Association between screen time and the variation of food intake markers among school-aged adolescents in Niterói/RJ, Brazil

Associação entre tempo de exposição à tela e variação de ingestão alimentar entre adolescentes em idade escolar de Niterói/Rio de Janeiro, Brasil

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Abstract

Background: Changes in eating habits may be associated with sedentary behaviors by favoring excessive weight gain among adolescents, and consequently leading to the occurrence of chronic Non-Communicable Diseases (NCD). **Objective:** To evaluate the association between screen time and consumption of healthy and unhealthy food markers in adolescents. **Method:** A longitudinal study with adolescents aged from 10-16 years of public schools in Niterói, in the state of Rio de Janeiro/Brazil was performed in 2014. It was applied a questionnaire about screen time, food consumption frequency and socio-demographic variables. Generalized linear models were applied with *p*-value <0.05. **Results:** 448 students participated in the study, 54.8% were male, and 67% were in the category of ≥5 hours/day of total screen time and 69% in the ≤4 hours/day of television time (TV time). It was not observed an association between total screen time and food intake variations. However, an inverse association was observed between TV time and vegetable consumption (*p*-value = 0.02). **Conclusion:** It was not observed an association between total screen time and food intake variations. Nevertheless, it was verified that time spent watching television was associated with consumption of vegetables. Thus, it is suggested that the reduction of the time spent in sedentary activities and healthy food choices are priorities in the elaboration of public policies.

Keywords: screen time; sedentary behavior; food intake; adolescents.

Resumo

Introdução: Alterações nos hábitos alimentares associadas a comportamentos sedentários favorecem o ganho excessivo de peso entre os adolescentes, consequentemente podendo levar à ocorrência de doenças crônicas não transmissíveis. **Objetivo:** Avaliar a associação entre tempo de exposição à tela e consumo de alimentos marcadores de alimentação saudável e não-saudável de adolescentes. **Método:** Realizou-se um estudo longitudinal com adolescentes de 10-16 anos de escolas públicas de Niterói, Rio de Janeiro/Brasil, em 2014. Foram aplicados questionários com questões sobre tempo de

exposição à tela, frequência do consumo alimentar e variáveis sóciodemográficas. Modelos lineares generalizados foram aplicados, com p-valor <0,05. **Resultados:** Participaram do estudo 448 alunos, 54,8% do sexo masculino e 67% encontravam-se na categoria de ≥5 horas/dia de tempo de tela total e 69% na de ≤4 horas/dia de tempo de TV. Não foi observada associação entre tempo de exposição à tela total e a variação do consumo alimentar. Foi observada uma associação inversa entre o tempo de TV e o consumo de hortaliças (p-valor=0,02). **Conclusão:** Não foi observada associação entre tempo de exposição à tela total e a variação do consumo alimentar. O tempo assistindo televisão foi associado ao consumo de hortaliças. Sugere-se que a redução do tempo gasto em atividades sedentárias e escolhas alimentares saudáveis sejam prioridades na elaboração de políticas públicas.

Palavras-chave: tempo de tela; comportamento sedentário; consumo alimentar; adolescentes.

INTRODUCTION

The increased prevalence of overweight is observed among, not only adults, but also children and adolescents in several countries[1-3]. Changes in eating habits, including the high consumption of processed foods, rich in simple sugars and with high energy value, and the reduced energy expenditure associated with sedentary behaviors favor weight gain among adolescents, and unfortunately these habits may consequently lead to the occurrence of other chronic Non-Communicable Diseases (NCD)[4,5].

Sedentary behavior is characterized by activities below energy expenditure of ≤1.5 Metabolic Equivalent (MET), performed in sitting or reclining position[6], including activities such as: to watch television, to use computer and / or to play video games or on cell phone. These activities are also known as "screen time"[7].

The number of hours spent on these activities has been increasing, possibly resulting from the advancement of technologies and the lack of safety in city streets where adolescents could practice physical activity[8,9]. Screen time already accounts for more than one quarter of the leisure time of children and adolescents and is considered a "key health risk factor" for these individuals[10].

In Brazil, results from the National School Health Survey (in Portuguese *Pesquisa Nacional de Saúde do Escolar* - PeNSE), conducted in 2012, showed that 80% of Brazilian schoolchildren spent two or more hours watching television per day, on average[11], which is the limit established in 2003 by the American Academy of Pediatrics (AAP) for overweight and obesity prevention in children and adolescents[12].

Also a systematic review of studies conducted with Brazilian adolescents showed that 60% of the studies found a prevalence of excessive screen time above 50%[13].

Recently, others cutoff points have been studied, and four or more hours of watching television a day have already been suggested as the new limit to classify adolescents with excessive screen time[3,5,14-16]. In addition to the effects of a sedentary lifestyle on energy balance, in some studies, screen time has been associated with the consumption of hypercaloric foods that are poor in nutrients and rich in sodium and sugars, including soft drinks, and also with the low consumption of fruits and vegetables[17-20]. This association was observed in a cross-national study of different European countries[17] and in a cohort study conducted from 2004 to 2008 with North American adolescents, which assessed that the increase in total screen time (hours/day) over the years meant an increase in the consumption of foods with low nutritional quality, primarily Sugar-Sweetened Beverages (SSB) and sweets, and a decrease in the consumption of fruits and vegetables[20].

In Brazil, some studies have evaluated 'screen time and nutritional status'[3,8,21-26], 'screen time and body fat'[27,28] and 'screen time and food intake'[16,22,29,30]. However, most studies only assessed television-viewing habits, without analyzing other media. Furthermore, no study performed a longitudinal analysis of food intake variation and screen time among adolescents.

Based on what was written above, this study aimed to evaluate the association between the number of hours spent on screen time a day and the consumption of healthy and unhealthy food markers variation among adolescents who participated in a study intervention aimed at reducing obesity among schoolchildren.

METHOD

Study design and population

This longitudinal study is part of the project Parents, Students and Teachers for Healthy Eating 2 (in Portuguese *Pais, Alunos e Professores Pela Alimentação Saudável 2* - PAPPAS 2), which assessed the feasibility of reducing the prevalence of overweight among schoolchildren, performed with adolescents enrolled in the 6th and 7th grades of two public schools of the municipal school network from Niterói, in Rio de Janeiro state (RJ), Brazil, during the 2014 school year. The city of Niterói is included in the Metropolitan Area of Rio de Janeiro and has a population of approximately 500,000 inhabitants, according to data from the Brazilian Institute of Geography and Statistics (in Portuguese *Instituto Brasileiro de Geografia e Estatística* – IBGE) in 2015[31].

The main objective of PAPPAS 2 was to assess the feasibility of new approaches of interventions and processes to combine primary and secondary preventions in reducing the prevalence of overweight among schoolchildren. Primary prevention consisted of nutritional education sessions lasting one hour each, held monthly by the project team addressing dietary and healthy lifestyle issues. The topics covered were: "Healthy Food + Rice Marriage with Beans"; "Knowing the food: the senses and the food"; "Salad Cooking Workshop"; "Sugar in Beverages"; "Marketing"; "Mini market + Food Choices" and "Sedentary lifestyle". Secondary prevention was related to the practice of physical activity among overweight adolescents. The activities consisted of dance and soccer classes lasting one hour, taught weekly by teachers hired by the project team.

The municipal school network of Niterói consisted of 47 schools, including 12 schools with the 6th and 7th grades (elementary school) in their curriculum, which was the target study population. Because this is a feasibility study, two schools were randomly selected to be included in the sample. Intervention and control schools were randomly selected using an opaque envelope in the presence of three researchers.

Considering 30-35 students in each class, 520 students were enrolled in 17 classes, 6th- and 7th- grade, in both schools. A total of 448 (86.1%) of those students have signed informed consent form, and 437 have answered the questions on screen time at baseline (beginning of the school year) and were, therefore, included in the present study. A sample of 179 individuals would be necessary to assess a prevalence of 13% obesity observed in adolescents from Niterói.

Study variables

At the beginning (baseline) and end of the school year, the students filled out a questionnaire with questions on food intake, sedentary behavior, which was measured by screen time, socio-demographic variables, the practice of physical activity, and furthermore their anthropometric measurements were taken. Sedentary behavior, sex and age data collected at baseline, and food intake data collected at both assessment times were used in the present study.

The following questions were used to assess total screen time: "Usually, how many hours a day do you spend watching television?" and "Usually, how many hours a day do you use a computer, play videogames or play on your cell phone?", considering the following choices: "I do not watch", "one hour", "two hours", "three hours", "four hours" and "five hours or more" to answer both questions[29]. Screen time was defined as the sum of the times (hours/day) answered in both questions. This variable was categorized as "less than or equal to four hours/day" and "more than or equal to five hours/day"[3,5]. The TV time variable was also categorized in the same way as the total screen time.

Food intake was evaluated using a semi-quantitative, self-reported Food Frequency Questionnaire (FFQ) regarding the three months before the evaluation date, consisting of 93 food items with standardized portions, previously validated in a sample of adolescents[32] and revised[33]. The frequency choices were differently organized for specific questionnaire items,

ranging from "less than once a week or never" to "six or more times a day". The consumption of four food groups was assessed and expressed as 'grams', including two groups with healthy food items ("fruits" and "vegetables") and two groups with unhealthy food items ("SSB" and "cookies"). The FFQ frequency choices were transformed into daily frequencies to analyze these items. The contents of FFQ portions expressed as 'grams' were determined using the Tables of Nutritional Composition and Portion Sizes (in Portuguese *Tabelas de Composição Nutricional e de Medidas Caseiras*) used in the National Dietary Survey (in Portuguese *Inquérito Nacional de Alimentação* - INA) for the period 2008-2009[34]. The daily consumption of each food group expressed in 'grams' was calculated by multiplying the quantity in grams by the daily frequency[35,36].

Statistical analysis

The database with the information contained in the questionnaires was constructed using Epi-Info software (version 3.5.1), with double-digit data. After data entry, data consistency was assessed and corrected.

Longitudinal analyses were performed using the Generalized Linear Models (GLM) (PROC genmod for longitudinal analysis), using the gamma distribution with log link function. This method considers repeated measures, as well as the correlation between individuals and missing data[37]. The final analysis was performed including the following variables in the model: group (intervention or control), sex, age and total energy consumption. The Statistical Analysis System (SAS) software (version 9.3) was used for statistical analysis.

Ethical aspects

The PAPPAS 2 project was approved by the Research Ethics Committee of the Institute of Social Medicine of the Rio de Janeiro State University (*Universidade do Estado do Rio de Janeiro* – UERJ, Brazil), according to opinion number 367.186, of 08/22/2013. The students participated in the research study after their father, mother or guardian signed their informed consent form. Before conducting the interview, the guardians were informed about the research objectives and procedures to be used and re-assured regarding the participants' confidentiality and anonymity.

RESULTS

A total of 437 students participated, of which 54.8% were male. The mean age was 12.2 years (SD ± 1.1). Regarding the screens, 67% were classified in the largest category of total screen time (≥5 hours per day), while 69.3% reported watching TV for ≤4 hours per day. Considering the healthy and unhealthy food markers, the median of fruit, vegetables, SSB and cookies were 257.4, 76.4, 620.6 and 69 g/day, respectively in the baseline (Table 1).

Table 1. Characteristics of the adolescents at study baseline - Niterói/RJ, 2014

Characteristics	n (%)
Sex	
Male	272 (54.8)
Female	224 (45.2)
Total screen time	
≤ 4 hours/day	144 (32.9)
≥ 5 hours/day	293 (67.0)
TV time	
≤ 4 hours/day	302 (69.3)
≥ 5 hours/day	134 (30.7)
Age (years)*	12.2 (1.1)
Fruit (g/day)**	257.38 [88.7 - 534.9]
Vegetables (g/day)**	76.39 [22.0 - 177.0]
Sugar-Sweetened Beverages (SSB) (ml/day)**	620.65 [209.8 - 1298.1]
Cookies (g/day)**	67.9 [16.3 - 160.0]

* Variables expressed as mean (standard deviation); ** Variables expressed as median and Interquartile Range (IQR) [25-75 percentiles]

Throughout the school year, the group with shorter screen times increased the consumption of all food markers, while the adolescents with longer screen time reduced the consumption of all food markers, except for vegetables that increased. The crude difference in the variation was statistically significant for fruits and SSB, including *p*-values of 0.04 and 0.03, respectively. After adjustment for potential confounding variables, it was not verified any statistical significance difference in the variation of the consumption (Table 2).

Table 2. Food intake markers variation according to total screen time at study baseline among adolescents from two schools of Niterói/RJ, 2014

Food groups*	≤ 4 hours/day		≥ 5 hours/day		*p*-value
	Initial	Final	Initial	Final	
Fruits (g/day) [a]	338.8 (8.4)	377.3 (9.3)	398.3 (9.7)	355.1 (8.5)	**0.04**
Vegetables (g/day) [a]	119.2 (9.6)	123.7 (9.9)	124.7 (9.9)	127.0 (9.4)	0.46
Sugar-Sweetened Beverages (SSB) (ml/day) [a]	752.7 (6.9)	878.1 (8.1)	1022.0 (9.3)	902.1 (895.0)	**0.03**
Cookies (g/day) [a]	109.4 (2.3)	114.7 (2.4)	130.7 (2.7)	127.9 (2.5)	0.38
Fruits (g/day) [b]	330.2 (164.3)	377.7 (187.3)	371.8 (251.9)	402.7 (272.3)	0.69
Vegetables (g/day) [b]	114.1 (47.1)	125.5 (51.4)	117.5 (66.3)	128.5 (72.0)	0.97
SSB (ml/day) [b]	718.16 (441.2)	913.7 (561.0)	951.2 (799.9)	1101.0 (924.6)	0.52
Cookies (g/day) [b]	95.3 (70.9)	120.0 (87.5)	130.5 (130.9)	135.6 (154.3)	0.77

* Variables expressed as mean (standard deviation); [a] Crude Model, considering group (intervention or control); [b] Adjusted Model. Model fitted using variables: group, sex, age and total energy consumption

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Table 3 shows the variation of healthy and unhealthy food markers throughout the school year according to the TV time and a similar result was observed in the total screen time, as could be seen a reduction of the consumption of all food groups by adolescents with higher TV time and increased consumption in TV time ≤ 4 hours / day, except for fruit that decreased in this group. The difference variation was statistically significant for vegetables and cookies (*p*-values 0.03 and 0.02). After adjustment for potential confounding variables, the statistical significance in the variation of the consumption difference remained only for the vegetables (*p*-value 0.02), which is a marker of healthy eating. Adolescents with lower TV time had an increase in the variation of the consumption of vegetables, while those with a longer TV time reduced the consumption of this marker over the period.

Table 3. Food intake markers variation according to TV time at study baseline among adolescents from two schools of Niterói/RJ, 2014

Food groups*	≤ 4 hours/day		≥ 5 hours/day		*p*-value
	Initial	Final	Initial	Final	
Fruits (g/day) [a]	361.5 (8.0)	360.3 (8.0)	417.9 (9.23)	347.3 (7.7)	0.17
Vegetables (g/day) [a]	111.6 (9.0)	119.1 (9.6)	147.4 (11.7)	120.6 (9.7)	**0.03**
Sugar-Sweetened Beverages (SSB) (ml/day) [a]	849.7 (5.1)	867.4 (5.2)	1127.7 (6.7)	940.8 (5.6)	0.15
Cookies (g/day) [a]	110.1 (2.5)	120.1 (2.7)	154.8 (3.4)	109.5 (2.5)	**0.02**
Fruits (g/day) [b]	340.3 (190.8)	385.0 (215.2)	401.5 (288.5)	413. 2 (296.7)	0.53
Vegetables (g/day) [b]	106.6 (50.4)	127.7 (59.5)	141.0 (81.1)	125.8 (72.9)	**0.02**
SSB (ml/day) [b]	795.1 (554.6)	974.6 (678.3)	1058.1 (955.2)	1191.8 (1074.7)	0.59
Cookies (g/day) [b]	99.9 (85.1)	135.3 (109.4)	165.9 (171.4)	156.9 (162.7)	0.06

* Variables expressed as mean (standard deviation); [a] Crude Model, considering group (intervention or control); [b] Adjusted Model. Model fitted using variables: group, sex, age and total energy consumption

DISCUSSION

In the present study, 67% of adolescents reported spending five hours or more a day in front of the screen and 69.3% reported watching TV for ≤4 hours / day. It was not observed an association between total screen time and food intake variations. However, adolescents who reported less TV time had an increase in the consumption of vegetables, while those with a longer TV time reduced the consumption of this group of foods, and it could be noted that this difference of the variations was statistically significant.

Studies conducted in Brazil also found a high mean screen time among adolescents[3,5,6,38]. According to Silva & Malina, the mean times spent watching television in adolescents of the public school network of Niterói (RJ) were 4.4 hours/day for boys, and 4.9 hours/day for girls[6]. Silva et al.[5] found means of 5.5 hours/day for school-aged adolescents of the city of Aracaju in Sergipe state (SE). Legnani et al.[38] assessed that 47.7% of adolescents of Toledo (in Paraná state (PR)) watched television for two hours a day or more. The screen times found by Vasconcellos et al.[3] among adolescents from Niterói (RJ) were 41.2 weekly hours for boys and 38.8 weekly hours for girls, surpassing 5 hours/day for both sexes. These results are above the limit recommended by the AAP, which is no more than 2 hours/day of screen time[10].

The expansion of industrialization and technological development that has occurred in the last decades, primarily in urban centers, has influenced a more sedentary lifestyle in

children, adolescents and adults[38]. We know that the recommended limit for screen time is easily exceeded by a large part of the population with the technological advances. Considering this fact, other authors have already suggested different screen time cutoff points for classification of sedentary lifestyle or obesity prevention[11-13]. A study performed with adolescents in the city of São Leopoldo, in Rio Grande do Sul state (RS) considered the limit of four hours or more a day of television to define adolescents with excessive television-viewing habits[12]. Thus, according to Ari Brown, from the AAP, the current limits "are just not the reality of what's happening and so we really need to kind of address our world as these kids are growing up as digital natives". With the advancement of technology, children and adolescents have very early contact with the media[39]. Therefore, we used the categories ≤ 4 hours/day and ≥ 5 hours/day for measuring screen time in this study.

The effect of screen time, more specifically television-viewing habit, on food intake has been discussed in the literature[14,40-43]. During the time spent watching television, adolescents spend little energy and are exposed to various ads for energy-rich foods that may influence the type of food they want and eat[43].

In the present study, consumption of fruits and vegetables over 300 grams per day was identified. This result shows that consumption is a bit lower according to the World Health Organization (WHO) minimum recommendation of 400 grams per day of fruits and vegetables or five servings per day. Considering the adjusted model in the longitudinal analysis for TV time, the food group of vegetables presented a statistically significant difference in the variation over time for the different categories of TV time. Considering adolescents with shorter TV times, they increased their consumption of vegetables, while those with longer TV times decreased. In the United States of America (USA), a study conducted by Coon et al.[41] with children and adolescents averaging 10 years of age, also found a significant negative association between the use of television during meals and consumption of fruit and vegetable. When evaluating the food intake of Californian children while watching television, Matheson et al.[42] assessed that the percentage of energy derived from fruits was 4.9% with the television turned on among third graders during weekdays and 9.9% with the television turned off for the same group. Consumption of vegetables was also lower with the television on. Considering the same group, the percentages of total energy derived from vegetables with the television 'on' and 'off' were 1.7% and 9.7%, respectively.

Possible explanations for the statistically significant association between food consumption and TV time and non-association with total screen time is exposure to fast food advertisements and other unhealthy foods that are daily transmitted on TV, which is the main means of communication for the propagation of advertisements[44]. Second, considering the socioeconomic status (SES) of adolescents, most students from public schools do not have computer and videogame in their homes, showing that TV is still one of the most popular means of entertainment and leisure in all socioeconomic strata and represents the largest portion of screen time studied[26].

In our study, results were firstly analyzed as intervention study, and it was not identified statistically significance difference between intervention and control groups, related to screen time and healthy and unhealthy food markers. Therefore, longitudinal approach was performed, considering the variable group (intervention or control) in the model, in order to estimate the association between screen time and healthy and unhealthy food markers independently of the intervention.

The external validity is a limitation of our study, since this data cannot be generalized to other populations, as this is a feasibility study in which the objective was to test new methods, new approaches and processes to reach specifics goal. Another limitation is that FFQ is a semi-quantitative instrument and therefore daily grams and energy consumption may be overestimated[45,46]. Screen time may also be overestimated, as this was calculated considering the sum of TV time, computer time, playing video game or playing on the cell phone time, and these activities can happen simultaneously. Moreover, the short period of study follow-up – one year school period - may not be sufficient to check for many changes in the consumption of healthy and unhealthy food markers.

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Unlike most studies reporting cross-sectional results, the data from the present study were collected and analyzed using both cross-sectional and longitudinal data, considering the total time of different types of screens (television, computer and video games) and specifically with TV time, using a cutoff point for screen time higher than that recommended by the AAP.

We found that vegetable consumption increased for adolescents with lower TV time and decreased for adolescents with longer TV times, and this difference in variation over time was statistically significant, showing an association between time spent watching television and the consumption of vegetables, which is a healthy eating marker. As seen in other studies, there is a negative association between watching TV and consuming healthy vegetables and/or food. The findings suggested that reducing the time spent in sedentary activities and healthy food choices may be a priority in intervention studies and in the design of public policies for these age groups.

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