Characteristics associated with the consumption of *in natura* or minimally processed and ultra-processed foods in one Brazilian metropolitan region

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Abstract *This cross-sectional study aimed to analyze the sociodemographic and lifestyle characteristics associated with the consumption of in natura or minimally processed and ultra-processed foods (UPFs) by adolescents in the Metropolitan Region of Greater Vitória, in Espírito Santo, Brazil. The data were obtained between 2016 and 2017. Logistic regression was adopted for the multivariate analysis. A total of 2,285 adolescents aged between 15 and 19 participated in the study. Greater consumption of minimally processed foods was associated with the adolescent doing paid work (OR=1.27; 95%CI=1.04-1.56), a high family income (OR=1.5; 95%CI=1.10-2.17), and engagement in physical activity (OR=1.9; 95%CI=1.45-2.63). Having brown/black skin (OR=1.3; 95%CI=1.02-1.61) and the habit of eating while surfing the web (OR=1.4; 95%CI=1.02-1.88) increased the chances of consuming UPFs. Being enrolled in a private school and being in the third/fourth year of high school reduced UPF consumption by 41.7% and 37.2%, respectively. It is concluded that greater purchasing power and engagement in physical activity influenced the consumption of minimally processed foods. On the other hand, self-reporting as brown/black and internet use increased the chances of greater UPF consumption.*

Key words *Food consumption, Nutrition, Adolescents, Risk factors, Cross-sectional studies*

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Introduction

Adolescence is a period marked by a high demand for nutrients and energy, associated with changes in dietary habit[1,2], with a diet characterized by the low intake of fruits and vegetables, and high consumption of industrialized foods[3,4]. Overconsumption of these foods is related with a higher intake of energy, saturated fat, and trans fat and a lower intake of dietary fiber and micronutrients[5,6], which is concerning given that adequate nutrition is fundamental for the healthy development of adolescents[7].

In light of the dietary profile focused on the consumption of foods with a high level of processing, since 2010, many studies in the area of diet and nutrition have been based on the NOVA[8] (not an acronym) classification system, which is anchored in the nature, extent, and degree of industrial processing of foods. This system classifies foods and food products into four distinct groups: *in natura* or minimally processed foods; processed culinary ingredients; processed foods; and ultra-processed foods (UPFs) [9].

UPF consumption has increased over the years[3-6] and among Brazilian adolescents it has been associated with the administrative dependence of the school[10-13]; with family income[6,14,15] and the parents' educational level[14]; with physical inactivity[6,16]; and with sedentary behavior, especially in individuals with high screen time[13,16,17]; culminating in excess weight[3,4,18], metabolic syndrome[19], and alterations in lipid profile[20] and in arterial pressure[21]. Similar data have been observed in the international literature[22,23]. In relation to the consumption of minimally processed foods, this is also influenced by screen time and socioeconomic stratum in Brazilian adolescents[15,17].

Despite this evidence, there is still a scarcity in the Brazilian literature of studies that include adolescents aged 15 to 19, from public and private schools[6,10-13,17], and that use the NOVA classification[8,9], primarily to analyze the consumption of *in natura* or minimally processed foods[17]. Thus, the present study aimed to analyze the sociodemographic and lifestyle characteristics associated with the consumption of *in natura* or minimally processed foods and UPFs by adolescents from the Metropolitan Region of Greater Vitória in Espírito Santo (MRGV-ES), Brazil.

Methodology

Study design

This is a school-based, cross-sectional, epidemiological study derived from the project "Surveillance of risk factors for diseases and grievances in adolescents aged 15 to 19 in the Metropolitan Region of Greater Vitória in Espírito Santo (VIGIADOLEC)"[24]. The MRGV-ES occupies an area of 2,331.01 km², corresponding to 4.97% of the total area of the State of Espírito Santo[25] and accounting for approximately 48% (1.6 million inhabitants) of the state's population and around 148,628 adolescents aged 15 to 19[26]. The Human Development Index of the MRGV-ES varies from 0.686 to 0.845 between the seven municipalities that compose it[27]. According to information from the State Secretariat for Education of Espírito Santo (2014), the MRGV-ES has 168 high schools and 65,763 regularly enrolled students. High school education covers students aged 15 to 19 in Brazil (Law 9,394/1996), the age group that makes up this study.

Sample size calculation

The sample size was calculated in order to estimate the proportion of enrolled students in the MRGV, considering the population of 65,763 high school students enrolled in 168 schools in the MRGV. Based on that universe, the sample size was calculated considering the estimated prevalence of daily consumption of at least one UPF among adolescents (39.7%)[16], with a 2.5% margin of error, a 95% confidence interval, and a project design effect of 1.5, resulting in a minimum required sample of 2,160 individuals. However, to improve the representativeness of the sample and the statistical relevance, we used the data on all the adolescents who participated in the VIGIADOLEC.

The sampling process was developed in multiple stages. Initially, the sample was stratified by calculating the municipal quotas, obtained from the percentage distribution of students enrolled in high schools of the MRGV-ES, which was subdivided as follows: Cariacica (19.3%), Fundão (0.5%), Guarapari (5.8%), Serra (23.2%), Viana (3.7%) Vila Velha (22.7%), and Vitória (24.8%). Next, 51 schools were randomly selected using the BioEstat 5.4 program, considering the municipality of the school's location, the administrative dependence of the school, and the size of the school, in order to guarantee the adequate quan-

tity of students. In the case of a selected school being rejected, it was substituted respecting all the aforementioned sampling criteria.

Inclusion and exclusion criteria

The study involved students regularly enrolled in the public (state and federal) and private high school education networks of the MRGV-ES, in the morning and afternoon sessions, aged between 15 and 19, and who did not present any type of cognitive, auditory, or visual impairment that impeded their active participation in the research. The study included all students who agreed to take part, who handed in the duly signed informed consent forms (ICFs), and who effectively answered the instrument. All the data were provided by the students themselves.

Data collection

The data collection occurred between 2016 and 2017 on the premises of the 54 schools, 43 of which were public and 11 were private. The structured interview was conducted in the chosen sessions during class time by previously trained interviewers. The responsible interviewer read to the group the research instrument, provided online. The adolescents completed it individually, using laptop computers, simultaneously to the reading. The Vigiadolec software is developed to carry out the data collection, enabling online or offline collection.

Instrument and variables

Consumption of *in natura* or minimally processed and ultra-processed foods

In this study we considered as an outcome adolescents' consumption of *in natura* or minimally processed foods and UPFs. We adopted the food questionnaire of the Surveillance of Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL)[28], which contains the food subgroups most often consumed in Brazil, to assess the dietary intake of the adolescents.

The variable was operationalized based on the question "In the last seven days, on how many days did you consume…?" in relation to each one of the following food groups: beans, raw vegetables or legumes, cooked vegetables or legumes, red meats, white meats, natural fruit juice, fresh fruits, soft drinks, artificial juices, milk, sweets (for example, ice-cream, chocolates, or others), sausages, cookies, and fried snacks. Six frequency categories were stipulated for each food: never, almost never, one or two times a week, three to four times a week, five to six times a week, or every day (including Saturdays and Sundays).

The consumption frequency reported was converted to daily frequency, using the method proposed by Cade *et al.*[29], so that all the foods had the same unit. In the conversion we considered the following daily frequency scores: 0 for never or almost never, 0.21 (1.5/7) for one to two times a week, 0.5 (3.5/7) for three to four times a week, 0.79 (5.5/7) for five to six times a week, and 1 (7/7) for every day of the week.

Subsequently, the foods were grouped according to the criteria proposed by Monteiro *et al.*[9] in the NOVA classification system at: *in natura* or minimally processed and UPFs. For the group of *in natura* or minimally processed foods the following food items were included: beans, vegetables, legumes, red meat, white meat, fruits, natural juice, and milk. For the UPF score the indicator variables were the consumption of artificial juice, soft drinks, sausages, cookies, fried snacks and sweets.

Subsequently, the "consumption of *in natura* or minimally processed foods" was categorized based on the cut-off point of the consumption quartiles[30], grouped as follows: 1st quartile up to 3.76g; 2nd quartile between 3.76 g and 5.0 g; 3rd quartile between 5.0 g and 6.21 g; 4th quartile over 6.21 g. The "UPF consumption" variable was categorized as follows: 1st quartile up to 0.71 g; 2nd quartile between 0.71 g and 1.21 g; 3rd quartile between 1.21 g and 1.79 g; 4th quartile over 1.79 g.

Independent variables

The following independent variables were included: age (15-16, 17, 18-19 years old), sex (female, male), skin color (white, brown/black, yellow, indigenous), administrative dependence of the school (public, private), study session (morning, afternoon), current year of high school (first, second, or third/fourth year), fit between the school year and age (behind, adequate, ahead), relationship status (no partner, lives with a partner, has a partner but does not live with them), whether the adolescent has in paid job (yes, no), educational level of the head of the family (illiterate, complete elementary I - 1st to 4th series, complete elementary II - 5th to 8th series, complete high school, complete higher education), total family income in minimum wages (<1, 1 to 2, 2 to 3, >3), and eating while surfing the web (yes, no).

The Physical activity level (PAL) was measured using the International Physical Activity

Questionnaire (IPAQ) (version 8, short form, last week), developed by the WHO, with the version in Portuguese validated by Matsudo *et al.*[31]. The IPAQ (version 8) was validated for adolescents by Guedes and Lopes[32], and the results of the study show that, in adolescents of both sexes older than 14 years old, the IPAQ presents acceptable measurement properties for monitoring PAL. To classify the adolescents' physical activity, the criterion developed by the IPAQ Research Committee[33] was used.

This classification takes into consideration the criteria of frequency and duration, and classifies PAL into three categories: *Sedentary* - does not engage in physical activity for at least 10 continuous minutes during the week; *Moderately active* - individuals who practice physical activities for at least 10 continuous minutes a week, but not enough to be classified as active; *Active* - fulfills the following recommendations: a) vigorous physical activity - ≥3 days/week and ≥20 minutes/session; b) moderate or walking - ≥5 days/week and ≥30 minutes/session; c) any summed activity: ≥5 days/week and ≥150 minutes/week; or very Active, fulfilling the following recommendations: a) vigorous - ≥5 days/week and ≥30 minutes/session; b) vigorous - ≥3 days/week and ≥20 minutes/session + moderate and/or walking ≥5 days/week and ≥30 minutes/session.

Using the Drug Use Screening Inventory (DUSI-R)[34] we measured substance use and related problems. This is a questionnaire with 10 areas and 149 questions. The present study used Area 1, composed of 15 questions, which investigates the level of consumption and intensity of substances in the last 12 months, such as: "Have you ever felt a strong desire for alcohol and/or drugs?" This variable was categorized as "Not a user", "Experimental use", "Abusive use", and "Dependence".

Statistical analysis

The data were analyzed in STATA version 14. The absolute and relative frequencies were calculated and the Pearson chi-squared (X^2) test was used to analyze the differences in proportions of quartiles of consumption *in natura* or minimally processed foods and UPFs with sociodemographic and lifestyle characteristics the adolescents. A 5% significance level was adopted.

The binary logistic regression model was used to investigate the association between the sociodemographic and lifestyle variables and the consumption of *in natura* or minimally processed foods and UPFs. Variables that presented statistical significance lower than 20% in the X^2 test were included in the logistic regression, comparing the greatest consumption (third and fourth quartiles) with the lowest consumption (first and second quartiles) of the food groups. The odds ratio (OR) was calculated with the respective 95% confidence intervals (95%CIs) and considering a 5% significance level.

Ethical questions

In order to carry out this study, first it was submitted to the Research Ethics Committee of the Center for Health Sciences of the Federal University of Espírito Santo (UFES) (Resolution 971,389/2015). The adolescents participating in the research who were under 18 needed an informed consent form signed by their parents or legal guardians. When the adolescents were already 18 or over, they had to sign the same consent form to answer the questionnaire.

Results

A total of 2,293 adolescents aged from 15 to 19 and belonging to the MRGV-ES participated in the study. However, only 2,285 presented complete information regarding food consumption. Among the interviewees, most were female (60%), brown/black (63.1%), went to public schools (87.9%), studied in the afternoon session (81.6%), were enrolled in the first year (47.8%), were an adequate age or ahead for their school year (47.0% and 47.9% respectively), did not have a partner (71.6%), had a paid job (23.3%), had a family income between one and two minimum wages (37.2%), ate while they surfed the web (27.1%), were not an alcohol or drug user (34.6%), and regularly engaged in physical activity (51.8%) (Table 1).

The sociodemographic and lifestyle variables were analyzed according to the quartiles of *in natura* or minimally processed food consumption (Table 1). It was observed a higher proportion of girls in the first quartile (26.7%, n=366) and boys in the fourth quartile of consumption (29.4%, n=269). Adolescents with family income up to one minimum wage showed higher frequency in the first quartile of consumption (32.1%, n=78) and those with higher income in the consumption quartile (26.9%, n=213). Regarding physical activity practice, active students had the highest consumption (30.9%, n=365, p<0.001) and

sedentary students had the lowest consumption (33.9%, n=113).

Regarding UPF consumption (Table 2), the indigenous presented the highest proportion in the first quartile (37.2%, n=16) and the yellow-skinned in the fourth quartile of consumption (26.7%, n=39). Regarding the administrative dependence of the school, adolescents from public school presented the lowest consumption (31.2%, n=86) and those from public schools the highest consumption (24.3%, n=487). As for the school year, the adolescents who are advanced presented the lowest consumption (36.5%, n=42) and the ones who are late the highest consumption (26.1%, n=286).

When checking the marital status, it was observed that adolescents who do not have a partner had the lowest consumption (30.4%, n=495) and those who live with a partner had the highest consumption of UPF (31.0%, n=45). Regarding the education of the head of household, the illiterate individuals showed the highest proportion in the first consumption quartile (46.7%, n=70) and those with primary schools education II, in the fourth quartile of consumption of UPF (26.9%, n=138). The families with income up to

Table 1. Consumption of fresh or minimally processed foods according to sociodemographic variables and lifestyle of 2,285 adolescents. VIGIADOLEC, MRGV-ES, 2016/2017.

Variables	Consumption of in natura or minimally processed foods									
	Q1		Q2		Q3		Q4		Total	
	n	%	n	%	n	%	n	%	n	%
Age (years) (n=2,285)										
15-16	304	23.9	308	24.2	350	27.5	309	24.3	1271	55.6
17	148	25.7	153	26.6	147	25.5	128	22.2	576	25.2
18-19	117	26.7	94	21.5	103	23.5	124	28.3	438	19.2
Sex (n=2,285)*										
Female	366	26.7	323	23.6	389	28.4	292	21.3	1370	60.0
Male	203	22.2	232	25.4	211	23.1	269	29.4	915	40.0
Skin color (n=2,282)										
White	170	26.0	153	23.4	174	26.6	156	23.9	653	28.6
Brown/Black	351	24.4	341	23.7	378	26.3	370	25.7	1440	63.1
Yellow	32	21.9	46	31.5	39	26.7	29	19.9	146	6.4
Indigenous	15	34.9	14	32.6	8	18.6	6	14.0	43	1.9
Administrative dependence of the school (n=2,284)										
Public	502	25.0	482	24.0	523	26.0	501	25.0	2008	87.9
Private	67	24.3	73	26.4	77	27.9	59	21.4	276	12.1
Study shift (n=2,272)										
Morning	455	24.4	453	24.3	504	27.0	453	24.3	1865	81.6
Afternoon	111	27.3	100	24.6	92	22.6	104	25.6	407	17.8
Year of high school you are attending (n=2,285)										
First	266	24.4	277	25.4	277	25.4	272	24.9	1092	47.8
Second	140	22.6	145	23.4	176	28.4	158	25.5	619	27.1
Third/Fourth	163	28.4	133	23.2	147	25.6	131	22.8	574	25.1
Adequacy of school year with age (n=2,285)										
Adequate	256	23.8	268	24.9	296	27.5	255	23.7	1075	47.0
Late	33	28.7	22	19.1	36	31.6	24	20.9	115	5.0
Early	280	25.6	265	24.2	268	24.5	282	25.8	1095	47.9
Marital status (n=2,264)										
Has no partner	412	25.3	393	24.2	428	26.3	393	24.2	1626	71.8
Lives with a partner	32	22.1	34	23.4	37	25.5	42	29.0	145	6.4
Has a partner, but does not live with him/her	117	237	125	25.4	129	26.2	122	24.7	493	21.8

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Table 1. Consumption of fresh or minimally processed foods according to sociodemographic variables and lifestyle of 2,285 adolescents. VIGIADOLEC, MRGV-ES, 2016/2017.

Variables	Consumption of in natura or minimally processed foods									
	Q1		Q2		Q3		Q4		Total	
	n	%	n	%	n	%	n	%	n	%
Paid work by adolescents (n=2,282)										
Yes	149	28.1	138	26.0	130	24.5	114	21.5	531	23.3
No	419	23.9	416	23.8	469	26.8	447	25.5	1751	76.7
Education of the head of household (n=2,237)										
Illiterate	45	30.0	35	23.3	37	24.7	33	22.0	150	6.7
Elementary I complete (1st to 4th grade)	112	29.0	89	23.1	95	24.6	90	23.3	386	17.3
Elementary II complete (5th to 8th grade)	127	24.8	120	23.4	131	25.5	135	26.3	513	22.9
Completed secondary education	186	24.3	197	25.8	203	26.5	179	23.4	765	34.2
Higher Education Complete	82	19.4	104	24.6	123	29.1	114	27.0	423	18.9
Total family income in minimum wage (n=2,285)*										
<1	78	32.1	62	25.5	46	18.9	57	23.5	243	10.6
1-2	222	26.1	213	25.1	212	24.9	203	23.9	850	37.2
2-3	94	23.6	96	24.1	121	30.3	88	22.1	399	14.2
>3	175	22.1	184	23.2	221	27.9	213	26.9	793	34.7
Eating while surfing the internet (n=2,234)										
Yes	148	24.5	153	25.3	159	26.3	145	24.0	605	27.1
No	397	24.4	396	24.3	434	26.6	402	24.7	1629	72.9
Use of alcohol and/or drugs (n=2,173)										
Non-user	169	22.5	204	27.1	201	26.7	178	23.7	752	34.6
Experimental use	163	22.2	181	24.7	198	27.0	191	26.1	733	33.7
Abusive use	133	25.2	121	22.9	137	25.9	137	25.9	528	24.3
Dependence	45	28.1	35	21.9	45	28.1	35	21.9	160	7.4
Level of physical activity (n=2,285)*										
Sedentary	113	33.9	82	24.6	83	24.9	55	16.5	333	14.6
Moderately active	250	32.5	197	25.6	181	23.5	141	18.3	769	33.7
Active	206	17.4	276	23.3	336	28.4	365	30.9	1183	51.8

Q1=first quartile; Q2=second quartile; Q3=third quartile; Q4=fourth quartile. * p-value<0.05 obtained by Pearson's chi-square test.

Source: Authors.

one minimum wage stood out with the lowest consumption of UPF (38.7%, n=94) and above three minimum wages with the highest consumption (23.7%, n=188) (Table 2).

The adolescents who were in the habit of eating while surfing the web presented a greater proportion in the fourth quartile of UPF consumption (23.8%, n=144), as did the sedentary ones (24.6%, n=82). In relation to alcohol or drug use, the adolescents who used these substances presented greater UPF consumption (30.0%, n=48) (Table 2).

In the adjusted logistic regression model, it was observed that the adolescents who had a paid job had 27% more chance of engaging in greater consumption of *in natura* or minimally processed foods compared with those who did not have a paid job (OR=1.27; 95%CI=1.04-1.56). A similar relationship was revealed with relation to family income, given that having a family income greater than three minimum wages increased the chance of consuming items from this food group by 55% (OR=1.55; 95%CI=1.10-2.17) compared with a family income under one minimum wage (Table 3).

Along these same lines, the adolescents who were in the habit of regularly engaging in physical activity had 1.96 times more chance of presenting greater consumption of *in natura* or minimally processed foods compared to the sedentary ones (95%CI=1.45-2.63) (Table 3).

Regarding the model adjusted for UPF consumption (Table 4), a greater probability of consumption was verified among brown/black ado-

Table 2. Consumption of ultra-processed foods according to sociodemographic and lifestyle variables of 2,285 adolescents. VIGIADOLEC, MRGV-ES, 2016/2017.

Variables	Consumption of ultra-processed food									
	Q1		Q2		Q3		Q4		Total	
	n	%	n	%	n	%	n	%	n	%
Age (years) (n=2,285)										
15-16	360	28.3	313	24.6	310	24.4	288	22.7	1271	55.6
17	168	29.2	154	26.7	135	23.4	119	20.7	576	25.2
18-19	131	29.9	103	23.5	87	19.9	117	26.7	438	19.2
Sex (n=2,285)										
Female	395	28.8	357	26.1	313	22.8	305	22.3	1370	60.0
Male	264	28.9	213	23.3	219	23.9	219	23.9	915	40.0
Skin color (n=2,282)*										
White	212	32.5	167	25.6	148	22.7	126	19.3	653	28.6
Brown/Black	389	27.0	345	24.0	351	24.4	355	24.7	1440	63.1
Yellow	40	27.4	45	30.8	22	15.1	39	26.7	146	6.4
Indigenous	16	37.2	13	30.2	10	23.3	4	9.3	43	1.9
Administrative dependence of the school (n=2,284)*										
Public	572	28.2	491	24.5	458	22.8	487	24.3	2008	87.9
Private	86	31.2	79	28.6	74	26.8	37	13.4	276	12.1
Study shift (n=2,274)										
Morning	540	29.0	470	25.2	429	23.0	426	22.8	1865	81.6
Afternoon	114	28.0	100	24.6	101	24.8	92	22.6	407	17.8
Year of high school you are attending (n=2,285)										
First	306	28.0	258	23.6	259	23.7	269	24.6	1092	47.8
Second	166	26.8	160	25.8	148	23.9	145	23.4	619	27.1
Third/Fourth	187	32.6	152	26.5	125	21.8	110	19.2	574	25.1
Adequacy of school year with age (n=2,285)*										
Adequate	304	28.3	279	26.0	278	25.9	214	19.9	1075	47.0
Late	313	28.6	264	24.1	232	21.2	286	26.1	1095	47.9
Early	42	36.5	27	23.5	22	19.1	24	20.9	115	5.0
Marital status (n=2,264)*										
Has no partner	495	30.4	411	25.3	389	23.9	331	20.4	1626	71.8
Lives with a partner	42	29.0	30	20.7	28	19.3	45	31.0	145	6.4
Has a partner, but does not live with him/her	115	23.3	122	24.7	111	22.5	145	29.4	493	21.8
Paid work by adolescents (n=2,282)										
Yes	158	29.8	134	25.2	120	22.6	119	22.4	531	23.3
No	499	28.5	436	24.9	411	23.5	405	23.1	1757	76.7
Education of the head of household (n=2,237)*										
Illiterate	70	46.7	34	22.7	26	17.3	20	13.3	150	6.7
Elementary I complete (1st to 4th grade)	99	25.6	109	28.2	90	23.3	88	22.8	386	17.3
Elementary II complete (5th to 8th grade)	138	26.9	126	24.6	111	21.6	138	26.9	513	22.9
Completed secondary education	220	28.8	174	22.7	200	26.1	171	22.4	765	34.2
Higher Education Complete	121	28.6	110	26.0	97	22.9	95	22.5	423	18.9

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lescents (OR=1.28; 95%CI=1.02-1.61) compared with white ones. The presence of schooling of the head of the family contributed to increasing UPF consumption in relation to the illiterate ones (elementary I - OR=1.85; 95%CI=1.15-2.99; elementary II - OR=2.07; 95CI%=1.30-3.28; high school - OR=1.94; 95%CI=1.23-3.04; and higher education - OR=1.82; 95%CI=1.12-2.95).

Another factor associated with greater UPF consumption was the habit of eating while surf-

Table 2. Consumption of ultra-processed foods according to sociodemographic and lifestyle variables of 2,285 adolescents. VIGIADOLEC, MRGV-ES, 2016/2017.

Variables	Consumption of ultra-processed food									
	Q1		Q2		Q3		Q4		Total	
	n	%	n	%	n	%	n	%	n	%
Total family income in minimum wage (n=2,285)*										
<1	94	38.7	46	18.9	48	19.8	55	22.6	243	10.6
1-2	229	26.9	233	27.4	199	23.4	189	22.2	850	37.2
2-3	119	29.8	89	22.3	99	24.8	92	23.1	399	17.5
>3	217	27.4	202	25.5	186	23.5	188	23.7	793	34.7
Eating while surfing the internet (n=2,234)*										
Yes	186	30.7	121	20.0	154	25.5	144	23.8	605	27.1
No	448	27.5	438	26.9	374	23.0	369	22.7	1629	72.9
Use of alcohol and/or drugs (n=2,173)*										
Non-user	240	31.9	197	26.2	170	22.6	145	19.3	752	34.6
Experimental use	204	27.8	177	24.1	171	23.3	181	24.7	733	33.7
Abusive use	120	22.7	138	26.1	131	24.8	139	26.3	528	24.3
Dependence	37	23.1	37	23.1	38	23.8	48	30.0	160	7.4
Level of physical activity (n=2,285)*										
Sedentary	120	36.0	70	21.0	61	18.3	82	24.6	333	14.6
Moderately active	225	29.3	201	23.3	179	23.3	164	21.3	769	33.7
Active	314	26.5	299	25.3	292	24.7	278	23.5	1183	51.8

Q1=first quartile; Q2=second quartile; Q3=third quartile; Q4=fourth quartile. *p-value<0.05 obtained by Pearson's chi-square test.

Source: Authors.

ing the web, with a 38% increase in the chance of this consumption compared to the adolescents who did not have that behavior (Table 4).

Regarding the protective factors, the students enrolled in private schools had a 41.7% lower chance of consuming UPFs compared with those from public schools. Along the same lines, being enrolled in the third/fourth year reduced UPF consumption by 37.2% compared with the students in the first year (Table 4).

Discussion

This study identified that the habit of eating while surfing the web, having brown/black skin, and the different educational levels of the head of the family contributed to increasing the chance of UPF consumption. On the other hand, being enrolled in the third/fourth school year and belonging to a private school presented a lower probability of UPF consumption. Regarding *in natura* or minimally processed food consumption, the adolescents who had a paid job, a higher family income, and who engaged in physical activity had a higher chance of consuming these foods.

The relationship between the habit of eating while surfing the web on UPF consumption can be explained by the distraction effect and the influence on satiety mechanisms, besides the presentation, practicality, palatability and the ease attributed to UPF also stimulate excessive consumption of these foods[10,35]. The habit of eating while watching TV or studying has been associated with excessive consumption of PU among Brazilian adolescents[10].

Exposure to digital marketing of unhealthy foods[35-37] is another factor justifying this association. In the United States, adolescents with high susceptibility to advertising were more prone to consuming at least one sugary drink a day[37]. There was a direct association between attraction to the foods advertised and purchasing the product among children and adolescents from a private school in Brazil[35]. Thus, it is important to consolidate policies that aim to restrict the presence of UPF advertising with the view to promoting healthy food choices among children and adolescents.

In addition, daily internet use may be associated with sedentary behavior. Silva *et al.*[10] highlighted that the habit of sitting for more than

Table 3. Binary logistic regression between the highest (Q3+Q4) and lowest (Q1+Q2) consumption of fresh or minimally processed foods and sociodemographic and lifestyle variables of 2,285 adolescents. VIGIADOLEC, MRGV-ES, 2016/2017.

Variables*	Consumption of in natura or minimally processed foods							
	Crude Analysis				Adjusted analysis			
	p	OR	95%CI		p	OR	95%CI	
			LL	UL			LL	UL
Age (years)								
15-16		1				1		
17	0.102	0.848	0.697	1.033	0.283	0.884	0.707	1.107
18-19	0.994	0.999	0.804	1.242	0.855	1.023	0.798	1.313
Sex								
Female		1				1		
Male	0.198	1.116	0.944	1.319	0.608	0.949	0.779	1.157
Skin color								
White		1				1		
Brown/Black	0.923	1.011	0.806	1.269	0.761	1.042	0.797	1.363
Paid work by adolescents								
No		1				1		
Yes	0.010	1.290	1.062	1.568	0.018	1.275	1.043	1.558
Total family income in minimum wage								
<1		1				1		
1-2	0.077	1.297	0.972	1.729	0.083	1.342	0.962	1.873
2-3	0.014	1.495	1.084	2.062	0.106	1.355	0.937	1.959
>3	0.001	1.643	1.229	2.197	0.012	1.547	1.101	2.174
Level of physical activity								
Sedentary		1				1		
Moderately active	0.894	1.018	0.784	1.321	0.826	0.966	0.711	1.313
Active	<0.001	2.055	1.605	2.631	<0.001	1.956	1.454	2.632

Q1=first quartile; Q2=second quartile; Q3=third quartile; Q4=fourth quartile. p=p-value obtained by binary logistic regression; 95%CI=95% confidence interval; LL=Lower Limit; UL=Upper Limit; OR=Odds ratio; *The variables that obtained p≤0.20 in Pearson's chi-square test were included in the logistic regression analysis: age, sex, skin color, adolescent's paid work, total family income in minimum wage, and level of physical activity.

Source: Authors.

four hours a day, including the use of screens and other electronic devices such as videogames, cellphones, and computers, contributed to an increase in UPF consumption. So, the constant interaction of young people with the technological environment may interfere decisively in the behaviors adopted by this population[38].

With relation to skin color, the data revealed greater UPF consumption among brown/black adolescents. This racial disparity in adolescents' food consumption was also found in the United States[37]. In Brazil, the consumption of food rich in fat, a characteristic of PSAs, is associated with brown/black skin color, while the consumption of fruit, vegetables and greens is higher among whites[39].

The educational level of the head of the family was another factor associated with a higher probability of UPF consumption. More schooling enhances food purchasing, which increases access to foods. A high educational level is generally associated with family income; however, a higher income is not always related to healthy food choices[14,40,41]. Miqueleiz *et al.*[23] observed that children and adolescents from Spanish families from a high socioeconomic stratum showed high consumption of unhealthy foods (fast food, sugary drinks, snacks, chips, and cookies).

Also, in the context of the adolescent's schooling, currently being in the third/fourth year of secondary school was a protective factor for UPF consumption. A higher educational level is nor-

Table 4. Binary logistic regression analysis between higher consumption (Q3+Q4) of ultra-processed foods and sociodemographic and lifestyle variables of 2,285 adolescents. VIGIADOLEC, MRGV-ES, 2016/2017.

Variables*	Consumption of ultra-processed food							
	Crude analysis				Adjusted analysis			
	p	OR	95%CI		p	OR	95%CI	
			LL	UL			LL	UL
Skin color								
White		1				1		
Brown/Black	0.028	1.291	1.028	1.621	0.031	1.283	1.023	1.609
Administrative dependence of the school								
Public		1				1		
Private	0.033	0.757	0.586	0.977	0.010	0.583	0.387	0.878
Year of high school you are attending								
First		1				1		
Second	0.686	0.960	0.788	1.169	0.310	0.884	0.697	1.121
Third/Fourth	0.004	0.740	0.604	0.908	<0.001	0.628	0.489	0.807
Adequacy of school year with age								
Adequate		1				1		
Late	0.473	1.064	0.898	1.259	0.981	0.997	0.811	1.227
Early	0.238	0.789	0.534	1.169	0.244	0.743	0.451	1.225
Marital status								
Has no partner		1				1		
Lives with a partner	0.160	1.276	0.908	1.792	0.212	1.302	0.860	1.969
Has a partner, but does not live with him/her	0.003	1.359	1.111	1.663	0.094	1.229	0.965	1.567
Education of the head of household								
Illiterate		1				1		
Elementary I complete (1st to 4th grade)	0.001	1.935	1.296	2.888	0.011	1.855	1.151	2.990
Elementary II complete (5th to 8th grade)	<0.001	2.132	1.447	3.143	0.002	2.067	1.305	3.273
Completed secondary education	<0.001	2.129	1.463	3.097	0.004	1.937	1.232	3.044
Higher Education Complete	0.002	1.879	1.264	2.793	0.015	1.819	1.124	2.946
Total family income in minimum wage								
<1		1				1		
1-2	0.368	1.411	0.856	1.522	0.346	1.185	0.832	1.688
2-3	0.177	1.248	0.905	1.721	0.868	1.033	0.702	1.521
>3	0.192	1.213	0.907	1.622	0.314	1.204	0.838	1.730
Eating while surfing the internet								
No		1				1		
Yes	0.125	1.157	0.960	1.385	0.038	1.385	1.018	1.885
Use of alcohol and/or drugs								
Non-user		1				1		
Experimental use	0.018	1.282	1.044	1.573	0.121	1.209	0.951	1.536
Abusive use	0.001	1.452	1.161	1.816	0.083	1.260	0.970	1.637
Dependence	0.006	1.612	1.144	2.271	0.130	1.353	0.914	2.000
Level of physical activity								
Sedentary		1				1		
Moderately active	0.610	1.069	0.825	1.386	0.665	0.928	0.664	1.298
Active	0.091	1.235	0.967	1.578	0.707	0.939	0.681	1.298

Q1=first quartile; Q2=second quartile; Q3=third quartile; Q4=fourth quartile. p=p-value obtained by binary logistic regression; 95%CI=95% confidence interval; LL=Lower Limit; UL=Upper Limit; OR=Odds ratio. *The variables that obtained p≤0.20 in Pearson's chi-square test were included in the logistic regression analysis: skin color, administrative dependence of the school, year of high school being attended, age appropriateness of the school year, marital status, education of the head of household, total family income in minimum wage, eating while surfing the Internet, use of alcohol and/or drugs and level of physical activity.

Source: Authors.

mally expected to be associated with a higher level of health knowledge, which can contribute to healthier behavior[39]. However, the association between schooling and food consumption still presents a divergence in the literature[14,39,40], which suggests that culture is another influencing factor for the dietary intake of Brazilians[39].

Adolescents from private schools presented a lower chance of UPF consumption. In contrast, excessive consumption of UPF was observed among Brazilian adolescents from private schools[10]. This divergence in the characterization of the food environment was observed among Brazilian regions; in the southern region, public schools presented a less obesogenic food environment; however, in the northern region, a more obesogenic environment was found[42].

It is believed that food consumption observed in public schools in the present study may be related to the recommendations of the National School Meals Programme (NSMP), despite the nonmandatory nature of public schools in adhering to the programme. NSMP presents guidelines to promote healthy eating in public basic education[43] and the incentive to include food and nutrition education actions in schools contributes to the adoption of healthier eating practices.

The adolescent having a paid job and high family purchasing power contributed to increasing the chance of consuming *in natura* or minimally processed foods. Adolescents who work have greater autonomy and a higher income, which may explain the better food choices observed in the study. Canuto *et al.*[39] found that the consumption of foods that contain essential nutrients for health (fruits, legumes, vegetables, and meats) is higher among higher income individuals.

It is noted that the association between family income and food consumption in Brazil still presents a contradictory dietary pattern[14,15,17,41]. In a recent review[39] that analyzed the social inequalities in food consumption in Brazil, it was highlighted that higher income families have a more diversified diet that is rich in nutrients, but they also engage in high UPF consumption. In contrast, more monotonous food consumption was inversely associated with a lower income[39]. Similar results were found in another review in developing countries[44]; however, in developed countries, there is a clearer association between a higher socioeconomic level and a healthy dietary intake[45].

Engagement in physical activity was another factor related with a greater chance of consuming *in natura* or minimally processed foods. Those who engage in physical activity tend make better food choices, as well as presenting control over the consumption of high calorie foods[46], as is the case of UPFs. Complementarily, other Brazilian studies indicate that sedentary behavior contributes to greater UPF consumption[6,16,36]. Thus, it is essential for engagement in physical activity to be stimulated in order to promote the health of adolescents and contribute to better food choices.

The consumption of *in natura* or minimally processed foods should be stimulated and it is essential to include actions for promoting dietary and nutritional education in the school context, putting Law 12,666 of 2018[47] into practice, which establishes the inclusion of the topic of food and nutrition education in science and biology subjects. This law constitutes a fundamental advancement for the promotion of healthy dietary habits in infancy and adolescence.

Regarding the limitations, there is the possibility that the method used for collecting the information about food consumption may have involved underestimation; however, the module of questions regarding the consumption of food subgroups, initially developed for the Vigitel system, has already been employed in two national surveys of the Brazilian Institute of Geography and Statistics (IBGE): the 2019 National Health Study[48] and the 2019-2020 National School Student Health Study[49]. In addition, this instrument was validated in a study conducted in 2018[50] and showed substantial agreement (PABAK index: 0.72) between quintiles of the UPF consumption score (calculated using an identical questionnaire to the one used in Vigitel) and quintiles of the contribution of UPFs to total daily energy intake (calculated using 24-hour food memory), both calculated based on food consumption the previous day[50]. Another possible limitation was the possibility of occurrence of reverse causality due to the cross-sectional characteristic of the study.

However, despite the limitation indicated, the data presented here reflect the food consumption reality of the adolescents aged 15 to 19 from the MRGV-ES and the study design adopted enables us to suppose that the conclusions can be used in a similar context. It also warrants mentioning that this research uses a school-based sample from the public and private network representative of adolescents from the MRGV-ES.

In the present study, the classification of foods by the extent of processing and the quartile was used to define the consumption of a given group. This classification enabled us to determine the

foods that belonged to the group that presented high levels of sugar, saturated fat, trans fat, and a low quantity of fibers, which are characteristics that the literature shows belong to UPFs, which intensifies the risks for obesity, dyslipidemia and metabolic syndrome[3,4,18-21].

Finally, this paper reinforces the need to develop strategies for promoting a healthy diet and reducing sedentary behavior, as well as the regulation of UPF advertising, with the aim of avoiding unhealthy lifestyles persisting into adult life. In the meantime, it warrants mentioning the importance of the school, as well as the parents or guardians, in the formation of the adolescents' dietary habits.

Conclusion

It is concluded that the fact the adolescent had a paid job, a family income above three minimum wages, and engaged in physical activity had the highest consumption of *in natura* or minimally processed foods. On the other hand, self-reporting as brown/black and the habit of eating while using the internet increased the chances of greater UPF consumption, while being from a private school and being enrolled in the third/fourth year of high school were protective factors for UPF consumption.

Thus, we suggest the promotion of dietary and nutritional health actions in the school and family environment, together with public policies that seek to make adolescents more aware of adopting a healthier lifestyle, with greater inclusion of *in natura* or minimally processed foods in their diet, as well as engagement in physical activity and rational use of the internet when eating.

Collaborations

DR Gomes, ET Santos Neto, DS Oliveira e LB Salaroli participated in the conception, design, analysis, writing of the article and critical review. All authors approved the version to be published.

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