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Missing class increases the daily frequency of screen use among schoolchildren

Faltar à aula eleva a frequência diária de uso de telas entre estudantes

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ABSTRACT

We analyzed the association between school attendance and the daily frequency of use of different forms of screens (TV, computer, cell phone and video game) among children and adolescents. Longitudinal study with four repeated measures during the 2015 school year. Children and adolescents from a public school participated in the study (n = 463, 53.6% boys; 9.3 ± 1.3 years old). The daily frequency of screen use was the outcome analyzed, which was reported on an online questionnaire for the previous-day recall, illustrated with 32 icons of activities including 4 types of electronic devices. The participant answered "What did you do yesterday?" in the morning, afternoon, and night. School attendance was assessed by responding to the item "Did you go to school yesterday?". The analysis was conducted using generalized estimation equations, with adjustment by sex, age, BMI z-scores, and season of the year. The average percentage of absences during the follow-up was 28.7%. The use of screens was 13% higher among students who missed class. Playing a video game was 37% higher among students who missed class. The daily frequency of screen use was 26% higher among adolescents (10-12 years) compared to children (7-9 years), especially in the analysis performed individually for TV and cell phone. The daily frequency of screen use and watching TV among students who missed classes during the winter was, respectively, 24% (IRR = 1.24; 95%CI = 1.11 - 1.39) and 35% (IRR = 1.35; 95%CI = 1.10 - 1.66) higher compared to those who missed classes during the fall. In conclusion, the use of screens predominated among students who missed class, mainly in winter.

Keywords: Sedentary behavior; Screen time; Children; Adolescent.

RESUMO

Nós analisamos a associação longitudinal entre presença na escola e frequência diária de uso de diferentes tipos de telas (TV, celular, computador e videogame). O follow-up incluiu quatro medidas repetidas durante o ano letivo de 2015. Participaram do estudo crianças e adolescentes de escola pública (n = 463; 53,6% meninos; 9,3 ± 1,3 anos). O uso de telas foi o desfecho analisado, relatado em um questionário online para a recordação do dia anterior, ilustrado com 32 ícones de atividades, incluindo 4 tipos de dispositivos eletrônicos. O participante respondeu "O que você fez ontem?" pela manhã, tarde e noite. A frequência escolar foi avaliada por meio do item "Você veio à escola ontem?". A análise foi conduzida via equações de estimativa generalizada, com ajuste por sexo, idade, estação do ano e escore-z de IMC. O percentual médio de faltas no período foi de 28,7%. De maneira geral, o uso de telas foi 13% mais frequente entre estudantes que faltaram à aula, com destaque para vídeogame, cuja frequência diária foi 37% maior. Adolescentes (10-12 anos) exibiram frequência diária de telas 26% maior quando comparados com as crianças (7-9 anos), especialmente de TV (36%) e celular (32%). A frequência diária de uso de telas e de assistir TV entre os alunos que faltaram às aulas no inverno foi, respectivamente, 24% (IRR = 1,24; IC95% = 1,11 - 1,39) e 35% (IRR = 1,35; IC95% = 1,10 - 1,66) maior em relação aos que faltaram às aulas no outono. Concluímos que o uso de telas predominou entre estudantes que faltaram à aula, sobretudo no período do inverno.

Palavras-chave: *Comportamento sedentário; Tempo de tela; Criança; Adolescente.*

Introduction

Cardiovascular diseases (CVD) are considered an important public health issue, leading the causes of mortality worldwide. This group of diseases shares modifiable risk factors, such as insufficient physical activity and excessive sedentary behaviors[1]. Thus, a strategy that can be used to mitigate the burden of CVD is to replace risk behaviors with healthy habits[2].

Although there is an increase in the number of deaths from CVD concomitantly with advancing age, recent research has shown an emerging scenario of risk factors for this group of diseases even in younger individuals[3]. In Brazil, a review study identified that approximately 58% of adolescents do not meet the recommendations for sedentary behavior[4]. This information becomes even more worrying when considering together with the high indicators of insufficient physical activity among adolescents worldwide[5].

Sedentary behavior generally encompasses behaviors performed in a sitting, reclining, or lying position including the use of electronic devices (watching TV, using a cell phone, and playing video games) with energy expenditure that does not exceed the threshold of 1.5 metabolic equivalents (METs)[6]. However, more recent research suggests that the effects of sedentary behavior may vary according to its nature. For example, Barker et al.[1] observed that the habit of watching TV, instead of total sedentary behavior, was a better predictor of cardiovascular risk in children, and watching TV has also been associated with unfavorable adiposity and diet outcomes. In addition, there is evidence of an association between video game and computer screen time with adiposity[7,8]. It is important to highlight that most of study's findings are related to television use, while studies examining other forms of screen use, like the computer, gaming, or mobile screen devices are sparse [9].

Concerns about sedentary behavior in adolescents are also linked to its association with worse health indicators, such as lower levels of physical fitness, unfavorable body composition, higher cardiovascular risk scores, and poor prosocial conduct[7].

The use of screens, such as TV, computers, cell phones, video games, and tablets has been reported as the most common sedentary behavior, accounting for up to about 50% of free time in children and adolescents[10]. Furthermore, the rise of sedentary behavior appears in a context where the availability of adequate spaces for physical activity is insufficient, and the growing violence in urban centers has kept children away from physical activity[11]. Previous research showed that the school environment and routine can promote the replacement of sedentary behavior with episodes of physical activity, for example, activities performed during recess, in active commuting to school[12], and in physical education classes[13].

Although sedentary behaviors predominate in the school shift[10], since students spend most of their time sitting, our hypothesis is that, even in this context, the school routine and rules can keep children away from excessive time in front of screens during weekdays, with school attendance being a proxy for this potentially inverse relationship. The evaluation of a cross-sectional association between school attendance and screen use does not take into account the seasonal variation observed in sedentary behaviors among young people. Previous studies showed that sedentary behaviors predominate during the winter, including among Brazilian students[14]. Thereby, the primary aim of the present study was to analyze the longitudinal association between school attendance and forms of screen use (TV, cell phone, computer, and video game) among children and adolescents over an academic year. The secondary aim was to analyze the interaction between school attendance with the influence of season, sex, age, and body mass index (BMI) z scores.

Methods

This is a longitudinal study with four repeated measures during the 2015 school year. The data analyzed are related to the year 2015 with collections carried out in the months of May (baseline), July, September, and November. The data include only weekdays.

The study included a convenience sample. Students from the second to the fifth grade of a public school in Feira de Santana, in the interior of the state of Bahia, participated in the study. The students at the school study for half the day in either the morning or the afternoon. The city's population is estimated at 624,107 inhabitants, the Human Development Index is 0.712, Gross Deep Product Per capita R$ 21,765.41, and the schooling rate for children and adolescents 97.4%[15].

To participate in the study, the school was required to meet the following requirements: acceptance of the principal and teachers, being a public school, offering classes from the second to the fifth grade, having access to the internet, and offering school meals. The selected school included 507 students authorized to participate. Participants with disabilities and ages outside the age range of seven to 12 years were included in the study but excluded from the analyses.

The study followed the ethical standards for research with human beings (Resolution No. 466/2012 of the National Health Council) and was approved by a Research Ethics Committee. Feira de Santana was chosen because there is scientific cooperation between the research centers of Feira de Santana State University and Santa Catarina Federal University regarding validation and surveillance studies with the Web-CAAFE. These research centers are in the northeast and south of Brazil, respectively, regions with substantial cultural and socioeconomic distinctions. Therefore, it was interesting to carry out validation and monitoring studies with the Web-CAAFE in both regions.

The study used an online questionnaire previously validated to obtain information about the daily use of screens (TV, computer, video game, and cell phone)

(Web-CAAFE)[16]. The Web-CAAFE has been developed to enable the self-reporting by Brazilian schoolchildren aged seven to 10 years. To complete the instrument, the participant is required to report the behaviors of the previous day at three moments: in the morning, in the afternoon, and at night. The research team instructed participants on how to operate the software, through prior exposure aided by banners.

The research team received training to measure body weight and height, following recommended standards[17]. To measure body weight, a Wiso® digital scale, model Ultra Slim W801 (100 g precision and 180 kg capacity) was used. For height measurement, a portable Height Exata® stadiometer (maximum height of 213 cm and precision of 1 mm) was used. Age- and sex-specific BMI z-scores were calculated according to the World Health Organization for children and adolescents aged 5-19 years.

The daily frequency of screen use was the outcome analyzed. Frequencies were obtained by adding all reports of watching TV, computer, video game, or cell phone in the morning, afternoon, and night (giving a count outcome ranging from 0 to 12 screens). Thus, if the participant reported having used a cell phone in the morning and at night, their daily frequency was two screens. We also analyzed the association between school attendance and the daily use of each screen, individually, whose frequencies were obtained by adding reports in the morning, afternoon, and night. The main exposure assessed was attendance at school, reported by the participant when answering the question "Did you go to school yesterday?" in the registration session of the Web-CAAFE. In addition, given that different types of sedentary behavior can differ according to sex[5], age group[10], and adiposity[26], we considered these factors as possible confounding variables in our analysis. Likewise, the season was included in the statistical modeling because of the influence of seasonal variation in sedentary behaviors[14]. Measures of association (Incidence-Rate Ratio: IRR) and respective 95% confidence intervals (95% CI) between school attendance and daily frequency of screens were estimated using generalized estimation equation (GEE) modeling, adopting Poisson probability distribution and statistical significance assumed at $p < 0.05$. Regression models with GEE also were adjusted for evaluate the association between school attendance and each form of screen. Interactions of school attendance with sex, age, BMI z-scores, and season were tested by including product terms in the statistical modeling, and those that showed statistical significance at the critical value of $p<0.05$ were described.

Results

The study initially included the participation of 478 children and adolescents who received authorization from their parents. During the follow-up, effective participation rates were 78.0% in the fall (May), 87.7% in the winter (July), 86.6% in the early spring (September), and 83.7% at the end of the spring (November). According to excluding criteria the data analysis excluded 8 individuals at the baseline (2.1%), 11 individuals from the first repeated measures collection (2.6%), 15 from the second (3.6%), and 15 from the third (3.8%). These exclusions consisted of some of the same individuals each time.

The characteristics of the participants are shown in Table 1. The mean percentage of absences during the follow-up period of the study was 28.5%, being more pronounced in the fall and late spring. Figure 1 shows the longitudinal variation in daily frequency of screen use during the school year. Throughout the study period, the frequencies of TV, cell phone, computer, and video game tended to be higher among students who missed class.

Table 1 – Sample characteristics.

Variable	Fall (May)	Winter (July)	Spring (September)	Spring (November)
	n = 373	n = 408	n = 399	n = 385
% of students who missed class	23.1	31.9	26.3	32.5
% of boys	53.6	54.2	54.4	54.3
% of girls	46.4	45.8	45.1	45.9
% of students by age group				
7-9 years	63.3	56.9	56.6	50.1
10-12 years	36.7	43.1	43.4	49.9
BMI z-score {mean (standard deviation)}	0.54 (1.34)	0.53 (1.31)	0.55 (1.32)	0.59 (1.30)

BMI = body mass index.

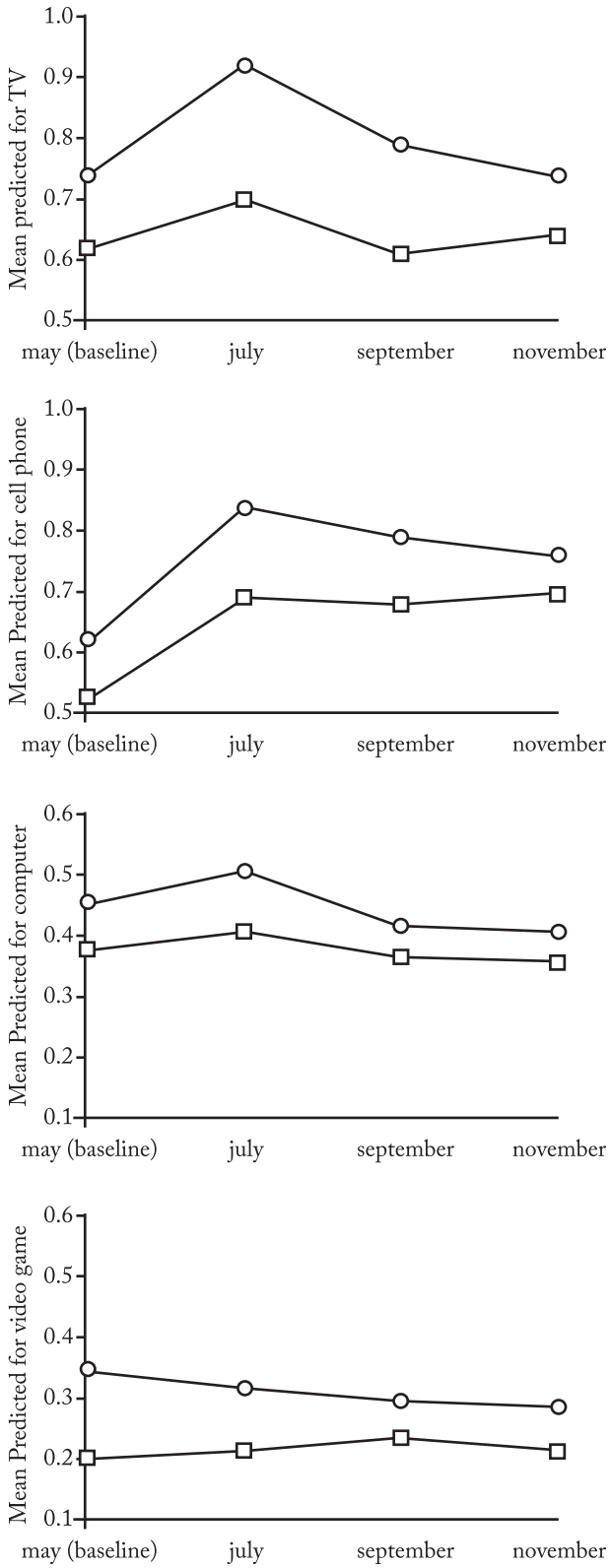

Figure 1 – Longitudinal variation in screen-based sedentary behaviors among children and adolescents.

The effect of school attendance on daily frequency of screen use was evaluated through the values of the regression coefficients (IRR), adjusted for sex, age, and season. BMI z-scores did not remain in the regression models, as it did not demonstrate statistical significance as either a confounding variable or as a modifier effect of the main associations tested.

When each one of the screens was analyzed independently, only TV and video games showed a statistically significant association with school attendance, whose daily frequencies were 14% and 37% higher among students who missed classes, respectively (Table 2). In general, the daily frequency of screen use was 13% higher among students who missed classes (Table 2). The adolescents (10-12 years) showed, on average, a 26% higher frequency of screen use, including in the analyses performed for TV and cell phone (Table 2).

Watching TV was 16% more frequent in winter, 43% higher among girls, and 36% higher among students in the adolescents age group (10-12 years old). Girls reported less computer and video game use than boys (Table 2).

The season modified the effect of school attendance on the use of screens. The daily frequency of use of screens among students who missed classes during the winter was 24% higher compared to those who missed classes during the fall (IRR = 1.24;95%CI = 1.11 - 1.39). Winter also increased the effect of missing classes on the daily frequency of watching TV. Watching TV among students who missed classes during the winter was 35% more frequent compared to those who missed classes in the fall (IRR = 1.35; 95%CI = 1.10 - 1.66). There were no interactions between sex, age, and school attendance.

Discussion

The current research tested the hypothesis of the association between school attendance and daily frequency of screen use among elementary school students in a public school, through a follow-up with four repeated measures over a year. Our results showed that the daily frequency of screen use was higher among students who missed class.

Watching TV is a sedentary behavior widely discussed by many studies focusing on health outcome[7], and our findings also report that there is a statistically significant association between watching TV and school attendance. Furthermore, to miss classes also led to a higher frequency of video games use.

The habit of watching TV has been replaced by the use of smartphones, computers, and tablets among children and adolescents[18]. By the end of 2019, it was esti-

Table 2 – Longitudinal association (IRR and 95%CI) between school attendance and daily frequency of screen use among children and adolescents.

Variable	TV	Computer	Video game	Cell phone	Daily frequency of screen use‡
School attendance					
Missed	1.14 (1.01 - 1.28)[c]	1.10 (0.94 - 1.28)	1.37 (1.12 - 1.68)[b]	1.07 (0.95 - 1.20)	1.13 (1.06 - 1.20)[a]
Attended	1.00	1.00	1.00	1.00	1.00
Season					
Winter	1.16 (1.01 - 1.34)[c]	1.12 (0.94 - 1.33)	1.05 (0.83 - 1.34)	1.31 (1.14 - 1.51)[a]	0.87 (0.79 - 0.95)[a]
Spring (September)	1.01 (0.87 - 1.16)	0.90 (0.74 - 1.08)	0.97 (0.76 - 1.25)	1.23 (1.10 - 1.42)[b]	1.05 (0.95 - 1.12)
Spring (November)	0.97 (0.84 - 1.13)	0.90 (0.74 - 1.10)	0.95 (0.73 - 1.22)	1.21 (1.04 - 1.40)[c]	1.03 (0.97 - 1.14)
Fall	1.00	1.00	1.00	1.00	1.00
Sex					
Female	1.43 (1.23 - 1.67)[a]	0.67 (0.54 - 0.83)[a]	0.13 (0.10 - 0.20)[a]	0.97 (0.82 - 1.13)	1.15 (1.05 - 1.27)[b]
Male	1.00	1.00	1.00	1.00	1.00
Age					
10-12 years	1.36 (1.17 - 1.58)[a]	1.20 (0.98 - 1.46)	1.05 (0.82 - 1.33)	1.32 (1.13 - 1.53)[a]	1.26 (1.15 - 1.38)[a]
7-9 years	1.00	1.00	1.00	1.00	1.00

a = $p < 0.001$; b = $p < 0.01$; c = $p < 0.05$; ‡ = Frequencies were obtained by adding all reports of watching TV, computer, video game, or cell phone throughout the day.

mated that 5.2 billion people had a cell phone worldwide[19]. In Brazil, it is estimated that there are 230 million cell phones in use and 420 million Digital Devices, which include computers, notebooks, tablets, and smartphones[20]. That is, among Brazilians there is more than 1 smartphone and more than 2 digital devices per inhabitant. In addition, for each TV sold in 2019, 4 smartphones were sold. However, our findings suggest that TV is a frequent habit among students who miss classes.

The structure of the school day substantially favors the time when young people are seated during the days of the week, especially girls[10]. However, it seems that breaking this routine during the week promotes greater use of screens[21]. Beck et al.[21] observed that American children were more sedentary during the period of the day when they were no longer at school on weekdays and at the weekend, especially girls. A longitudinal study conducted with children from South Carolina, USA, showed that school days were associated with less sedentary behavior[22]. Among Mexican children, the excessive use of electronic devices, that is, spending time equal to or greater than four hours a day in front of screens was greater on the weekend (25.2%) than on weekdays (14.9 %)[23].

It is possible that this effect is exacerbated during the weekdays when the young person does not go to school, since the parents/guardians are probably away from home and cannot control the excessive use of electronic devices. In fact, in a study carried out in the United Kingdom, teenagers spent approximately 1/3 of their time in the after-school period on weekdays using screens, with greater use observed among those who spent more time alone, or without adult supervision[24]. An additional concern with this scenario is the aggregation of other risk factors for obesity and CVD, such as unhealthy food consumption, which is favored by the use of screens[25].

Obesity is an outcome that is often assessed as resulting from exposure to screens, but the evidence available on this association is conflicting[26]. Biddle et al.[26] found weak associations between screen time and adiposity based on evidence from cross-sectional studies and less consistent associations from longitudinal studies[7]. Carson et al.[7] showed that longer durations/frequencies of screen time, watching TV, and using a computer are significantly associated with unfavorable body composition. On the other hand, a more recent review study found moderately strong evidence for associations between screen time and obesity[9]. This divergence could underline a complex relationship between these variables, since obesity can lead to more sedentary behaviors, and more sedentary behaviors lead to increases in BMI over time, while the decrease in time in sedentary behaviors leads to a reduction in BMI[27]. In the present study, BMI z-scores were included in the models to test their effect as an adjustment or in-

teraction variable, however, no influence was observed on the association between school attendance and the use of screens.

Our results also showed that adolescents had a higher frequency of screen use than children and that the use of screens was more frequent in winter. This last finding is consistent with the seasonal variation in sedentary behaviors, which tend to predominate in periods of the year with lower temperatures, abundant rain, or the occurrence of snow[28].

Regarding age, previous studies report results similar to ours, indicating that children spend an average of 41% to 51% of their time after school in front of screens, while teenagers spend an average of 57%[8]. In addition, the time spent being sedentary during the waking period increases from 51.3% to 74.2% during the transition from childhood to adolescence[29].

Despite the relevance of our findings, some limitations should be highlighted. The school attendance assessed did not consider the reason why the student missed class. Some of the students who missed school on school days may have done so because of illness. In addition, parents may be unable to take them to school for personal, family, or work commitments. Future studies should include an investigation into these reasons and include the data in the modeling for more detailed considerations on the association between missing classes and the use of screens. Our findings were based on a single school, therefore generalizations are limited. Furthermore, although the students included in our study were enrolled in a typical public school, no socioeconomic indicators were investigated. Economic factors such as owning a car can change the effect of winter on missing school due to rain, which is common at this time of year in the city where the study was performed.

To our knowledge, this is the first study focusing on the effect of absence from class during the weekdays on the use of screens among Brazilian children and adolescents. The variability of sedentary behaviors between weekdays and weekends has been more widely researched and the evidence shows that there is a significant increase in the use of screens and sedentary time on weekends[21,23].

Our results revealed, however, that the use of screens also predominates on weekdays, when the young person does not go to school. Thus, parents should be alerted to the health risk generated by the accumulation of time in sedentary behaviors among children and adolescents who fail to attend class, for any reason.

Strategies for reducing sedentary behaviors at home include creating family norms that limit exposure time to screens for the purpose of leisure and entertainment to a maximum of two hours a day. When possible, this time can be used for exergames, which are video games that depend on body movements at varying levels of intensity. Physical activity can also be stimulated through active play at home, in the yard, or in the garden, such as jumping rope, circuits, ball games, dancing, and yoga. These strategies are particularly useful for children and adolescents who are currently experiencing significant increases in screentime because of isolation and social distance measures due to the COVID-19 pandemic[30].

A strong point of the research was the longitudinal design and the inclusion of analysis by forms of screen. This strategy made it possible to show that the pattern of presenting a higher frequency of use of screens on the days when the student was absent from the class tended to be recurrent during the school year.

The use of screens predominated among students who missed class. When we analyzed each form of screen, TV viewing and video games use showed a statistically significant association with school attendance, being the last one the most frequently used device by students who were absent from class. During winter, the associations between the use of screens and missing classes became stronger, especially related to watching TV. On other hand, there were no differences in reports of computer or cell phone use among students who attended or missed class.

Conflict of interest

The authors declare no conflict of interest.

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Author's contributions

Jesus GM, conceptualization, methodology, funding acquisition, project administration, investigation, formal analysis, writing-original draft, and review. Araujo RHO, support to data analysis, writing-original draft, and review. Dias LA, investigation, writing-original draft, and review. Barros AKC, writing-original draft and review. Araujo LDMS, writing-original draft, and review. Assis MAA, conceptualization, writing-original draft, and review.

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