vegetables dietary pattern, according to demographic, socioeconomic, behavioral and health variables in public elementary school students in the city of Caxias do Sul/Rio de Grande do Sul, Brazil, 2016 (n=1750)

Variables	**Dietary pattern: Fruits & Vegetables**			
	Crude PR PR (95% CI)	**p-valor**	**PR adjusted[a] PR (95% CI)**	**p-valor**
1st level				
Sex*		0.653		–
Male	1.00		–	
Female	1.04 (0.88–1.22)		–	
Age in years (n=1748)[†]		0.080		0.058
12–13	1.00		1.00	
14	1.09 (0.84–1.42)		1.10 (0.89–1.35)	
15	1.17 (0.86–1.59)		1.18 (0.92–1.50)	
≥16	1.33 (0.94–1.89)		1.33 (0.96–1.83)	
Skin color*		0.812		–
White	1.00		–	
Black/brown	0.95 (0.81–1.12)		–	
Other	0.95 (0.66–1.37)		–	
Mother's schooling[†]		0.200		0.153
Did not study/Incomplete elementary school	1.00		1.00	
Incomplete high school	0.91 (0.70–1.19)		0.92 (0.71–1.21)	
Incomplete higher education	1.12 (0.90–1.39)		1.15 (0.92–1.43)	
Complete higher education	1.13 (0.83–1.53)		1.15 (0.84–1.57)	
2nd level				
Physical activity min/week (n=1687)*		**<0.001**		**<0.001**
Insufficient <300	1.00		1.00	
Sufficient ≥300	1.43 (1.24–1.65)		1.42 (1.20–1.68)	
Sedentary behavior hours/day*		0.085		0.265
Adequate <2	1.00		1.00	
Excessive ≥2	0.87 (0.73–1.02)		0.90 (0.75–1.09)	
Smoke in the last month (n=1717)*		0.815		–
Never smoked	1.00		–	
Haven't smoked	0.92 (0.69–1.23)		–	
Smoked at least one day	1.04 (0.77–1.40)		–	
Alcohol consumption in the last month*		0.936		–
Never drank	1.00		–	
Not consumed	0.96 (0.77–1.21)		–	
Drank at least one day	0.97 (0.78–1.19)		–	

Meals with the family at least once a week†		**<0.001**		**<0.001**
None	1.00		1.00	
Once	0.92 (0.68–1.26)		0.91 (0.60–1.40)	
Twice	1.25 (0.82–1.89)		1.21 (0.82–1.77)	
Three	1.57 (1.12–2.20)		1.44 (1.04–2.13)	
Self-perception of health (n=1721)†		**0.006**		**0.014**
Excellent/very good/good	1.00		1.00	
Regular	0.64 (0.49–0.83)		0.70 (0.53–0.93)	
Bad	0.63 (0.30–1.34)		0.71 (0.37–1.33)	

PR, Prevalence ratio. 95% CI, 95% confidence interval. [a]Each variable is adjusted for those at the same level and those at levels above. Only variables with p-value ≤0.20 were included. *Wald test for heterogeneity. †Wald test for linear trend.

In the adjusted analysis of the and Dairy Products pattern, the probability of adherence was 23% lower among black/brown-skinned schoolchildren when compared to white-skinned ones. On the other hand, students whose mothers had higher education, those who had excessive sedentary behavior and who had more meals with the family were more likely to adhere to this pattern (Table 5).

4 DISCUSSION

The present study identified three dietary patterns in schoolchildren in Southern Brazil: Fast Food, Fruits & Vegetables and Dairy Products, which were distinctly associated with the demographic, socioeconomic, behavioral and health variables investigated.

The dietary patterns found were similar in composition to those of other studies, although with different names. The names for patterns similar to the Fast Food dietary pattern were: Processed[20], High energy density[21], Junk food[22] and Obesogenic[23]. As for the Fruits & Vegetables dietary pattern, the following names were found: Healthy[20], Natural foods[21], Fruits[22] and Vegetables[22]. Regarding the Dairy Products pattern, some studies named it as Breakfast products[22] or Milk and sugary products[24]. Although some patterns are similar, comparisons should be made with caution given the nature of PCA, as not all foods that carry in one pattern will carry in the other. Thus, the patterns must be interpreted as indicators of the characteristics of food intake of a given population[9].

In the multivariate analysis, the demographic variables associated with the Fast Food pattern were age and skin color. The probability of high adherence to the standard increased with age, reaching 55% higher in students aged 16 years or more, when compared to those aged 12 to 13 years, a finding consistent with both the national[25] and international[26] literature. As adolescents get older, they acquire more autonomy to make

their choices, including food choices, in addition, they are more subject to the influence of friends and the media, which can result in the consumption of unhealthy foods[22]. As for skin color, it was found that students who self-classified as black/brown skin color were more likely to adhere to the Fast Food pattern, a finding consistent with the literature[7]. This could be related to the socioeconomic level of these students, as it has been shown that people with black/brown skin color have lower income, less education and belong to the lowest economic strata[27]. As reviewed by Darmon and Drewnowski[28], the lower socioeconomic level would favor greater consumption of low-cost snacks and foods, however, with high energy density. However, a recent study showed that a lower socioeconomic level was positively associated with the Western pattern, similar to our Fast Food pattern, in European adolescents, but not among Brazilian adolescents[29]. Different measures of socioeconomic status could be an explanation for these conflicting outcomes. Furthermore, in explaining our findings, skin color is being considered as a proxy measure of socioeconomic status.

In the present study, both students who showed excessive sedentary behavior (≥2 hours/day) and those who consumed alcohol in the last month were more likely to adhere to the Fast Food pattern. These associations configure a cluster of health risk behaviors, making these students more vulnerable. These characteristics have been observed in a study with Spanish adolescents[24], in which researchers identified that adolescents were grouped according to their behavior, that is, a cluster of those with risk behaviors and a cluster of those with healthy behaviors. However, despite the fact that students with risk behaviors adhered more to the Fast Food pattern, it is noteworthy that having more meals with the family, a behavior considered to promote healthy food consumption[29], increased the probability of adherence to this pattern. Although this variable was ordinal, a minimum of once a week was considered. Thus, some students may have had the maximum number of meals, but only once a week, and, on other days, they had meals away from home. Studies have shown that, in general, such meals are characterized by ultra-processed foods[13,30].

The Fruits and Vegetables pattern was positively associated with performing sufficient physical activity (≥300 min./week), as well as with a greater number of meals eaten with the family. A study conducted with Spanish adolescents found a cluster of these behaviors[24]. As for having meals with the family, this is one of the

recommendations of the Food Guide for the Brazilian Population as a way to ensure healthier consumption and improve the population's health level[31].

The self-perceived health variable was also significantly associated with the Fruits & Vegetables pattern. The probability of adhering to this pattern was 30% lower in students who rated their health as regular compared to those who rated it as excellent/very good/good. Similar results were found in the literature[32]. Considering that, currently, there is more dissemination of information about what is a healthy diet, which includes both the consumption of fruits and vegetables, it cannot be ruled out that students who have less consumption of these foods consider themselves less healthy.

In the present study, the probability of high adherence to the dietary pattern of Dairy Products was 23% lower among black/brown schoolchildren and linearly increased with the mother's level of education. A possible explanation could be of an economic nature if we consider both skin color and maternal education as proxy measures of the socioeconomic level of these students[27,33]. The dietary pattern of Dairy Products is mostly made up of higher-cost foods, such as calcium-rich foods, and their acquisition depends on income[20,21]. Regarding behavioral characteristics, most studies that identified patterns similar to the Dairy Products pattern showed that they are associated with healthy lifestyle habits[22,23]. In our results, however, it was observed that having excessive sedentary behavior (≥2 hours/day) increased the probability of high adherence to this pattern. A possible explanation for this finding is the fact that foods such as milk drinks and chocolate drinks carried this pattern, which are more frequently consumed by adolescents while watching TV[34].

Some limitations must be considered in this study. The first one refers to the use of a self-administered paper questionnaire, which allowed the student to leave questions blank. However, only 27 students (1.52%) left 30% or more questions unanswered. The information bias cannot be discarded either, as some questions addressed aspects related to behaviors that could be considered unacceptable, such as alcohol consumption. However, anonymity is believed to have minimized this bias. Recall errors may also be present, however, for the questions used in this study, the longest reference time was 30 days. The way in which food consumption was assessed is another potential limitation of this study, as, in addition to having investigated a short period (number of days of consumption in the week prior to the survey), a restricted number of foods were assessed. However, the foods evaluated are considered markers of healthy and unhealthy eating,

which have been related to both prevention and the occurrence of health problems[14]. As this is a cross-sectional study, the occurrence of reverse causality cannot be ruled out. Finally, as only students enrolled in public schools were investigated, the results of this study are not generalizable to students from private schools.

Despite the limitations, this study provides important and worrying data about the food consumption of the investigated students, since the Fast Food dietary pattern explained the highest percentage of variance, that is, this dietary pattern is what best represents the consumption of this group. Furthermore, this pattern was more strongly associated with risk behaviors, making this group more susceptible to the development of obesity and other non-communicable chronic diseases, relationships that have been observed in other studies that evaluated adolescents[4,5]. These findings should be considered in the formulation of public policies aimed at promoting healthy eating as well as other health-promoting behaviors in this population group. In Brazil, the National School Feeding Program (*Programa Nacional de Alimentação Escolar (PNAE)*), in addition to providing food for schoolchildren at all stages of basic education in the public network, has, as one of its attributions, to carry out food and nutrition actions[35].

Three dietary patterns were identified that explained 39.65% of the total variance, with the Fast Food dietary pattern explaining the greatest variance (19.1%). The factors associated with each pattern were distinct, but, in general, risk behaviors were associated with the Fast Food pattern and healthy behavior with the Fruits & Vegetables pattern. The Dairy Products pattern was associated with both types of behavior.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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