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Physical activity level and nutritional status associated with screen habits of students living in Brazil

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Abstract
Purpose: Physical activity level and nutritional status associated with screen habits of students living in Brazil.
Methods: The sample consisted of 577 students (female = 274, male = 303) aged 10 to 16 years, enrolled in 6th year of elementary school in state public schools. The usual practice of physical activity was assessed through the application of the Physical Activity Questionnaire for Older Children/Adolescent. The nutritional status was verified by BMI. Already the screen habits were verified through a questionnaire previously structured by the researchers.
Results: Approximately 80% of students use screen more than 2 hours daily and majority, ~90%, use more than one screen. The cellphone screen was type most used ~44% and, ~84% of students use the screens for entertainment. The X^2 test showed that boys use more video games than girls ($p \leq 0,01$), and girls use more for communication purposes when compared to boys ($p \leq 0,01$). The physical activity level was significantly higher in male group ($p \leq 0,01$). Approximately 70% of students are physically inactive and the number classified as very sedentary is proportionally higher in the female group ($p \leq 0,01$). Almost 30% of students are overweight for their age and height. Finally, physical activity level and nutritional status were not shown associated with screen habits.
Conclusion: High prevalence of excessive screen time and a representative number of physically inactive and overweight schoolchildren were observed. Also, the screen habits between the genders are distinct and it was not associated with level habitual physical activity level and the nutritional state.

Keywords: Screen habits, BMI, physical activity, schoolchildren

1. Introduction
Currently, the use of various technological resources and electronic devices such as cellular, computer and television (TV) are increasingly present in the daily habits of children and adolescents [1]. This phenomenon has been observed not only in developed countries [2], but also in several emerging countries such as Brazil [3]. Data such as these deserve to be seen with attention, given that this has led to a series of habitual and behavioral changes, especially regarding of population physical activity level [1].
The time allocated to the use of these electronic devices, described in the literature as "screen time" (ST) [4], brings with it a low caloric expenditure, typical of sedentary behaviors (SB) (≤1.5 MET metabolic equivalent) [5]. Excessive ST by children and adolescents is extremely worrying, since a large part of the world population in this age group is not obeying the minimum recommendations regarding the time spent practicing physical activity to maintain health [6]. Thus, current recommendations suggest that the daily ST of children and adolescents does not exceed two hours per day [4].
Overall, low levels of physical activity in children and adolescents today are directly contributing to a major public health problem, in this case childhood obesity [7]. Obesity in childhood and adolescence should be avoided, as there is a great chance that this condition

persists and remain in adulthood [8]. In addition, obesity is a major risk factor for the development of the metabolic syndrome [9], Diabetes Mellitus [10] and systemic arterial hypertension [11] in childhood. In this sense, excessive screen time should also be avoided, basically because of its association with several health problems such as overweight and obesity, changes in glucose metabolism and blood cholesterol. In addition, this behavior can also be related to negatively influencing school performance, social interaction and physical activity level [12-14]. Interestingly, just like childhood obesity, excessive ST may also be transferred to adulthood, along with its eventual complications [15].

Despite the large number of studies already conducted to verify the influence of ST on activity level and nutritional status, data are still conflicting [5, 16-18]. This is mainly due to the absence of a standardization of materials and methods in regard to obtaining data [16, 17]. In addition, studies of greater representativity are limited to the collection of data in large urban centers and capitals, which leaves to a great gap in the knowledge of these variables for the more peripheral regions. Therefore, the aim of this study was to evaluate the physical activity levels and nutritional status associated with the habits of children living in metropolitan area of São Paulo state, Brazil.

2. Materials and Methods

2.1 Study design and ethics approval

The present research is a descriptive, cross-sectional study with primary data collection and for convenience. Data were collected during August and December 2017 in five state public schools in the cities of Itaquaquecetuba and Mogi das Cruzes, belonging to the metropolitan region of Alto Tietê in the state of São Paulo, Brazil. The sample of the present study consisted of 577 schoolchildren of both sexes (female = 274, male = 303) aged 10 to 16 years, regularly enrolled in the 6th year of elementary school. All procedures adopted in the research were approved by the Research Ethics Committee of the University of Mogi das Cruzes (2.459.458).

2.2 Procedures

The habitual physical activity level was verified through the Physical Activity Questionnaire for Older Children (PAQ-C), which was designed for children aged 8 to 13 years and Physical Activity Questionnaire for Adolescent (PAQ-A) for adolescents between the ages of 14 and 18 years [19]. Based on the answers to the questionnaires, it was possible to classify the students in "Very Sedentary", "Sedentary", "Moderately Active", "Active" and "Very Active". It should be noted that 57 female students and 52 male students had data regarding this variable excluded. This was due to the intercurrences that prevented them from normally performing their physical activity habits in the week prior to data collection (Information obtained through question 10 of the Physical Activity Questionnaire for Children/Adolescents.

Body weight and height were obtained using an anthropometric digital scale with a coupled stadiometer (Toledo Prix A 2098 PP), duly calibrated, with an accuracy of 100 grams and 0,1 centimeters, respectively. All anthropometric variables were obtained by calculating the average of three measurements, considering only values that presented, at most, an oscillation of ± 0,100 grams for weight and ± 0,5 centimeters for height. The body mass index (BMI) was calculated by dividing the body weight (kg) by the square value of the height (m), and its final value expressed in (kg/m²). In this way the students were classified as thinner, eutrophic, overweight or obese [20].

Students screen habits were verified through a questionnaire previously structured by the researchers. Composed of 10 closed and open questions, in this case 4 multiple choice questions and 6 essay questions. After being duly completed, it was possible to identify the most used types of screen, the time of use and also, the purpose that the students uses the technological resources described. It is noteworthy that 7 male and 6 female schoolchildren were excluded from the analysis of this variable, due to the poor completion of the evaluation instrument.

2.3 Data analysis

The normality of the data was verified by Kolmogorov-Smirnov test. Height and physical activity level presented a parametric distribution and were compared using Student's T test. However, age, weight, BMI and ST presented non-parametric distribution, then were compared by Mann-Whitney test. The variables corresponding to the habits of the screen, as well as the classifications obtained for the level of physical activity and nutritional status were compared between the sexes using the test of X^2: Chi-square with correction of Yates, when necessary. Finally, factors associated with sedentary lifestyle and overweight were investigated with the multiple logistic regression test. Results were considered statistically significant with $p<0.05$. All analyzes were performed using Bioestat version 5.3 statistical software.

3. Results

Table 1 presents the values of age (years), weight (kg), height (m), BMI (kg/m²), daily ST (h) and habitual physical activity level (PAQ-C score). The unpaired Student t test revealed differences between the sexes in relation to height and habitual level of physical activity. The same was pointed out by the Mann-Whitney U test in relation to the mass and BMI variables. In summary, male students have lower stature, mass and BMI, but a higher level of habitual physical activity when compared to female students ($p\leq005$).

Table 1: Sample characterization.

Male (n=303)		Female (n=274)	
Continuous variables	**Mean (SD)**	**Mean (SD)**	**Estatistic**
Age (years)	11.95 (0.65)	12.02 (0.74)	($U_{(39321.00)}$;p= 0.27)
Weight (Kg)	43.64(11.80)	47.20 (11.35)	($U_{(32738.50)}$;p=0.00)*
Height (m)	1.51 (0.07)	1.53 (0.07)	($T_{(-2.9146)}$;p=0.00)*
BMI (Kg/m²)	18.89 (4.12)	19.97 (3.94)	($U_{(33513.50)}$;p=0.00)*
Daily ST (h)	3.72 (1.65)	3.92 (1.65)	($U_{(36869.50)}$;p=0.14)
Score PAQ-C	2.70 (0.71)	2.45 (0.72)	($T_{(3.9088)}$;p=0.00)*

N = Number of students; SD = Standard Deviation; ST = Screen time; h = Hours; Kg = Kilograms; BMI = Body Mass Index; m = Meters; m² = Height in meters squared; Score PAQ-C = Indicates in arbitrary unit the level of average physical activity predicted by the Physical Activity Questionnaire for Children; p = value of significance; * = $p\leq0.05$ according Student's T test, Mann-Whitney U test or X^2: Chi-square; # ST (♂n=296), (♀n=268); # *PAQ-C* (♂n=251), (♀n=217).

Table 2 describes the screen habits of the students who composed the study. Among them are the time of use of the screen, the most used devices, the purposes of using the screens in question and also points out how many students use more than one screen in their daily activities. We found that ~80% of students spend more than 2 hours a day on screen, and the vast majority ~90% use more than one screen. The

type of screen most used by students was the cell phone ~44% and still, ~84% of students use the screens for entertainment. Finally, among the variables presented in this table, the X^2 test showed a difference between the male and female groups only for the use of video games (greater by boys) and for communication (greater by girls) ($p \leq 0,01$).

Table 2: Screen habits of students.

Male (n=296)		Female (n=268)	
Continuous variables	**n (%)**	**n (%)**	**Estatistic**
≤ two hours	61 (20.60)	48 (17.91)	($X^2_{(0.316)}$;p=0.57)
> two hours	235 (79.40)	220 (82.09)	($X^2_{(0.041)}$;p=0.84)
1 eletronic device	24 (8.10)	33 (12.31)	($X^2_{(1.836)}$;p=0.17)
> 1 eletronic device	272 (91.90)	235 (87.69)	($x^2_{(0.103)}$;p=0.74)
Weighted average	%	%	Estatistic
Cellphone	41.90	47.21	($x^2_{(0.472)}$;p=0.49)
Television	23.41	31.07	($x^2_{(1.999)}$;p=0.15)
Computer	14.78	14.54	($x^2_{(0.003)}$;p=0.95)
Vídeo game	15.31	2.39	($x^2_{(20.875)}$;p=0.00)*
Tablet	4.57	4.78	($x^2_{(0.010)}$;p=0.92)
Entertainment	89.08	78.92	($x^2_{(0.745)}$;p=0.38)
Communication	8.62	17.49	($x^2_{(6.612)}$;p=0.01)*
School activities	2.28	3.57	($x^2_{(0.370)}$;p=0.54)

N = number of students; (%)= Sample value proportional to sex; X^2: chi-square; *= $p \leq 0,05$ according to x^2 test: chi-square.

Table 3 presents data referring to the level of habitual physical activity of schoolchildren, obtained with the application of PAQ-C/PAQ-A. We observed in the sample investigated a high number of physically inactive (very sedentary and sedentary) students, ~70%. In addition, the X^2 test showed that the number of schoolchildren classified as very sedentary was proportionally higher in the female group (p≤0, 01). Another intriguing finding is that none of the schoolchildren were classified as "very active".

Table 3: Physical activity level of students.

Male (n=251)		Female (n=217)	
Continuous variables	**n(%)**	**n(%)**	**Estatistic**
Very sedentary	39(15.53)	61(28.11)	($X^2_{(6.486)}$;p=0.01)*
Sedentary	130(51.79)	105(48.38)	($X^2_{(0.118)}$;p=0.73)
Moderately active	71 (28.28)	45 (20.73)	($X^2_{(1.861)}$;p=0.17)
Active	11 (4.38)	6 (2.76)	($X^2_{(0.425)}$;p=0.51)

N= Number of students; (%) = Sample value proportional to sex; *= $p \leq 005$ according to X^2 test: Chi-square.

Table 4 presents the nutritional status of the students obtained through BMI. According to the results, ~30% of students are overweight for their age and height. In order to verify possible differences between the sexes in the proportion of the respective classifications of BMI (thinness, eutrophy, overweight and obesity), the X^2 test was applied, however, no significant difference was observed (p>0,05).

Table 4: Nutritional status of students.

Male (n=303)		Female (n=274)	
Continuous variables	**n (%)**	**n (%)**	**Estatistic**
Thinnes	19(6.27%)	10(3.64%)	($X^2_{(1.389)}$;p=0.23)
Eutrophy	198(65.34%)	178(64.96%)	($X^2_{(0.000)}$;p=0.98)
Overweight	43(14.19%)	46(16.78%)	($X^2_{(0.389)}$;p=0.53)
Obesity	43(14.19%)	40(14.59%)	($X^2_{(0.000)}$;p=0.99)
Overweight and obesity	86(28.38%)	86(31.38%)	($X^2_{(0.242)}$;p=0.62)

N= Number of students; (%) = Sample value proportional to sex.

In table 5, we sought to verify which screen habits may be associated with sedentary lifestyle and overweight, respectively, and a possible association between the primary variables (sedentary lifestyle vs. overweight). For this the multiple logistic regression test was applied, however, no significant association was established (p>0,05).

Table 5: Associated factors with physical inactivity and overweight

	Physical Inactivity				Overweight			
	Male		Female		Male		Female	
	OR	p	OR	P	OR	p	OR	P
Nutritional status:								
Not overweight								
Overweight	0.9464	0.86	1.5173	0.23	-	-	-	-
Physical activity level:								
Physically active								
Physically inactive	-	-	-	-	0.9390	0.82	1.6003	0.19
Screen time:								
≤ Two hours								
> Two hours	1.1076	0.76	0.5774	0.21	0.7337	0.40	0.6961	0.40
Cellphone:								
No								
Yes	0.7697	0.83	0.1914	0.20	0.3007	0.34	56736.9244	0.90
Television:								
No								
Yes	1.1616	0.90	0.1650	0.17	0.2219	0.25	35705.0565	0.91
Computer:								
No								
Yes	0.8964	0.93	0.3292	0.44	0.1999	0.22	1.3929	0.99
Video game:								
No								
Yes	0.6819	0.77	0.0000	0.94	0.2463	0.30	1.4133	0.99
Tablet:								
No								
Yes	1.1244	0.93	0.0000	0.88	0.4808	0.59	187296.7574	0.89
More than one electronic device:								
No								
Yes	0.8136	0.65	0.7858	0.65	3.3684	0.06	1.0303	0.95

Entertainment:								
No								
Yes	0.8717	0.91	34014.3459	0.91	21850.6553	0.91	1.0466	0.97
Comunication:								
No								
Yes	0.9299	0.95	31464.3113	0.91	25895.60	0.91	0.6333	0.73
School activities:								
No								
Yes	1.0629	0.97	2.5808	0.99	31267.9730	0.91	0.0000	0.90

OR= Odds ratio.

4. Discussion

The objective of this study was to verify the level of physical activity and nutritional status associated with the screen habits of children living in the metropolitan area of São Paulo state, Brazil. Thus, 577 students of both sexes (female = 274, male = 303), aged between 10 and 16 years, regularly enrolled in the 6th year of elementary school, come from five public schools in the metropolitan area.

Childhood obesity can be defined as a condition in which excessive accumulation of body fat occurs in adipose tissue during childhood [21]. This accumulation in turn can bring about a series of physical and metabolic alterations that are detrimental to child health and development [22]. In childhood and adolescence, obesity is usually classified using the Body Mass Index (BMI), with percentile values equal to or greater than 95, according to gender and age group [20]. A worrying fact is that the development of childhood obesity may be associated with the maintenance of the pathophysiological state during adulthood [23, 8].

In our study, we observed that ~30% of schoolchildren are overweight for their age and height (overweight 15, 48% and obesity 14, 39%) (Table 4). Additionally, we observed a significant difference between the male and female groups in relation to the gross BMI value (male = 18.89 ± 4.12, female = 19.97 ± 3.94, p=0.00). However, regarding the possible classifications obtained for the nutritional state (thinness, eutrophy, overweight and obesity), we did not see any difference in the proportion between the sexes (Table 4). These values are close to the findings of Rivera *et al.* [24], which show that in Latin America about 20-25% of the population of children and adolescents have childhood obesity.

In Brazil, specifically the Family Budget Survey (FBS), conducted in 2008 and 2009 with Brazilian children, point to a high prevalence of overweight in children in Brazil. An interesting fact is that these values vary according to economic class and region [25].

The FBS pointed out that between the years 1989 and 2009, there was an increase in the prevalence of overweight in children from 8, 9% to 26, 5%. Another important fact is that for children of high economic class, this picture is even more worrying, since in the same period (1989-2009), there was a growth of 25, 8% to 46, 2%. The survey also showed that the Center-West region had the highest variation of overweight boys in the period in question, rising from 13, 8% in 1989 to 37,9% in 2008. For girls, in the same period, The sharpest increase occurred in the Southeast region, increasing from 15% to 37,9%. In the period that includes adolescence this tendency to obesity remains. It is estimated that 5% of the Brazilian population in this age group is obese [25].

In relation to the level of physical activity, we observed that boys are more active when compared to girls (male = 2, 70 ± 0,71, female = 2,45 ± 0,72, p = 0,00) and that more than 70% of schoolchildren are insufficiently active (sedentary 50,08 % and very sedentary 21,82%). Furthermore, based on the classifications suggested by PAQ-C/A (very sedentary, sedentary, moderately active and active) (Table 3), we observed that the number of female students classified as very sedentary is significantly higher when compared to the male. According to the minimum recommendation of physical activity suggested by the World Health Organization (WHO) for children and adolescents [26, 27], it is possible to verify a high rate of physical inactivity in this public. For example, in a study conducted by De Moraes *et al.* [28], the authors point out that physical inactivity in children and adolescents can range from 18.7% to 90.6% in the world. An interesting fact is that the highest percentages of physical inactivity were present in emerging or developing countries, such as Brazil. In addition, it was possible to verify that girls are less active than boys, a result similar to that of our study, and also that socio-demographic variables such as housing, socioeconomic profile and the use of electronic devices such as computers, video games and TV influence significantly in the high levels of physical inactivity in childhood and adolescence [7]. In addition, it is worth mentioning that childhood obesity is associated with a greater susceptibility to the occurrence of Chronic Noncommunicable Diseases (CNCD) [29, 30].

Some factors such as excessive screen time for children and adolescents may be detrimental to their development and lifestyle, especially on physical activity levels [31]. In fact, although technological resources are important tools for accessing information and Consequently, they are to some extent beneficial in the process of teaching children and adolescents [32, 33] their excessive use should be avoided [12-14].

In our study, we did not only focus on total screen time, as much of the studies have done [13, 34-35], but we have tried to understand some screen habits regarding this sedentary behavior. In this sense, we observed that the electronic device most used by the students, that is, the main responsible for their sedentary behavior are the smartphones (male = 41,90%, female = 47,21%), followed by TV (male = 23,41%, female = 31,07 (male = 14,78%, female = 14,54%), video game (male = 15,31%, female = 2,39%) and tablet (male = 4,57%, female = 4,58%). These data are important, since many studies consider only the use of TV, computer and video game as indicative of sedentary behavior[13, 34-35], which underestimates this de facto behavior. Given this, it is crucial that the studies conducted in this area include the analysis of screen time with smartphones. Thus, it is necessary to disregard the idea that TV represents the main sedentary behavior in children and adolescents [36]. Another curious fact is related to the use of video games. Our study showed that this type of device is less used in comparison with smartphones, TV and computers, and, when compared between the sexes, it is significantly less used by girls (x^2 (20,875), $p \leq 0,01$). This reinforces the need for studies that evaluate screen time to develop gender-specific assessment tools, thus respecting different habits. Another possibility is the application of instruments in which responses are "open". This brings to the evaluated the possibility of describing the

electronic devices that, in fact, make up their screen habits in an individual way, as we did in this study.

Still on screen habits, we chose to use the cutoff point (> 2 hours) as excessive screen time, as suggested by the American Academy of Pediatrics [4]. In this way, we showed a high excessive screen time among schoolchildren (male = 79,40%, female = 82,09%). It should be noted that there was no significant difference in the total screen time between the sexes. Data like this have been described in other Brazilian regions [37] and in the world [38]. Another important information that we obtained through the application of the questionnaire is that even in populations with lower purchasing power, such as the students who composed this study, their screen habits mostly represent the use of more than one electronic device (male = 91.90 %; female = 87.69%). Finally, we observed that the major time spent on the screen by the students is for entertainment purposes (male = 89,08%, female = 78,92%), followed by communication activities (male = 8,62%, female = 17,49%) and school activities / surveys (male = 2,28%, female = 3,57%). Regarding the communication habits, it is worth mentioning that this was significantly more present in females (x^2 (6,612), p = 0,01). In addition, it is clear that schoolchildren have used electronic devices very little for the purpose of school activities/research, which is a pity, considering the great potential of these resources as facilitators of the teaching and learning process [28, 29].

About excessive time of the screen, on June 18, 2018, in the 11th update of the International Classification of Diseases (ICD), a manual that describes the definition and codes of pathologies, serving as a parameter for the work of physicians from all over the world. Compulsive gambling began to be considered a mental disorder and was titled "gaming disorder." In the paper, the disorder is described as a pattern of frequent or persistent behavior electronic games, so severe that it makes one prefer games to any other daily life activity. According to the board of the WHO Department of Mental Health, this inclusion of the gaming disorder that had already been processed in the committees of the organ since the year 2014, has become emerging due to scientific evidence that the increase in the demand for the treatment of this, now disturbance, in various parts of the world [39]. Although this was not directly one of the focuses of our study, it is necessary to point out that the electronic games represented a considerable part of the entertainment of the students in front of the screens, including in the smartphones.

Finally, in order to contribute to the elucidation of the variables that possibly influence overweight and sedentary lifestyle, we observed that the screen habits described here, in this case, screen time, types of electronic devices used and the purposes of use were not associated with these variables. Additionally, the variables overweight and physical activity level also showed no association between them (Table 5). Similar data have been described in previous studies [35, 36, 40]. Taken together, these findings demonstrate the complexity of understanding the factors involved in the level of physical activity and excess weight in childhood. This reinforces the need for more studies that allow a better understanding of these variables.

5. Conclusions

High prevalence of excessive screen time and a representative number of physically inactive and overweight schoolchildren were observed. Also, the screen habits between the genders are distinct and it was not associated with level habitual physical activity level and the nutritional state.

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