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Association between screen use at night, food consumption at dinner, and evening snack in schoolchildren aged 7 to 14 years with and without overweight, Florianópolis, Santa Catarina, Brazil

Associação entre o uso de tela no período noturno e consumo alimentar no jantar e lanche da noite em escolares de 7 a 14 anos com e sem sobrepeso, Florianópolis, Santa Catarina, Brasil

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ABSTRACT

Objective
Analyze the association between screen use at night, food consumption at dinner, and evening snack in schoolchildren with and without overweight.

Methods
Cross-sectional study with a probabilistic sample of 1396 schoolchildren from 7 to 14 years of age from public and private schools of Florianópolis, Santa Catarina, Brazil. Dietary intake and frequency of screen use of the previous day were obtained through the questionnaire *Consumo Alimentar e Atividades Físicas de Escolares* (Food Consumption and Physical Activities of Schoolchildren). The association between screen use at night (exposure) and consumption of food groups (outcome) according to weight status was assessed using multivariate logistic regression.

Results
At dinner, schoolchildren without overweight who used screens once had a lower chance of consuming fruits and vegetables (OR: 0.62, p=0.017) compared to those who did not use screens. In addition, those who used screens twice were more likely to consume sweets (OR: 2.01, p=0.002), and screen use three times or more was inversely associated with beans (OR:

0.24, *p*=0.003) and meat, eggs, and seafood (OR: 0.35, *p*=0.011) consumption. Overweight schoolchildren who used screens three times or more were more likely to consume ultra-processed foods and pizza/hamburger/hot dogs (OR: 2.51, *p*=0.009). For the evening snack, it was observed that schoolchildren without overweight who used screens three times or more had a greater chance of consuming ultra-processed foods and pizza/hamburger/hot dogs (OR: 8.26; *p*=0.016).

Conclusion

Overweight and non-overweight schoolchildren who used screens were more likely to consume ultra-processed foods. Schoolchildren without overweight and who use screens more often at night are less likely to consume healthy foods.

Keywords: Children. Dinner. Food consumption. Screen time. Snacks.

RESUMO

Objetivo

Analisar a associação entre o uso de dispositivo de tela no período noturno, o consumo alimentar no jantar e lanche da noite em escolares com e sem sobrepeso.

Métodos

Estudo transversal com uma amostra probabilística de 1.396 escolares de 7 a 14 anos de idade de escolas públicas e privadas de Florianópolis, Santa Catarina, Brasil. O consumo alimentar e a frequência de uso de dispositivos de telas do dia anterior foram obtidas por meio do questionário Consumo Alimentar e Atividades Físicas de Escolares. A associação entre o uso de dispositivo de tela no período noturno (exposição) e o consumo alimentar (desfecho) foi verificada por meio de regressão logística.

Resultados

No jantar, os escolares sem sobrepeso que utilizaram dispositivo de tela uma vez tiveram menor chance de consumir frutas, verduras e legumes (OR: 0,62, p=0,017) comparado com aqueles que não usaram dispositivos de telas. Além disso, aqueles que usaram dispositivo de tela duas vezes, tiveram maior chance de consumir doces (OR: 2,01, p=0,002) e a utilização de dispositivo de tela três vezes ou mais foi inversamente associado ao consumo de feijão (OR: 0,24, p=0.003), carnes, ovos e peixes (OR: 0,35, p=0,011). Os escolares com sobrepeso que utilizaram dispositivo de tela três vezes ou mais tiveram maior chance de consumirem ultraprocessados e lanches tipo pizza/hambúrguer/cachorro-quente (OR: 2,51, p=0,009). No lanche da noite, observou-se que os escolares sem sobrepeso que utilizaram dispositivo de tela três vezes ou mais, tiveram maior chance de consumir ultraprocessados e lanches (OR: 8,26; p=0,016).

Conclusão

Os escolares com e sem sobrepeso que utilizaram dispositivo de tela tiveram mais chances de consumir alimentos ultraprocessados. Os escolares sem sobrepeso que utilizam dispositivo de tela mais vezes a noite possuem menor chance de consumir alimentos saudáveis.

Palavras-chave: *Crianças. Jantar. Consumo alimentar. Tempo de tela. Lanches.*

INTRODUCTION

Increased screen time (characterized as the use of mobile phones, tablets, video games, and television [1]) is associated with an increased risk for the development of overweight and obesity in children and adolescents [2]. This association can be explained by replacing activities with higher energy expenditure by sedentary behavior [3] and by the greater consumption of high-calorie density foods such as ultra-processed foods [3,4]. The Brazilian Society of Pediatrics recommends avoiding exposure to screen devices for children under two years of age, limiting screen time for children between two and five years of age to one hour daily, for children between six and ten years of age to 1-2 hours, and for children and adolescents between 11 and 18 years of age to 2-3 hours per day. In addition, it recommends that screens not be used during meals [5]. However, a survey

conducted in 2022 with 1,745 parents of Brazilian children up to 12 years old identified that 44% of children owned a mobile phone/smartphone, 35% use their parents' mobile phone, and children spend an average of four hours a day using the device [6].

The survey on Internet Use by children and adolescents in Brazil (TIC Kids Online Brazil 2021) conducted with 2,651 Brazilian children and adolescents aged nine to 17 years showed an increase in internet users (93% in 2021 compared to 89% in 2019). The primary device used for internet access was the mobile phone (93%), with 84% of children and adolescents watching videos, series, and movies and 78% using social media. The survey also reveals that 57% of users reported seeing videos, photos, or texts that showed publicity or advertisements for foods, drinks, and sweets [7]. It should be noted that the impact of food marketing through social media is still unknown [8].

Evidence suggests the importance of the time of day when food is consumed for body weight regulation [9-11]. In this sense, a higher percentage of energy consumption at night has been positively associated with increased risk for overweight and obesity in children and adolescents [12,13]. Studies have identified the association between higher consumption of ultra-processed foods and children and adolescents' use of cell phones, tablets, video games, and television [14-16]. The foods generally purchased ready-to-eat or quickly prepared claim convenience and practicality, although they have low nutritional quality and a large amount of fats, added sugar, and sodium [17]. Screen devices serve food advertisements, mostly of ultra-processed foods [18], stimulating its acquisition and consumption by children and adolescents. The consumption of these foods is associated with a higher risk of developing overweight and obesity and other chronic Non-Communicable Diseases [17]. Data on food consumption at nighttime meals, such as dinner and evening snack, are scarce in children and adolescents. Cezimbra et al. (2020) identified meal and snack patterns in schoolchildren aged seven to 13 who attended the public school system in a capital in southern Brazil. The main dinner pattern was described as 'traditional Brazilian', consisting of rice, beans, beef/poultry, manioc flour, eggs, vegetables and green leaves. In addition, the authors identified an "unhealthy" pattern for the first evening snack pattern, which was composed of pizza/hamburger/hot dog, chips, sodas, cake, and fruit juices [19]. In Florianópolis, cross-sectional surveys of the *Estudo da Prevalência e da Obesidade em Crianças e Adolescentes de Florianópolis* (EPOCA, Study on the Prevalence of Obesity in Children and Adolescents of Florianópolis) aiming to monitor the trend in the prevalence of overweight and obesity and their associated factors in schoolchildren between seven to 14 years of age have been conducted since 2002. An increase in the prevalence of overweight, including obesity, was identified, being 30.3% in 2002, 34.4% in 2007 [20], and 34.2% in 2012 [21]. Although the 2018/2019 panel identified a prevalence of 33.7% [22], this percentage is still high. Studies investigated the association of overweight and obesity with food consumption [23], birth weight [24], age at menarche [25], breastfeeding [26], aspects of the built environment [27], physical activity, and socioeconomic factors [28]. Pinho et al. (2017) investigated the association between screen time and dietary patterns with overweight among adolescents aged 11 to 14 who participated in the EPOCA survey in 2012. It was identified that 39.1% of adolescents performed screen activities three times or more, lasting two hours or more daily [29]. Although this study found no association between screen time and overweight/obesity, other studies have shown that longer screen time is associated with a higher prevalence of overweight and obesity in children and adolescents [30]. Thus, this study aims to evaluate the association between screen use at night, food consumption at dinner, and evening snack in schoolchildren aged 7 to 14 years with and without overweight in Florianópolis, Santa Catarina.

METHODS

This is a cross-sectional study, inserted in the EPOCA study whose objective is to analyze the prevalence of obesity and associated factors in schoolchildren aged 7 to 14 years in the municipality of Florianópolis, Santa Catarina [22].

We used information from the school census for schoolchildren aged 7 to 14 enrolled in elementary school in public and private schools to calculate the sample [31]. The final sample size considered a prevalence of overweight, including obesity of 39% [32], margin of error of 3.5%, 95% confidence interval (CI), and design effect of 1.8. The sample size was doubled to allow comparisons with previous surveys and increased by 10% for possible losses and refusals, resulting in 2,891 schoolchildren. The sampling procedure was previously described by Pereira et al. (2023) [22]. A team of trained researchers collected data from 30 randomly selected schools representative of the five regions of Florianópolis (North, South, East, Center, and Continent), 19 of which were public and 11 private, taking place between November 2018 and December 2019.

The participants were schoolchildren enrolled between the 2nd and 9th grades. The inclusion criteria were students aged seven to 14 bearing a Free and Informed Consent Form signed by the parents or guardians and the Free and Informed Acceptance Form signed by the schoolchild. The research protocol was submitted to the Human Research Ethics Committee of the Universidade Federal de Santa Catarina (protocol number 7539718.1.0000.0121). A total of 1,691 schoolchildren were included in the study, of which 188 were excluded from the database due to the absence of food consumption data and 87 for presenting implausible dietary data (consumption of less than three food items per day or consumption of a number of items greater than the mean +3 standard deviations, [23]). Only schoolchildren who consumed at least one food item (except for water) at dinner and in the evening snack were considered for this study, totaling 1,273 and 647 schoolchildren, respectively.

Data on dietary intake and screen use activities were obtained through the *Consumo Alimentar e Atividade Física de Escolares* (Web-CAAFE, Food Intake and Physical Activities of Schoolchildren) online questionnaire developed for schoolchildren of the municipal school system of Florianópolis. This instrument aims to obtain data concerning the previous day and has been subjected to reproducibility, usability, and validity tests [33-36]. Web-CAAFE does not provide quantification of the amount of food consumed or the time spent on screen activities since it was developed considering the cognitive development of children aged seven to ten years [37]. Thus, the instrument allows us to identify markers of healthy and unhealthy eating and the performance of physical activities and sedentary behavior through daily frequency. Data were collected on school days (Monday to Friday), making it possible to obtain data from Sunday, representing the weekend. The Web-CAAFE begins with a registration section, followed by a section on food intake and another on physical activities and sedentary behaviors. The food intake section is divided into three meals and three snacks ordered chronologically (breakfast, mid-morning snack, lunch, mid-afternoon snack, dinner, and evening snack), presenting icons of 31 food items for each eating event. Therefore, the student can select rice, vegetables, green leaves, vegetable soup, beans, manioc flour, pasta, instant noodles, French fries, beef/poultry, eggs, fish/seafood, maize/potatoes, sausage, breakfast cereal, fruits, bread, cheese bread, cake without icing, cheese, coffee with milk, milk, yogurt, chocolate milk, fruit juices, cream cookies, soda, sweets (chocolate bars, ice cream, candies, cake with icing), chips, pizza/hamburger/hot dog, and water [36].

The food items selected for dinner and evening snack were considered according to the instructions provided by the avatar "*cafito*". For dinner, "[...] *is the main meal we make at night*", and for the evening snack, "[...] *is what you ate after dinner and before bed*". Web-CAAFE does not specify the time in hours of these meals. Dinner and the evening snack were considered when the schoolchild included at least one food item, except for water. The selected items were grouped into seven food groups considering nutritional similarity, groups proposed by the Brazilian Dietary Guidelines [38], and the use of this classification in previous studies [39,40]. The food groups were: Dairy Products (Milk, coffee with milk, yogurt, and cheese); Cereals (bread, cake without icing, manioc flour, maize/potatoes, pasta, rice, breakfast cereal, and cheese bread); Beans; Meats, eggs, and seafood (meat/poultry, egg, fish/seafood); Fruits, and vegetables (fruits, legumes, green leaves, and vegetable soup); Sweets (chocolate milk, cream cookies, soda, fruit juice, and chocolate/candy/lollipop/ice cream/cake with icing); and Ultra-processed foods (instant noodles, French fries, sausage, chips, and pizza/hamburger/hot dog). The frequency of consumption greater than 5% of each food group at each meal was considered for this study [41]. Thus, the group of beans and meat, eggs, and seafood were excluded since they had a frequency of consumption of less than 5% in the evening snack.

The physical activities and sedentary behaviors section of Web-CAAFE is divided into three times of day (morning, afternoon, and evening) and presents 32 types of activities, including four screen-use activities at each time: watching television, using the computer, using the cell phone/*tablet*, and playing video games. For this study, frequency of screen use at night was considered and classified into the following categories: does not use; uses once; uses twice; uses three times or more [42]. Thus, the child selecting the item "television" at night is counted as one use. If the child selects one more item like "computer", it will be counted as two uses.

Data on age, gender, and school shift were obtained from a list provided by the schools. Weight and height were measured by a previously trained team following standardized procedures [43]. Body weight was collected using an electronic scale with a capacity of 200 kg and an accuracy of 50 g (Marte brand, model LC 200 PP). Height was measured using a portable stadiometer fixed to the wall (Alturexata® brand), with a zero point at ground level and a scale of 1 mm. The schoolchildren were classified according to BMI z-score for age, referencing the growth curves from 5 to 19 years of the WHO of 2007, adopting the following criteria for the weight status classification: overweight (including obesity) z-score ≥ +1 and non-overweight z-score < +1 [44].

The association between screen use at night and consumption of food groups at dinner and evening snack was verified through logistic regression stratified by weight status (non-overweight and overweight including obesity). The consumption of the food group (yes or no) was considered as a dependent variable, and the frequency of screen use at night (does not use; uses once; uses twice; uses three times or more) adjusted for gender, age (7 to 10 years and 11 to 14 years), type of school (public and private), and day of consumption report (weekday or weekend) were considered independent variables. All variables were entered simultaneously, and a statistical significance level of $p<0.05$ was considered for statistical decision. The statistical program Stata 16.0 was used for analyses. The Stata command "*svy*" was used due to the type of sampling.

RESULTS

The total sample consisted of 1,396 schoolchildren aged seven to 14 from Florianópolis. Table 1 presents the sample characteristics. Most schoolchildren were female (53.5%), aged 7 to 10 years (57.9%), and attended public schools (59.9%). The highest number of reports occurred on

weekdays (87.6%). It was observed that 36.8% of the schoolchildren did not use a screen, 36.6% used a screen once at night, and the most used device was the cell phone/tablet (41.2%). Concerning dinner, 92.2% of the students ate the meal, and 43.3% consumed the evening snack. The highest proportion among overweight children was 7 and 10 years old (59.3%), and among schoolchildren with non-overweight, the highest proportion was female (58.5%).

Table 1 – Description of the sample of schoolchildren aged 7 to 14 years according to weight status. Florianópolis (SC), Brazil, 2018/2019.

Characteristics	Non-overweight (n=919)		Overweight (n=460)		Total (n=1.396)	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
Gender						
Male	365	41.5 (36.6; 46.5)	227	56.1 (45.5; 66.2)	601	46.5 (43.1; 50.0)
Female	554	58.5 (53.4; 63.4)	233	43.9 (33.8; 54.5)	795	53.5 (50.0; 57.0)
Age						
7 - 10 years	526	57.2 (48.7; 65.2)	284	59.3 (51.0; 67.1)	820	57.9 (49.6; 65.7)
11-14 years old	390	42.8 (34.7; 51.3)	176	40.7 (32.8; 49.0)	576	42.1 (34.3; 50.4)
Type of school						
Public	536	58.3 (55.1; 61.5)	292	63.5 (58.9; 67.8)	836	59.9 (57.3; 62.4)
Private	383	41.7 (38.5; 44.9)	168	36.5 (32.2; 41.0)	560	40.1 (37.6; 42.7)
Food consumption reporting day						
Weekend	185	12.3 (4.2; 30.8)	87	12.7 (4.7; 29.8)	278	12.4 (4.5; 30.1)
Weekday	734	87.7 (69.2; 95.8)	371	87.3 (70.2; 95.3)	1.118	87.6 (69.9; 95.5)
Dinner						
Yes	843	92.7 (89.8; 94.8)	415	91.0 (83.8; 95.1)	1,273	92.2 (89.1; 94.4)
No	76	7.3 (5.1; 10.2)	45	9.0 (4.9; 16.2)	123	7.8 (5.6; 10.9)
Evening snack						
Yes	445	44.6 (37.5; 51.9)	192	39.3 (35.6; 43.0)	647	43.3 (38.1; 48.6)
No	474	55.4 (48.0; 62.5)	268	60.7 (56.9; 64.3)	749	56.7 (51.4; 61.9)
Frequency of screen use at night						
No use	366	35.0 (29.6; 40.8)	185	39.8 (34.6; 45.2)	561	36.8 (32.0; 41.8)
1-time use	347	38.5 (34.7; 42.5)	158	33.5 (31.3; 35.7)	508	36.6 (33.9; 39.4)
2-times use	175	21.0 (17.3; 25.2)	82	18.5 (15.9; 21.3)	258	20.0 (17.3; 23.0)
3-or more times use	31	5.5 (2.9; 10.1)	35	8.2 (5.5; 12.2)	69	6.6 (4.1; 10.3)
Screen devices used at night						
Cell phone/tablet	351	43.2 (37.7; 48.8)	175	38.0 (33.2; 43.1)	531	41.2 (36.7; 45.8)
Television	303	35.5 (27.4; 44.5)	160	33.1 (27.5; 39.4)	468	34.8 (29.6; 40.4)
Video game	75	10.6 (7.7; 14.5)	48	14.0 (9.2; 20.5)	126	11.8 (8.2; 16.7)
Computer	67	8.7 (6.1; 12.4)	52	12.7 (9.0; 17.5)	121	10.2 (7.5; 13.6)

Note: CI: Confidence Interval.

Tables 2 and 3 show the results of the association between screen use at night and the consumption of food groups at dinner of schoolchildren with and without overweight, respectively. Schoolchildren without overweight who used screens once had a lower chance of consuming fruits and vegetables (OR: 0.62, 95% CI 0.43; 0.90) compared to those who did not use screens. Schoolchildren without overweight and who used screens twice had a higher chance of consuming sweets (OR: 2.01, 95% CI 1.40; 2.91) than those who did not. Schoolchildren without overweight who used screens three times or more were less likely to consume beans, meat, eggs, and seafood (OR: 0.24, 95% CI 0.11; 0.54 and OR: 0.35, 95% CI 0.16; 0.74, respectively) compared to those who did not use screens (Table 2).

Table 2 – Association of screen use at night with the consumption of food groups at dinner in non-overweight schoolchildren aged 7 to 14 years, Florianópolis (SC), Brazil, 2018/2019. (n=843)

Food groups	Screen use at night								
	1 time			2 times			3 or more times		
	OR	95% CI	*p**	OR	95% CI	*p**	OR	95% CI	*p**
Dairy products	0.80	(0.28; 2.30)	0.639	1.04	(0.33; 3.29)	0.934	1.00	(0.05; 18.21)	0.998
Cereals	1.38	(0.86; 2.22)	0.158	0.99	(0.61; 1.60)	0.947	0.66	(0.38; 1.16)	0.130
Beans	1.06	(0.90; 1.24)	0.461	0.85	(0.54; 1.33)	0.429	**0.24**	**(0.11; 0.54)**	**0.003**
Meat, eggs, and seafood	0.83	(0.57; 1.21)	0.295	1.48	(0.95; 2.32)	0.079	**0.35**	**(0.16; 0.74)**	**0.011**
Fruits and vegetables	**0.62**	**(0.43; 0.90)**	**0.017**	0.73	(0.41; 1.31)	0.257	0.62	(0.33; 1.16)	0.121
Sweets	1.28	(0.52; 3.18)	0.549	**2.01**	**(1.40; 2.91)**	**0.002**	1.51	(0.67; 3.42)	0.282
Ultra-processed foods and pizza/ hot dog/ hamburger	1.02	(0.80; 1.30)	0.829	1.32	(0.71; 2.46)	0.339	1.87	(0.86; 4.10)	0.102

Note: *Adjusted for gender, age, type of school, and day of consumption reporting. Significant values are shown in bold. CI: Confidence Interval; OR: Odds Ratio.

It was identified that overweight schoolchildren who used screens three times or more had a greater chance of consuming ultra-processed foods and pizza/ hot dog/ hamburger (OR: 2.51, 95% CI 1.35; 4.67) compared to those who did not use a screen (Table 3).

Table 3 – Association of screen use at night with the consumption of food groups at dinner in overweight schoolchildren aged 7 to 14 years, Florianópolis, 2018/2019. (n= 415)

Food groups	Screen use at night								
	1 time			2 times			3 or more times		
	OR	95% CI	*p**	OR	95% CI	*p**	OR	95% CI	*p**
Dairy products	1.24	(0.52; 2.96)	0.583	1.62	(0.26; 10.07)	0.562	2.07	(0.28; 15.52)	0.436
Cereals	1.33	(0.56; 3.17)	0.474	1.10	(0.76; 1.60)	0.560	0.83	(0.49; 1.41)	0.454
Beans	1.31	(0.84; 2.05)	0.199	0.63	(0.18; 2.18)	0.424	0.35	(0.05; 2.61)	0.270
Meat, eggs, and seafood	0.86	(0.30; 2.47)	0.760	0.69	(0.25; 1.90)	0.431	0.69	(0.38; 1.25)	0.195
Fruits and vegetables	0.81	(0.56; 1.18)	0.236	0.55	(0.27; 1.13)	0.092	0.17	(0.03; 1.04)	0.054
Sweets	0.93	(0.43; 2.00)	0.825	1.53	(0.49; 4.79)	0.421	0.89	(0.20; 4.03)	0.869
Ultra-processed foods and pizza/ hot dog/ hamburger	0.87	(0.47; 1.62)	0.635	2.35	(1.00; 5.54)	0.050	**2.51**	**(1.35; 4.67)**	**0.009**

Note: *Adjusted for gender, age, type of school, and day of consumption reporting. Significant values are shown in bold. CI: Confidence Interval; OR: Odds Ratio.

Schoolchildren without overweight and who used screens three times or more had a higher chance of consuming ultra-processed foods and pizza/hamburger/hot dog in the evening snack (OR: 8.26, 95% CI 1.63; 41.88) than those who did not (Table 4). No differences were observed in the evening snack of overweight schoolchildren (Table 5).

Table 4 – Association of screen use at night with the consumption of food groups in the evening snack in non-overweight schoolchildren aged 7 to 14 years, Florianópolis (SC), Brazil, 2018/2019. (n= 445)

Food groups	Screen use at night								
	1 time			2 times			3 or more times		
	OR	95% CI	*p**	OR	95% CI	*p**	OR	95% CI	*p**
Dairy products	0.53	(0.18; 1.53)	0.206	0.83	(0.34; 2.04)	0.652	0.12	(0.01; 2.33)	0.142
Cereals	0.66	(0.30; 1.45)	0.260	0.57	(0.17; 1.92)	0.321	1.14	(0.10; 13.71)	0.908
Fruits and vegetables	0.98	(0.59; 1.62)	0.927	1.29	(0.68; 2.42)	0.389	1	-	-
Sweets	1.74	(0.99; 3.04)	0.053	1.83	(0.83; 4.03)	0.118	2.66	(0.55; 12.94)	0.196
Ultra-processed foods and pizza/ hamburger/hot dog	1.13	(0.54; 2.35)	0.716	1.20	(0.42; 3.43)	0.700	**8.26**	**(1.63; 41.88)**	**0.016**

Note: *Adjusted for gender, age, type of school, and day of consumption reporting. Significant values are shown in bold. There was no consumption of the food group in the category with a value of 1 odds ratio. CI: Confidence Interval; OR: Odds Ratio.

Table 5 – Association of screen use at night with the consumption of food groups in the evening snack in overweight schoolchildren aged 7 to 14 years, Florianópolis (SC), Brazil, 2018/2019. (n=192)

Food groups	Screen use at night								
	1 time			2 times			3 or more times		
	OR	95% CI	*p**	OR	95% CI	*p**	OR	95% CI	*p**
Dairy	0.63	(0.16; 2.44)	0.457	2.15	(0.52; 8.98)	0.255	0.20	(0.02; 1.83)	0.135
Cereals	0.73	(0.25; 2.13)	0.528	0.75	(0.40; 1.41)	0.330	0.36	(0.07; 1.71)	0.170
Fruits and vegetables	1.31	(0.17; 9.78)	0.771	1.39	(0.80; 2.40)	0.213	2.49	(0.03; 177.85)	0.640
Sweets	0.95	(0.31; 2.90)	0.914	1.10	(0.61; 1.99)	0.718	1.04	(0.18; 5.99)	0.956
Ultra-processed foods and pizza/ hamburger/hot dog	0.90	(0.23; 3.53)	0.861	0.56	(0.09; 3.34)	0.482	1.60	(0.53; 4.78)	0.358

Note: *Adjusted for gender, age, type of school, and day of consumption reporting. CI: Confidence Interval; OR: Odds Ratio.

DISCUSSION

This study investigated the association between screen use at night, the consumption of food groups at dinner, and evening snack in schoolchildren aged 7 to 14 years with and without overweight. The main results observed were (i) At dinner, higher frequency of screen use was inversely associated with consumption of fruits and vegetables, beans, meats, eggs, and seafood and a higher likelihood of consuming sweets in schoolchildren without overweight; (ii) Overweight schoolchildren who used screens more frequently had a higher chance of consuming ultra-processed foods and pizza/hamburger/hot dog at dinner; (iii) In the evening snack, schoolchildren without overweight who used screens more frequently had a higher chance of consuming ultra-processed foods and pizza/hamburger/hot dog.

The most used screen device was the mobile phone/tablet, similar to the results of other studies with children and adolescents [42,45]. The mobile phone was the most used device in a study of British female adolescents, followed by the tablet and laptop [45]. These data corroborate the results observed by Oliveira et al. (2020), who showed that the mobile phone/tablet was more used among schoolchildren aged 7 to 13 years in the public schools of Florianópolis in 2017 [42].

This study identified that screen use at night was associated with greater consumption of unhealthy foods at dinner and evening snack. These results corroborate other studies with children and adolescents that have identified an association between screen use and higher daily consumption of ultra-processed foods [15,46]. Melo et al. (2019) identified a positive correlation between the consumption of ultra-processed foods and the use of mobile phones, tablets, video games, and television in a study with schoolchildren aged 7 to 10 years from a private school in the municipality of Teresina, Brazil [15]. Similar results were observed in a study of 13486 Iranian schoolchildren between the ages of 6 and 18, in which screen use for more than four hours daily was associated with higher daily consumption of sweets, sugary drinks, packaged snacks, and fast food [14]. It is noteworthy that there was lower consumption of healthy foods among schoolchildren with and without overweight who used screens. This result corroborates the result found by Shang et al. (2015), who studied 630 Canadian children aged 8 to 10 years, in which a longer screen time (≥2 hours daily) was associated with lower daily consumption of fruits and vegetables, in children with and without overweight [47]. Kelishadi et al. (2017) identified lower milk consumption among students who used screens for more than four hours daily, although without stratifying according to weight status [14].

Pearson et al. (2017) investigated the presence of health risk behaviors by cluster analysis. One of the behaviors grouped was "increased screen time and unhealthy eating habits". The study identified that schoolchildren who used more screens also consumed fewer fruits and vegetables

and more high-calorie density foods [16]. It should be noted that the Brazilian Dietary Guidelines recommends that foods *in natura* and minimally processed be the basis of the diet and that the consumption of ultra-processed foods should be avoided, given its relationship with an increase in the prevalence of overweight and obesity and Non-Communicable Diseases [38].

National research has identified an association between screen use and less healthy eating habits. According to a study that used data from the *Pesquisa Nacional de Saúde do Escolar* (National School Health Survey) (2015), adolescents with more than two hours daily of sedentary behavior (television, computer, video games, talking to friends, etc.) had a higher prevalence of daily consumption of ultra-processed foods (42.8%) compared to 28% of students who spend less than two hours a day in sedentary behavior and consume ultra-processed foods [48]. Likewise, a study with Brazilian adolescents participating in the *Estudo de Riscos Cardiovasculares em Adolescentes* (Study of Cardiovascular Risks in Adolescents) identified that 40% of adolescents almost always or always consumed snacks (packet snacks, popcorn, sandwiches, chocolates, and candies) while using screens [46]. It is important to note that screen devices can distract the child or adolescent, making it difficult to perceive satiety, leading to excessive consumption and eating without hunger [49,50]. Therefore, these habits can directly affect the health of schoolchildren, reflecting the increase in the prevalence of overweight and obesity [51].

A hypothesis for children and adolescents to consume more ultra-processed foods and, consequently, less food *in natura* or minimally processed while using screen devices is exposure to advertisements of ultra-processed foods, which aim to cause greater interest in consuming these products [50,52]. In addition, it is convenient to consume ultra-processed foods since they are purchased in ready-to-eat or quick-preparation packaging [17]. A study conducted in two Brazilian open television stations identified that about 50% of the foods served in the commercials were rich in sugars, and the most displayed foods in ads were soft drinks, yogurts/fermented drinks, and biscuits [53]. A study by Santos et al. (2012) mapped 239 food advertisements broadcast by Brazilian open television stations, finding that 85% presented foods rich in fats and sugars and that no commercials encouraged the acquisition and consumption of fruits and vegetables [54]. Although the impact of social media and digital influencers on the consumption of unhealthy foods is still unknown, evidence suggests that this type of advertising content can especially persuade children and adolescents [55,56]. Coates et al. (2019) investigated the impact of food advertising by influencers on social media in a sample of 176 children between nine and 11 years of age [56]. They identified that children exposed to influencer content containing unhealthy foods (such as cookies) had a higher caloric intake soon after exposure and consumed more unhealthy foods compared to children who were exposed to healthy food content or without the presence of food on social media. The authors also indicate that exposure to healthy food (banana) content did not change children's food consumption [56]. Finally, it should be noted that these ultra-processed foods are being consumed at night, therefore close to bedtime, and can cause changes in the circadian cycle, responsible for hormonal and metabolic oscillations related to overweight and obesity [57]

The strengths of this study are the use of data from children and adolescents from public and private schools, data collection by trained researchers, and the use of a food consumption and sedentary behavior questionnaire validated for schoolchildren [33,34,36,39]. One of the limitations of this study is that Web-CAAFE does not allow the identification of screen time or the amount of food consumed since it was developed to be a relatively brief questionnaire and to simplify the completion by the schoolchildren [36]. Data on food consumption and screen use were obtained from one day, which may not represent schoolchildren's usual food consumption and screen use

behaviors. However, this method has been used to evaluate these behaviors in studies with large samples [58]. The smaller number of students who consumed the evening snack may have contributed to the greater confidence interval range and the classification of the variable "screen use at night". Therefore, future studies should use larger samples to reduce the confidence interval range and the bias of reverse causality since it is a cross-sectional study.

CONCLUSION

The present study identified that using screens at night was associated with a higher consumption of unhealthy foods and a lower consumption of healthy foods at dinner in non-overweight students. In addition, there was a higher consumption of ultra-processed foods in the evening snack by students without overweight who used screens three times or more. A higher frequency of screen use was associated with higher consumption of ultra-processed foods and fast food at dinner in overweight schoolchildren.

Therefore, it should be noted that screens at night can impact food consumption at dinner and evening snack in children. In this sense, these findings indicate the need for guidance on the "screen use at night" and consumption of ultra-processed foods by schoolchildren, considering the impact of these habits on the health of children and adolescents with and without overweight. These actions can be performed in the school environment as part of the School Health Program or Food and Nutrition Education activities. It is essential that these actions also reach families and be associated with other health promotion actions within the scope of Primary Health Care.

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CONTRIBUTORS

DMT ROBERTO contributed to the data collection, analysis and interpretation of data, discussion of results, writing and review and approval of the final version of the article. LC BASNIAK, SS COSTA, SS SILVA and FGK VIEIRA contributed to the writing, review, and final approval of the article. PF HINNIG contributed to the funding acquisition, project administration, conception and design analysis, interpretation of data and review, and final approval of the article.