Rev Andal Med Deporte.. 2024; **17(1-2)**

Revista Andaluza de
Medicina del Deporte

https://www.juntadeandalucia.es/deporte/ramd

Originales

INTERACTION OF SEX AND SEXUAL MATURATION WITH MOBILE AND SCREEN TIME IN ADOLESCENTS; ROLE OF PHYSICAL ACTIVITY

Thiago Silva Piola[a,b,c,*], Ana Beatriz Pacífico[b], Jhonatan Gritten Campos[b], Edina Maria de Camargo[b], Eliane Denise Araújo Bacil[b,c], Michael Pereira da Silva[c], Wagner de Campos[b]

[a] *Secretaria de Estado da Educação, Brazil.*
[b] *Centro de Estudos em Atividade Física e Saúde, Universidade Federal do Paraná, Brazil.*
[c] *Grupo de Pesquisa em Atividade Física e Saúde Pública, Universidade Federal do Rio Grande, Brazil.*

ABSTRACT

Objective: To estimate the prevalence of time spent in cell phone and screen time in adolescents moderated by physical activity level. Methods: A study with a representative sample of 772 adolescents (52.6% female) with a mean age of 16.63 ± 0.69 years selected in a sampling process by multiple stages. The cell phone and screen time were auto reported. Poisson regression analyzes verified the associations. Results: Were observed associations between nutritional status and cell phone use by insufficiently active adolescents (PR: 1.433; CI95%: 1.123 - 1.829; p = 0.004). Female (PR: 0.728; CI95%: 0.621 - 0.853; p = 0.001) and female sex*pubertal interaction (PR: 0.768; CI 95%: 0.637 - 0.925; p = 0.005) and female sex*post pubert (PR: 0.709; CI95%: 0.522 - 0.963; p = 0.028) with screen time in insufficiently active activities. Female sex (PR: 0.713; CI95%: 0.536 - 0.967; p = 0.029) and female sex*pubertal interaction term (PR: 0.622; CI 95%: 0.464 - 0.944; p = 0.023) with screen time on sufficiently active. Conclusions: physical activity level may moderate the relationship of overweight/obese adolescents with cell phone use. Females seem to be the main factor related to screen time.

Keywords: smartphone; screen time; motor activity; adolescent.

INTERAÇÃO DO SEXO E MATURAÇÃO SEXUAL COM O USO DE CELULAR E TEMPO DE TELA EM ADOLESCENTES; PAPEL DA ATIVIDADE FÍSICA

RESUMO

Objetivo: verificar as possíveis interações entre o sexo e a maturação sexual com o uso do celular e com o tempo de tela em adolescentes suficientes e insuficientemente ativos. Métodos: estudo realizado com uma amostra representativa de 772 adolescentes (52,6% do sexo feminino) com média de idade de 16,63 ± 0,69 anos selecionados em um processo de amostragem por estágios múltiplos. O tempo em uso do celular e de tela foram autorreportados. As associações foram testadas com a regressão de Poisson. Resultados: foram observadas associações entre o excesso de peso e o uso do celular por adolescentes insuficientemente ativos (RP: 1,433; IC95%: 1,123 – 1,829; p = 0,004). Do sexo feminino (RP: 0,728; IC95%: 0,621 – 0,853; p = 0,001) e da interação feminino*púbere (RP: 0,768; IC95%: 0,637 – 0,925; p = 0,005) e sexo feminino*pós-púbere (RP: 0,709; IC95%: 0,522 – 0,963; p = 0,028) com o tempo de tela nas meninas insuficientemente ativas. E do sexo feminino (RP: 0,713; IC95%: 0,536 – 0,967; p = 0,029) e do termo de interação sexo feminino*púbere (RP: 0,622; IC95%: 0,464 – 0,944; p = 0,023) com o tempo de tela nas suficientemente ativas. Conclusões: o nível de atividade física pode moderar a relação de adolescentes com excesso de peso com o uso do celular. Ser do sexo feminino parece o principal fator na relação com o tempo de tela.

Palavras-chave: smartphone; tempo de tela; atividade motora; adolescente.

[*] Corresponding author: Prof. Dr Thiago Silva Piola. Secretaria da Educação, Av. Presidente Kennedy, 2511 - Guaira, Curitiba, Paraná, Brazil. CEP 80610-011. Email: thiagopiola@educacao.pro.gov.br (Thiago Silva Piola)

https://doi.org/10.33155/ramd.v17i1-2.1075
ISSN-e: 2172-5063/

INTERACCIÓN DEL SEXO Y LA MADURACIÓN SEXUAL CON EL USO DEL MÓVIL Y EL TIEMPO DE PANTALLA EN ADOLESCENTES; PAPEL DE LA ACTIVIDAD FÍSICA

RESUMEN

Objetivo: Estimar la prevalencia de tiempo de uso de celular y tiempo de pantalla en adolescentes moderado por nivel de actividad física. Métodos: Estudio con una muestra representativa de 772 adolescentes (52,6% mujeres) con una edad media de 16,63 ± 0,69 años seleccionados en un proceso de muestreo por etapas múltiples. El teléfono celular y el tiempo de pantalla se informaron automáticamente. Los análisis de regresión de Poisson verificaron las asociaciones. Resultados: Se observaron asociaciones entre el estado nutricional y el uso del celular por adolescentes insuficientemente activos (RP: 1.433; IC95%: 1.123 - 1.829; p = 0.004). Femenino (RP: 0,728; IC95%: 0,621 - 0,853; p = 0,001) y sexo femenino*interacción puberal (RP: 0,768; IC 95%: 0,637 - 0,925; p = 0,005) y sexo femenino*postpubertad (RP: 0,709; IC95%: 0.522 - 0.963; p = 0.028) con tiempo de pantalla en actividades insuficientemente activas. Sexo femenino (RP: 0,713; IC95%: 0,536 - 0,967; p = 0,029) y sexo femenino*término de interacción puberal (RP: 0,622; IC 95%: 0,464 - 0,944; p = 0,023) con tiempo de pantalla suficientemente activo. Conclusiones: el nivel de actividad física puede moderar la relación de los adolescentes con sobrepeso/obesidad con el uso del celular. Las mujeres parecen ser el principal factor relacionado con el tiempo de pantalla.

Palabras clave: teléfono inteligente; tiempo de pantalla; actividad motora; adolescente.

Introduction

The time in sedentary behavior has been increasing throughout the population, especially in relation to mobile phone use and screen time. This also occurs in a large proportion during adolescence, a phase that deserves special attention, since the behaviors of adolescence tend to be reflected in adulthood[1].

Mobile phones are no longer just a means of communication, being also a means for social relations, leisure and entertainment practices, becoming extremely frequent in the daily life of adolescents[2], however, its use is still little investigated by the national literature. Unlike screen time, which presents alarming results of time spent in this behavior[3,4], after all, the estimates of Brazilian studies[3,5] indicate prevalence of high screen time above 50% in most of the samples investigated[4,6].

The high time in sedentary behaviors is routinely accompanied by another problem, the little engagement of most adolescents in regular physical activity practices. In the ERICA[7] study, adolescents who did not meet the minimum recommendations for physical activity (54.3%) and adolescents who claim not to perform any physical activities (26.5%) together they represent 80.8% of Brazilian adolescents, a result similar to the global prevalence's, which indicate 81%[8] of insufficiently active adolescents. These data are worrisome, because in addition to the practice of physical activity being beneficial to the adolescent's health, it can compensate for some harm that sedentary behavior can bring[9].

Sedentary behavior and physical activity level (PAL) can be explained by different factors, such as sex, sexual maturation, socioeconomic level (SES), nutritional status, among others[4,6,10-12]. However, there are still limitations regarding the analyses with the use of cell phones by adolescents. Thus, the objectives of this study were: i) to estimate the prevalence of high cell phone use and screen time in sufficient and insufficiently active adolescents; ii) to verify the possible associations between sex, sexual maturation, socioeconomic status and nutritional status with cell phone use and screen time in adolescents in sufficient and insufficiently active adolescents, iii) to verify the possible interactions between sex and sexual maturation with cell phone use and with screen time in adolescents in sufficient and insufficiently active adolescents.

Methods

Design

This is a cross-sectional correlational study, with a representative sample of adolescents enrolled in high school in state schools in the city of São José dos Pinhais (n= 9418), Paraná, Brazil[13]. São José dos Pinhais is part of the greater Curitiba, being the 5th largest municipality in the state, in extension. Its human development index is considered high (0.758), occupying the 400th position in relation to the 5565 municipalities in Brazil[14].

Sample

The sample size calculation *a priori* for the study was conceived in order to contemplate the two different objectives of the study: (i) first, to estimate the prevalence of cell phone use and increasing screen time in adolescents, based on the procedures suggested by Luiz and Magnanini[15], considering a sampling error of 5%, a prevalence of high time in sedentary activity at 50%. (which also guarantees a maximum n to the calculation), estimating a minimum n of 369 adolescents for the study. Considering a design effect of 1.5 and an increase of 30% predicting possible losses and refusals, the minimum sample size to estimate the prevalence of the outcome was 720 subjects; (ii) subsequently, to estimate the minimum sample to test the hypothesis of the associations[16], considering a prevalence ratio of 1.68[17] in a prevalence of 38%, a confidence level of 95% (α = 0.05) and a power of 80% (β = 20), resulting in a minimum sample size of 241 subjects with a probability of correctly rejecting the null hypothesis of 80%. Considering a design effect of 1.5 and an increase of 30% to prevent possible losses and refusals, the minimum sample for the hypothesis test was established in 470 subjects.

The sample was selected from the multi-stage sampling process, in four stages: i) the five urban regions of the municipality of São José dos Pinhais were eligible for the study; ii) a simple random selection of a school was carried out in the regional Guatupê, Afonso Pena, Borda do Campo, São Marcos and two schools in the regional Center to participate in the study; iii) all morning high school classes of the school were invited to participate in the study and iv) all students in the class were invited to participate in the study.

Data collection was performed in the classroom by previously trained evaluators from the Center for Studies in Physical Activity - CEAFS / UFPR. The study followed the research standards involving human beings established by the National Health Council (resolution 466/2012) and was approved by the Research Ethics Committee of the Federal University of Paraná (CAAE: 97392818.1.0000.0102).

Altogether, 845 adolescents were evaluated between September and October 2018. Adolescents who presented physical limitations (n

= 2) and those who reported prepubescent maturational stage (n = 14) were excluded from the analyses. Also, adolescents who did not deliver the free and informed consent form signed by their parents or guardians, those who refused to participate in the study, filled out the instruments incorrectly and/or incompletely or were still missing on the day of data collection (n = 57). Therefore, the final sample of the study included 772 adolescents betwe'en 15.0 and 17.9 years.

To verify the statistical power of the sample, a posteriori calculation was performed considering the same parameters of the hypothesis a priori test (α = 0.05 and β = 0.20) and the prevalence for each sedentary behavior outcome observed in the present study. Where we observed that 772 subjects could identify prevalence ratios above 1.35 as risk and below 0.70 as protection, in prevalence above 39.4% for mobile phone use and above 1.30 as risk and below 0.74 as protection, in prevalence above 51.8% for high screen time.

Instruments and procedures

The sociodemographic factors investigated in this study were sex and SES and biological factors were sexual maturation and nutritional status of adolescents. Gender was self-reported by the adolescents themselves and categorized as male or female. Moreover, sexual maturation was determined using the method proposed by Tanner[18], where the maturational stages are arranged between 1 (prepubescent), 2, 3 and 4 (pubescent) and 5 (postpubertal). For this classification, the adolescents evaluated themselves by comparing pubic hairiness, through images[19,20].

The PAL was estimated using the Brazilian version[21] of the Self-Administered Activity Checklist[22]. In this instrument, adolescents reported the weekly frequency and duration of participation in up to 25 types of physical activities at moderate to vigorous intensities in the last week. To calculate the physical activity score, the sum of the product of the weekly frequency was calculated by the volume in minutes, spent in each activity. In the analyses, adolescents with a weekly volume of physical activity equal to or greater than 420 minutes per week were considered sufficiently active[23]. The instrument has an intraclass correlation coefficient (ICC) of 0.88, a Spearman correlation of 0.62 (p<0.001) and Kappa index of 0.5921.

Sedentary behavior, contemplated by mobile phone time and screen time, was estimated, respectively, through the Brazilian version of youth activity profile[24] (YAP) and adolescents' sedentary activity questionnaire[25] (ASAQ). In the first questionnaire, the adolescents answered among five options about the time of daily use of the cell phone ("I did not use the cell phone"; "I used the cell phone for less than 1 hour a day"; "I used the cell phone for 1 to 2 hours a day"; "I used the cell phone for 2 to 3 hours a day" and "I used the cell phone more than three hours a day"). In addition, in the second questionnaire the adolescents reported the time spent in front of the screen (TV, computer and/or computer for leisure) in hours and/or minutes during each day of a typical week and weekend. For the analyses, the time of use of the cell phone was considered high when equal to or greater than two hours per day, and the screen time was considered high when above the 50th percentile of the sample distribution itself. Thes instruments YAP[24] and ASAQ presents a Rho: 0.32 and a CCI=0.90 with 95% CI: 0.86-0.93[25], respectively.

The SES was evaluated based on the number of household items in the student's residence, the presence or not of a monthly employee and the education of the financial guardian at the household[26]. In the analyses, the adolescents were divided into three categories: low (classes C, D and E), intermediate (classes B1 and B2) and elevated (classes A1 and A2).

To evaluate the nutritional status, the total body mass was first measured, with a digital scale of the Brand PLENNA, with a resolution of 100g. Subsequently, height was evaluated for height with a portable stadiometer (WISO), with scales of 0.1cm[27]. From these data, the body mass index/age (BMI/age) was calculated by the ratio between body mass and height squared (Body mass (Kg) / height $(m)^2$). The adolescents were classified according to the Z score and divided into "no overweight" (low weight and normal weight) and "overweight" (overweight and obese) (based on the cutoff points of <1 standard deviation as no overweight and above >1 standard deviation as overweight).

Data analysis

The data were initially described in simple and relative frequencies, stratified by the PAL. The chi-square test was used to compare the frequencies among adolescents sufficiently and insufficiently active. The possible associations of sex, sexual maturation, SES and nutritional status with cell phone use for more than two hours and the high screen time were verified by crude Poisson regression and then adjusted for all variables (sex, sexual maturation, SES and nutritional status) with their respective 95% confidence intervals.

Interaction terms involving sex and sexual maturation were also created, and again the Poisson regression used to verify possible associations with mobile phone use for more than two hours and the high screen time in crude analysis and adjusted to the SES and nutritional status. PAL being tested as moderator in all analyses.

To avoid bias related to the sample selection process of complex characteristic, sample weights and standard error corrections were used based on robust clusters in all analyses, considering the chance of each student being selected. All analyses were performed in the Software SPSS version 24.0, with a significance level established at 95%.

Results

The final sample consisted of 772 adolescents (52.6% female) with a mean age of 16.63 ± 0.69 years. Among girls, 79.1% do not perform at least 420 minutes of physical activity per week (p = 0.001). Regarding the time of mobile use, 69.7% of insufficiently active adolescents spend more than two hours per day in this behavior (p = 0.045) and, in all, 74.3% of adolescents who did not meet the recommendations for physical activity had high screen time (p = 0.849) (Table 1).

The crude analysis (Chart 1 and table 2) and the adjusted analysis (Chart 2 and table 3) showed similarities in the significance of the associations. In the adjusted analysis, insufficiently active and overweight adolescents are more likely to engage with mobile use (PR: 1.43; CI95%: 1.12 - 1.82; p = 0.004) in relation to adolescents without excess weight (Chart 2 and table 3).

Table 1. Prevalence of physical activity level in relation to sex, sexual maturation, socioeconomic status, nutritional status, mobile phone use and screen time in adolescents. São José dos Pinhais. Paraná. Brazil (*n* = 772)

	Insufficiently active		Sufficiently active		Total	
	N	%	N	%	N	%
Sex						
Male	249	68.0	117	32.0*	366	47.4
Female	321	79.1	85	20.9*	406	52.6
Sexual maturation						
Pubescent	414	74.5	142	25.5	556	72.0
Postpubescent	156	72.2	60	27.8	216	28.0
Socioeconomic status						
High	71	68.9	32	31.1	103	13.3
Intermediate	339	75.0	113	25.0	452	58.5
Low	160	73.7	57	26.3	217	28.1
Nutritional status						
No excess weight	485	73.4	176	26.6	661	85.6
Overweight	85	76.6	26	23.4	111	14.4
Mobile phone use						
Up to two hours	358	76.5	110	23.5*	468	60.6
More than two hours	212	69.7	92	30.3*	304	39.4
Screen time						
Suitable	273	73.4	99	26.6	372	48.2
High	297	74.3	103	25.8	400	51.8

* significant for the chi-square continuity correction test; p< 0.05

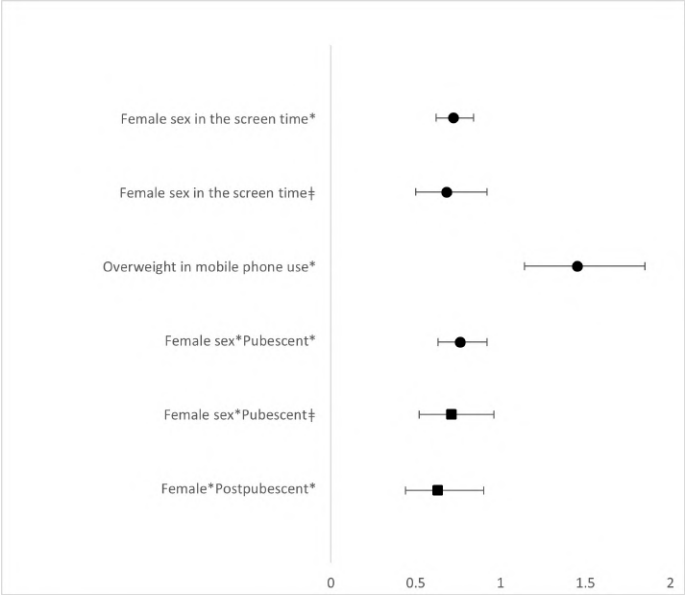

Chart 1. Sex prevalence ratio, sexual maturation, socioeconomic status, nutritional status and the interaction between sex*sexual maturation with cell phone use and screen time in adolescents moderated by the level of physical activity in adolescents. São José dos Pinhais, Paraná, Brazil (n = 772). * Insufficiently active; ǂ Sufficiently active.

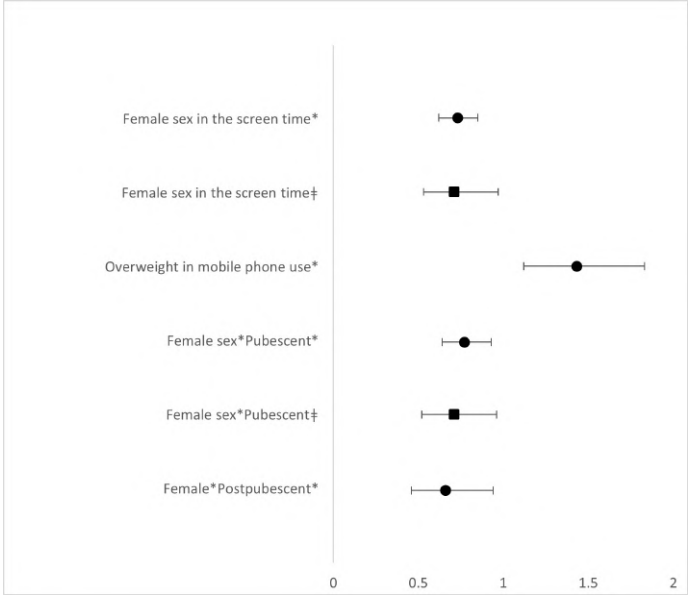

Chart 2. Sex prevalence ratio, sexual maturation, socioeconomic status, nutritional status and the interaction between sex*sexual maturation with cell phone use and screen time in adolescents moderated by the level of physical activity in adolescents. São José dos Pinhais, Paraná, Brazil (n = 772). * Insufficiently active; ǂ Sufficiently active.

The adjusted analyses also indicate associations between female gender and screen time (PR: 0.73; 95% CI: 0.62 - 0.85; p = 0.001), in addition to nutritional status with mobile phone use (PR: 1.43; CI95%: 1.12 - 1.83; p = 0.001). And in terms of female*pubescent interaction (PR: 0.77; 95% CI: 0.64 - 0.93; p = 0.005) and female*postpubescent (PR: 0.71; 95% CI: 0.52 - 0.96; p = 0.028) in insufficiently active ones (Chart 2 and table 3).

In the sufficiently active adolescents, associations were also observed between the female gender and the screen time (PR: 0.71; 95% CI: 0.53 - 0.97; p = 0.029) and in the term of female*pubescent interaction (PR: 0.66; 95% CI: 0.46 - 0.94; p = 0.023) (Chart 2 and table 3).

Discussion

Regarding the prevalence of cell phone use, the estimates of the present study presented similar results to boys in the study by Barbosa et al.[28] and higher than those observed in the meta-analysis by Sohn et al.[29] However, these comparisons should be made with caution, because studies on cell phone use from the perspective of physical activity and sedentary behavior are still scarce and without standardization, hindering such comparisons. For example, while in the study by Barbosa et al[28] the question raised was whether the adolescent makes the use of video games or cell phones, in the meta-analysis by Sohn et al[29] reported on the problematic use of the smartphone.

Table 2. Gender prevalence ratio, sexual maturation. socioeconomic status, nutritional status and the interaction between sex*sexual maturation with cell phone use and screen time in adolescents moderated by the level of physical activity in adolescents, São José dos Pinhais. Paraná. Brazil (*n* = 772)

Crude analysis	Mobile phone use						Screen time					
	Insufficiently active			Sufficiently active			Insufficiently active			Sufficiently active		
	RP	IC95%		RP	IC95%		RP	IC95%		RP	IC95%	
Sex												
Male	1	-	-	1	-	-	1	-	-	1	-	-
Female	0.87	0.70	1.08	0.77	0.56	1.06	**0.72**	**0.62**	**0.84**	**0.68**	**0.50**	**0.92**
Sexual maturation												
Pubescent	1	-	-	1	-	-	1	-	-	1	-	-
Postpubescent	1.05	0.83	1.33	0.74	0.51	1.08	1.10	9	1.30	1.02	0.76	1.37
Socioeconomic status												
High	1	-	-	1	-	-	1	-	-	1	-	-
Intermediate	1.03	0.74	1.44	1.01	0.65	1.58	0.86	0.69	1.07	1.05	0.73	1.51
Low	0.99	0.69	1.43	1.12	0.70	1.80	0.88	0.69	1.12	0.76	0.48	1.20
Nutritional status												
No excess weight	1	-	-	1	-	-	1	-	-	1	-	-
Overweight	**1.45**	**1.14**	**1.85**	0.73	0.42	1.27	1.10	0.90	1.35	0.65	0.38	1.12
Sex*Sexual maturation												
Male*Pubescent	1	-	-	1	-	-	1	-	-	1	-	-
Male*Postpubescent	1.19	0.88	1.62	0.78	0.52	1.18	1.13	0.93	1.37	0.90	0.65	1.26
Female*Pubescent	0.96	0.74	1.24	0.79	0.56	1.12	**0.76**	**0.63**	**0.92**	**0.63**	**0.44**	**0.90**
Female*Postpubescent	0.81	0.54	1.22	0.46	0.21	1.01	**0.71**	**0.52**	**0.96**	0.74	0.44	1.24

PR: prevalence ratio estimated by Poisson regression; CI95%: 95% confidence interval; p< 0.05

Table 3. Gender prevalence ratio, sexual maturation, socioeconomic status, nutritional status and the interaction between sex*sexual maturation with cell phone use and screen time in adolescents moderated by the level of physical activity in adolescents. São José dos Pinhais. Paraná. Brazil (*n* = 772)

Adjusted analysis	Mobile phone use						Screen time					
	Insufficiently active			Sufficiently active			Insufficiently active			Sufficiently active		
	RP	IC95%		RP	IC95%		RP	IC95%		RP	IC95%	
Sex												
Male	1	-	-	1	-	-	1	-	-	1	-	-
Female	0.89	0.72	1.10	0.76	0.55	1.04	**0.73**	**0.62**	**0.85**	**0.71**	**0.53**	**0.97**
Sexual maturation												
Pubescent	1	-	-	1	-	-	1	-	-	1	-	-
Postpubescent	1.02	0.81	1.29	0.72	0.50	1.04	1.04	0.88	1.23	0.96	0.72	1.29
Socioeconomic status												
High	1	-	-	1	-	-	1	-	-	1	-	-
Intermediate	1.03	0.74	1.44	1.04	0.67	1.62	0.87	0.70	1.09	1.08	0.76	1.54
Low	0.99	0.68	1.42	1.15	0.72	1.83	0.87	0.68	1.11	0.79	0.51	1.22
Nutritional status												
No excess weight	1	-	-	1	-	-	1	-	-	1	-	-
Overweight	**1.43**	**1.12**	**1.83**	0.77	0.43	1.38	1.07	0.88	1.30	0.68	0.40	1.16
Sex*Sexual maturation												
Male*Pubescent	1	-	-	1	-	-	1	-	-	1	-	-
Male*Postpubescent	1.17	0.86	1.59	0.79	0.52	1.19	1.12	0.92	1.37	0.89	0.63	1.24
Female*Pubescent	0.97	0.75	1.25	0.81	0.57	1.15	**0.77**	**0.64**	**0.93**	**0.66**	**0.46**	**0.94**
Female*Postpubescent	0.83	0.55	1.24	0.46	0.21	1.02	**0.71**	**0.52**	**0.96**	0.77	0.47	1.28

PR: prevalence ratio estimated by Poisson regression; CI95%: 95% confidence interval; p< 0.05

In relation to the prevalence of screen time, the findings of the present study corroborate the systematic review by Barbosa Filho, Campos and Lopes[3], which indicated the prevalence mostly is above 50% for Brazilian adolescents. What draws attention to this result is the high prevalence of screen time in insufficiently active adolescents, which could present a greater harm in relation to the impact on health, when compared with isolated analyses.

Regarding mobile phone use, PAL may not play a moderating role for the relationship. Currently mobile phones are increasingly indispensable and, go beyond communication instruments, contributing to the network of friendships, as a form of leisure and sedentary entertainment for several hours throughout the day[2]. On the other hand, mobile phones can contribute to the promotion and maintenance of physical activity[30]. These gaps were observed in the present study, when we did not find significant relationships between sex, sexual maturation and SES with cell phone use. Thus, the relationship of adolescents with cell phone use needs to be better investigated in the literature.

On the other hand, overweight seems to favor cell phone use for more than two hours a day, especially in insufficiently active

adolescents. It is known that nutritional status tends to be related to habits contrary to the practice of physical activity[31] besides possibly resulting in social exclusion and higher levels of depression[32,33]. The combination of these facts may be determinant to explain a 43% higher probability of cell phone engagement compared to adolescents without excess weight. After all, among other features, the mobile phone allows to increase and modify the network of friendships[2].

Both insufficiently active and sufficiently active girls presented inverse associations with high screen time, which limits conclusive results related to these variables. This relationship is still little investigated by Brazilian studies[4], perhaps this is why it still presents inconclusive results, where it is possible to observe female indicators as risk[34], as protective[35] as in the present investigation. But there are also studies that have not observed associations between the female sex and screen time[31].

However, in the present, the premise was used that the PAL could mediate these sex relations with screen time, which was not confirmed, perhaps due to the high prevalence of screen time in both sexes and similarity of behavior in adolescents who comply and in those who do not meet the minimum recommendations for the practice of physical activities, both facts previously described in the literature[3,5]. This makes clear the need for interventions aimed at reducing screen time in Brazilian adolescents.

In the analysis of the terms of interaction, in relation to the reference used (male*pubescent), insufficiently active girls in the pubescent stage (female*pubescent) are 23% less likely to have a high screen time. While in sufficiently active, this probability increases to 33%. This finding is consistent with information present in the literature, stating that sedentary behavior tends to increase and present positive associations with the advancement of maturational processes[11].

It was also possible to observe a protective factor of insufficiently active and postpubertal girls (female*postpubescent) in relation to the high screen time. Although, as already mentioned, maturational processes seem to favor the acquisition of sedentary habits[11], but not showing themselves as absolute truth, after all, girls tend to differ from boys both in relation to the practice of physical activities[3] and in sedentary behaviors[6]. What leaves no doubt is that even the associations showing different directions, boys and girls insufficiently active present high prevalence of both behaviors analyzed by the present study, evidencing the need for actions aimed at reducing these behaviors and new studies to better explain the factors associated with sedentary behavior in adolescents.

Additionally, this study is not free of limitations, which requires caution in the interpretation of the results. The investigation had self-reported measures to estimate the outcomes of interest, which may present limitations regarding their accuracy and tend to overestimate the responses. The sample, although representative, did not include adolescents from private schools, which restricts the extrapolation of the data in part.

Cell phone use, although it has a high prevalence of use by insufficiently active adolescents, is not moderated by the practice of physical activities, except for overweight adolescents. Future investigations could verify which factors would be associated with cell phone use moderating the analysis by sex and sexual maturation, or even by nutritional status. After all, evidence needs to be generated to support future interventions in relation to the excessive use of cell phones.

The present study provides valuable insights into the relationship between physical activity levels, mobile phone use, and screen time among adolescents. Our findings suggest that physical activity level moderates the association between nutritional status and mobile phone use, particularly among insufficiently active adolescents. Specifically, overweight adolescents who are insufficiently active are more likely to engage in extended mobile phone use compared to their non-overweight peers. This highlights the potential role of targeted interventions to reduce sedentary behaviors in this subgroup.

Moreover, the study reveals significant gender differences in screen time, with female adolescents showing distinct patterns of interaction with both physical activity and sexual maturation stages. Insufficiently active females, particularly those in the pubescent and postpubescent stages, demonstrate lower likelihoods of excessive screen time compared to their male counterparts. Conversely, sufficiently active females show an increased likelihood of high screen time, indicating that the impact of physical activity on sedentary behavior may vary significantly across different maturational stages.

These findings underscore the importance of considering both gender and maturation stage when designing interventions aimed at reducing screen time and promoting healthier lifestyles among adolescents. Additionally, the high prevalence of screen time across both active and inactive adolescents points to a widespread issue that requires comprehensive strategies beyond promoting physical activity alone.

References

1 Farren GL, Zhang T, Gu X, Thomas KT. Sedentary behavior and physical activity predicting depressive symptoms in adolescents beyond attributes of health-related physical fitness. J Sport Health Sci 2018;7(4):489-96. https://doi.org/10.1016/j.jshs.2017.03.008

2 Divan HA, Kheifets L, Obel C, Olsen J. Cell phone use and behavioural problems in young children. J Epidemiol Community Health 2012;66(6):524-9. https://doi.org/10.1136/jech.2010.115402

3 Barbosa Filho VC, Campos W, Lopes AS. Epidemiology of physical inactivity, sedentary behaviors, and unhealthy eating habits among Brazilian adolescents: a systematic review. Cien Saude Colet 2014;19(1):173-93. https://doi.org/10.1590/1413-81232014191.0446

4 Guerra PH, Farias Júnior JC, Florindo AA. Comportamento sedentário em crianças e adolescentes brasileiros: revisão sistemática. Rev Saude Publica 2016;50(9):2-15. https://doi.org/10.1590/S1518-8787.2016050006307

5 Schaan CW, Cureau FV, Bloch KV, Carvalho KMB, Ekelund U, Schaan BD. Prevalence and correlates of screen time among Brazilian adolescents: findings from a country-wide survey. Appl Physiol Nutr Metab 2018;43(7):684-90. https://doi.org/10.1139/apnm-2017-0630

6 Piola TS, Bacil ED, Silva MP, Campos JG, Malta Neto NA, Campos W. Comportamento sedentário em adolescentes: análise hierárquica de fatores associados. Rev Contexto Saúde 2019;19(37):9. https://doi.org/10.21527/2176-7114.2019.37.128-136

7 Cureau FV, Silva TLN, Bloch KV, Fujimori E, Belfort DR, Carvalho KMB, et al. ERICA: leisure-time physical inactivity in Brazilian adolescents. Rev Saude Publica 2016;50(Suppl 1):4s. https://doi.org/10.1590/s01518-8787.2016050006683

8 Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1· 6 million participants. Lancet Child Adolesc Health 2019; 4 (1), P23-35. https://doi.org/10.1016/S2352-4642(19)30323-2

9 2018 Physical Activity Guidelines Advisory Committee Scientific Report. Department of Health and Human Services. Physical Activity Guidelines Advisory Committee Scientific Report, Washington, DC: 2018.

10 Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW. Correlates of physical activity: why are some people physically active and others not? Lancet 2012;380(9838):258-71.

11 Bacil EDA, Piola TS, Watanabe PI, Silva MP, Legnani RFS, Campos W. Biological maturation and sedentary behavior in children and adolescents: a systematic review. J Phys Educ 2016;27:e2730-016. https://doi.org/10.4025/jphyseduc.v27i1.2730

12 Bacil ED, Mazzardo Junior O, Rech CR, Legnani RF, Campos W. Physical activity and biological maturation: a systematic review. Rev Paul Pediatr 2015;33(1):114-21. doi: https://doi.org/10.1016/j.rpped.2014.11.003

13 SEED-PR. Consulta escolas Secretaria da Educação 2017. Available from: http://www.consultaescolas.pr.gov.br/consultaescolas/f/fcls/municipio/visao?idNav=25

14 Atlas do desenvolvimento humano no Brasil 2013. Available from: http://atlasbrasil.org.br/2013/

15 Luiz RR, Magnanini MMF. A lógica da determinação do tamanho da amostra em investigações epidemiológicas. Cad Saude Publica 2000;8(2):9-28.

16 Demidenko E. Poisson regression for clustered data. Int Stat Rev 2007;75(1):96-113. https://doi.org/10.1111/j.1751-5823.2006.00003.x

17 Rey-Lopez JP, Tomas C, Vicente-Rodriguez G, Gracia-Marco L, Jimenez-Pavon D, Perez-Llamas F, et al. Sedentary behaviours and socio-economic status in Spanish adolescents: the AVENA study. Eur J Public Health 2011;21(2):151-7. https://doi.org/10.1093/eurpub/ckq035

18 Tanner JM. Growth at adolescence: J. B. Lippincott Company; 1962.

19 Martin RHC, Uezu R, Parra A, Arena S, Bojikian L, Bohme M. Auto-avaliação da maturação sexual masculina por meio da utilização de desenhos e fotos. Rev Bras Educ Fís Esporte 2001;15(2):212-22. https://doi.org/10.11606/issn.2594-5904.rpef.2001.139903

20 Bojikian LP, Massa M, Martin RHC, Teixeira CP, Kiss MAPDM, Böhme MTS. Auto-avaliação puberal feminina por meio de desenhos e fotos. Rev Bras Ativ Fis Saúde 2002;7(2):24-34. https://doi.org/10.12820/rbafs.v.7n2p24-34

21 Farias Júnior JC, Lopes AS, Mota J, Santos MP, Ribeiro JC, Hallal PC. Validade e reprodutibilidade de um questionário para medida de atividade física em adolescentes: uma adaptação do Self-Administered Physical Activity Checklist. Rev Bras Epidemiol 2012;15(1):198-210. https://doi.org/10.1590/S1415-790X2012000100018

22 Sallis JF, Strikmiller PK, Harsha DW, Feldman HA, Ehlinger S, Stone EJ, et al. Validation of interviewer- and self-administered physical activity checklists for fifth grade students. Med Sci Sports Exerc 1996;28(7):840-51.

23 WHO. Global recommendations on physical activity for health. Geneva: World Health Organization; 2010.

24 Silva MP, Saint-Maurice PF, Piola TS, Malta Neto NA, Campos W. A versão brasileira do Youth Activity Profile: evidências preliminares de validade em adolescentes brasileiros. Revista Brasileira de Atividade Física & Saúde 2017;22.

25 Guimarães RF, Silva MP, Legnani E, Mazzardo O, Campos W. Reproducibility of adolescent sedentary activity questionnaire (ASAQ) in Brazilian adolescents. Rev Bras Cineantropom Desempenho Hum. 2013;15:276-85. http://dx.doi.org/10.5007/1980-0037.2013v15n3p276

26 ABEP. Critério de Classificação Econômica Brasil. Associação Brasileira de Empresas de Pesquisa, 2015.

27 Alvarez BR, Pavan AL, Petroski E. Alturas e comprimentos. 31-45,

28 Barbosa LMA, Arruda IKG, Canuto R, Lira PIC, Monteiro JS, Freitas DL, et al. Prevalence and factors associated with excess weight in adolescents in a low-income neighborhood - Northeast, Brazil. Rev Bras Saude Mater Infant 2019;19:661-70. https://doi.org/10.1590/1806-93042019000300010

29 Sohn S, Rees P, Wildridge B, Kalk NJ, Carter B. Prevalence of problematic smartphone usage and associated mental health outcomes amongst children and young people: a systematic review, meta-analysis and GRADE of the evidence. BMC Psychiatry 2019;19(1):356. https://doi.org/10.1186/s12888-019-2350-x

30 Direito A, Pfaeffli Dale L, Shields E, Dobson R, Whittaker R, Maddison R. Do physical activity and dietary smartphone applications incorporate evidence-based behaviour change techniques? BMC Public Health 2014;14(1):646. https://doi.org/10.1186/1471-2458-14-646

31 Barbosa Filho VC, Campos W, Bozza R, Lopes AS. The prevalence and correlates of behavioral risk factors for cardiovascular health among Southern Brazil adolescents: a cross-sectional study. BMC Pediatrics 2012;12(130):12. https://doi.org/10.1186/1471-2431-12-130

32 (NCD-RisC) NRFC. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. Lancet 2017;390(10113):2627-42. https://doi.org/10.1016/S0140-6736(17)32129-3

33 Rivera JÁ, de Cossío TG, Pedraza LS, Aburto TC, Sánchez TG, Martorell R. Childhood and adolescent overweight and obesity in Latin America: a systematic review. Lancet 2014;2(4):321-32. https://doi.org/10.1016/S2213-8587(13)70173-6

34 Ferreira RW, Rombaldi AJ, Ricardo LIC, Hallal PC, Azevedo MR. Prevalence of sedentary behavior and its correlates among primary and secondary school students. Rev Paul Pediatr 2016;34(1):56-63. https://doi.org/10.1016/j.rppede.2015.09.002

35 Tenório MCM, Barros MVG, Tassitano RM, Bezerra J, Tenório JM, Hallal PC. Atividade física e comportamento sedentário em adolescentes estudantes do ensino médio. Rev Bras Epidemiol 2010;13:105-17. https://doi.org/10.1590/S1415-790X2010000100010