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Screen time as discriminator for overweight, obesity and abdominal obesity in adolescents

Tempo de tela como discriminador de excesso de peso, obesidade e obesidade abdominal em adolescentes

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Abstract – Many researches have concluded that the time spent in front of TV, computer and other screen-type devices is an important risk factor for overweight and obesity. The aim of this study was to identify the discriminatory power and to propose screen time cutoff points for overweight, obesity and abdominal obesity in adolescents. This household survey had cross-sectional design with sample of 613 adolescents aged 15-18 years living in a city in northeastern Brazil. The predictive power and cutoffs points of screen time for the outcomes of interest were identified by receiver operating characteristic curves (ROC). The study adopted 95% confidence interval (CI). Screen time during one day on the weekend was a good discriminator for the presence of overweight only among girls, area under the curve ROC = 0.59 (0.51 to 0.65). There were no areas under the ROC curve with statistical significance to discriminate obesity and abdominal obesity. Remain sitting for accumulated four hours per day during the weekend discriminates presence of overweight among girls (sensitivity = 60.9%, specificity = 52%). The long time spent in front of TV, computer and other screen-type devices on the weekend discriminate overweight in girls.

Key words: Abdominal obesity; Obesity; Overweight; Sedentary lifestyle.

Resumo – *Diversas investigações vêm observando que o tempo de tela frente a TV, computador e assemelhados é um importante fator de risco para sobrepeso e obesidade. Objetivou-se iidentificar o poder discriminatório e propor pontos de corte do tempo de tela para excesso de peso, obesidade e obesidade abdominal em adolescentes. O desenho de estudo foi transversal, tipo inquérito domiciliar, com amostra composta por 613 adolescentes de ambos sexos, com idade entre 15 a 18 anos residentes em município do nordeste do Brasil. O poder preditivo e os pontos de corte do tempo de tela para os desfechos de interesse foram identificados por meio das curvas Receiver Operating Characteristic (ROC). Utilizou-se intervalo de confiança (IC) a 95%. O tempo de tela durante um dia no final de semana foi um bom discriminador da presença de excesso de peso apenas entre as moças, área sob a curva ROC=0,59 (0,51–0,65). Não foram observadas áreas sob a curva ROC com significância estatística para discriminar obesidade e obesidade abdominal. Ficar sentado a partir de 4 horas acumuladas por dia, durante o final de semana, discrimina a presença do excesso de peso entre moças (Sensibilidade=60,9%, Especificidade=52%). O maior tempo de tela frente à TV, computador e assemelhados no final de semana discrimina ao excesso de peso em moças.*

Palavras-chave: *Estilo de vida sedentário; Obesidade; Obesidade abdominal; Sobrepeso.*

INTRODUCTION

Currently, there are several reasons to believe that sedentary behaviors, especially those related to technology such as watching television, playing on the phone or video game and computer use, i.e., screen time, are significant risk factors for metabolic and cardiovascular diseases, as well as physical activity levels, and deserve to be investigated[1-6].

Recent investigation carried out in Australia has shown that prolonged sitting time is a risk factor for all-cause mortality regardless of regular physical activity[7]. Especially in the case of children and adolescents, studies have shown that having TV in the bedroom and/or watching TV for more than two hours/day is positively associated with overweight[8], and there is evidence that prolonged sitting time have deleterious association with obesity and cardiometabolic risk markers[9].

The investigation of possible mechanisms that explain the association between sedentary behavior and metabolic and cardiovascular health, despite being in initial research phase, already shows some results. Significant reductions in muscle lipoprotein lipase activity (LPL), a key enzyme that regulates the metabolism of lipids were observed during sedentary activity. Low levels of LPL activity, in turn, appear to be associated with decreased absorption of plasma triglycerides by skeletal muscles, decreased HDL cholesterol concentration and postprandial elevation of lipids, causing fats to become deposited on vessels or adipose tissue, particularly visceral abdominal area, contributing to obesity[10].

The conduction of studies addressing not only physical activity, but also screen time, especially in adolescents, is of utmost importance to the extent that even the existence of an active behavior by performing leisure activities, common adolescence, does not guarantee the necessary protection against the occurrence of diseases and problems related to sedentary behavior since spending long times in a sitting position in front of the TV, computer and other screen-type devices is common practice in this group.

This study aims to identify the discriminatory power and propose cutoff points of screen time for overweight, obesity and abdominal obesity in adolescents.

METHODOLOGICAL PROCEDURES

Study design

This is a household survey with cross-sectional design that is part of the study "Evaluation of the Family Health Strategy effects: adoption of healthy habits and accessibility to primary health promotion services and prevention of risks and diseases", a household survey with young people aged 15-24 years held in the city of Camaçari, Bahia, Brazil.

Sampling

The sample was probabilistic by clusters in three selection stages: primary

unit - micro area ascribed to the Basic Health Unit (BHU), secondary unit - domicile, tertiary unit - adolescents.

To calculate the sample size, Stata 12 software was used, estimating the number of subjects required to detect a 20% difference in the prevalence of unhealthy eating habits among adolescents in two populations (one ascribed to the Family Health Unit - FHU and other to conventional BHU), with 5% significance level and 80% statistical power. Intraclass correlation coefficient of 0.0104[12], conglomeration size of 30 and design effect of 1.30 were considered reference indicator for prevalence of 36%[11]. The sample was estimated in 1,755 individuals, it was thus approximate to 1,800 (900 per group). The final sample obtained was representative of the municipality, totaling 1701 individuals aged 15-24 years living in 65 micro areas of Camaçari.

Dealing with a cluster sampling, the first stage of the study used a database from the Municipal Health Secretary with information on all municipal territories, divided into 477 micro areas, characterized by presenting similar number of households and identification of streets. To achieve the sample of 1,800 individuals and considering micro areas as conglomerates, the random drawing of forty micro areas was conducted (ten micro areas considered as reserve) for each group (FHS and BHU), totaling eighty micro areas. Of randomly selected micro areas, fifteen were excluded, fourteen of them being excluded before the field work because they were considered areas of extreme violence and one micro area was excluded because interviewers were unable to reach the place of difficult access in the countryside. At the end, 65 micro areas were included in the study, 33 of Family Health Strategy and 32 conventional BHU.

In the second stage, in each micro area, streets were ordered following a random drawing, and data collection started up from the lowest numbered address, following domicile to domicile by the right and at the end, going to the left side of the street. At the end of the street, the interviewer followed to the next street ordered by draw to complete the planned sample of 30 households per micro area.

In the third sampling stage, after domicile identification with at least one resident aged 15-24 years, random draw was performed among eligible residents. Excluded criteria were: pregnant women, people with special needs that make the completion of the questionnaire impossible and domestic servants in that household. In case of closed households without information about its residents, and when the randomly selected resident was absent, the interviewer returned up to three times, preferably in different shift or weekend. Scheduling by phone or in person were also strategies adopted for the interviews.

Considering the specific characteristics of the theme and influence of age, this study analyzed adolescents aged 15-18 years, representing 45% (n = 769) of the sample. After the exclusion of individuals who did not undergo complete anthropometric assessment or did not answer questions on the screen time, 613 individuals were included, 275 males and 338 females.

All study participants or their legal guardians signed the free and informed consent form and the project was approved by the Ethics Research Committee of the Collective Health Institute, protocol No. 019-09 / CEP-ISC.

Study variables

For this study, the following were used as independent variables:

a) Screen time, defined in hours and checked by two questions about the average time that the respondent spend watching television, playing video games, using mobile phone or computer on a normal weekday and one day on the weekend;
b) Respondent's gender;
c) Respondent's age, calculated from the reported date of birth.

The following were used as dependent variables: overweight, obesity and abdominal obesity.

Overweight and obesity were analyzed by body mass index (BMI) and identified by means of percentiles proposed by Cole et al.[13]. Overweight was identified by including individuals who had both overweight as obesity. Abdominal obesity was analyzed by waist circumference and identified by the 75th percentile in tables proposed by Fernandez et al.[14]. Waist circumference was obtained through the average of two measures located in an equidistant line between lower edge of the rib and the iliac crest.

Data collection

Data collection was carried out between October 2011 and January 2012 and consisted of the application of structured tool by a team of trained interviewers (undergraduates or health area graduates), monitored by field supervisors and health professionals.

Anthropometric measurements were performed at home, in a standardized way, according to procedures recommended by the Anthropometric Standardization Reference Manual[15]. Interviewers were trained by nutritionists and used the following instruments:

- Leicester Portable Height Measure Stadiometer with 0.1cm precision scale to measure in upright position;
- Portable Tanita BF-680W Electronic scale;
- Inelastic 150cm anthropometric tape (graduated in centimeters and millimeters).

Waist circumference was measured at the midpoint between the lower edge of the rib and the iliac crest in the middle axillary line. If the evaluator could not find the points, the measure was taken in the height of the umbilicus. Two measurements were performed, considering the arithmetic mean between them.

All collection procedures were tested through the conduction of a pilot study in the same municipality, which reproduced the entire field routine.

Analysis Procedures

The predictive power, in addition to cutoffs of screen time for overweight, obesity and abdominal obesity, was identified through Receiver Operating Characteristic curves (ROC), commonly used to determine cutoffs in diagnostic or screening tests[16]. Nonparametric estimation with bootstrap by conglomerates stratified by sex and age was used to obtain an accurate quantitative measure of screen time to discriminate overweight, obesity and abdominal obesity. Bootstrapping corrects the uncertainty of estimates associated with ROC curves, incorporating the sampling process by conglomerates in the estimation methodology[17].

The total area under the ROC curve between screen time in a week day and a day on the weekend and presence of overweight, obesity and abdominal obesity was initially identified. The greater the area under the ROC curve, the more discriminatory power for the presence of overweight, obesity and abdominal obesity. Confidence interval (CI) of 95% was used. The calculation of the 95% CI determines whether the predictive capacity of the sitting time is not by chance, and its lower limit should not be less than 0.50[18].

Following, cutoffs were found with their respective sensitivity and specificity of screen time (hours/day) for the presence of overweight, obesity and abdominal obesity,

The cutoff points were identified according to the most appropriate balance between sensitivity and specificity. Data were analyzed using the "STATA" statistical software version 12.0.

RESULTS

For the purposes of this study, all adolescents aged 15-18 years who made all anthropometric measurements and answered questions related to screen time were evaluated, totaling 275 boys and 338 girls.

The sample characteristics are in shown in Table 1. It is noteworthy that boys have higher absolute weight and height values and spend more time sitting in front of the TV, computer screen and others on the weekend than girls. With respect to absolute waist circumference values and screen time during the week, there are no differences between girls and boys. There are also no differences in the proportions of overweight, obesity and abdominal obesity between sexes.

Table 2 shows the areas under the ROC curve between screen time and overweight, obesity and abdominal obesity in male adolescents. The time spent in front of TV, computer screen, and others both on a weekday as in one day on the weekend does not discriminate the presence of overweight, obesity and abdominal obesity.

Table 3 shows the areas under the ROC curve between time sitting in front of the TV, computer screen and and overweight, obesity and abdominal obesity in female adolescents. It is noteworthy that in the screen time on the weekend (Figure 1), there are areas under the ROC curve statistically significant for discriminating overweight.

Table 1. Mean, standard deviation, minimum and maximum values or percentage of variables analyzed in the study.

	Boys (n=275)	Girls (n=338)	p *
Weight (kg)	62.6 ± 12.9 (37.1-124.2)	57.2 ± 12.3 (35.6-117.0)	<0.01
Height (m)	1.71 ± 0.07 (1.49-1.90)	1.61 ± 0.06 (1.45-1.88)	<0.01
Waist (cm)	72.6 ± 8.6 (40.0-114.5)	71.5 ± 9.8 (54.9-119.0)	0.14
Screen Time (hours / day)			
Weekday	5.8 ± 3.8 (0.0-20.0)	5.5 ± 4.0 (0.0-20.0)	0.34
Weekend	6.0 ± 4.6 (0.0-20.0)	4.9 ± 4.4 (0.0-20.0)	<0.01
Overweight - n (%)	49 (17.8%)	69 (20.4%)	0.42
Obesity - n (%)	13 (4.7%)	22 (6.5%)	0.34
Abdominal obesity - n (%)	18 (6.6%)	28 (8.3%)	0.42

* Continuous variables were compared using the "t" Student test for independent samples and categorical variables using the chi-square test.

Table 2. Areas under the ROC curve and 95% CI of screen time as a discriminator of the presence of overweight, obesity and abdominal obesity in male adolescents.

|	Overweight	Obesity	Abdominal obesity
Sitting time			
Weekday	0.44 (0.36-0.53)	0.39 (0.20-0.57)	0.45 (0.29-0.61)
Weekend	0.51 (0.42-0.59)	0.45 (0.26-0.65)	0.57 (0.36-0.72)

ROC = receiver operating characteristic; 95% CI = 95% confidence interval.

Table 3. Areas under the ROC curve and 95%CI of screen time as a discriminator for the presence of overweight, obesity and abdominal obesity in female adolescents.

	Overweight	Obesity	Abdominal obesity
Sitting time			
Weekday	0.50 (0.43-0.58)	0.40 (0.28-0.52)	0.38 (0.28-0.48)
Weekend	0.59 (0.51-0.65)*	0.38 (0.29-0.49)	0.49 (0.37-0.61)

ROC = receiver operating characteristic; 95% CI = 95% confidence interval. * Area under the ROC curve showing discriminatory power for the presence of overweight, obesity and abdominal obesity (Li-CI ≥ 0.50).

Figure 1 shows the screen time cutoff point with its respective sensitivities and specificities as overweight discriminator in female adolescents. It was found that accumulating more than 4 hours sitting front of the TV, computer screen and other screen-type devices in one day on the weekend discriminates the presence of overweight.
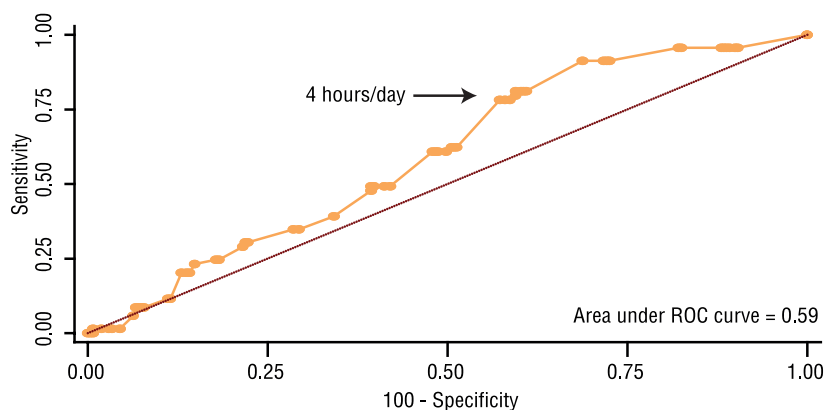
Figure 1. Area under the ROC curve with its respective cutoff point, sensitivity and specificity of screen time in one day at the weekend as overweight discriminator in female adolescents (15-18 years).

DISCUSSION

The research sought to demonstrate the discriminatory power and screen time cutoff points for overweight, obesity and abdominal obesity in adolescents of both sexes. No studies on this topic using the ROC curves technique as analysis method were found in literature. Thus, our comparisons were made based on association or intervention studies.

Areas under the ROC curve with statistical significance were observed only for girls (overweight). Recent research[19] found that having TV in the bedroom and/or watching television for more than two hours/day were positively associated with overweight. In our study, it was found that screen time at the weekend discriminate overweight in female adolescents. Furthermore, it was also found that the cutoff of 4 hours accumulated per day was the most appropriate value for this fact to occur.

In a recent systematic review, it was found that adiposity and cardiometabolic risk markers are positively associated with sedentary behavior in general, especially with sitting time related to computer use and television and these relationships appear to be mediated by the influence of sedentary behaviors and food intake as well as by the direct metabolic impact of prolonged sitting time[20].

Another systematic review that analyzed 170 studies on sedentary behavior and health indicators in children and adolescents at school age found that the increase in sitting time was associated with an increase in fat mass, BMI and body weight gain[21]. Among these studies, the intervention study by Robinson [22] stands out, where it was observed that the reduction in sitting time decreased abdominal obesity (waist circumference) in 192 children from two public schools in San Jose, California, USA.

In our study, we could not demonstrate discriminatory power of screen time on one day in the week or weekend for obesity and abdominal obesity in male and female adolescents.

The mechanisms by which the increase in sitting time influences overweight, obesity and abdominal obesity are related to reduced lipoprotein lipase activity (LPL), which decreases the absorption of plasma triglycerides, mainly by skeletal muscle[23]. Thus, fats are deposited on vessels or on the adipose tissue, particularly in the visceral abdominal area, thus contributing to obesity.

In this perspective, considering studies in rats, there is evidence that muscular inactivity causes decreased lipoprotein lipase protein activity (LPL), which has the function of regulating the absorption of triglycerides and production of high-density lipoproteins (HDL) in muscle[24]. The absence of muscle contraction in muscles of lower limbs specialized in the maintenance of posture is associated with 75% reduction in the capacity of absorbing fat from the blood stream[25].

On the other hand, some authors suggest that sedentary behavior based on screen time, especially watching television, can lead to a greater intake of calories through a variety of mechanisms that increase food intake[26,27], and this could contribute to overweight and obesity. This may have had

an influence in our study, so that there was no discriminatory power of screen time for overweight, obesity and abdominal obesity in boys, as the caloric intake of adolescents included in the study was not analyzed. However, we were able to demonstrate discriminatory power of screen time for overweight in girls, which leads us to believe that this sedentary behavior can influence changes in body weight regardless of calorie intake.

Corroborating our results, recent literature systematic review study showed that most of the studies analyzed found association between sedentary behavior and increased body weight levels in children and adolescents[28].

One of the main limitations of this work was the construction of screen time variable from self-reported information, which may have underestimated this sedentary behavior. As main strength, we highlight the determination of screen time cutoff point for discriminating overweight in girls, since there are only few studies that have identified these values, especially in Brazil.

CONCLUSIONS

Based on the results found in this study, it could be inferred that the time spent in front of TV, computer and other screen-type devices in one day on the weekend discriminates overweight in girls aged 15-18 years. The screen time cutoff point in one day on the weekend to discriminate overweight was 4 hours accumulated per day.

These results point to the need to expand health promotion actions among young people to encourage the reduction of time sitting in front of the TV, computer screen and other screen-type devices, especially on days of the weekend. Adolescents should also be clarified about the importance of the regular practice of physical activities and avoid sedentary behaviors.

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