

ORIGINAL

Collective Health

Editor

Carla Cristina Enes

Conflict of interest

The authors declare that there is no conflicts of interest.

Received

December 12, 2023

Final version

December 18, 2024

Approved

February 12, 2025

Prevalence of overweight among adolescent students attending public technical schools during the COVID-19 pandemic: an analysis of the disease associated factors

Prevalência de excesso de peso entre adolescentes estudantes de escola técnica pública durante a pandemia de COVID-19: uma análise dos fatores associados

Cláudia Rosana Trevisani Corrêa¹ , Maria Antonieta Barros Leite Carvalhaes¹ 

¹ Universidade Estadual Paulista “Júlio de Mesquita Filho”, Faculdade de Medicina de Botucatu, Programa de Pós-Graduação em Saúde Pública. Botucatu, SP, Brasil. Correspondence to: MABL CARVALHAES. E-mail: <maria.carvalhaes@unesp.br>.

Article based on the thesis of CRT CORRÊA, entitled “Prevalência de excesso de peso entre adolescentes estudantes de escola técnica pública durante a pandemia de COVID-19: uma análise dos fatores associados”. Universidade Estadual Paulista “Júlio de Mesquita Filho”, 2023.

How to cite this article: Corrêa CRT, Carvalhaes MABL. Prevalence of overweight among adolescent students attending public technical schools during the COVID-19 pandemic: an analysis of the disease associated factors. Rev Nutr. 2025;38:e230242. <https://doi.org/10.1590/1678-9865202538e230242>

ABSTRACT

Objective

Identify factors associated with excess weight in adolescents during the COVID-19 pandemic.

Methods

Cross-sectional study with 302 students from an integrated high school/technical education unit. A digital questionnaire was used with questions about time spent on screens, amount of sleep hours (Mini Sleep Questionnaire), eating habits in front of a screen, food consumption, physical activity, socioeconomic variables and obesity in parents. In order to assess nutritional status, weight and height were used as informed by the respondents. Descriptive statistics and regression analyses were produced to identify factors associated with excess weight, defined as BMI Z-score \geq 1.0.

Results

Excess weight was present in 28.5% of the students and obesity (BMI Z-score \geq 2.0) in 8.9%. Four out of ten students reported eating their main meal in front of the screen every day of the week; 87.7% had poor sleep quality and 29.9% slept less than 7 hours/night. Only 29.8% performed the daily physical activity recommendation. Those in the 3rd tertile of total screen time tripled the chance of being overweight (OR=3.35, 95% CI=1.62-6.89) and eating meals in front of screens 5 or more days/week multiplied that chance by 3.25 (OR=3.25; 95% CI=1.63-6.49). Having the mother with low education was a protective factor for being overweight (OR=0.37; 95% CI=0.16-0.84).

Conclusion

Even during the pandemic period, students with more screen time and those who regularly ate meals in front of a screen were more likely to be overweight, confirming the negative role of these factors on adolescents' nutritional status.

Keywords: Adolescent behavior. Cross-sectional Studies. Food, processed. Nutritional status. Screen time.

RESUMO

Objetivo

Identificar fatores associados ao excesso de peso em adolescentes durante a pandemia de COVID-19.

Métodos

Estudo transversal com 302 estudantes de unidade de ensino médio/técnico integrados. Utilizou-se de questionário digital com questões sobre tempo em telas, quantidade do sono (Mini Sleep Questionnaire), hábito de refeições frente a tela, consumo alimentar, atividade física, variáveis socioeconômicas e presença de obesidade nos pais. Para avaliação do estado nutricional utilizou-se peso e altura, informados pelo estudante. Foram produzidas estatísticas descritivas e análises de regressão para identificação dos fatores associados ao excesso de peso, definido como escore-Z de IMC $\geq 1,0$.

Resultados

Excesso de peso esteve presente em 28,5% dos estudantes, obesidade (escore-Z de IMC $\geq 2,0$), em 8,9%. Quatro em cada dez estudantes informaram fazer a refeição principal em frente a tela em todos os dias da semana; 87,7% apresentaram má qualidade do sono e 29,9% dormiam menos de 7 horas/noite. Apenas 29,8% alcançaram a recomendação de atividade física diária. Estar no 3º tercil de tempo de tela triplicou a chance de excesso de peso (OR=3,35, IC 95%=1,62-6,89) e fazer refeições em frente a telas 5 ou mais dias/semana multiplicou por 3,25 (OR=3,25; IC 95%=1,63-6,49) esta chance. Ser filho de mãe com baixa escolaridade foi fator de proteção para o excesso de peso (OR=0,37, IC 95%=0,16-0,84).

Conclusão

Mesmo no período pandêmico, estudantes com maior tempo em telas e aqueles que faziam regularmente as refeições diante de tela apresentaram mais chances de excesso de peso, confirmando o papel negativo destes fatores sobre o estado nutricional de adolescentes.

Palavras-chave: Comportamento do adolescente. Estudos transversais. Alimento processado. Estado nutricional. Tempo de tela.

INTRODUCTION

Adolescence, between the ages of 10 and 19, is a challenging transitional period. This period is marked by the search for identity and changes in lifestyle habits, which may include harmful behaviors [1,2]. Between 1975 and 2016, there was an increase in the global prevalence of obesity in youth aged 5 to 19 years; this growth was from 0.7% to 5.6% in females and 0.9% to 7.8% in males [3]; with projection for the year 2022 indicating a continuous growth in the number of overweight people [4]; it is estimated that one billion individuals with obesity will reach this mark by 2030 on a global scale.

The consumption of Ultra-Processed Foods (UPF) emerges as a focal point of concern due to its high consumption, as well as its connection to the development of excess weight and chronic diseases (arterial hypertension, dyslipidemia, type 2 diabetes, atherosclerosis and metabolic syndrome) in adulthood [5,6]. In addition, other risk factors, such as short duration and poor quality of sleep [2], lack of time dedicated to daily physical activity [7], and increased screen time [8], also contribute to the scenario of excess weight growing.

Addressing the prevention of overweight among adolescents requires an in-depth analysis of the determinants, including both socioeconomic and behavioral aspects. This understanding is

critical for the development of effective strategies that encourage healthy habits in this changing population [9]. Furthermore, it is important to consider the additional challenges that have arisen due to the Coronavirus Disease 2019 (COVID-19) pandemic, which have had significant impacts on adolescents' living standards and daily routines.

To assess the prevalence of behavioral factors potentially associated with the nutritional status and their association with excess weight in adolescents during the COVID-19 pandemic.

METHODS

Design and participants

This is a quantitative, cross-sectional study. The sample included 302 students, out of 400 students enrolled in the 1st, 2nd and 3rd years of a High School integrated with Technical Education (ETEC Darcy Pereira de Moraes). This is a technical high school located in Centro Paula Souza, in the municipality of Itapetininga, State of São Paulo. The survey was conducted in 2021, a period when in-person classes were discontinued as a health measure to contain the pandemic. The questionnaires were completed online, using the Google Forms, after obtaining the signed Free and Informed Consent Form from parents and the Free and Informed Assent Form from students, with 75.5% adherence.

Data collected

The participants' socioeconomic and demographic conditions were investigated using questions taken from the 2010 IBGE sample questionnaire [10]: gender, age, race, course enrollment, housing conditions, number of residents in the house, parents' education and family income.

Information regarding weight and height was self-reported, an option supported by evidence of reliability in this method [11]. From these data, the Body Mass Index (BMI) and BMI Z-score were calculated according to the age and gender of the participants. The cutoff points were: for underweight (BMI Z-score by age <-2); eutrophy (BMI Z-score by age ≥-2 and $<+1$); overweight (BMI Z-score by age $\geq+1$ and $<+2$) and obesity (BMI Z-score by age $\geq+2$) according to the WHO recommendations published in 2007. The BMI Z-score calculation was performed with the AnthroPlus software [12], according to the 2007 WHO references.

The student's perception of their parents' nutritional status was also investigated, considering obesity, with the following alternatives: neither parent was obese, only the father, only the mother, or both parents were obese.

Screen time was assessed with questions about the daily time spent in front of the following screen: TV, computer, cell phone, and video game. By adding up the time spent on each type of device, the variable total daily screen time was obtained and was categorized into tertiles.

Sleep quality was assessed using the Mini Sleep Questionnaire [13], which contains 10 questions with seven answer options that generate a score. A score between 10 and 24 points indicated good quality and above that it was an indication of poor quality. Sleep duration was also categorized as meeting or not meeting the standard recommendation of 8 to 10 hours sleep.

Physical activity was assessed using the International Physical Activity Questionnaire [14], short version, with 8 questions that allow an estimation of the time spent in moderate to vigorous

intensity activities during the 7 days of the week. In order to be considered “physically active” the adolescent should perform at least 60 minutes per day workout, according to the WHO [15].

The definition of UPF was adopted according to the NOVA Classification [16]. The weekly consumption frequencies (ranging from 0 to 7) of the following foods were investigated: sweets, artificial juice, soft drinks, fast food, stuffed cookies, ultra-processed meats, instant noodles and packaged snacks. For descriptive purposes, the maximum, minimum and median weekly frequency for each UPF was calculated. A summary variable of weekly UPF consumption was created, ranging from 0 to 56; it was later categorized into tertiles: first tertile or lowest consumption (<11), second tertile or intermediate (≥ 11 and <17) and third tertile (≥ 17), highest consumption.

The frequency of meals in front of the screen was investigated, with responses divided into: never or rarely, 1 to 4 times/week, 5 or 6 times or more/week and daily during the week, later categorized as never or rarely, 1 to 4 times/week, 5 or more times a week. During the pandemic, there was no distribution of school meals. A question was included in the questionnaire asking who prepared the adolescent’s lunch. The alternatives were: “Someone in the family prepares and the meal is offered ready-made to the adolescent”, “Adolescent prepares his/her own meal”, or “Adolescent helps prepare the family meal”.

Statistical analysis

After classifying the adolescents’ nutritional status (underweight, normal weight, overweight and obesity), the initial analyses involved comparing the frequency distribution of adolescents according to the nutritional status and exposure factors, with the differences being assessed using Pearson’s chi-square test. All variables that showed association at this stage at a level of $p < 0.20$ were selected for multivariate regression analysis, aiming to identify factors associated with excess weight (overweight and obesity together). This generated adjusted Odds Ratio (OR) values and 95% confidence interval (95% CI). The analyses were performed using the IBM®SPSS® v. 20 software. The level of statistical significance adopted was $p < 0.05$.

All study procedures were reviewed and approved by the Research Ethics Committee of the Botucatu School of Medicine, Universidade Estadual Paulista “Júlio de Mesquita Filho” (CAAE: 16722819.9.0000.5411).

RESULTS

The study involved a population of 302 adolescents, the majority of whom were female (64.6%), having 16.2 years average age, and who attended different vocational courses offered in the high school. The students were distributed between the 1st, 2nd, and 3rd grades: 31.8%, 36.8%, and 31.4%, respectively. The majority identified themselves as being of white complexion; 72.8% lived in their own homes, located either in the central region or on the outskirts of the city, with a minority living in rural areas. The average family size was 3.94 members, with the majority belonging to families with an income between 1 and 3 minimum wages. Parental education varied, with 42.4% of fathers and 47.4% of mothers having nine to 11 years education, although some students did not know their parents’ education level. With regard to parental obesity, 6.0% of participants reported that both parents were obese, while the same 6.0% mentioned that only the father (7.3%) or only the mother (7.9%) was obese. The proportion of students with obesity (8.9%) or underweight (8.6%)

was similar. More than a quarter (28.5%) were overweight (28.7% girls and 28.1% boys). Regarding behaviors that can influence the nutritional status of adolescents, it is noteworthy that 40% of them reported eating meals in front of screens (TV, cell phone, computer) every day of the week. Only 13% stated that they prepared the main meal (lunch) alone. The majority (87.7%) had poor sleep quality, with almost one third (29.9%) sleeping less than 7 hours per night. Regarding physical activity, less than a third (29.8%) met the recommendation of practicing moderate or intense activities for at least 1 hour every day of the week (Table 1).

Table 1 – Adolescents and their families' socioeconomic and demographic characteristics, nutritional status and behavioral variables (N=302). ETEC Darcy Pereira de Moraes, Itapetininga/SP, 2021.

1 of 2

Characteristics of participants	Frequency	
	N	%
Gender		
Male	107	35.4
Female	195	64.6
Age range (years)		
14 and 15	83	27.5
16 and 17	182	60.3
18 and 19	37	12.2
Average age – 16.2 years (SD=1.052)	–	–
Course		
Integrated High School – Administration	96	31.8
Integrated High School – Secretarial	82	27.2
High School – Human Resources	96	31.8
High School – Languages	28	9.2
Grade		
1 st	96	31.8
2 nd	111	36.8
3 rd	95	31.4
Skin color (self-reported)		
White	213	70.5
Black	10	3.3
Yellow	7	2.3
Brown	72	23.9
House		
Own	220	72.8
Rented	66	21.9
Granted	16	5.3
No. of Residents		
<2	29	9.6
3 and 4	187	61.9
5 and 6	80	26.5
Above 7	6	2.0
Region of the city where you live		
Neighborhood on the Outskirts	117	38.7
Central Region	117	38.7
Gated community	4	1.3
Housing complex (CDHU, COHAB, CNH)	19	6.4
Rural region (farm. ranch. farm)	45	14.9

Table 1 – Adolescents and their families' socioeconomic and demographic characteristics, nutritional status and behavioral variables (N=302). ETEC Darcy Pereira de Moraes, Itapetininga/SP, 2021.

2 of 2

Characteristics of participants	Frequency	
	N	%
Father's education (years)		
1 to 4	23	7.6
5 to 8	44	14.6
9 to 11	128	42.4
≥12	81	26.8
Unknown	26	8.6
Mother's education (years)		
1 to 4	27	8.9
5 to 8	24	8.0
9 to 11	143	47.4
≥12	90	29.7
Doesn't know	18	6.0
Family income (minimum wage)		
Zero to 1 (≤R\$ 1.100.00)	44	14.6
>1 to 3 (from R\$ 1.100.01 to R\$ 3.300.00)	155	51.3
>3 (>R\$ 3.300.01)	103	34.1
Parental obesity		
Neither parent	237	78.5
Only the father	22	7.3
Only the mother	24	7.9
Both parents	18	6.0
Unknown	1	0.3
Body Mass Index – Z-score for age		
Underweight	26	8.6
Eutrophic	190	62.9
Overweight	61	20.2
Obese	25	8.3
Meal in front of the screen		
Never or rarely	110	36.4
1 to 4 times/w	44	14.6
5 to 6 times/w	27	8.9
Every day	121	40.1
Meal preparation - Lunch		
Meal ready served	170	56.3
Prepare own meal	39	12.9
Help prepare the meal for the family	93	30.8
Sleep quality		
Good quality	37	12.3
Poor quality	265	87.7
Hours of sleep per night		
Under 7 hours	90	29.8
Between 7 and 7:59	146	48.3
Between 8 and 8:59	49	16.2
Over 9 hours	17	5.7
Physical Activity - Meets recommendations		
Yes	90	29.8
No	212	70.2

The most frequently consumed UPF by adolescents were sweet treats, soft drinks, and ultra-processed meats. Approximately half of the adolescents consumed sweet treats and ultra-processed meats in three or more days of the week; soft drinks were consumed on two days, and

fast food on one day. The average daily time spent in front of screens was very high: 10.02 hours (SD=3.426), median 10 hours, with a minimum of 1 hour and 30 minutes (1.50) and maximum of 20 hours, adding up the time spent on TV, video games, computers, and cell phones. The medians were higher in overweight (11 hours) and obese (12h45 minutes) students compared to those who were underweight (8h30 minutes) and eutrophic (9h15 minutes). These data are not shown in Tables.

Table 2 shows the frequencies of students with different nutritional statuses (underweight, normal weight, overweight and obesity) in relation to the socioeconomic and demographic variables and parental nutritional status. The frequency of overweight and obesity was higher in adolescents whose mothers had higher education levels ($p=0.030$). When both parents were not obese, the frequency of overweight students was the lowest, but when only the father was obese, the proportion of obese adolescents was the highest (p -value=0.003).

Table 3 shows the frequencies of students according to nutritional status and different behaviors during meals, sleep quality, physical activity and screen time. It is noteworthy that eating

Table 2 – Distribution of adolescents according to their nutritional status and the sociodemographic variables and perception of parents' nutritional status. ETEC Darcy Pereira de Moraes, Itapetininga/SP, 2021.

Variables	Low weight		Eutrophy		Overweight		Obesity		Total		p-value
	N	%	N	%	N	%	N	%	N	%	
Gender											0.600
Male	11	10.3	66	61.7	19	17.8	11	10.3	107	34.4	
Female	15	7.7	124	63.6	42	21.5	14	7.2	195	64.6	
Age range											0.993
14 and 15	6	7.2	51	61.4	19	22.9	7	8.4	83	27.5	
16 and 17	17	9.3	115	63.2	35	19.2	15	8.2	182	60.3	
18 and 19	3	8.1	24	64.9	7	18.9	3	8.1	37	12.3	
Skin color											0.589
White	20	9.4	134	62.9	44	20.7	15	7.0	213	70.5	
Not white	6	6.7	56	62.9	17	19.1	10	11.2	89	29.5	
House											0.429
Own	20	9.1	144	65.5	40	18.2	16	7.3	220	72.8	
Rented	6	9.1	35	53.0	17	25.8	8	12.1	66	21.9	
Granted	0	0.0	11	68.8	4	25	1	6.2	16	5.3	
Number of residents											0.569
<2	0	0	20	69.0	5	17.2	4	13.8	29	9.6	
3 and 4	15	8.0	121	64.7	36	19.3	15	8.0	187	61.9	
5 and 6	10	12.5	45	56.2	19	23.8	6	7.5	80	26.5	
Above 7	1	16.7	4	66.7	1	16.7	0	0.0	6	2.0	
Father's education (years of study)											0.586
Up to 8 years	11	11.8	57	61.3	17	18.3	8	8.6	93	30.8	
Above 8 Years	15	7.2	133	63.6	44	21.1	17	8.1	209	69.2	
Mother's education (years of study)											0.030
Up to 8 years	5	7.2	53	76.8	6	8.7	5	7.2	69	22.8	
Above 8 Years	21	9.0	137	58.8	55	23.6	20	8.6	233	77.2	
Obese parents											0.003
None	22	9.3	159	67.1	38	16.0	18	7.6	237	78.5	
Only the mother	3	12.5	12	50.0	8	33.3	1	4.2	24	7.9	
Only the father	1	4.5	10	45.5	6	27.3	5	22.7	22	7.3	
Both of them	0	0.0	8	44.4	9	50.0	1	5.6	18	6.0	
Family Income (minimum wages)											0.180
Zero to [≤ R\$ 1.100,00]	2	4.5	31	70.5	4	9.1	7	15.9	44	14.6	
>1 to 3 (from R\$ 1.100,01 to R\$ 3.300,00)	13	8.4	96	61.9	34	21.9	12	7.7	155	51.3	
>3 [>R\$ 3.300,01]	11	10.7	63	61.2	23	20.2	6	5.8	103	34.1	

meals in front of a screen every day of the week was associated with a higher prevalence of obesity among students. In addition, the frequency of overweight was higher among students who prepared their own meals at lunch, compared to those who only helped with the preparation. No significant differences were observed in the frequency of overweight between adolescents who followed or not the recommendations for sleep duration. On the other hand, adolescents who spent more time in front of the screen, especially those in the third tertile of total time, exhibited a higher prevalence of overweight and obesity. It is worth noting that the prevalence of overweight was higher among students who met the recommendations for time and frequency of daily physical activity.

Table 3 also shows the weekly frequency with which adolescents had their meals in front of some type of screen ($p=0.003$), the adequacy of sleep duration ($p=0.003$) and the total screen time ($p=0.003$). The variables investigated, according to the established criteria ($p<0.20$) as possible risk factors for the presence of excess weight included family income and responsibility for preparing the adolescent's lunch, identified as potential confounding variables.

To assess the specific effect of each variable, a multiple logistic regression model was adjusted, the outcome of which was overweight (yes or no) compared to normal weight. Underweight adolescents were excluded from this analysis. The results are shown in Table 4.

Table 3 – Distribution of adolescents according to their nutritional status and behavioral variables. ETEC Darcy Pereira de Moraes, Itapetinga/SP, 2021.

Behavioral variables	Low weight		Eutrophy		Overweight		Obesity		Total		p-value
	N	%	N	%	N	%	N	%	N	%	
Frequency score UPF consumption											0.533
1 st Tertile (<11 UPF/week)	9	9.0	64	64.0	17	17.0	10	10.0	100	33.1	
2 nd Tertile (≥11 and <17 UPF/week)	10	10.3	54	55.7	25	25.8	8	8.2	97	32.1	
3 rd Tertile (≥17 UPF/week)	7	6.7	72	68.6	19	18.1	7	6.7	105	34.8	
Meal in front of TV, cell phone or computer											0.003
Never or rarely	11	10.0	82	74.5	13	11.8	4	3.6	110	36.4	
1 to 4 times/week	02	4.5	28	63.3	8	18.2	6	13.6	44	14.6	
5 or 6 times/week	1	3.7	20	74.1	06	22.2	0	0.0	27	8.9	
Every day	12	9.9	60	49.6	34	28.1	15	12.4	121	40.1	
During the Pandemic at lunchtime											0.067
Ready meal offered	19	11.2	103	60.6	32	18.8	16	9.4	170	56.3	
Prepare own meal	3	7.7	19	48.7	12	30.8	5	12.8	39	12.9	
Help the family prepare	4	4.3	68	73.1	17	18.3	4	4.3	93	30.8	
Sleep quality											0.245
Good	3	8.1	28	75.7	3	8.1	3	8.1	37	12.3	
Difficulty sleeping	23	8.7	162	61.1	58	21.9	22	8.3	265	87.7	
Sleep duration											0.003
Under 7h	11	12.2	48	53.3	23	25.6	8	8.9	90	29.8	
Between 7am and 7:59am	11	7.5	96	65.8	23	15.8	16	11.0	146	48.3	
Between 8am and 7:59am	4	8.2	38	77.6	7	14.3	0	0.0	49	16.2	
Between 9am and 9:59am	0	0.0	7	46.7	8	53.3	0	0.0	15	5.0	
Above 10h	0	0.0	1	50.0	0	0.0	1	50.0	2	0.7	
Meets the FA recommendation for the age group											0.199
Yes	7	7.8	52	57.8	19	21.1	12	13.3	90	29.8	
No	19	9.0	138	65.1	42	19.8	13	6.1	212	70.2	
Total screen time (hours)											0.003
1 st tertile (1.50 to 8 hours)	12	11.7	74	71.8	14	13.6	3	2.9	-	-	
2 nd tertile (8 to 12 hours)	8	8.2	64	66.0	20	20.6	5	5.2	-	-	
3 rd tertile (12 to 20 hours)	5	5.4	49	52.7	25	26.9	14	15.1	-	-	

Note: FA (Physically active).

Table 4 – Factors associated with overweight and independent variables by multivariate logistic regression model. ETEC Darcy Pereira de Moraes, Itapetininga/SP, 2021.

Variable	OR	(95% CI)		p-value
Parents obesity				
None	1.00	1.00	1.00	
Only the mother	1.173	0.432	3.186	0.754
Only the father	1.962	0.684	5.830	0.210
Both parents	2.213	0.693	7.061	0.180
Physically active (≥ 60 minutes/day = 7 days a week)				
Did not answer	0.715	0.381	1.339	0.294
Meal in front of the screens				
None	1.00	1.00	1.00	
1 to 4 times/week	2.146	.874	5.273	0.096
5 or more times/week	3.252	1.628	6.495	0.001
During the Pandemic at lunchtime				
Meal ready served	1.00	1.00	1.00	
Help the family prepare	1.382	0.593	3.219	0.453
Prepare own meal	0.740	0.378	1.448	0.380
Sleep time				
Less than 8 hours	1.051	0.515	2.146	0.891
Maternal Education				
Above 8 years	1	-	-	
Up to 8 years	0.372	0.165	0.838	0.017
Screen time in tertiles				
1 st Tertile (<1.50 to 8 hours/day)	1.00	1.00	1.00	
2 nd Tertile (≥ 8 and <12 hours/day)	1.819	0.863	3.836	0.116
3 rd Tertile (≥ 12 hours/day)	3.345	1.624	6.890	0.001

Screen time, maternal education and eating in front of screens were identified as risk factors for overweight. Students in the third tertile had more than three times the chance of being overweight (OR=3.345, 95% CI=1.624-6.890), compared to students in the first tertile. Eating in front of screens 5 or more days a week multiplied the chances of being overweight by 3.25 (OR=3.252; 95% CI=1.628-6.495), compared to students who did not do so.

Adolescents with mothers who had studied more than 8 years had a higher chance of being overweight, while having a mother with less than 8 years education reduced this chance by 62.8% (OR=0.372, 95% CI=0.165–0.838). No relationship was identified between overweight and parents' obesity and also with sleep time.

All these results are independent of each other and were adjusted for gender, physically active individuals and parental nutritional status; these are variables that did not reach the stipulated statistical significance ($p < 0.05$) to establish an association with excess weight, but were maintained in the model because they were potentially capable of exerting some confounding effect.

DISCUSSION

This study revealed that, during the COVID-19 pandemic, the majority of adolescent students at a technical school presented habits and behaviors associated with health and nutritional problems [17]. Most of them did not comply with physical activity recommendations and the time spent on screens/electronic devices was very high, greater than the time spent in classes. Eating meals in front of screens was frequent and the quality and quantity of sleep was unsatisfactory for most participants. These results represent a situation of concern: high prevalence of risk factors for

chronic non-communicable diseases and obesity in adolescents during the COVID-19 pandemic, corroborating similar findings in an international study [18].

The fact that more than ¼ (28.5%) of adolescents were overweight is a cause for concern. This rate is close to that reported in a study carried out in Spain (23.1%) [19], but it is lower than that reported in other national studies, carried out before the pandemic period: in the Brazilian Northeast (32.5%) [20]; in the interior of the State of São Paulo (47%) [7]; reaching 87.2% in studies in Southern Brazil [21].

Eating meals in front of screens 5 or more times a week was shown to be a common practice among students and this habit increased the chance of being overweight by 3.25 times (OR=3.252, 95% CI 1.628-6.495), compared to the students who did not adopt this habit. Data from the *Pesquisa Nacional de Saúde do Escolar de 2015* (2015 National School Health Survey) [22] and another Brazilian study [23] associated unhealthy eating patterns to eating while studying or watching TV; there is a study showing that the habit of eating while browsing the web increases the chance of consuming UPF [24]. It is known that frequent screen use negatively affects eating habits, promoting careless and practical eating trends, contributing to excess weight [24]. On the contrary, mindful eating, the practice of eating with full attention, has been associated with more conscious and healthy food selection, being considered a self-care approach [25].

However, a result that is difficult to interpret was the higher mean consumption of UPF among eutrophic adolescents and, in contrast, the lower mean among obese individuals, suggesting the possibility of reverse causality. Perhaps overweight adolescents were trying to change their diet to lose weight, avoiding foods known to be obesogenic, including UPF. This may explain the lack of an independent association between UPF consumption and overweight in the present study.

Among the UPF, adolescents consumed mainly sweets/treats, consistent with studies carried out during the pandemic including Brazil [26], which highlighted an increase in the consumption of fried foods and sweets [17], especially due to remote education and the psychological stress associated with the pandemic. This may be explained by the fact that these foods are convenient to consume during prolonged periods in front of screens, a common condition during the pandemic.

Although 13% of adolescents prepared their own meals, “instant noodles” were not widely consumed, despite this dish easy preparation. A limitation of the present study was the fact that adolescents were not asked about the type of meals that they prepared. The pandemic has restricted school meal distribution, especially affecting adolescents who relied on them as their main source of healthy nutrition [27]. This occurred at a time of widespread unemployment, poverty and economic hardship [28].

Social isolation and online classes during the pandemic likely resulted in an increase in sedentary behavior, with less than a third (29.8%) adolescents complying with the daily physical activity recommendations. However, there was no association between lack of physical activity and overweight, possibly because social isolation caused a standard sedentary behavior among adolescents, regardless of their previous habits. Still, it is essential to emphasize the importance of physical activity for health after the end of social isolation, indicating the need to promote it again in school health initiatives [29,30],

In this study, the average screen time exceeded 10 hours per day, and adolescents who spent more than 10 hours in front of screens were over three times likely to be overweight. However, the comparison with previous studies outside the pandemic scenario has limitations, since the screen time of all students increased substantially during the period of online classes. In addition, the data

may contain some overestimation due to the way screen time was assessed, since the daily time spent on each type of screen device was added together, despite the fact that it is common for the participants to use several screen devices at the same time [31].

Despite these caveats, we observed a positive association between screen time and the risk of becoming overweight, which is consistent with previous studies. Previous research conducted before the pandemic had already identified an increased risk of adolescents who spent more time in front of screens becoming overweight compared to those who spent less time. A study of American adolescents showed that spending ≥ 4 hours watching TV or playing video games increased the likelihood of becoming overweight by 2.19 times, enhancing the hypothesis that screen time is linked to obesity [23]. In addition to the association with overweight, excessive screen time has also been associated with sleep disorders and unhealthy eating habits, which may explain the connection between more screen time and increased obesity [32].

Before the pandemic, the American Academy of Pediatrics recommended to limit screen exposure up to two hours/day [33]. But this guideline has become challenging during the pandemic due to the need for studying online. A study in China revealed that 48.2% of high school students spent more than 5 hours on digital devices for learning purposes [34], despite the recommendation to limit screen time to 4 hours/day for high school students [35]. The increasing digital interaction in daily life, both for academic activities and for leisure, requires a continuous assessment of its repercussions on the health and development of children and adolescents. Excessive screen time was already a concern for health professionals, due to its potential adverse effects on the health and development of children and adolescents, and may actually have become even more frequent after the pandemic.

This study revealed a high rate of adolescents with sleep problems, a condition possibly aggravated during the pandemic by emotional factors and excessive screen time. Lack of sleep is a risk factor for obesity [35] and depression [34]. The finding that 87.7% of the adolescents assessed experienced poor sleep quality, a frequency well above that reported for Chinese adolescents (38.5%) [35], and that 1/3 slept less than 7 hours a night is of concern, since sleeping less than eight to ten hours is also considered a risk factor for obesity [19]. Research has shown that factors such as physical inactivity, excessive screen time and insufficient sleep in adolescents tend to occur simultaneously and are both cause and consequence of each other, especially during the pandemic [36].

It is important to highlight two results not related to adolescents' behavioral factors. One of them was the identification of social inequality regarding the occurrence of excess weight. Adolescents whose mothers had low levels of education (up to eight years) were less likely to exhibit excess weight. In addition, a study reveals that 22.3% of households with low-level education heads of the household (up to four years of education) faced food insecurity during the COVID-19 pandemic in Brazil [37].

Another result observed was the lack of association between the nutritional status of parents and children. Although a higher frequency of overweight was observed among adolescents whose both parents were obese, and a higher frequency of obesity when only the father was obese, the multivariate analyses were unable to establish an independent relationship between the nutritional status of parents and the presence of excess weight in children. This result contradicts the literature, which suggests a relationship between parental obesity and obesity in children, with studies that detected an increased probability of obesity in adolescents when at least one of the parents was obese and an even greater increase when both were obese [38,39]. The discrepancy observed in the nutritional status of parents may be attributed to the use of less precise information, since parents

were not weighed or questioned, but rather the report on whether or not their parents were obese was given by the children.

This finding reflects the complexity of the factors that influence excess weight, suggesting that in addition to the nutritional status of parents, it is necessary to consider sociocultural, psychological and environmental factors that impact the eating behavior and weight of adolescents.

CONCLUSION

During the COVID-19 pandemic, potentially harmful health behaviors were very common among adolescent students, with emphasis on poor quality and inadequate sleep time, physical inactivity, excessive screen time and the habit of eating meals in front of some type of screen; these last two behaviors were identified as factors that, independently of the others, increase the chances of being overweight. The presence of social inequality in the risk of students being overweight was also evident, with adolescents whose mothers had up to eight years education exhibiting a lower chance of being overweight, when compared to adolescents in other situations.

REFERENCES

1. World Health Organization. Physical status: the use and interpretation of anthropometry technical report. Geneva: WHO; 1995.
2. Santos EVO, Almeida ATC, Ferreira FELL. Duração do sono, excesso de peso e consumo de alimentos ultraprocessados em adolescentes. *Ciênc Saúde Colet*. 2021;26(12):6129-39.
3. Di Cesare M, Sorić M, Bovet P, Miranda JJ, Bhutta Z, Stevens GA, et al. The epidemiological burden of obesity in childhood: a worldwide epidemic requiring urgent action. *BMC Med*. 2019;17(1):212.
4. Lobstein T, Brinsden H, Neveux M. World Obesity Atlas 2022. World Obesity Federation; 2022 [cited 2023 Nov 14]. Available from: https://policycommons.net/artifacts/2266990/world_obesity_atlas_2022_web/3026660/?utm_medium=email&utm_source=transaction
5. Louzada MLC, Martins APB, Canella DS, Baraldi LG, Levy RB, Claro RM, et al. Ultra-processed foods and the nutritional dietary profile in Brazil. *Rev Saúde Pública*. 2015;49. doi: <https://doi.org/10.1590/S0034-8910.2015049006132>
6. Enes CC, Camargo CM, Justino MIC. Ultra-processed food consumption and obesity in adolescents. *Rev Nutr*. 2019;32:e180170.
7. Cé JA, Zanoni EM, Carvalho RPDD, Kades G, Fin G, Silva BBD, et al. Atividade física e obesidade na infância: uma revisão integrativa. *IDonline*. 2023;17(67):224-47.
8. Lissak G. Adverse physiological and psychological effects of screen time on children and adolescents: literature review and case study. *Env Res*. 2018;164:149-57.
9. Bittar C, Soares A. Mídia e comportamento alimentar na adolescência. *Cad Bras Ter Ocup*. 2020;28(1):291-308.
10. Instituto Brasileiro de Geografia e Estatística. Censo Brasileiro de 2010. Rio de Janeiro: IBGE; 2012.
11. Teixeira IP, Pereira JL, Barbosa JPAS, Mello AV, Onita BM, Fisberg RM, et al. Validade da massa corporal e da estatura autorreferidas: relações com sexo, idade, atividade física e fatores de risco cardiometabólicos. *Rev Bras Epidemiol*. 2021;(24):e210043.
12. World Health Organization. Growth reference data for 5-19 years. Geneva: WHO; 2007 [cited 2023 Dec 12]. Available from: <https://www.who.int/tools/growth-reference-data-for-5to19-years/application-tools>.
13. Falavigna A, Souza Bezerra ML, Teles AR, Kleber FD, Velho MC, Silva RC, et al. Consistency and reliability of the Brazilian Portuguese version of the Mini-Sleep Questionnaire in undergraduate students. *Sleep Breath*. 2011;15(3):351-5.
14. Silva NSSE, Silva RRV, Santos BN, Silveira MF, Brito MFSF, Pinho LD, et al. Prevalência dos níveis de atividade física e fatores associados entre adolescentes escolares. *Rev Bras Ativ Fís Saúde*. 2022;27:1-9.

15. Ministério da Saúde (Brasil). Guia de atividade física para a população brasileira. Brasília: Ministério da Saúde; 2021 [cited 2023 Nov 15]. Available from: https://bvsmms.saude.gov.br/bvs/publicacoes/guia_atividade_fisica_populacao_brasileira.pdf
16. Louzada MLC, Costa CS, Souza TN, Cruz GL, Levy RB, Monteiro CA. Impacto do consumo de alimentos ultraprocessados na saúde de crianças, adolescentes e adultos: revisão de escopo. *Cad Saúde Pública*. 2021;37:e00323020.
17. Raphaelli CO, De Figueiredo MF, Pereira EDS, Granada GG. A pandemia de COVID-19 no Brasil favoreceu o consumo de alimentos ultraprocessados? *Braz Ap Sci Rev*. 2021;5(3):1297-313.
18. Lima CT, Abreu DRVSD, Bezerra KCB, Landim LADSR, Santos LCLD. Hábitos alimentares de crianças e adolescentes e repercussões no decurso da pandemia do Covid-19 *Res. Soc Develop*. 2022;11(9):e7011931549.
19. Vaquero Alvarez M, Aparicio-Martinez P, Fonseca Pozo FJ, Valle Alonso J, Blancas Sánchez IM, Romero-Saldaña M. A sustainable approach to the metabolic syndrome in children and its economic burden. *Int J Environ Res Public Health*. 2020;17(6):1891.
20. Souza Neto JM, Costa FF, Barbosa AO, Prazeres Filho A, Santos EVO, Farias Júnior JC. Physical activity, screen time, nutritional status and sleep in adolescents in Northeast Brazil. *Rev Paul Pediatr*. 2021;39:e2019138.
21. Instituto Brasileiro de Geografia e Estatística. Pesquisa de orçamentos familiares 2017-2018: primeiros resultados [Internet]. Rio de Janeiro: IBGE; 2019 [cited 2019 Nov 4]. Available from: <https://servicodados.ibge.gov.br/Download/Download.ashx?http=1&u=biblioteca.ibge.gov.br/visualizacao/livros/liv101670.pdf>
22. Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional de Saúde Escolar. Rio de Janeiro: IBGE; 2019.
23. Bakour C, Mansuri F, Johns-Rejano C, Crozier M, Wilson R, Sappenfield W. Association between screen time and obesity in US adolescents: a cross-sectional analysis using National Survey of Children's Health 2016–2017. *Plos One*. 2022;17(12):e0278490. doi: <https://doi.org/10.1371/journal.pone.0278490>
24. Gomes DR, Santos Neto ETD, Oliveira DSD, Salaroli LB. Características associadas ao consumo de alimentos in natura ou minimamente processados e ultraprocessados por adolescentes em uma região metropolitana brasileira. *Ciênc Saúde Coletiva*. 2023;28(2):643-56.
25. Souza RG. Nutrição comportamental e o mindful eating: uma revisão da literatura [trabalho de conclusão de curso]. Goiânia: Pontifícia Universidade Católica de Goiás; 2021.
26. Ruiz-Roso MB, Carvalho Padilha P, Mantilla-Escalante DC, Ulloa N, Brun P, Acevedo-Correa D, et al. Covid-19 confinement and changes of adolescent's dietary trends in Italy, Spain, Chile, Colombia and Brazil. *Nutrients*. 2020;12(6):1807.
27. Arque RGC, Ferreira JCD, Figueiredo RS. A importância nutricional da merenda escolar para a comunidade. *RSD*. 2021;10(14):e111101421852. doi: <https://doi.org/10.33448/rsd-v10i14.21852>
28. Neves JA, Machado ML, Oliveira LDDA, Moreno YMF, Medeiros MATD, Vasconcelos FDAGD. Unemployment, poverty, and hunger in Brazil in Covid-19 pandemic times. *Rev Nutr*. 2021;34:e200170. doi: <https://doi.org/10.1590/1678-9865202134e200170>
29. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. 2020;54(24):1451-62. doi: <https://doi.org/10.1136/bjsports-2020-102955>
30. Prado CC, Enes CC, Nucci LB. Prevalência e fatores associados ao sobrepeso e obesidade em adolescentes a partir de inquéritos populacionais de base escolar. *Sustinere*. 2021;9(1):372-97. doi: <https://doi.org/10.12957/sustinere.2021.45707>.
31. Grillo GP, Fróes DNS, Bachetti LG, Marra LJ, Oliveira MD, Gurgel MVG, et al. Impacto do uso excessivo de multtelas no comportamento e saúde mental de crianças e adolescentes. *Braz J Hea Rev*. 2023;6(2):6841-51. doi: <https://doi.org/10.34119/bjhvr6n2-188>.
32. Ko CH, Lin HC, Lin PC, Yen JY. Validity, functional impairment and complications related to Internet gaming disorder in the DSM-5 and gaming disorder in the ICD-11. *Aust N Z J Psychiatry*. 2020;54(7):707-18.
33. American Academy of Pediatrics. Children, adolescents, and the media. *Pediatrics*. 2013;132(5):958-961.
34. Guo Y-F, Liao M-Q, Cai W-L, Yu X-X, Li S-N, Ke X-Y, et al. Physical activity, screen exposure and sleep among students during the pandemic of COVID-19. *Sci Rep*. 2021;11(1):8529.

35. Bruce ES, Lunt L, McDonagh JE. Sleep in adolescents and young adults. *Clin Med*. 2017;17(5):424-8.
36. Cabral BL, Oliveira TPF, Christmann M, Gerlach A, Brum LDS, Skupien JA. A prática de atividade física no período de isolamento social. *Braz J Hea Rev*. 2021;4(5):21218-31.
37. Rede PENSSAN. II VIGISAN - Inquérito Nacional sobre Insegurança Alimentar no Contexto da Pandemia da COVID-19 no Brasil: suplemento I - insegurança alimentar nos estados. Rio de Janeiro: Fundação Friedrich Ebert; 2022.
38. Barbalho EV, Pinto FJM, Silva FR, Sampaio RMM, Dantas DSG. Influência do consumo alimentar e da prática de atividade física na prevalência do sobrepeso/obesidade em adolescentes escolares. *Cad Saúde Coletiva*. 2020;28(1):12-23.
39. Silva LR, Silva Lima MR, Teixeira ECA, Cardoso AAR, Pinheiro JSR, Nogueira MDDA, et al. A influência dos pais no aumento do excesso de peso dos filhos: uma revisão de literatura. *Braz J Hea Rev*. 2019;2(6):6062-75.

CONTRIBUTORS

Conceptualization: CRT CORRÊA. Formal analysis: CRT CORRÊA. Methodology: MABL CARVALHAES. Project administration: CRT CORRÊA, Supervision. MABL CARVALHAES. Writing – original draft: CRT CORRÊA. Writing – review and editing: CRT CORRÊA and MABL CARVALHAES.