

# Screen time, body mass index and neck circumference: is there an association with social class in children?

## Tempo de tela, índice de massa corporal e circunferência do pescoço: existe associação com a classe social em crianças?

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**Abstract** – Life habits during childhood are decisive for future health conditions. The aim of this study was to evaluate screen time and anthropometry of children enrolled in municipal schools in the interior of the State of São Paulo. A cross-sectional study was carried out with students from 9 to 10 years of age from a city in the State of São Paulo, Brazil. A socio-economic questionnaire validated by the Brazilian Association of Research Companies was used, containing also the determination of screen time (TV, video game, computer and cell phone), recommended by the Pediatrics Society. Anthropometry data was collected according to the Lohmam Anthropometric Standardization Reference Manual and compared to the z-score level with the WHO 2007. For the statistical analysis, Kruskal-Wallis, Chi-square or Fisher's Exact tests were used. The confidence level was at 95%. Out of the 703 schoolchildren assessed, 97.44% had adequate height, 59.17% eutrophy BMI and 30.44% overweight. There was a correlation between BMI and non-stratified social class ( $p=0.038$ ) and BMI and neck circumference (NC) ( $p<0.001$ ). The z-score of the BMI showed that children with weight loss stayed longer watching TV ( $p=0.0486$ ). The gender comparison showed that girls of higher social class stayed longer at the computer ( $p=0.0351$ ) and using the cell phone ( $p<0.0001$ ), and boys playing videogame ( $p=0.0005$ ). Overweight and weight loss shown in the positive correlation between BMI and NC, although on opposite sides, were associated with screen time and especially with TV in children of higher social class.

**Key words:** Anthropometry; Body mass index; Circumference; Neck; School health.

**Resumo** – Hábitos de vida apresentados durante a infância, serão decisivos para a situação de saúde no futuro. Objetivou-se avaliar tempo de tela e antropometria de crianças matriculadas em escolas municipais do interior de São Paulo. Estudo transversal com escolares de 9 a 10 anos de idade de uma cidade do estado de São Paulo-Brasil. Utilizou-se um questionário sócio-econômico validado pela Associação Brasileira de Empresas de Pesquisa, contendo também a determinação do tempo de tela (TV, vídeo game, computador e celular), recomendado pela Sociedade de Pediatria. A antropometria foi coletada de acordo com o Anthropometric Standardization Reference Manual de Lohmam e comparada à nível de escore-z, com a WHO 2007. Para a análise estatística utilizou-se os testes de Kruskal-Wallis, Qui-quadrado ou Exato de Fisher. O nível de confiança foi de 95%. Dos 703 escolares avaliados, 97,44% apresentaram estatura adequada, 59,17% IMC de eutrofia e 30,44% de sobrepeso. Houve correlação entre o IMC e a classe social não estratificada ( $p=0,038$ ) e o IMC e circunferência do pescoço (CP) ( $p<0,001$ ). O escore-z do IMC mostrou que as crianças com magreza ficaram mais tempo na TV ( $p=0,0486$ ). A comparação de gêneros mostrou que as meninas de classe social mais alta ficaram mais tempo no computador ( $p=0,0351$ ) e no celular ( $p<0,0001$ ), e os meninos no videogame ( $p=0,0005$ ). O sobrepeso e a magreza mostrados na correlação positiva entre IMC e CP, embora estejam em lados opostos, foram associados ao tempo de tela e principalmente à TV, nas crianças de maior classe social.

**Palavras-chave:** Antropometria; Circunferência; Índice de massa corporal; Pescoço; Saúde do escolar.

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## INTRODUCTION

A scenario of significant changes in body weight and in the nutritional status of the population, a phenomenon known as nutritional transition characterized by overweight and obesity, replacing low weight; has been occurring in Brazil in recent years<sup>1</sup>.

The number of overweight and obese people has increased exponentially worldwide and is a public health problem. In Brazil, privileged social classes exhibit the highest number of cases<sup>2,3</sup>. In the year 2000 there were already many studies about the occurrence of the “Nutrition Transition” and many researchers were investigating its factors and causes. According to a study by Monteiro et al.<sup>4</sup>, this change in the nutritional status of the general population is fully associated with the change in eating habits. Already at that time an increase in the consumption of sweets, hypercaloric and fatty foods and processed products was being observed, as well as a gradual decrease in consumption of fruits, vegetables and fresh food. According to the authors, overweight and obese children are found at all socioeconomic levels, with the highest prevalence occurring among students in private schools.

Data from the Family Budget Survey (POF) of the Brazilian Institute of Geography and Statistics (IBGE)<sup>2</sup> showed a variation in weight rates between the years 1974-1975 and 2008-2009, where the prevalence of excess weight among adolescents boosted from 11.3% to 20.5%, and the obesity rate increased from 1.1% to 4.9%, respectively.

Increase in consumption of high energy density ultra-processed foods and of fats, sugars and sodium<sup>3,4</sup>, enhanced by sedentary behavior such as excess use of cell phones, computers, video games and TV, has caused a greater occurrence of cardiovascular and metabolic diseases and obesity mainly among the youngest<sup>5</sup>.

The use of direct measures to assess nutritional status, such as body mass index and neck circumference<sup>6</sup>, can predict if there is any degree of overweight, allowing the setting of guidelines for intervention against the disease, called obesity. However, in pediatric visits, measurements with other techniques such as observation and classification of obesity, have not yet been implemented, and, in this connection, the present work may contribute to the discussion about the measurement of neck circumference of schoolchildren with different social characteristics.

Accordingly, the objective of this study was to evaluate screen time and anthropometric data of children of different social classes, enrolled in municipal schools of a municipality of the interior of the State of São Paulo, verifying their interrelationship.

## METHODS

### Study characteristics, location, type and population and ethics approval

This is a cross-sectional study in which students, aged between 9 and 10

years, enrolled in the 4<sup>th</sup> and 5<sup>th</sup> grade in an elementary school of the State of São Paulo education network in a municipality with a high human development index (HDI= 0.811)<sup>7</sup> were included. The city of Americana was selected for the performance of this survey, since this municipality stands out with regard to several population indices, being considered the city of Brazil exhibiting the highest urban well-being rates<sup>7</sup>.

The present study was carried out in 11 schools of a city located in the Southeast region of Brazil that extends over a total area of 133.63 km<sup>2</sup>. This municipality was chosen because of its high indexes in the socio-economic, health and education areas, which gives the community an HDI of 0.811, considered as very high development. The sample was calculated from the total number of students (1,800 students), enrolled in the 4<sup>th</sup> and 5<sup>th</sup> grade of Elementary School I of the State education network. Since actual prevalence is not known, we assumed 50% obesity prevalence, 95% confidence limit, 3% error and design effect 1; a sample of 671 adolescents was estimated; however, 703 were evaluated. For the calculation of the sample, the Openepi site was used.<sup>8</sup> Invitation letters were distributed to school principals who, after being informed about the objective of the investigation and its importance, as well as the methods that would be used for its performance, signed permission for the data collection.

Those students who did not complete the informed consent form (EHIC) and those who had some deficiency that involved the growth process or had thyroid diseases were excluded from the study. The study was approved by the Research Ethics Committee of the Institution and began after the Free and Informed Consent Form (TCLE) had been signed by parents or guardians.

### **Socio-economic classification and social class**

A Socioeconomic Questionnaire validated by the National Association of Research Companies (ANEP)<sup>9</sup>, named Criteria of Socioeconomic Classification Brazil was used. In this questionnaire, those responsible for school-children should report in numbers how many bathrooms, cars, computers, television sets, video games and cell phones, dishwashers, refrigerators, freezers, washing machines, DVD's, microwave ovens, motorbikes and clothes dryers were available in their household, besides the existence and quantity of maids employed. The screen time, that is; how much access time to cell phone, video game, TV and computer were also investigated. In order to do so, time watching screen contents was compared to that recommended by the Brazilian Society of Pediatrics<sup>10</sup>, department of adolescence, which indicates less than two hours of equipment use (TV, video game, mobile phone, and computer). According to the Brazilian Society of Pediatrics<sup>10</sup>, the new generation is part of the digital age. The benefits and especially the damages of technology are under scrutiny by parents and professionals. According to the Society, 97% of social classes A/B, and 51% of classes D/E, use the Internet. Thus, the daily media exposure should be limited to a maximum of 1 hour per day for children between 2

and 5 years of age, or limiting the use of computers and cell phones to 1-2 hours/day, regardless of the pediatric age group. In addition, the level of education of the parents or guardians should be informed. The response options were: illiterate; incomplete grammar school; complete grammar school; junior high incomplete; junior high complete; high school incomplete; high school complete; incomplete college degree and college degree. Finally, access to public services availability such as piped water and paved streets should be informed, and the response options were yes and no, only

The schools were divided into two groups, considering the scores of the socio-economic questionnaire. To divide the groups, the mean scores were chosen, with Group 1 including the lowest social class, composed of 6 schools with a score lower than 26.76 and Group 2 representing the highest social class, composed of 5 schools with a score greater than 26.76. Classification of social classes was performed based on a maximum score of 100 points. Thus, the following classes were listed: class A= 45-100; Class B1= 38-44; class B2= 29-37; class C1= 23-28; class C2= 17-22 and class D-E= 0-16<sup>9</sup>.

### **Anthropometric Assessment**

The anthropometric data, weight and height of schoolchildren was collected according to the standardized procedures described in Lohmam's Anthropometric Standardization Reference Manual<sup>11</sup>. Weight data was obtained in a single measurement, using a digital scale Onrom HBF 514C brand, with 150 kilos capacity and 100 grams accuracy. Schoolchildren were weighted wearing light clothing (school uniform only, no heavy sweaters or other props like caps, watches or other heavy objects) and barefoot.

To obtain the height, a measuring tape with a millimeters scale was used, fixed to a wall that had no baseboard. During height measurement, the students remained barefoot, without socks, with feet and ankles together, heels against the wall, standing upright and head positioned in the Frankfurt plane<sup>11</sup>. Therefore, the classification used for height/age was that recommended by the WHO 2007<sup>12,13</sup> being z-score  $\leq -2$  short stature/age, z-score  $< -2$  and  $> +1$  stature/age adequate, z-score  $\geq +1$  and  $< +2$  risk for high stature/age, z-score  $\geq +2$  high stature/age.

The combined measures of weight and height were used to calculate the BMI [Body Mass Index = weight (kg)/height<sup>2</sup> (m)]. The nutritional status of schoolchildren was defined according to the classification proposed by the WHO<sup>12,13</sup>, which uses a BMI/age z-score according to gender and age. The scores used were: z-score  $\leq -2$  low weight, between  $< -2$  and  $> +1$  eutrophic, between  $\geq +1$  and  $< +2$  overweight, and z-score  $\geq +2$  obese.

The neck circumference (NC) was measured with an inelastic and inextensible measuring tape placed below the laryngeal prominence, perpendicular to the long axis of the neck and at the level of the cricoid cartilage (for boys, below this level), and the cut points above 32.7 cm and 38.0 cm for girls and boys respectively, indicated obesity<sup>14</sup>. This measure can be used to determine if there is resistance to insulin<sup>14</sup>. The advantage

of this measurement is the ease of obtaining the measurement, since it does not require a supine position nor the exclusion of the individual's clothes, thus being non invasive and not of high cost.

Although the measurement technical error was not determined, approximately 20% of the student sample (140 students) was measured in duplicate for anthropometric measurements quality control. All measurements were performed exclusively by the investigator in charge of the research, thus minimizing any potential error that could occur when several people carry out the measurements.

## Statistical Analysis

An exploratory data analysis was performed through descriptive statistics (mean, standard deviation, minimum, median, maximum, frequency and percentage). The Chi-Square or Fisher's exact test was used when the social class was studied in its categorical form. Spearman's correlation coefficient was used to evaluate correlation of anthropometric data with lifestyle and social class scores. Comparison between the two groups of schools with high and low social class in relation to lifestyle, was performed through the Mann-Whitney test. Genders and social classes (high and low social class) were compared in relation to the percentile and Z-score of height and BMI for age, using the Mann-Whitney test. Height groups for age and BMI for age were compared using the Kruskal-Wallis test, Chi-Square, or Fisher's exact test. The confidence level in the analyses was 95% and the software used was SAS9.4, Minitab 16 and SPSS.13.

## RESULTS

A total of 703 primary school students between 9 and 10 years of age from the education network of a city of the State of São Paulo, Brazil, with a very high HDI (0.811) were assessed; the students were enrolled in the 4<sup>th</sup> and 5<sup>th</sup> grade and 58,2% were girls (n=409.14) and 41.8% boys (n=293.85). Since the year 2010, the HDI combines three dimensions to verify the degree of development of a municipality: the ratio average school level on average school years, gross national income per capita and health level, which is based on the life expectancy of the municipality population. Thus, five classifications are determined: very high (HDI between 0.800 and 1.000); high (HDI between 0.700 and 0.799); average (HDI between 0.600 and 0.699); low (HDI between 0.500 and 0.599); and very low (HDI between 0.000 and 0.499). Therefore, the city in which the study was conducted is included in the very high degree of human development.

As to height, 18 children (2.56%) were very short or short for their age and 685 (97.44%) with adequate height. With regard to BMI, the following distribution was observed: 20 students (2.84%) with weight loss + severe weight loss, 416 (59.17%) eutrophic, 241 (30.44%) overweight and 53 (7.54%) obese. No significant association was found between BMI and height classifications.

With regard to the distribution of social classes, class C1 (40.26%, n=283) stood out. The lowest rates were found in classes A-B1 (7.25%; n=51) and D-E (4.27%; n=30). Classes B2 and C2 values were 26.46% (n=186) and 21.76% (n=153), respectively (data not reported in tables). Evaluating the social class score, no significant differences were found among children with low or adequate height (p-value = 0.4357), that is, height was not associated to social class.

The characteristics of the studied population can be seen in Table 1. Regarding the lifestyle, it can be observed that the use of television was at the top (in minutes) ( $112.39 \pm 108.82$ ), followed by cell phone ( $85.37 \pm 109.71$ ), computer ( $65.54 \pm 91.29$ ) and videogame ( $49.84 \pm 83.87$ ). Regarding the anthropometric evaluation, the mean weight was  $39.43 \text{ kg} \pm 10.18$ , while the mean BMI was  $19.18 \text{ kg/m}^2 \pm 4.11$  (with z-score of  $0.45 \pm 1.23$ ). The mean height was  $1.43\text{m} \pm 0.09$  (with z-score of  $0.50 \pm 1.20$ ) and the mean neck circumference was  $28.82\text{cm} \pm 2.60$ . On the other hand, the average score of the social class, was  $26.74 \text{ points} \pm 6.79$ .

**Table 1.** Characteristics of the studied population, according to the variables analyzed.

Variable	N	Average	$\pm \text{SD}^{*3}$
Television* 1	702	112.39	$\pm 108.82$
Video game*1	703	49.84	$\pm 83.87$
Computer*1	703	65.54	$\pm 91.92$
Cell phone*1	702	85.37	$\pm 109.71$
Social Class*2	703	26.74	$\pm 6.79$
Weight (Kg)	703	39.43	$\pm 10.18$
Height (m)	703	1.43	$\pm 0.09$
Z-score Height/Age	703	0.50	$\pm 1.20$
BMI (Kg/m <sup>2</sup> )*4	703	19.18	$\pm 4.11$
Z-score BMI/Age	703	0.45	$\pm 1.23$
Neck Circumference (cm)	703	28.82	$\pm 2.60$

Note. \*1 Time in minutes; \*2 Social Class from A to E; \*3 Standard Deviation; \*4 Body Mass Index.

From the observation of Figure 1, which shows the correlation coefficient between social class (in a non-stratified form) and anthropometric data, it appears that there was a significant but weak positive correlation between BMI and social class, with p-value=0.0038. In relation to the NC, a significant correlation with BMI was observed (p-value <0.001).

The variables computer use and BMI, were compared between social class categories in a stratified form. Significant differences were found between social class categories for computer use time and for BMI. Children in classes A-B1 and B2 spend more time using the computer than children in classes C2 and D-E (p=0.0013). In relation to BMI, class A-B1 exhibited higher values than class D-E (p=0.0412). Likewise, with regard to BMI, students belonging to the higher social classes exhibited higher values (classes A-B1 =  $19.8 \text{ kg} / \text{m}^2$  and classes D-E =  $17.81 \text{ kg} / \text{m}^2$ ).

The data reported in Table 2 show that there was a weak negative correlation for the time spent watching TV and the z-score of BMI for



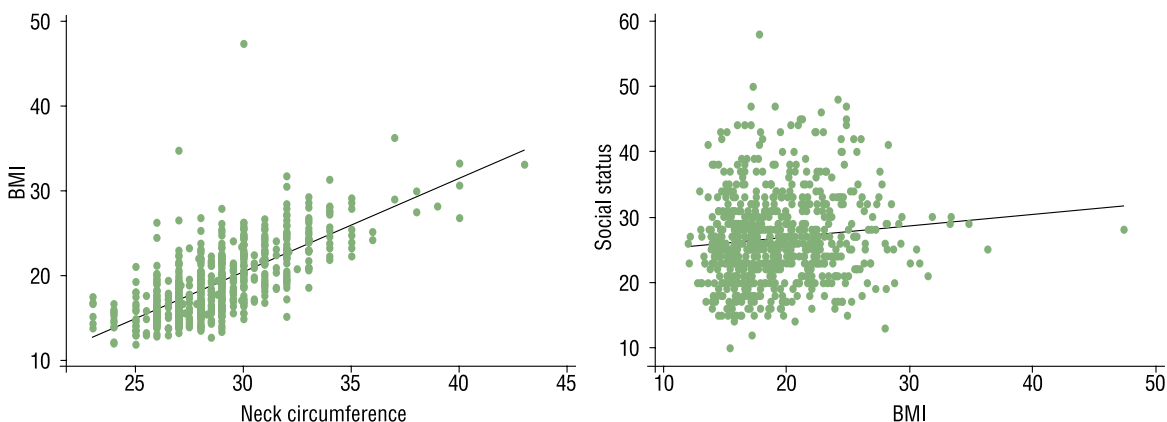
age, i.e., the longer the time spent watching TV, the least the z-score ( $p=0.0425$ ). The opposite is observed in the social class, where there is a weak positive correlation between BMI for age and this variable, i.e., the higher the social class, the higher the BMI Z score for age ( $p=0.0035$ ).

Table 3 shows that, in relation to TV time, children with severe weight loss or weight loss spend more time in front of the TV set than overweight children ( $p=0.0486$ ).

Tables 4 and 5 shows comparisons between genders. The Mann-Whitney test was used for numerical variables. Categorical variables were presented as frequency and percentage for each category. The genders were compared using the Chi-Square test.

As to the girls, when comparing the lowest social class (D-E, group 1) with the highest social class (A-B, group 2) it was observed that there was a statistically significant difference for computer use, with an average equal to  $44.54 \pm 74.21$  for group 1 and  $74.10 \pm 89.18$  for group 2 ( $p < 0.0001$ ) and cell phone, with mean values equal to  $73.34 \pm 98.38$  for group 1 and mean equal to  $93.10 \pm 109.40$  for group 2 ( $p = 0.0351$ ). Briefly, it can be said that girls of higher social class spend more time using the computer and the cell phone.

As to the boys, it was observed that the use of video game yielded a statistically significant difference with mean values equal to  $66.30 \pm 91.03$  for group 1 and  $104.67 \pm 111.27$  for group 2, ( $p=0.0005$ ). Briefly it may be said that boys of a higher social class use video game longer.



**Figure 1.** Correlation between social class and BMI ( $p=0.0038$ ) and neck circumference ( $p<0.001$ ).

**Table 2.** Comparison between height/age z-scores, BMI/age, social class, gender, and lifestyle

Variable	TV	p-value	Social Class	p-value
Z Stat/Age	0.04518 (N=702)	0.2319	0.03224 (N=703)	0.3924
Z BMI/Age	-0.07659 (N=702)	0.0425*	0.10999 (N=703)	0.0035*
Variable	Female Gender		Male Gender	p-value
Z Stat/Age	$0.5 \pm 1.2$ (N=409)		$0.5 \pm 1.2$ (N=294)	0.62
Z BMI/Age	$0.4 \pm 1.2$ (N=409)		$0.5 \pm 1.3$ (N=294)	0.22

Note. \* $P<0.5$  = Significant (Mann-Whitney test); BMI:- Body Mass Index; Stat:- Stature

**Table 3.** Comparison between lifestyle (screen time in minutes) and BMI categories.

BMI/Age	Variable	N	SD Average ( $\pm$ SD)	p-value
WL + SWL	TV	20	124.00 $\pm$ 130.24	0.0486*
	Video Game	20	35.00 $\pm$ 44.54	0.9849
	Computer	20	36.30 $\pm$ 49.99	0.8705
	Cell Phone	20	106.60 $\pm$ 137.20	0.8207
	Social Class	20	25.30 $\pm$ 5.53	0.1647
Eutrophy	TV	415	120.07 $\pm$ 109.97	
	Video Game	416	53.87 $\pm$ 92.57	
	Computer	416	64.69 $\pm$ 89.99	
	Cell Phone	415	88.96 $\pm$ 114.44	
	Social Class	416	26.30 $\pm$ 6.70	
Overweight	TV	214	94.36 $\pm$ 99.28	
	Video Game	214	43.93 $\pm$ 68.53	
	Computer	214	68.56 $\pm$ 94.20	
	Cell Phone	214	76.42 $\pm$ 93.06	
	Social Class	214	27.72 $\pm$ 7.20	
Obesity	TV	53	120.75 $\pm$ 121.89	
	Video Game	53	47.64 $\pm$ 78.96	
	Computer	53	71.00 $\pm$ 101.02	
	Cell Phone	53	85.42 $\pm$ 122.66	
	Social Class	53	26.76 $\pm$ 5.85	

Note. \* WL + SWL = Weight loss + Severe weight loss (BMI). \*<sup>1</sup> P<0.05. SD: Standard Deviation

**Table 4.** Comparison between social classes and the variables studied in the female gender.

Social Class	Variable	N	Average + SD	p-value
1	TV	217	112.17 $\pm$ 109.11	0.5019
	Video Game	217	24.02 $\pm$ 57.07	0.1991
	Computer	217	44.54 $\pm$ 74.21	<0.0001*
	Cell Phone	217	73.34 $\pm$ 98.38	0.0351*
	BMI	217	18.96 $\pm$ 3.80	0.5824
	Neck Circumf	217	28.32 $\pm$ 2.16	0.4248
	Social Class	217	26.07 $\pm$ 6.27	
2	TV	192	114.46 $\pm$ 104.84	
	Video Game	192	26.64 $\pm$ 54.24	
	Computer	192	74.10 $\pm$ 89.18	
	Cell Phone	192	93.10 $\pm$ 109.40	
	BMI	192	19.35 $\pm$ 4.42	
	Neck Circumf	192	28.51 $\pm$ 2.55	
	Social Class	192	28.81 $\pm$ 7.14	

Note. \*significant p<0.05 (Mann-Whitney); Group 1:- lower social class and Group 2: - higher social class. SD: Standard Deviation; BMI:- Body Mass Index; Circumf:- circumference.

## DISCUSSION

Despite the prevalence of eutrophy, 38% of the children in the present study were overweight, exceeding the rates found in national statistics<sup>2</sup>, which total is 22% for males and 20% for females.

The growth in the overweight and obesity rates that has been detected



**Table 5.** Comparison between social classes and the variables studied in the male gender.

Social Class	Variable	N	Average $\pm$ SD	p-value
1	TV	157	111.41 $\pm$ 115.36	0.9300
	Video Game	158	66.30 $\pm$ 91.03	0.0005*
	Computer	158	71.89 $\pm$ 96.41	0.8528
	Cell Phone	157	81.89 $\pm$ 105.71	0.2869
	BMI	158	19.07 $\pm$ 4.07	0.4993
	Neck Circumf	158	29.17 $\pm$ 2.42	0.2581
	Social Class	158	24.73 $\pm$ 5.85	
2	TV	136	110.96 $\pm$ 102.27	
	Video Game	136	104.67 $\pm$ 111.27	
	Computer	136	79.57 $\pm$ 106.78	
	Cell Phone	136	97.66 $\pm$ 129.16	
	BMI	136	19.41 $\pm$ 4.23	
	Neck Circumf	136	29.66 $\pm$ 3.22	
	Social Class	136	27.21 $\pm$ 7.27	

Note. \*significant  $p < 0.05$  (Mann-Whitney); Group 1:- lower social class and Group 2: - higher social class

in the nutritional assessment studies may be directly related to inadequate diet and lack of physical activity added to the longer time spent on the computer, cell phone, TV and video game which may disrupt health conditions, especially in children and young people<sup>15</sup>.

According to the Brazilian Society of Pediatrics<sup>10</sup>, a few studies show that children are influenced by what they see on television. Those children end up creating distorted eating habits that go against healthy eating habits and physical activity. Automatically, these poor habits are taken to schools, where the cycle perpetuates itself.

The scientific community is well aware that children and young people are influenced by media content. However, the negative implications of these contents in the development of children's eating habits are little understood by the population. Such is true that, according to surveys, children and young people spend more and more time watching television, video games, games, etc. Those surveys also reveal that most television advertising content has to do with sugar. The negative implications and/or factors arising out of this practice include: increased consumption of nutritionally poor foods rich in glucose<sup>16</sup>.

Recently, a study<sup>17</sup> verified the prevalence of too much screen time and associated factors in adolescents, and showed that almost 80% of the total population reviewed ( $n=2874$  adolescents) reached that standard. The authors defined too much screen time as watching television, using the computer and playing video games for more than two hours a day. They also verified that prevalence was high and varied according to the sociodemographic characteristics of adolescents. Therefore, they emphasize the need to develop interventions to reduce the use of such technological equipment<sup>17</sup>.

The results of this study show that the main nutritional negative impact in the students of the State schools in the Municipality investigated was

overweight and obesity. When height and age against BMI were reviewed, the data were alarming, since 41.0% of the boys were overweight or obese and the girls, 34.17%.

The importance of studying the health conditions of schoolchildren with view at developing actions that help in the prevention of chronic noncommunicable diseases among other disorders is well known. Araujo et al.<sup>18</sup>, reported the nutritional status of adolescents in the 9<sup>th</sup> grade of public and private schools in the Brazilian capitals, with overweight in 23% and obesity in 7.3% of the adolescents; these values were higher in the South and Southeast regions of the country. As in the present study, Araujo et al.<sup>18</sup>, found that overweight and obesity were higher in male adolescents. They also observed some 3.3% deficit in stature. Recently, a study conducted by Barreto Neto et al.<sup>19</sup> with the objective of determining the prevalence of overweight and reviewing hazardous dietary intake and protection against cardiovascular diseases in adolescents, showed that in the research participants, overweight was frequent, presenting a prevalence of overweight of about 11% and obesity 6.8%, according to the BMI. A multilevel analysis reporting social levels that investigated individual characteristics of schoolchildren enrolled in public and private schools, showed that students attending private schools exhibited higher BMIs<sup>20</sup>.

On the other hand, and unlike our study, Guedes et al.<sup>21</sup>, evaluated the anthropometric conditions of schoolchildren from a low economic development region in Brazil. The authors found high proportions of short stature and indication of overweight/obesity. Therefore, regardless of the social level, obesity rates were found in both studies, revealing that overweight should be controlled in this population.

Social differences and their relationship with screen time were investigated by Yang-Huang et al.<sup>22</sup>. At the age of nine, 69.8% of children watch more than one hour TV per day, 85% in the lower social level and 61.4% in the highest social level. These results are consistent with those of the present investigation, where especially students with BMI indicating weight loss and lower socioeconomic level, sat in front of TV longer.

Research conducted by Lucena et al.<sup>17</sup>, who evaluated the prevalence of excessive screen time - called free time spent with activities using computer, mobile, videogame and television and their associated factors - found that this time is associated with gender, age, economic class and level of physical activity. Regarding economic class and gender, male adolescents belonging to higher economic classes were more likely to be exposed to excessive screen time, which was defined in the study as spending more than two screen hours per day. The same behaviour was observed in the current study with adolescents from the city of Americana, since in the comparison between Groups 1 and 2, boys belonging to Group 2 spent more time playing video game, and girls more time using the computer and the cell phone.

The economic growth observed in recent years in Brazilian families justifies the results found in this survey, since economic growth allowed

families, especially those with low and middle income, greater access to television, computer, internet and other electronic media<sup>23</sup>. This, in addition to the lack of safety conditions in urban centers for practicing physical activity and/or other types of activities with personal outdoor interaction is the cause of an enhanced use of equipment such as television, mobile, etc.

In a study carried out in 2013<sup>1</sup>, the authors verified that the relationship between screen time and economic class presents variations, since those adolescents that belong to lower economic classes, watch more television. In our study, we found that the higher social class spends more time using the computer, TV and cell phone.

NC can be used to investigate obesity, insulin resistance and even the metabolic syndrome<sup>14,24,25</sup>. In view of the above, the Brazilian Metabolic Syndrome Study<sup>26</sup> indicated that NC is being poorly explored in youngsters and, thus, the present work collaborates in this sense, since the anthropometric and lifestyle variables were investigated, compared with the NC of students in different social classes, indicating also the risks that such association can lead to. The NC also positively correlated with BMI, showing it is a good parameter for the evaluation of obesity<sup>6</sup>.

The latest Telephone Survey for Risk Factors Surveillance and Protection for Chronic Diseases, known as Vigitel, carried out in Brazil, revealed that among the adults surveyed, women showed a tendency towards increased obesity rates<sup>27</sup>.

It is well known that excess body fat can increase the risk of metabolic changes, such as dyslipidemia, insulin resistance and reduced glucose tolerance. In children, such disorders are even worse since they will be carried on into adult life and can cause suffering and irreparable losses. Therefore, increased importance and attention should be given to the period considered as the most critical in human development, in which creation and maintenance of lifestyle and consumption habits are observed<sup>125,28</sup>.

In this sense NC is a measure that may be used to detect insulin resistance, especially among obese individuals<sup>26,28,30</sup>. In our study, mean NC values for girls and boys differed according to social class, reaching values between 28.32cm and 29.66cm, respectively. These findings were lower than those of Silva et al.<sup>26</sup> (30.6 cm for girls and 32.8 cm for boys), indicating that the children assessed in our study are less likely to develop complications related to insulin resistance than those investigated in the Silva et al.<sup>26</sup> study, despite the obesity observed. Thus, NC was a significant indicator in the diagnosis of obesity in the population studied. We thus indicate that in future studies this measurement be also correlated with waist circumference, in order to better predict, besides the degree of obesity, resistance to insulin, since chronic noncommunicable diseases are affecting young people more and more. In a recent review, Moraes et al.<sup>28</sup>, found an association between NC and BMI, central fat distribution and metabolic syndrome, and pointed out that there is a shortage of studies about these measures in different population groups.

It is interesting to note that in past decades, weight deficit and weight

loss were associated to nutritional deficits. However, currently, with the occurrence of the Nutritional Transition - a phenomenon described in the literature<sup>1</sup>, it is perceived that the problem has turned into overweight and obesity, issues addressed in this study and with alarming rates as previously discussed. Maybe it is possible to infer that the populations belonging to the most privileged economic classes are able, through actions to control overweight and obesity, to change the current nutritional situation. Conversely, we can deduce that the current situation of the lower income populations leads to overweight and obesity. However, these changes can occur in different ways in the female and male gender.

Although in the present study no association between BMI and height was found, 18 students (2.56%) had short or very short stature for their age. It is known that short stature interferes in a negative way in the different stages of life, and may be associated with a delay in intellectual capacity, low school performance, less physical capacity for work, among other disorders<sup>28-30</sup>.

Although, in this study a positive statistical association between Stature/Age and social class was not observed, a study by Araujo et al.<sup>18</sup>, showed that greater prevalence of height and weight deficits were observed among students belonging to lower social classes. With regard to overweight and obesity, prevalence was higher among adolescents belonging to the higher social classes.

Among those evaluated in the present study, it was verified that 97% of the sample showed prevalence of adequate height for the age. The height-for-age parameter, according to Giuliani<sup>29</sup>, represents, more appropriately, the adverse relationships that occur in connection with children and adolescents growth.

In our study, height had no correlation with BMI and social class. Perhaps this fact is due to the homogeneity of the sample. We suggest that in future research, a larger number of students be investigated, with view at mixing samples.

## CONCLUSION

The performance of this study made it possible to identify the nutritional status of adolescent students of State Schools of a municipality in the interior of the State of São Paulo. With regard to social class, it was observed that there was a higher concentration of students in social classes C1, B2 and C2, which places the city in a prominent position, since the less privileged social classes (D-G) entered with a lower number of students.

There are few national studies that compare data together as they were presented. In this way, the present study allowed to conclude that the majority of the sample was eutrophic in terms of weight, height, BMI and NC. However, there was a high percentage of overweight, which represented a greater nutritional risk for boys. In addition, both overweight and weight loss, reported in connection with the positive correlation between BMI and

NC, although on opposite sides, were associated with screen and especially with TV time in children of higher social level, enhancing the fact that interventions in this direction should be carried out.

## COMPLIANCE WITH ETHICAL STANDARDS

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### Ethical approval

This study was approved by the Research Ethics Committee of the Pontifical Catholic University of Campinas (CAAE: 44785415.4.0000.5481). This research is in accordance with the standards set by the Declaration of Helsinki.

### Conflict of interest statement

The authors have no conflict of interests to declare.

### Author Contributions

Conceived and designed the experiments: SB,SMS. Performed the experiments: SB, SMS Analyzed the data: SB, SMS. Contributed reagents/materials/analysis tools: SB, SMS, JLDB, VALM. Wrote the paper: JLDB, VALM.

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